MANAGEMENT OF ANTERIOR CRUCIATE LIGAMENT INJURIES

EVIDENCE- BASED CLINICAL PRACTICE GUIDELINE

Adopted by the American Academy of Orthopaedic Surgeons Board of Directors
September 5, 2014

This Guideline has been endorsed by the following organizations:

Disclaimer
This Clinical Practice Guideline was developed by an AAOS multidisciplinary volunteer Work Group based on a systematic review of the current scientific and clinical information and accepted approaches to treatment and/or diagnosis. This Clinical Practice Guideline is not intended to be a fixed protocol, as some patients may require more or less treatment or different means of diagnosis. Clinical patients may not necessarily be the same as those found in a clinical trial. Patient care and treatment should always be based on a clinician's independent medical judgment, given the individual patient's clinical circumstances.

Disclosure Requirement
In accordance with AAOS policy, all individuals whose names appear as authors or contributors to Clinical Practice Guideline filed a disclosure statement as part of the submission process. All panel members provided full disclosure of potential conflicts of interest prior to voting on the recommendations contained within this Clinical Practice Guidelines.

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FDA Clearance
Some drugs or medical devices referenced or described in this Clinical Practice Guideline may not have been cleared by the Food and Drug Administration (FDA) or may have been cleared for a specific use only. The FDA has stated that it is the responsibility of the physician to determine the FDA clearance status of each drug or device he or she wishes to use in clinical practice.

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I. SUMMARY OF RECOMMENDATIONS

The following is a summary of the recommendations of the AAOS clinical practice guideline on the Management of Anterior Cruciate Ligament Injuries. All readers of this summary are strongly urged to consult the full guideline and evidence report for this information. We are confident that those who read the full guideline and evidence report will see that the recommendations were developed using systematic evidence-based processes designed to combat bias, enhance transparency, and promote reproducibility.

This summary of recommendations is not intended to stand alone. Treatment decisions should be made in light of all circumstances presented by the patient. Treatments and procedures applicable to the individual patient rely on mutual communication between patient, physician, and other healthcare practitioners.

Strength of Recommendation Descriptions

Strength	Overall Strength of Evidence	Description of Evidence Strength	Strength Visual
Strong	Strong	Evidence from two or more “High” strength studies with consistent findings for recommending for or against the intervention.	
Moderate	Moderate	Evidence from two or more “Moderate” strength studies with consistent findings, or evidence from a single “High” quality study for recommending for or against the intervention.	
Limited	Low Strength Evidence or Conflicting Evidence	Evidence from two or more “Low” strength studies with consistent findings **or** evidence from a single study for recommending for or against the intervention or diagnostic test or the evidence is insufficient or conflicting and does not allow a recommendation for or against the intervention.	
Consensus*	No Evidence	There is no supporting evidence. In the absence of reliable evidence, the work group is making a recommendation based on their clinical opinion. Consensus recommendations can only be created when not establishing a recommendation could have catastrophic consequences.	

ACL HISTORY AND PHYSICAL

Strong evidence supports that the practitioner should obtain a relevant history and perform a musculoskeletal exam of the lower extremities, because these are effective diagnostic tools for ACL injury.

Strength of Recommendation: Strong

Description: Evidence from two or more "High" strength studies with consistent findings for recommending for or against the intervention.

ACL RADIOGRAPHS

In the absence of reliable evidence, it is the opinion of the work group that in the initial evaluation of a person with a knee injury and associated symptoms [giving way, pain, locking, catching] and signs [effusion, inability to bear weight, bone tenderness, loss of motion, and/or pathological laxity] that the practitioner obtain AP and lateral knee xrays to identify fractures or dislocations requiring emergent care.

Strength of Recommendation: Consensus

Description: There is no supporting evidence. In the absence of reliable evidence, the work group is making a recommendation based on their clinical opinion. Consensus recommendations can only be created when not establishing a recommendation could have catastrophic consequences.

ACL MAGNETIC RESONANCE IMAGING (MRI)

Strong evidence supports that the MRI can provide confirmation of ACL injury and assist in identifying concomitant knee pathology such as other ligament, meniscal, or articular cartilage injury.

Strength of Recommendation: Strong

Description: Evidence from two or more "High" strength studies with consistent findings for recommending for or against the intervention.

ACL PEDIATRIC

There is limited evidence in skeletally immature patients with torn ACLs, but it supports that the practitioner might perform surgical reconstruction because it reduces activity related disability and recurrent instability which may lead to additional injury.

Strength of Recommendation: Limited

Description: Evidence from two or more "Low" strength studies with consistent findings **or** evidence from a single study for recommending for or against the intervention or diagnostic test or the evidence is insufficient or conflicting and does not allow a recommendation for or against the intervention.

ACL YOUNG ACTIVE ADULT

Moderate evidence supports surgical reconstruction in active young adult (18-35) patients with an ACL tear.

Strength of Recommendation: Moderate

Description: Evidence from two or more "Moderate" strength studies with consistent findings, or evidence from a single "High" quality study for recommending for or against the intervention.

ACL MENISCAL REPAIR

There is limited evidence in patients with combined ACL tears and reparable meniscus tears, but it supports that the practitioner might repair these meniscus tears when combined with ACL reconstruction because it improves patient outcomes.

Strength of Recommendation: Limited ★★☆☆

Description: Evidence from two or more "Low" strength studies with consistent findings **or** evidence from a single study for recommending for or against the intervention or diagnostic test or the evidence is insufficient or conflicting and does not allow a recommendation for or against the intervention.

ACL RECURRENT INSTABILITY

There is limited evidence comparing non-operative treatment to ACL reconstruction in patients with recurrent instability, but it supports that the practitioner might perform ACL reconstruction because this procedure reduces pathologic laxity.

Strength of Recommendation: Limited ★★☆☆

Description: Evidence from two or more "Low" strength studies with consistent findings **or** evidence from a single study for recommending for or against the intervention or diagnostic test or the evidence is insufficient or conflicting and does not allow a recommendation for or against the intervention.

ACL CONSERVATIVE TREATMENT

There is limited evidence to support non-surgical management for less active patients with less laxity.

Strength of Recommendation: Limited ★★☆☆

Description: Evidence from two or more "Low" strength studies with consistent findings **or** evidence from a single study for recommending for or against the intervention or diagnostic test or the evidence is insufficient or conflicting and does not allow a recommendation for or against the intervention.

ACL SURGERY TIMING

When ACL reconstruction is indicated, moderate evidence supports reconstruction within five months of injury to protect the articular cartilage and menisci.

Strength of Recommendation: Moderate ★★★☆

Description: Evidence from two or more "Moderate" strength studies with consistent findings, or evidence from a single "High" quality study for recommending for or against the intervention.

ACL COMBINED MCL

There is limited evidence in patients with acute ACL tear and MCL tear to support that the practitioner might perform reconstruction of the ACL and non-operative treatment of the MCL tear.

Strength of Recommendation: Limited ★★☆☆

Description: Evidence from two or more "Low" strength studies with consistent findings **or** evidence from a single study for recommending for or against the intervention or diagnostic test or the evidence is insufficient or conflicting and does not allow a recommendation for or against the intervention.

ACL LOCKED KNEE

In the absence of reliable evidence, it is the opinion of the work group that patients with an ACL tear and a locked knee secondary to a displaced meniscal tear have prompt treatment to unlock the knee in order to avoid a fixed flexion contracture.

Strength of Recommendation: Consensus ★☆☆☆

Description: There is no supporting evidence. In the absence of reliable evidence, the work group is making a recommendation based on their clinical opinion. Consensus recommendations can only be created when not establishing a recommendation could have catastrophic consequences.

ACL SINGLE OR DOUBLE BUNDLE RECONSTRUCTION

Strong evidence supports that in patients undergoing intra-articular ACL reconstruction the practitioner should use either single bundle or double bundle technique, because the measured outcomes are similar.

Strength of Recommendation: Strong ★★★★

Description: Evidence from two or more "High" strength studies with consistent findings for recommending for or against the intervention.

ACL AUTOGRAFT SOURCE

Strong evidence supports that in patients undergoing intra-articular ACL reconstruction using autograft tissue the practitioner should use bone-patellar tendon-bone or hamstring-tendon grafts, because the measured outcomes are similar.

Strength of Recommendation: Strong ★★★★

Description: Evidence from two or more "High" strength studies with consistent findings for recommending for or against the intervention.

ACL AUTOGRAFT VS ALLOGRAFT

Strong evidence supports that in patients undergoing ACL reconstructions, the practitioner should use either autograft or appropriately processed allograft tissue, because the measured outcomes are similar, although these results may not be generalizable to all allografts or all patients, such as young patients or highly active patients.

Strength of Recommendation: Strong ★★★★

Description: Evidence from two or more "High" strength studies with consistent findings for recommending for or against the intervention.

ACL FEMORAL TUNNEL TECHNIQUE

Moderate evidence supports that in patients undergoing intra-articular ACL reconstruction the practitioner could use either a tibial independent approach or transtibial approach for the femoral tunnel, because the measured outcomes are similar.

Strength of Recommendation: Moderate ★★★☆

Description: Evidence from two or more "Moderate" strength studies with consistent findings, or evidence from a single "High" quality study for recommending for or against the intervention.

ACL POST-OP FUNCTIONAL BRACING

Moderate evidence does not support the routine use of functional knee bracing after isolated ACL reconstruction, because there is no demonstrated efficacy.

Strength of Recommendation: Moderate ★★★☆

Description: Evidence from two or more "Moderate" strength studies with consistent findings, or evidence from a single "High" quality study for recommending for or against the intervention.

ACL PROPHYLACTIC BRACES

Limited evidence supports that the practitioner might not prescribe prophylactic knee braces to prevent ACL injury, because they do not reduce the risk for ACL injury.

Strength of Recommendation: Limited ★★☆☆

Description: Evidence from two or more "Low" strength studies with consistent findings **or** evidence from a single study for recommending for or against the intervention or diagnostic test or the evidence is insufficient or conflicting and does not allow a recommendation for or against the intervention.

ACL NEUROMUSCULAR TRAINING PROGRAMS

Moderate strength evidence from pooled analyses with a small effect size (Number Needed to Treat=109) supports that neuromuscular training programs could reduce ACL injuries.

Strength of Recommendation: Moderate ★★★☆

Description: Evidence from two or more "Moderate" strength studies with consistent findings, or evidence from a single "High" quality study for recommending for or against the intervention.

ACL POST-OP PHYSICAL THERAPY

For those undergoing post-operative rehabilitation after ACL reconstruction, moderate evidence supports early, accelerated, and non-accelerated protocols because they have similar outcomes.

Strength of Recommendation: Moderate ★★★☆

Description: Evidence from two or more "Moderate" strength studies with consistent findings, or evidence from a single "High" quality study for recommending for or against the intervention.

ACL RETURN TO SPORTS

Limited strength evidence does not support waiting a specific time from surgery/ injury, or achieving a specific functional goal prior to return to sports participation after ACL injury or reconstruction.

Strength of Recommendation: Limited ★★☆☆

Description: Evidence from two or more "Low" strength studies with consistent findings **or** evidence from a single study for recommending for or against the intervention or diagnostic test or the evidence is insufficient or conflicting and does not allow a recommendation for or against the intervention.

Table of Contents

I. Summary of Recommendations iii
ACL History and Physical iv
ACL Radiographs iv
ACL Magnetic Resonance Imaging (MRI) iv
ACL Pediatric iv
ACL Young Active Adult iv
ACL Meniscal Repair v
ACL Recurrent Instability v
ACL Conservative Treatment v
ACL Surgery Timing v
ACL Combined MCL v
ACL Locked Knee vi
ACL Single or Double Bundle Reconstruction vi
ACL Autograft Source vi
ACL Autograft vs Allograft vi
ACL Femoral Tunnel Technique vi
ACL Post-Op Functional Bracing vii
ACL Prophylactic Braces vii
ACL NeuroMuscular Training Programs vii
ACL Post-Op Physical Therapy vii
ACL Return to Sports vii
II. Introduction 12
Overview 12
Goals and rationale 12
Intended Users 12
Patient Population & Scope of Guideline 13
Burden of Disease 13
Etiology 13
Incidence and Prevalence 13
Risk Factors 13
Potential Benefits, Harms, and Contraindications 13
III. Methods 14
Formulating Preliminary Recommendations 15
Study Selection Criteria 15
Best Evidence Synthesis 16
Minimally Clinically Important Improvement 17
Literature Searches 17
Methods for Evaluating Evidence 18
Studies of Intervention/Prevention 18
Studies of Screening and Diagnostic Tests 20
Studies of Prognostics 22
Final Strength of Evidence 23
Defining the Strength of the Recommendations 24

Wording of the Final Recommendations ... 25
Applying the Recommendations to Clinical Practice ... 25
Voting on the Recommendations ... 26
Statistical Methods ... 26
Peer Review ... 27
Public Commentary ... 28
The AAOS Guideline Approval Process ... 28
Revision Plans ... 29
Guideline Dissemination Plans ... 29
AAOS Clinical Practice Guideline Development Process Overview ... 30
IV. Recommendations ... 31
Overview of Study Quality Per Recommendation ... 31
ACL History and Physical ... 32
Rationale ... 32
Benefits of Implementation ... 32
Possible Harms of Implementation ... 32
Future Research ... 32
Summary of Findings ... 33
Results ... 37
ACL Radiographs ... 43
Rationale ... 43
Benefits of Implementation ... 43
Possible Harms of Implementation ... 43
Future Research ... 43
ACL Magnetic Resonance Imaging (MRI) ... 44
Rationale ... 44
Possible Harms of Implementation ... 44
Future Research ... 44
Summary of Findings ... 45
Results ... 47
ACL Pediatric ... 59
Rationale ... 59
Benefits of Implementation ... 59
Possible Harms of Implementation ... 59
Future Research ... 59
Summary of Findings ... 60
Results ... 63
ACL Young Active Adult ... 68
Rationale ... 68
Possible Harms of Implementation ... 68
Future Research ... 68
Summary of Findings ... 69
Results ... 72
ACL Meniscal Repair ... 84
Rationale ... 84
Possible Harms of Implementation ... 84

Future Research 84
Summary of Findings 85
Results 88
ACL Recurrent Instability 97
Rationale 97
Possible Harms of Implementation 97
Future Research 97
Results 99
ACL Conservative Treatment 109
Rationale 109
Benefits of Implementation 109
Possible Harms of Implementation 109
Future Research 109
Summary of Findings 110
Results 113
ACL Surgery Timing 123
Rationale 123
Possible Harms of Implementation 123
Future research 123
Summary of Findings 124
Results 131
ACL Combined MCL 154
Rationale 154
Potential Benefits of Implementation 154
Potential Harms of Implementation 154
Future Research 154
Summary of Findings 155
Results 156
ACL Locked Knee 160
Rationale 160
Potential Harms of Implementation 160
Future Research 160
ACL Single or Double Bundle Reconstruction 161
Rationale 161
Potential Harms of Implementation 161
Future Research 161
Summary of Findings 162
Results 167
ACL Autograft Source 190
Rationale 190
Potential Harms of Implementation 190
Future Research 190
Summary of Findings 191
Results 205
ACL Autograft vs Allograft 305
Rationale 305

Potential Harms of Implementation 305
Future Research 306
Summary of Findings 307
Results 320
ACL Femoral Tunnel Technique 350
Rationale 350
Potential Harms of Implementation 350
Future Research 350
Summary of Findings 351
Results 357
ACL Post-Op Functional Bracing 402
Rationale 402
Potential Benefits of Implementation 402
Potential Harms of Implementation 402
Future Research 402
Summary of Findings 403
Results 412
ACL Prophylactic Braces 427
Rationale 427
Future Research 427
Summary of Findings 428
Results 429
ACL Neuromuscular Training Programs 433
Rationale 433
Potential Benefits of Implementation 433
Potential Harms of Implementation 433
Future Research 434
Results 438
ACL Post-Op Physical Therapy 452
Rationale 452
Potential Benefits of Implementation 452
Potential Harms of Implementation 452
Future Research 452
Summary of Findings 454
Results 459
ACL Return to Sports 476
Rationale 476
Potential Harms of Implementation 476
Future Research 476
Summary of Findings 477
Results 478
V. Appendices 484
Appendix I 484
Work Group Roster 484
Guidelines Oversight Chair 486
AAOS Clinical Practice Guidelines Section Leader 486

AAOS Council on Research and Quality Chair 486
Additional Contributing Members 486
AAOS Staff 486
Appendix II 488
AAOS Bodies That Approved This Clinical Practice Guideline 488
Appendix III 489
Determining Critical Outcomes 489
Critical Outcomes Form 489
Appendix IV 493
Study Attrition Flowchart 493
Appendix V 494
Literature Search Strategies 494
Appendix VI 497
Evaluation of Quality 497
Applicability 500
Appendix VII 503
Opinion Based Recommendations 503
Appendix VIII 505
Structured Peer Review Form 505
Appendix IX 507
Participating Peer Review Organizations 507
Appendix X 508
Interpreting the Forest Plots 508
Appendix XI 509
Conflict of Interest 509
Appendix XII 511
Methods 511
Included Studies 512
Tables of Lower Quality Studies that Met the Initial Inclusion Criteria but Were Not Best Available Evidence 524
Articles Excluded from the AAOS Systematic Review and Reason for Exclusion 542
Review Articles Screened for for Additional Articles by Recommendation 600
Appendix XIII 616
Letters of Endorsement from External Organizations 616

List of Tables

Table 1. Relationship between Quality and Domain Scores for Interventions 19
Table 2. Brief Description of the PRECIS Questions and Domains 20
Table 3. Relationship between Applicability and Domain Scores for Studies of Treatments 20
Table 4. Relationship Between Domain Scores and Quality of Screening/Diagnostic Tests 21
Table 5. Relationship Between Domain Scores and Applicability for Studies of Screening/Diagnostic Tests 22

Table 6. Relationship Between Quality and Domain Scores for Studies of Prognostics . 23
Table 7. Relationship Between Domain Scores and Applicability for Studies of Prognostics ... 23
Table 8. Strength of Recommendation Descriptions ... 24
Table 9. AAOS Guideline Language Stems ... 25
Table 10. Clinical Applicability: Interpreting the Strength of a Recommendation ... 25
Table 11. Interpreting Likelihood Ratios ... 26
Table 12. Summary of Findings: Diagnosing Anterior Ligament Injuries With History and Physical ... 33
Table 13. Summary of Findings: Diagnosing Medial Side Ligament Injuries With History and Physical ... 34
Table 14. Summary of Findings: Diagnosing Lateral Side Ligament Injuries With History and Physical ... 35
Table 15. Quality and Applicability Summary: Diagnosis: History and Physical ... 36
Table 16. Quality and Applicability of Diagnostic Test of History and Physical ... 37
Table 17. Diagnostic Results: Anterior Cruciate Ligament Injuries With History and Physical ... 39
Table 18. Diagnostic Results: Medial Ligament Injuries With History and Physical ... 40
Table 19. Diagnostic Results: Lateral Ligament Injuries With History and Physical ... 42
Table 20. Diagnostic Result: Posterior Cruciate Ligament Injury With History and Physical ... 42
Table 21. Summary of Findings: Diagnosing Ligament Injuries with MRI ... 45
Table 22. Diagnostic Quality and Applicability Summary: MRI ... 46
Table 23. Diagnostic Quality and Applicability: MRI ... 47
Table 24. Diagnostic Results Table: MRI ... 49
Table 25. Summary of Findings: Treating Skeletally Immature Patients With Torn ACL ... 60
Table 26. Treatment Quality and Applicability Summary: Treatment of Skeletally Immature Patients With Torn ACL ... 61
Table 27. Quality and Applicability: Treatment of Skeletally Immature Patients With Torn ACL ... 63
Table 28. Treating Skeletally Immature Patients With ACL Injury: Operative Versus Non-Operative ... 65
Table 29. Summary of Findings: Surgical Reconstruction for Young (18-35), Active Patients With an ACL Tear ... 69
Table 30. Quality and Applicability Summary: Treatment of Young (18-35) Active Patient With ACL Tear ... 70
Table 31. Quality and Applicability: Treatment of Young (18-35) Active Patient With ACL Tear ... 72
Table 32. Treatment of Young (18-35) Active Patients ... 74
Table 33. Treatment of Young (18-35) Active Patient: Post Hoc Analysis of Early ACLR and Delayed ACLR ... 77
Table 34. Treatment of Young (18-35) Active Patient: Post Hoc Analysis of Early ACLR Versus Rehab Alone ... 78
Table 35. Treatment of Young (18-35) Active Patients: 5 Year Follow-up ... 79
Table 36. Early Versus Late ACLR ... 81

Table 37. Quality and Applicability Summary: Treatment of Patients With ACL and Meniscal Injuries 85
Table 38. Quality and Applicability: Treatment of Patient With ACL and Meniscal Injuries 88
Table 39. Results: Treatment of Patient With ACLR and Meniscal Injuries 92
Table 40. Results: Treatment of Patient With ACLR and Meniscal Injuries (All Inside Meniscal Repair With FasT-Fix) 95
Table 41. Results: Treatment of Patient With ACLR and Meniscal Injuries (Red-White Longitudinal Meniscal Repairs) 96
Table 42. Results: Treatment of Patient With ACLR and Meniscal Injuries (All Inside Meniscal Repair) 96
Table 43. Quality and Applicability Summary: ACL Reconstruction and Instability 98
Table 44. Quality and Applicability: ACL Reconstruction and Instability 99
Table 45. ACL Reconstruction and Instability 100
Table 46. Summary of Findings: Operative Versus Non-Operative 110
Table 47. Quality and Applicability Summary: Non-Surgical Management of Patients With Torn ACL 111
Table 48. Quality and Applicability: Non-Surgical Management of Patients With Torn ACL 113
Table 49. Result: Non-Surgical Management of Patients With Torn ACL: Operative Versus Conservative 116
Table 50. Conservative Treatment of Patient With Torn ACL 119
Table 51. Summary of Findings: ACLR Early Versus Late: Six Month Follow-up 124
Table 52. Summary of Findings: ACLR Early Versus Late: One Year Follow-up 125
Table 53. Summary of Findings: ACLR Early Versus Late 2 Year Follow-up 125
Table 54. Quality and Applicability Summary: Early Versus Late 127
Table 55. Quality and Applicability Summary: Ideal Time for ACLR 2 Year Follow-up 128
Table 56. Quality and Applicability: Delay of ACLR Until Extension and Flexion has Returned 131
Table 57. Quality and Applicability: Ideal Time for ACLR 2 Year Follow- up 132
Table 58. Results: Early Versus Late 135
Table 59. Results: Early Versus Late 12 Month Follow-up 136
Table 60. Results: Early Versus Late 6 Month Follow-up 141
Table 61. Result: Early Versus Late ACLR 2 Year Follow-up 147
Table 62. Treatment of Young (18-35) Active Patient: Post-Hoc Analysis of Early ACLR and Delayed ACLR 2 Year Follow-up 152
Table 63. Quality and Applicability Summary: Treating Patients With ACL and MCL Tears 155
Table 64. Quality and Applicability: Treating Patients With ACL and MCL Tears 156
Table 65. Results: Treating Patients With ACL and MCL Tear 158
Table 66. Summary of Findings: Single Bundle Versus Double Bundle 162
Table 67. Quality and Applicability Summary: Single Bundle Versus Double Bundle. 163
Table 68. Quality and Applicability: Single Bundle Versus Double Bundle 167
Table 69. Results: Single Bundle Versus Double Bundle 173
Table 70. Results: Single Bundle Versus Double Bundle (3 and 5 Year Follow-up) 180

Table 71. Results: Single Bundle Versus Double Bundle (Tibialis Anterior Allograft) 186
Table 72. Results: Augmentation Versus Double Bundle 187
Table 73. Summary of Findings: Patellar Tendon Versus Hamstring Tendon 2 Year ... 191
Table 74. Patellar Tendon Versus Hamstring Tendon 3 Years 192
Table 75. Patellar Tendon Versus Hamstring Tendon 5-11 Year Follow-up 193
Table 76. Patellar Tendon Versus Quadrupled Hamstring Tendon 194
Table 77. Quality and Applicability Summary: Bone Patellar Tendon Bone Versus Hamstring, Other.. 195
Table 78. Quality and Applicability: Bone Patellar Tendon Bone Versus Hamstring, Other 205
Table 79. Results: Bone Patellar Tendon Versus Hamstring Tendon (2 Year Follow-up) 222
Table 80. Results: Bone Patellar Tendon Versus Quadrupled Hamstring Tendon (2 Year Follow-up).. 241
Table 81. Results: Bone Patellar Tendon Versus Hamstring Tendon (Long Term Follow-up) 267
Table 82. Results: Bone Patellar Tendon Versus Hamstring Tendon (Intermediate Follow-up).. 284
Table 83. Results: Bone Patellar Tendon Versus Hamstring Tendon 302
Table 84. Summary of Findings: Autograft Versus Allograft (Patellar Tendon 2 Year) 307
Table 85. Summary of Findings: Autograft Versus Allograft (Patellar Tendon Long Term)... 308
Table 86. Summary of Findings: Autograft Versus Allograft (Hamstring)................... 309
Table 87. Quality and Applicability Summary: Autograft Versus Allograft................. 310
Table 88. Quality and Applicability: Autograft Versus Allograft 320
Table 89. Results: Autograft Versus Allograft (Patellar Tendon) 327
Table 90. Results: Autograft Versus Allograft (Hamstring).. 331
Table 91. Results: Autograft Versus Allograft Long Term Follow-up 339
Table 92. Summary of Findings: Tibial Independent Approach Versus Transtibial...... 351
Table 93. Quality and Applicability Summary: Tibial Independent Approach Versus Transtibial 352
Table 94. Quality and Applicability: Surgical Technique 357
Table 95. Results: Anterior Medial Portal Versus Transtibial....................................... 363
Table 96. Results: Two Incision Versus Transtibial (Endoscopic)................................ 366
Table 97. Results: Two Incision Versus Transtibial (Single Incision) 378
Table 98. Results: Outside In Versus Transtibial (All-Inside) 383
Table 99. Results: Outside In Versus Transtibial (Inside Out)..................................... 385
Table 100. Results: Anteromedial Portal Versus Transtibial (Achilles Tendon Allograft) 390
Table 101. Results: Single Incision Versus Extra-Articular Lateral Incision 3cm and 5cm 393
Table 102. Summary of Findings: Functional Knee Brace After ACLR 403
Table 103. Quality and Applicability Summary: Functional Knee Brace After ACLR 404
Table 104. Quality and Applicability: Functional Knee Brace After ACLR 412
Table 105. Results: Functional Knee Brace After ACLR: No Brace Versus Brace....... 418
Table 106. Results: Functional Knee Brace After ACLR... 424

Table 107. Quality and Applicability Summary: ACL Injury Prevention (Prophylactic Brace) 428
Table 108. Quality and Applicability: ACL Injury Prevention (Prophylactic Brace) 429
Table 109. Results: ACL Injury Prevention (Prophylactic Brace) 430
Table 110. Summary of Findings: ACL Injury Prevention (Neuromuscular Training Program) 435
Table 111. Quality and Applicability Summary: ACL Injury Prevention (Neuromuscular Training Program) 436
Table 112. Quality and Applicability: ACL Injury Prevention (Neuromuscular Training Program) 438
Table 113. Results: ACL Injury Prevention (Pre-Season Neuromuscular Training Program) 440
Table 114. Results: ACL Injury Prevention (In-Season Neuromuscular Training Program) 443
Table 115. Summary of Findings: Rehabilitation: Accelerated Versus Non Accelerated 454
Table 116. Quality and Applicability Summary: Rehabilitation After ACLR 455
Table 117. Quality and Applicability: Rehabilitation After ACLR 459
Table 118. Results: Rehabilitation After ACLR (Accelerated Versus Non Accelerated) 463
Table 119. Results: Rehabilitation After ACLR (Early Versus Late Start) 471
Table 120. Results: Rehabilitation After ACLR (Other) 473
Table 121. Quality and Applicability Summary: Return to Play After ACLR 477
Table 122. Quality and Applicability: Return to Play After ACLR 478
Table 123. Results: Return to Play After ACLR 480
Table 124. Results: Return to Play After ACLR 483
Table 125. Articles Excluded for Recommendation 3 for Not Best Available Evidence524
Table 126. Articles Excluded for Recommendation 8 for Not Best Available Evidence528
Table 127. Articles Excluded for Recommendation 12 for Not Best Available Evidence 529
Table 128. Articles Excluded for Recommendation 13 for Not Best Available Evidence 531
Table 129. Articles Excluded for Recommendation 14 for Not Best Available Evidence 537
Table 130. Articles Excluded for Recommendation 15 for Not Best Available Evidence 540
Table 131. Articles Excluded for Recommendation 16 for Not Best Available Evidence 540
Table 132. Articles Excluded for Recommendation 19 for Not Best Available Evidence 541
Table 133. Articles Excluded for ACL Radiographs for Not Meeting Study Selection Criteria 542
Table 134. Articles Excluded for ACL Magnetic Resonance Imaging (MRI) for Not Meeting Study Selection Criteria 544
Table 135. Articles Excluded for ACL Pediatric for Not Meeting Study Selection Criteria 547

Table 136. Articles Excluded for ACL Young Active Adult for Not Meeting Study Selection Criteria 552
Table 137. Articles Excluded for ACL Meniscal Repair for Not Meeting Study Selection Criteria 553
Table 138. Articles Excluded for ACL Recurrent Instability for Not Meeting Study Selection Criteria 562
Table 139. Articles Excluded for ACL Conservative Treatment for Not Meeting Study Selection Criteria 564
Table 140. Articles Excluded for ACL Surgery Timing for Not Meeting Study Selection Criteria 566
Table 141. Articles Excluded for ACL Combined MCL for Not Meeting Study Selection Criteria 568
Table 142. Articles Excluded for ACL Locked Knee for Not Meeting Study Selection Criteria 570
Table 143. Articles Excluded for ACL Single or Double Bundle Reconstruction for Not Meeting Study Selection Criteria.. 571
Table 144. Articles Excluded for ACL Autograft Source for Not Meeting Study Selection Criteria 576
Table 145. Articles Excluded for ACL Autograft vs Allograft for Not Meeting Study Selection Criteria 582
Table 146. Articles Excluded for ACL Femoral Tunnel Technique for Not Meeting Study Selection Criteria 585
Table 147. Articles Excluded for ACL Post-op Functional Bracing for Not Meeting Study Selection Criteria 588
Table 148. Articles Excluded for ACL Prophylactic Braces for Not Meeting Study Selection Criteria 590
Table 149. Articles Excluded for ACL Neuromuscular Training Programs for Not Meeting Study Selection Criteria.. 590
Table 150. Articles Excluded for ACL Post-op Physical Therapy for Not Meeting Study Selection Criteria 593
Table 151. Articles Excluded for ACL Return to Sports for Not Meeting Study Selection Criteria 597
Table 152. Review Articles for ACL History and Physical... 600
Table 153. Review Articles for ACL Radiographs... 600
Table 154. Review Articles for ACL Magnetic Resonance Imaging (MRI)................. 600
Table 155. Review Articles for ACL Pediatric... 601
Table 156. Review Articles for ACL Young Active Adult 603
Table 157. Review Articles for ACL Meniscal Repair.. 603
Table 158. Review Articles for ACL Recurrent Instability... 603
Table 159. Review Articles for ACL Conservative Treatment 604
Table 160. Review Articles for ACL Surgery Timing 604
Table 161. Review Articles for ACL Combined MCL.. 604
Table 162. Review Articles for ACL Locked Knee 604
Table 163. Review Articles for ACL Single or Double Bundle Reconstruction............ 605
Table 164. Review Articles for ACL Autograft Source 606
Table 165. Review Articles for ACL Autograft vs Allograft 608

Table 166. Review Articles for ACL Femoral Tunnel Technique 609
Table 167. Review Articles for ACL Post-op Functional Bracing 610
Table 168. Review Articles for ACL Neuromuscular Training Programs 610
Table 169. Review Articles for ACL Post-op Physical Therapy 612
Table 170. Review Articles for ACL Return to Sports 614

List of Figures

Figure 1. Meta-Analysis of Diagnosing ACL Injury with MRI 53
Figure 2. Meta-Analysis of Diagnosing Lateral Meniscus Injuries with MRI 55
Figure 3. Meta-Analysis of Diagnosing Lateral Meniscus Injuries with MRI 57
Figure 4. Meta-Analysis Forest Plot of Double Bundle Versus Single Bundle (Pain)... 188
Figure 5. Meta-Analysis Forest Plot of Double Bundle Versus Single Bundle (IKDC Subjective) 188
Figure 6. Meta-Analysis: Forest Plot of Double Bundle Versus Single Bundle Lysholm Score 189
Figure 7. Meta-Analysis: Forest Plot of Patellar Tendon Versus Hamstring: IKDC Normal (2 and 3 Years).. 303
Figure 8. Meta-Analysis: Forest Plot of Patellar Tendon Versus Hamstring: Lysholm Score (5-11 Years) 304
Figure 9. Meta-Analysis: Forest Plot of Tibial Independent Versus Transtibial IKDC A 401
Figure 10. Forest Plot of Tibial Independent Versus Transtibial Lysholm Score 401
Figure 11. Meta-Analysis of All Investigations Meeting Inclusion Criteria for ACL Neuromuscular Training Programs 448
Figure 12. Meta-Analysis of Investigations that Employed the Most Homogeneous Intervention 449
Figure 13. Number Needed to Treat (NNT) Analysis for Most Homogeneous Investigations (NNT =108.75) 450
Figure 14. Publication Bias Assessment 451

II. INTRODUCTION

OVERVIEW

This clinical practice guideline is based on a systematic review of published studies on the treatment of anterior cruciate ligament (ACL) injuries in skeletally mature and immature patients. In addition to providing practice recommendations, this guideline also highlights gaps in the literature and areas that require future research.

This guideline is intended to be used by all appropriately trained surgeons and all qualified physicians managing the treatment of anterior cruciate ligament injuries. It is also intended to serve as an information resource for decision makers and developers of practice guidelines and recommendations.

GOALS AND RATIONALE

The purpose of this clinical practice guideline is to help improve treatment based on the current best evidence. Current evidence-based medicine (EBM) standards demand that physicians use the best available evidence in their clinical decision making. To assist them, this clinical practice guideline consists of a systematic review of the available literature regarding the treatment of ACL injuries. The systematic review detailed herein was conducted between June 11, 2011 and June 27, 2013 and demonstrates where there is good evidence, where evidence is lacking, and what topics future research must target in order to improve the treatment of patients with anterior cruciate ligament injuries. AAOS staff and the physician work group systematically reviewed the available literature and subsequently wrote the following recommendations based on a rigorous, standardized process.

Musculoskeletal care is provided in many different settings by many different providers. We created this guideline as an educational tool to guide qualified physicians through a series of treatment decisions in an effort to improve the quality and efficiency of care. This guideline should not be construed as including all proper methods of care or excluding methods of care reasonably directed to obtaining the same results. The ultimate judgment regarding any specific procedure or treatment must be made in light of all circumstances presented by the patient and the needs and resources particular to the locality or institution.

INTENDED USERS

This guideline is intended to be used by orthopaedic surgeons and physicians managing patients with anterior cruciate ligament injuries. Typically, orthopaedic surgeons will have completed medical training, a qualified residency in orthopaedic surgery, and some may have completed additional sub-specialty training. Insurance payers, governmental bodies, and health-policy decision-makers may also find this guideline useful as an evolving standard of evidence regarding treatment of anterior cruciate ligament injuries. Physical therapists, occupational therapists, nurse practitioners, athletic trainers, emergency room physicians, primary care physicians, physiatrists, physician assistants and other healthcare professionals who routinely see this type of patient in various practice settings may also benefit from this guideline.

ACL treatment is based on the assumption that decisions are predicated on patient and physician mutual communication with discussion of available treatments and procedures applicable to the individual patient. Once the patient has been informed of available therapies and has discussed these options with his/her physician, an informed decision can be made. Clinician input based on experience with conservative management and the clinician's surgical experience and skills increases the probability of identifying patients who will benefit from specific treatment options.

PATIENT POPULATION & SCOPE OF GUIDELINE

This document is intended for use for both skeletally immature and skeletally mature patients who have been diagnosed with an ACL injury of the knee.

BURDEN OF DISEASE

Persons who suffer ACL injuries are at increased risk for developing arthritis later in life.[M9] Females are two to eight times more likely to suffer an ACL injury compared to males.[M9]

ETIOLOGY

ACL rupture is typically the result of a traumatic, sports-related injury. This injury may be contact or non-contact.

INCIDENCE AND PREVALENCE

The annual rate of patients who present with anterior cruciate ligament injuries has been estimated at 252,000.[M9]

RISK FACTORS

List applicable risk factors.

POTENTIAL BENEFITS, HARMS, AND CONTRAINDICATIONS

Most treatments are associated with some known risks, especially invasive and operative treatments. Contraindications vary widely based on the treatment administered. A particular concern when treating ACL injuries is routine surgical complications such as infection, DVT, anesthesia complications, etc. Other complications associated with ACL surgery include: postoperative loss of motion or arthrofibrosis, ongoing instability episodes, neurovascular injury, etc. Additional factors may affect the physician's choice of treatment including but not limited to associated injuries the patient may present with as well as the individual's co-morbidities, skeletal maturity, and/or specific patient characteristics including obesity, activities, work demands, etc.. Clinician input based on experience increases the probability of identifying patients who will benefit from specific treatment options. The individual patient and the patient's family dynamic will also influence treatment decisions therefore, discussion of available treatments and procedures applicable to the individual patient rely on mutual communication between the patient and the patient's guardian (when appropriate for minor patients) and physician, weighing the potential risks and benefits for that patient. Once the patient and patient's guardian has been informed of available therapies and has discussed these options with the patient and guardian (if appropriate), an informed decision can be made.

III. METHODS

The methods used to perform this systematic review were employed to minimize bias and enhance transparency in the selection, appraisal, and analysis of the available evidence. These processes are vital to the development of reliable, transparent, and accurate clinical recommendations for treating anterior cruciate ligament injuries.

This clinical practice guideline and the systematic review upon which it is based evaluate the effectiveness of treatments for anterior cruciate ligament injuries. This section describes the methods used to prepare this guideline and systematic review, including search strategies used to identify literature, criteria for selecting eligible articles, determining the strength of the evidence, data extraction, methods of statistical analysis, and the review and approval of the guideline. The AAOS approach involves methodologists and a multidisciplinary work group, which includes practicing physicians as content and clinical experts, who are free of potential conflicts of interest as recommended by guideline development experts.[M1]

The AAOS understands that only high-quality guidelines are credible, and we go to great lengths to ensure the integrity of our evidence analyses. The AAOS addresses bias beginning with the selection of work group members. Applicants with financial conflicts of interest (COI) related to the guideline topic cannot participate if the conflict occurred within one year of the start date of the guideline's development or if an immediate family member has, or has had, a relevant financial conflict. Additionally, all work group members sign an attestation form agreeing to remain free of relevant financial conflicts for two years following the publication of the guideline.

This guideline and systematic review were prepared by the AAOS ACL Injuries guideline work group (clinical experts) with the assistance of the AAOS Evidence-Based Medicine (EBM) Unit in the Department of Research and Scientific Affairs (methodologists) at the AAOS. To develop this guideline, the work group held an introductory meeting on June 11-12, 2011 to establish the scope of the guideline and the systematic reviews. The clinical experts defined the scope of the guideline by creating preliminary recommendations (Questions) that directed the literature search. When necessary, these clinical experts also provided content help, search terms and additional clarification for the AAOS Medical Librarian. The Medical Librarian created and executed the search(es). The supporting group of methodologists and statistician (AAOS EBM Unit) reviewed all abstracts, recalled pertinent full-text articles for review and evaluated the quality of studies meeting the inclusion criteria. They also abstracted, analyzed, interpreted, and/or summarized the relevant evidence for each recommendation and prepared the initial draft for the final meeting. Upon completion of the systematic reviews, the work group participated in a three-day recommendation meeting on October 4-6, 2013. At this meeting, the clinical experts and methodologists then evaluated and integrated all material to develop the final recommendations. The final recommendations and rationales were edited, written and voted on at the final meeting. The draft guideline recommendations and rationales received final review by the methodologists to ensure that these recommendations and rationales were consistent with the data. The draft was then completed and submitted for peer review on February 28, 2014.

The resulting draft guidelines were then peer-reviewed, edited in response to that review and subsequently sent for public commentary, whereafter additional edits were made. Thereafter, the draft guideline was sequentially approved by the AAOS Committee on Evidence-Based Quality and Value, AAOS Council on Research and Quality, and the AAOS Board of Directors (see Appendix II for a description of the AAOS bodies involved in the approval process). The AAOS Medical Librarian will periodically search the literature to determine whether new published research meets the inclusion criteria. The AAOS Committee on Evidence Based Quality and Value will determine whether new research warrants a revision or update of the guideline. All AAOS guidelines are reviewed and updated, or retired, after five years in accordance with the criteria of the Agency for Healthcare Research and Quality (AHRQ) National Guideline Clearinghouse (NGC).

Thus the process of AAOS guideline development incorporates the benefits from clinical physician expertise as well as the statistical knowledge and interpretation of non-conflicted methodologists. The process also includes an extensive review process offering the opportunity for clinical physicians and multidisciplinary experts to provide input into the draft prior to publication. This process provides a sound basis for minimizing bias, enhancing transparency and ensuring the highest level of accuracy for interpretation of the evidence.

FORMULATING PRELIMINARY RECOMMENDATIONS

The work group began work on this guideline by constructing a set of preliminary recommendations. These recommendations specify [what] should be done in [whom], [when], [where], and [how often or how long]. They function as questions for the systematic review, not as final recommendations or conclusions. Preliminary recommendations are almost always modified on the basis of the results of the systematic review. Once established, these *a priori* preliminary recommendations cannot be modified until the final work group meeting.

STUDY SELECTION CRITERIA

We developed *a priori* article inclusion criteria for our review. These criteria are our "rules of evidence" and articles that did not meet them are, for the purposes of this guideline, not evidence.

To be included in our systematic reviews (and hence, in this guideline) an article had to be a report of a study that:

- Study must be of an Anterior Cruciate Ligament injury or prevention thereof
- Article must be a full article report of a clinical study.
  - Retrospective non-comparative case series, medical records review, meeting abstracts, historical articles, editorials, letters, and commentaries are excluded.
  - Confounded studies (i.e. studies that give patients the treatment of interest AND another treatment) are excluded.
  - Case series studies that have non-consecutive enrollment of patients are excluded.

  - Controlled trials in which patients were not stochastically assigned to groups AND in which there was either a difference in patient characteristics or outcomes at baseline AND where the authors did not statistically adjust for these differences when analyzing the results are excluded.
  - All studies of "Very Weak" strength of evidence are excluded.
  - All studies evaluated as Level V will be excluded.
  - Composite measures or outcomes are excluded even if they are patient-oriented.
- Study must appear in a peer-reviewed publication
- Study should have 10 or more patients per group
- Study must be of humans
- Study must be published in English
- Study must be published in or after 1990 for surgical treatment, rehabilitation, bracing, prevention and MRI
- Study must be published in or after 1966 for x rays and nonoperative treatment
- Study must be published in or after 1966 for all others non specified
- Study results must be quantitatively presented
- For surgical treatment a minimum of 2 year follow up duration
- For nonoperative treatment (Rec 25, Rec 26, Rec 28) a minimum of 6 months, but quality for those that are less than 2 years is downgraded one step
- For prevention studies (Rec 23 and Rec 24) a minimum of one sport season (dependent on sport)
- For any given follow-up time point in any included study, there must be ≥ 50% patient follow-up (if the follow-up is >50% but <80%, the study quality will be downgraded by one Level)
- For any included study that uses "paper-and-pencil" outcome measures (e.g., SF-36), only those outcome measures that have been validated will be included
- Study must not be an in vitro study
- Study must not be a biomechanical study
- Study must not have been performed on cadavers

We will only evaluate surrogate outcomes when no patient oriented outcomes are available.
We did not include systematic reviews or meta-analyses compiled by others or guidelines developed by other organizations. These documents are developed using different inclusion criteria than those specified by the AAOS work group. Therefore they may include studies that do not meet our inclusion criteria. We recalled these documents, if the abstract suggested they might provide an answer to one of our recommendations, and searched their bibliographies for additional studies to supplement our systematic review.

BEST EVIDENCE SYNTHESIS

When determining the best available evidence, we first include the highest-strength studies available for the outcomes examined. If there are two or more high-strength studies, the recommendation grade is strong. In this case, moderate- and low- strength evidence do not influence the grade of the recommendation. If there is one high- or at least two moderate- strength studies, the recommendation grade is moderate. If there is one moderate- or at least one low- strength studies, the recommendation grade is limited. Consensus based recommendations are established only when the rules for consensus recommendations apply (Table 8). A summary of the evidence that met the initial inclusion criteria, but was not best available evidence was created for each recommendation and can be viewed by recommendation in Appendix XII.

MINIMALLY CLINICALLY IMPORTANT IMPROVEMENT

Wherever possible, we consider the effects of treatments in terms of the minimally clinically important difference (MCII) in addition to whether their effects are statistically significant. The MCI is the smallest clinical change that is important to patients, and recognizes the fact that there are some treatment-induced statistically significant improvements that are too small to matter to patients. However, there were no occurrences of validated MCID outcomes in the studies included in this clinical practice guideline.

When MCID values from the specific guideline patient population are not available, we use the following measures listed in order of priority:

1) MCID/MID
2) PASS or Impact
3) Another validated measure
4) Statistical Significance

LITERATURE SEARCHES

We begin the systematic review with a comprehensive search of the literature. Articles we consider were published prior to June 2013 in four electronic databases; PubMed, EMBASE, CINAHL, and The Cochrane Central Register of Controlled Trials. The medical librarian conducts the search using key terms determined from the work group's preliminary recommendations.

We supplement the electronic search with a manual search of the bibliographies of all retrieved publications, recent systematic reviews, and other review articles for potentially relevant citations. Recalled articles are evaluated for possible inclusion based on the study selection criteria and are summarized for the work group who assist with reconciling possible errors and omissions.

The study attrition diagram in Appendix IV provides a detailed description of the numbers of identified abstracts and recalled and selected studies that were evaluated in the systematic review of this guideline. The search strategies used to identify the abstracts are contained in Appendix V.

METHODS FOR EVALUATING EVIDENCE
STUDIES OF INTERVENTION/PREVENTION
QUALITY

As noted earlier, we judge quality based on *a priori* research questions and use an automated numerical scoring process to arrive at final ratings. Extensive measures are taken to determine quality ratings so that they are free of bias.

We evaluate the quality of evidence separately for each outcome reported in every study using research design domains suggested by GRADE work group members and others.[M2, M3] The GRADE evidence appraisal system is used in the Cochrane Collaboration[M4] and has been developed for studies evaluating matched control groups. We incorporate a coding scheme adaptable to all research designs that involves incremental increases or decreases based on the following criteria:

- The study was prospective (with prospective studies, it is possible to have an a priori hypothesis to test; this is not possible with retrospective studies.)
- The statistical power of the study
- The assignment of patients to groups was unbiased
- There was sufficient blinding to mitigate against a placebo effect
- The patient groups were comparable at the beginning of the study
- The treatment was delivered in such a way that any observed effects could reasonably be attributed to that treatment
- Whether the instruments used to measure outcomes were valid
- Whether there was evidence of investigator bias

Each of the above quality domains is rated for possible flaws based on up to four indicator questions that define them. See Appendix VI for a discussion of the AAOS appraisal system. Domains are considered “flawed” if one indicator is coded “No” or at least two defining questions are “Unclear.” The Statistical Power domain is considered flawed if sample size is too small to detect at least a small effect size of 0.2.

If there are flawed domains then the evidence quality is downgraded according to the reductions shown in Table 1. As an example, the evidence reported in a randomized controlled trial (RCT) for any given outcome is rated as “High” quality if zero or one domain is flawed. If two or three domains are flawed, the rating is reduced to “Moderate.” If four or five domains are flawed, the quality of evidence is downgraded to “Low.” The quality of evidence is reduced to “Very Low” if six or more domains are flawed. As indicated above, very low quality evidence is not included in this AAOS guideline.

Table 1. Relationship between Quality and Domain Scores for Interventions

Number of Domains With No More Than One "Unclear" Answer	Strength of Evidence
0	High
1-2	Moderate
3-4	Low
>5	Very Low

Some flaws are so serious that we automatically term the evidence as being of "Very Low" quality if a study exhibits them. These serious design flaws are:

- Non-consecutive enrollment of patients in a case series
- Case series that gave patients the treatment of interest AND another treatment
- Measuring the outcome of interest one way in some patients and measuring it in another way in other patients
- Low Statistical Power

Conversely, the quality of research articles may be upgraded if the research is of high applicability or if providing the intervention decreases the potential for catastrophic harm, such as loss of life or limb. The criteria, based on the G.R.A.D.E. methodology, which can be used to upgrade the quality of a study, are as follows:

- The study has a large (>2) or very large (>5) magnitude of treatment effect: used for non-retrospective observational studies;
- All plausible confounding factors would reduce a demonstrated effect or suggest a spurious effect when results show no effect;
- Consideration of the dose-response effect.

Quality is one of two dimensions that determine the strength of the final recommendations.

APPLICABILITY

The applicability (also called "generalizability" or "external validity") of an outcome is one of the factors used to determine the strength of a recommendation. We categorize outcomes according to whether their applicability is "High", "Moderate", or "Low." As with quality, we separately evaluate the applicability for each outcome a study reports.

The applicability of a study is evaluated using the PRECIS instrument.[M5] The instrument was originally designed to evaluate the applicability of randomized controlled trials, but it can also be used for studies of other design. For example, the existence of an implicit control group in a case series (see above) make it useful for evaluating outcomes from these latter studies.

This instrument is comprised of the 10 questions that are briefly described in Table 2. All 10 questions are asked of all studies, regardless of design. The questions are divided into four domains. These domains and their corresponding questions are given in Table 2.

Table 2. Brief Description of the PRECIS Questions and Domains

Question	Domain
All Types of Patients Enrolled	Participants
Flexible Instructions to Practitioners	Interventions and Expertise
Full Range of Expt'l Practitioners	Interventions and Expertise
Usual Practice Control	Interventions and Expertise
Full Range of Control Practitioners	Interventions and Expertise
No Formal Follow-up	Interventions and Expertise
Usual and Meaningful Outcome	Interventions and Expertise
Compliance Not Measured	Compliance and Adherence
No Measure of Practitioner Adherence	Compliance and Adherence
All Patients in Analysis	Analysis

Each study is assumed to have "High" applicability at the start, and applicability is downgraded for flawed domains as summarized in Table 3.

Table 3. Relationship between Applicability and Domain Scores for Studies of Treatments

Number of Flawed Domains	Applicability
0	High
1, 2, 3	Moderate
4	Low

A study's applicability is "High" if there is only one "Unclear" answer in one domain and the answers to all of the questions for all other domains is "Yes." A study's applicability is low if there is one "Unclear" answer in one domain and the answers to all of the questions for all other domains is "No." A study's applicability is "Moderate" under all other conditions.

STUDIES OF SCREENING AND DIAGNOSTIC TESTS

QUALITY

As with our appraisal of the quality of studies of intervention, our appraisal of studies of screening and diagnostic tests is a domain-based approach conducted using *a priori* questions and scored by a computer program. The questions we used are those of the QUADAS instrument[M6] and the six domains we employed are listed below:

1. Participants (whether the spectrum of disease among the participants enrolled in the study is the same as the spectrum of disease seen in actual clinical practice)
2. Reference Test (whether the reference test , often a "gold standard," and the way it was employed in the study ensures correct and unbiased categorization of patients as having or not having disease)
3. Index Test (whether interpretation of the results of the test under study, often called the "index test", was unbiased)

4. Study Design (whether the design of the study allowed for unbiased interpretation of test results)
5. Information (whether the same clinical data were available when test results were interpreted as would be available when the test is used in practice)
6. Reporting (whether the patients, tests, and study protocol were described well enough to permit its replication)

We characterized a study that has no flaws in any of its domains as being of “High” quality, a study that has one flawed domain as being of “Moderate” quality, a study with two flawed domains as being of “Low” quality, and a study with three or more flawed domains as being of “Very Low” quality (Table).We characterized a domain as “flawed” if one or more questions addressing any given domain are answered “No” for a given screening/diagnostic/test, or if there are two or more “Unclear” answers to the questions addressing that domain.

We considered some design flaws as so serious that their presence automatically guarantees that a study is characterized as being of “Very Low” quality regardless of its domain scores. These flaws are:

- The presence of spectrum bias (occurs when a study does not enroll the full spectrum of patients who are seen in clinical practice. For example, a diagnostic case control study enrolls only those known to be sick and those known to be well, a patient population quite different from that seen in practice. Because diagnostic case control studies enroll only the easy to diagnose patients, these kinds of studies typically overestimate the abilities of a diagnostic test.)
- Failure to give all patients the reference standard regardless of the index test results
- Non-independence of the reference test and the index text

Table 4. Relationship Between Domain Scores and Quality of Screening/Diagnostic Tests

Number of Flawed Domains	Quality
0	High
1	Moderate
2	Low
≥3	Very Low

APPLICABILITY

We judged the applicability of evidence pertinent to screening and diagnostic tests using a modified version of the PRECIS instrument, implying that the questions are determined *a priori*. As before, scoring was accomplished by a computer. The applicability domains we employed for screening and diagnostic tests were:

1. Patients (i.e., whether the patients in the study are like those seen in actual clinical practice)

2. Index Test (i.e., whether the test under study could be used in actual clinical practice and whether it was administered in a way that reflects its use in actual practice)
3. Directness (i.e., whether the study demonstrated that patient health is affected by use of the diagnostic test under study)
4. Analysis (i.e., whether the data analysis reported in the study was based on a large enough percentage of enrolled patients to ensure that the analysis was not conducted on "unique" or "unusual" patients)

We characterized a domain as "flawed" if one or more questions addressing any given domain are answered "No" for a given screening/diagnostic/test, or if there are two or more "Unclear" answers to the questions addressing that domain. We characterized the applicability of a screening/diagnostic test as "High" if none of its domains are flawed, "Low" if all of its domains are flawed, and "Moderate" in all other cases (Table 5).

Table 5. Relationship Between Domain Scores and Applicability for Studies of Screening/Diagnostic Tests

Number of Flawed Domains	Applicability
0	High
1,2, 3	Moderate
4	Low

STUDIES OF PROGNOSTICS

QUALITY

Our appraisal of studies of prognostics is a domain-based approach conducted using *a priori* questions, and scored by a computer program for the questions we used and the domains to which they apply). The five domains we employed are:

1. Prospective (A variable is specified as a potential prognostic variable *a priori*. This is not possible with retrospective studies.)
2. Power (Whether the study had sufficient statistical power to detect a prognostic variable as statistically significant)
3. Analysis (Whether the statistical analyses used to determine that a variable was rigorous to provide sound results)
4. Model (Whether the final statistical model used to evaluate a prognostic variable accounted for enough variance to be statistically significant)
5. Whether there was evidence of investigator bias

We separately determined a quality score for each prognostic reported by a study. We characterized the evidence relevant to that prognostic variable as being of "High" quality if there are no flaws in any of the relevant domains, as being of "Moderate" quality if one of the relevant domains is flawed, as "Low" quality if there are two flawed domains, and as "Very Low" quality if three or more relevant domains are flawed (Table 5). We characterized a domain as "flawed" if one or more questions addressing any given domain are answered "No" for a given prognostic variable, or if there are two or more "Unclear" answers to the questions addressing that domain.

Table 6. Relationship Between Quality and Domain Scores for Studies of Prognostics

Number of Flawed Domains	Quality
0	High
1	Moderate
2	Low
≥3	Very Low

APPLICABILITY

We separately evaluated the applicability of each prognostic variable reported in a study, and did so using a domain-based approach for the relevant questions and the domains they address) that involves predetermined questions and computer scoring. The domains we used for the applicability of prognostics are:

1. Patients (i.e. whether the patients in the study and in the analysis were like those seen in actual clinical practice)
2. Analysis (i.e., whether the analysis was conducted in a way that was likely to describe variation among patients that might be unique to the dataset the authors used)
3. Outcome (i.e., whether the prognostic was a predictor of a clinically meaningful outcome)

We characterized the evidence relevant to that prognostic as being of "High" applicability if there are no flaws in any of the relevant domains, as being of "Low" applicability if all three domains are flawed, and as of "Moderate" applicability in all other cases (Table 6). We characterized a domain as "flawed" if one or more questions addressing any given domain are answered "No" for a given prognostic variable, or if there are two or more "Unclear" answers to the questions addressing that domain.

Table 7. Relationship Between Domain Scores and Applicability for Studies of Prognostics

Number of Flawed Domains	Applicability
0	High
1,2	Moderate
3	Low

FINAL STRENGTH OF EVIDENCE

To determine the final strength of evidence for an outcome, the strength is initially taken to equal quality. An outcome's strength of evidence is increased by one category if its applicability is "High", and an outcome's strength of evidence is decreased by one category if its applicability is "Low." If an outcome's applicability is "Moderate", no adjustment is made to the strength of evidence derived from the quality evaluation.

DEFINING THE STRENGTH OF THE RECOMMENDATIONS

Judging the strength of evidence is only a stepping stone towards arriving at the strength of a guideline recommendation. The strength of recommendation also takes into account the quality, quantity, and the trade-off between the benefits and harms of a treatment, the magnitude of a treatment's effect, and whether there is data on critical outcomes.

Strength of recommendation expresses the degree of confidence one can have in a recommendation. As such, the strength expresses how possible it is that a recommendation will be overturned by future evidence. It is very difficult for future evidence to overturn a recommendation that is based on many high quality randomized controlled trials that show a large effect. It is much more likely that future evidence will overturn recommendations derived from a few small case series. Consequently, recommendations based on the former kind of evidence are given a high strength of recommendation and recommendations based on the latter kind of evidence are given a low strength.

To develop the strength of a recommendation, AAOS staff first assigned a preliminary strength for each recommendation that took only the final strength of evidence (including quality and applicability) and the quantity of evidence (see Table 8).

Table 8. Strength of Recommendation Descriptions

Strength	Overall Strength of Evidence	Description of Evidence Strength	Strength Visual
Strong	Strong	Evidence from two or more "High" strength studies with consistent findings for recommending for or against the intervention.	
Moderate	Moderate	Evidence from two or more "Moderate" strength studies with consistent findings, or evidence from a single "High" quality study for recommending for or against the intervention.	
Limited	Low Strength Evidence or Conflicting Evidence	Evidence from two or more "Low" strength studies with consistent findings **or** evidence from a single study for recommending for against the intervention or diagnostic or the evidence is insufficient or conflicting and does not allow a recommendation for or against the intervention.	
Consensus*	No Evidence	There is no supporting evidence. In the absence of reliable evidence, the work group is making a recommendation based on their clinical opinion. Consensus recommendations can only be created when not establishing a recommendation could have catastrophic consequences.	

WORDING OF THE FINAL RECOMMENDATIONS

To prevent bias in the way recommendations are worded, the AAOS uses specific predetermined language stems that are governed by the evidence strengths. Each recommendation was written using language that accounts for the final strength of the recommendation. This language, and the corresponding strength, is shown in Table 9.

Table 9. AAOS Guideline Language Stems

Guideline Language	Strength of Recommendation
Strong evidence supports that the practitioner should/should not do X, because…	Strong
Moderate evidence supports that the practitioner could/could not do X, because…	Moderate
Limited evidence supports that the practitioner might/might not do X, because…	Limited
In the absence of reliable evidence, it is the ***opinion*** of this work group that…*	Consensus*

**Consensus based recommendations are made according to specific criteria. These criteria can be found in Appendix VII.*

APPLYING THE RECOMMENDATIONS TO CLINICAL PRACTICE

To increase the practicality and applicability of the guideline recommendations in this document, the information listed in Table 10 provides assistance in interpreting the correlation between the strength of a recommendation and patient counseling time, use of decision aids, and the impact of future research

Table 10. Clinical Applicability: Interpreting the Strength of a Recommendation

Strength of Recommendation	Patient Counseling (Time)	Decision Aids	Impact of Future Research
Strong	Least	Least Important, unless the evidence supports no difference between two alternative interventions	Not likely to change
Moderate	Less	Less Important	Less likely to change
Limited	More	Important	Change possible/anticipated
Consensus	Most	Most Important	Impact unknown

VOTING ON THE RECOMMENDATIONS

The recommendations and their strength were voted on by the work group members during the final meeting. If disagreement between the work group occurred, there was further discussion to see whether the disagreement(s) could be resolved. Up to three rounds of voting were held to attempt to resolve disagreements. If disagreements were not resolved following three voting rounds, no recommendation was adopted. Lack of agreement is a reason that the strength for some recommendations can be labeled "Limited."

STATISTICAL METHODS

ANALYSIS OF DIAGNOSTIC DATA

Likelihood ratios, sensitivity, specificity and 95% confidence intervals were calculated to determine the accuracy of diagnostic modalities based on two by two diagnostic contingency tables extracted from the included studies. When summary values of sensitivity, specificity, or other diagnostic performance measures were reported, estimates of the diagnostic contingency table were used to calculate likelihood ratios. Likelihood ratios (LR) indicate the magnitude of the change in probability of disease due to a given test result. For example, a positive likelihood ratio of 10 indicates that a positive test result is 10 times more common in patients with disease than in patients without disease. Likelihood ratios are interpreted according to previously published values, as seen in Table below.

Table 11. Interpreting Likelihood Ratios

Positive Likelihood Ratio	Negative Likelihood Ratio	Interpretation
>10	<0.1	Large and conclusive change in probability
5-10	0.1-0.2	Moderate change in probability
2-5	0.2-0.5	Small (but sometimes important change in probability)
1-2	0.5-1	Small (and rarely important) change in probability

ANALYSIS OF INTERVENTION/PREVENTION DATA

When possible, we recalculate the results reported in individual studies and compile them to answer the recommendations. The results of all statistical analysis conducted by the AAOS Clinical Practice Guidelines Unit are conducted using STATA 12. STATA was used to determine the magnitude, direction, and/or 95% confidence intervals of the treatment effect. For data reported as means (and associated measures of dispersion) the mean difference between groups and the 95% confidence interval was calculated and a two-tailed t-test of independent groups was used to determine statistical significance. When published studies report measures of dispersion other than the standard deviation the value was estimated to facilitate calculation of the treatment effect. In studies that report standard errors or confidence intervals the standard deviation was back-calculated. In some circumstances statistical testing was conducted by the authors and measures of dispersion were not reported. In the absence of measures of dispersion, the results of the statistical analyses conducted by the authors (i.e. the p-value) are considered as evidence. For proportions, we report the proportion of patients that experienced an outcome along with the percentage of patients that experienced an outcome. The variance of the arcsine difference was used to determine statistical significance.[M7] P-values < 0.05 were considered statistically significant.

We performed meta-analyses using the random effects method of DerSimonian and Laird.[M8] A minimum of four studies was required for an outcome to be considered by meta-analysis. Heterogeneity was assessed with the I-squared statistic. Meta-analyses with I-squared values less than 50% were considered as evidence. Those with I-squared larger than 50% were not considered as evidence for this guideline. All meta-analyses were performed using STATA 12 and the "metan" command. The arcsine difference was used in meta-analysis of proportions. In order to overcome the difficulty of interpreting the magnitude of the arcsine difference, a summary odds ratio is calculated based on random effects meta-analysis of proportions and the number needed to treat (or harm) is calculated. The standardized mean difference was used for meta-analysis of means and magnitude was interpreted using Cohen's definitions of small, medium, and large effect.

PEER REVIEW

Following the final meeting, the guideline draft undergoes peer review for additional input from external content experts. Written comments are provided on the structured review form (see Appendix VIII for an example of the structured review form) adapted from the Appraisal of Guidelines for Research and Evaluation (AGREE) instrument. All peer reviewers are required to disclose their conflicts of interest.

To guide who participates, the work group identifies specialty societies at the introductory meeting. O*rganizations*, not *individuals*, are specified.

The specialty societies are solicited for nominations of individual peer reviewers approximately six weeks before the final meeting. The peer review period is announced as it approaches and others interested are able to volunteer to review the draft. The chair of the AAOS committee on Evidence Based Quality and Value reviews the draft of the guideline prior to dissemination.

Some specialty societies (both orthopaedic and non-orthopaedic) ask their evidence-based practice (EBP) committee to provide review of the guideline. The organization is responsible for coordinating the distribution of our materials and consolidating their comments onto one form. The chair of the external EBP committees provides disclosure of their conflicts of interest (COI) and manages the potential conflicts of their members.

Again, the AAOS asks that reviews be assembled into a single response form by the specialty society and for the individual submitting the review to provide disclosure of potentially conflicting interests. The peer review stage gives external stakeholders an opportunity to provide evidence-based direction for modifications that they believe have been overlooked. Since the draft is subject to revisions until its approval by the AAOS Board of Directors as the final step in the guideline development process, confidentiality of all working drafts is essential.

The manager of the evidence-based medicine unit and the statistician draft the initial responses to comments that address methodology. These responses are then reviewed by the work group chair and vice-chair, who respond to questions concerning clinical practice and techniques. The director of the Department of Research and Scientific Affairs provides input as well. All comments received and the initial drafts of the responses are also reviewed by all members of the work group. All changes to a recommendation as a result of peer review are based on the evidence and undergoes majority vote by the work group members via teleconference. Final revisions are summarized in a detailed report that is made part of the guideline document throughout the remainder of the review and approval processes.

The AAOS believes in the importance of demonstrating responsiveness to input received during the peer review process and welcomes the critiques of external specialty societies. Following final approval of the guideline, all individual responses are posted on our website http://www.aaos.org/research/guidelineswith a point-by-point reply to each non-editorial comment. Reviewers who wish to remain anonymous notify the AAOS to have their names de-identified; their comments, our responses, and their COI disclosures are still posted.

Review of the Management of Anterior Cruciate Ligament Injuries guideline was requested of 26 organizations and 18 external content experts were nominated to represent them. Thirteen individuals (nine organizations) returned comments on the structured review form (see Appendix XI).

PUBLIC COMMENTARY

After modifying the draft in response to peer review, the guideline was subjected to a thirty day period of "Public Commentary." Commentators may consist of members of the AAOS Board of Directors (BOD), members of the Council on Research and Quality (CORQ), members of the Board of Councilors (BOC), and members of the Board of Specialty Societies (BOS). The guideline is automatically forwarded to the AAOS BOD and CORQ so that they may review it and provide comment prior to being asked to approve the document. Members of the BOC and BOS are specifically solicited for interest as well as organizations with representatives on the multidisciplinary panel. In addition to announcements that are sent out, a notice is posted on the AAOS website announcing that the draft guideline is available for public comment. Upon request, the document is forwarded to interested individuals along with a structured review form adapted from the Appraisal of Guidelines for Research and Evaluation (AGREE) instrument. For this guideline, four members returned formal public comments.

THE AAOS GUIDELINE APPROVAL PROCESS

This final guideline draft must be approved by the AAOS Committee on Evidence Based Quality and Value, the AAOS Council on Research and Quality, and the AAOS Board of Directors. These decision-making bodies are described in Appendix II and are not designated to modify the contents. Their charge is to approve or reject its publication by majority vote.

REVISION PLANS

This guideline represents a cross-sectional view of current treatment and may become outdated as new evidence becomes available. This guideline will be revised in accordance with new evidence, changing practice, rapidly emerging treatment options, and/or new technology. This guideline will be reviewed and updated, or retired and withdrawn, after five years in accordance with the standards of the Agency for Healthcare Research and Quality National Guideline Clearinghouse.

GUIDELINE DISSEMINATION PLANS

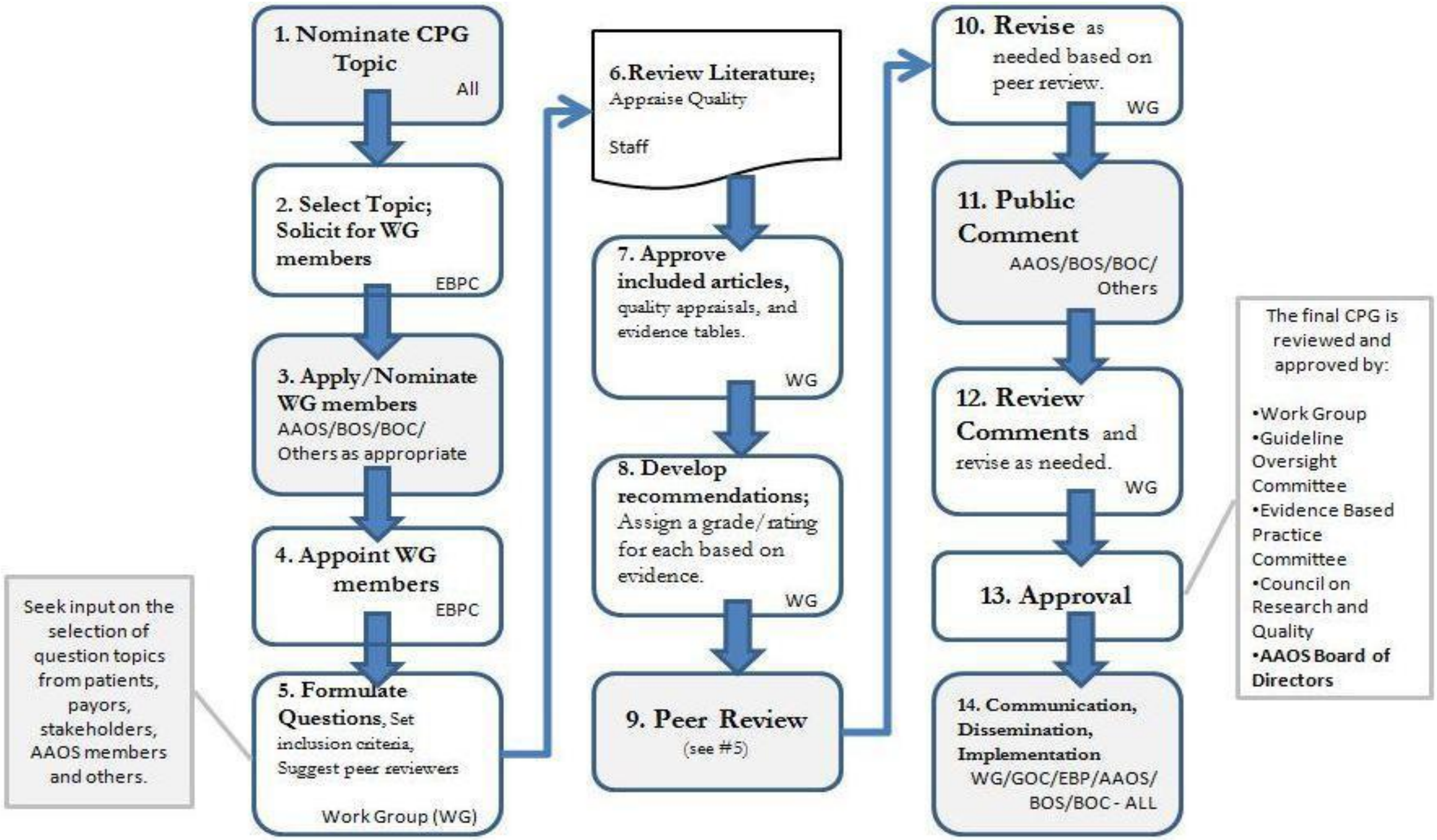
The primary purpose of the present document is to provide interested readers with full documentation about not only our recommendations, but also about how we arrived at those recommendations. This document is also posted on the AAOS website at http://www.aaos.org/research/guidelines/guide.asp.

Shorter versions of the guideline are available in other venues. Publication of guidelines is announced by an Academy press release, articles authored by the work group and published in the Journal of the American Academy of Orthopaedic Surgeons (JAAOS), and articles published in AAOS *Now*. A summary will be submitted for publication in the Journal of Bone and Joint Surgery (JBJS). With funding from AHRQ, AAOS is also developing a mobile application, Orthoguidelines, to enhance dissemination efforts. Most guidelines are also distributed at the AAOS Annual Meeting in various venues.

Selected guidelines are disseminated by webinar, an Online Module for the Orthopaedic Knowledge Online website, Radio Media Tours, Media Briefings, and by distributing them at relevant Continuing Medical Education (CME) courses and at the AAOS Resource Center.

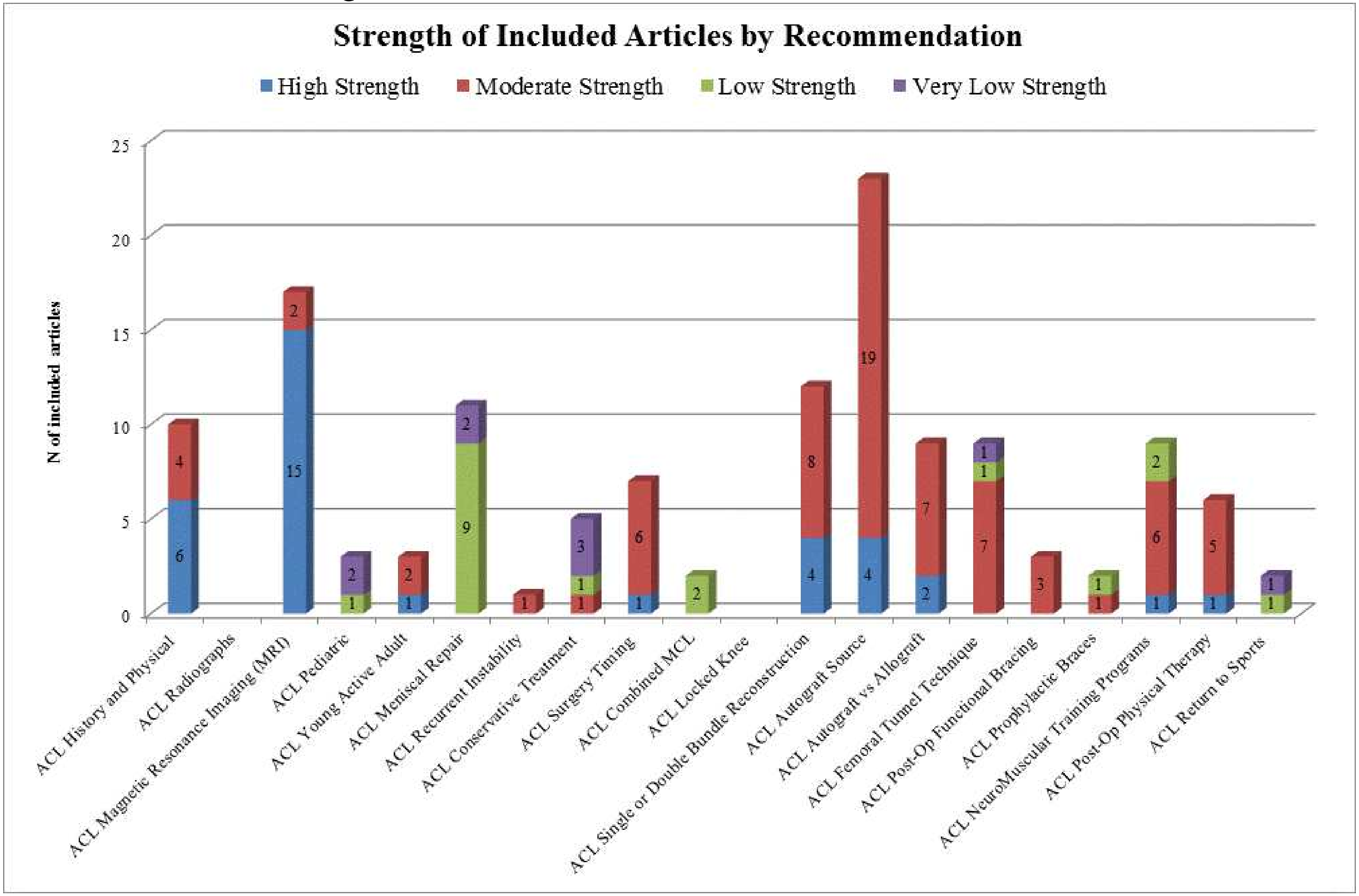
Other dissemination efforts outside of the AAOS will include submitting the guideline to the National Guideline Clearinghouse, the Guidelines International Network database, and distributing the guideline at other medical specialty societies' meetings. The work group chair, vice chair and work group members will seek appropriate speaking opportunities at professional meetings to disseminate the findings in the guideline and encourage the implementation and adoption of the recommendations.

AAOS CLINICAL PRACTICE GUIDELINE DEVELOPMENT PROCESS OVERVIEW



IV.RECOMMENDATIONS

OVERVIEW OF STUDY QUALITY PER RECOMMENDATION



ACL HISTORY AND PHYSICAL

Strong evidence supports that the practitioner should obtain a relevant history and perform a musculoskeletal exam of the lower extremities, because these are effective diagnostic tools for ACL injury.

Strength of Recommendation: Strong ★★★★

RATIONALE

There were six high-strength and four moderate-strength studies evaluating history and physical examination as diagnostic tools for ACL injury. [8, 23, 32, 55, 58, 60, 87, 91, 104, 105] A relevant history is important for diagnosing ACL injuries and concomitant pathology and should include at a minimum the mechanism of injury, history of hearing/feeling a popping sensation, ability to bear weight, ability to return to play, history of mechanical symptoms of locking or catching, localization of pain if possible, and any history of prior knee injuries. [55, 60, 91] History of hearing/feeling a popping sensation and associated swelling is important in predicting an ACL injury.[87]

Appropriate physical exam is important in diagnosing ACL injuries and concomitant pathology and should also be performed including at a minimum: a neurovascular exam with documentation of both distal perfusion and tibial/peroneal nerve function, assessment for joint line tenderness or obvious step off/deformity, evaluation for an effusion, assessment of varus and valgus laxity at 0 and 30 degrees of extension, evaluation of anterior-posterior and rotational laxity. [8, 32, 58, 104, 105] Lachman's test should be performed and has been shown to be sensitive for ACL injury.[23]

BENEFITS OF IMPLEMENTATION

A thorough history and physical exam will assist the practitioner in prompt and accurate diagnosis of ACL injuries and concomitant pathology.

POSSIBLE HARMS OF IMPLEMENTATION

There are no known harms associated with appropriate implementation of this recommendation.

FUTURE RESEARCH

Future research could help confirm the most useful history and physical exam findings for the diagnosis of ACL injury and concomitant pathology.

SUMMARY OF FINDINGS

Table 12. Summary of Findings: Diagnosing Anterior Ligament Injuries With History and Physical

🟢 +LR>10, -LR<.01 **“Strong”**: In “Strong” agreement with the reference standard

🔴 +LR=5-10, -LR=0.1-0.2: **“Moderate”:** In “Moderate” agreement with the reference standard

🔵 +LR=2-5, -LR=0.2-0.5: **“Weak”:** In “Weak” agreement with the reference standard

○ +LR=1-2, -LR=0.5-1: **“Poor”:** In “Poor” agreement with the reference standard

Diagnostic Test		Juyal et al. 2013 *(H)*	Kocabey et al. 2004 *(L)*	Rayan et al. 2009 *(H)*	Cooperman et al. 2012 *(M)*	Pookarnjanamorakot et al. 2004 *(H)*
Clinical examination	***Rule in test***	🟢				
	Rule out test	🔴				
Lachman's test	***Rule in test***				○	
	Rule out test				○	
Pivot shift sign	***Rule in test***					
	Rule out test					
Anterior drawer test	***Rule in test***					
	Rule out test					
History and Physical	***Rule in test***		🟢	🟢		
	Rule out test		🔴	🔵		
Effusion	***Rule in test***					
	Rule out test					
Popping sensation	***Rule in test***					
	Rule out test					
Swelling	***Rule in test***					🔵
	Rule out test					○

Table 13. Summary of Findings: Diagnosing Medial Side Ligament Injuries With History and Physical

🟢 +LR>10, -LR<.01 **“Strong”:** In “Strong” agreement with the reference standard

🔴 +LR=5-10, -LR=0.1-0.2 **“Moderate”:** In “Moderate” agreement with the reference standard

🔵 +LR=2-5, -LR=0.2-0.5 **“Weak”:** In “Weak” agreement with the reference standard

○ +LR=1-2, -LR=0.5-1 **“Poor”:** In “Poor” agreement with the reference standard

Diagnostic Test		Juyal et al. 2013 *(H)*	Kocabey et al. 2004 *(M)*	Rayan et al. 2009 *(H)*	Pookarnjanamorakot et al. 2004 *(H)*	Jah et al. 2005 *(M)*	Akseki et al. 2004 *(M)*
Clinical examination	***Rule in test***	○					
	Rule out test	🔴					
History and Physical	***Rule in test***		🔵	🟢		🟢	
	Rule out test		🔴	🔴		🔴	
Joint line tenderness	***Rule in test***				🔴		○
	Rule out test				○		🔵
Swelling	***Rule in test***				🔵		
	Rule out test				○		
Steinmann I sign	***Rule in test***				🟢		
	Rule out test				○		
McMurray test	***Rule in test***				🔵		🔵
	Rule out test				○		🔵
Apley test	***Rule in test***				🔴		
	Rule out test				○		
Ege's test	***Rule in test***						🔵
	Rule Out Test						🔵

Overall strength of study; High: *(H)*, Moderate: *(M)*, Low: *(L)*, Very low: *(V)*

Table 14. Summary of Findings: Diagnosing Lateral Side Ligament Injuries With History and Physical

🟢 +LR>10, -LR<.01 **"Strong":** In "Strong" agreement with the reference standard

🔴 +LR=5-10, -LR=0.1-0.2 **"Moderate":** In "Moderate" agreement with the reference standard

🔵 +LR=2-5, -LR=0.2-0.5 **"Weak":** In "Weak" agreement with the reference standard

○ +LR=1-2, -LR=0.5-1 **"Poor":** "Poor" agreement with the reference standard

Diagnostic Test		Juyal et al. 2013 *(H)*	Kocabey et al. 2004 *(M)*	Rayan et al. 2009 *(H)*	Akseki et al. 2004 *(M)*
Clinical examination	***Rule in test***	🔴			
	Rule out test	🔵			
Joint line tenderness	***Rule in test***				🔵
	Rule out test				🔵
McMurray test	***Rule in test***				🔵
	Rule out test				○
Ege's test	***Rule in test***				🔴
	Rule out test				🔵
History and Physical	***Rule in test***		🟢	🟢	
	Rule out test		🔵	🔵	

Overall strength of study; High: *(H)*, Moderate: *(M)*, Low: *(L)*, Very low: *(V)*

QUALITY AND APPLICABILITY SUMMARY

Table 15. Quality and Applicability Summary: Diagnosis: History and Physical

Study	Test	Reference Test	Quality	Applicability	Overall Strength of Evidence
Pookarnjanamorakot 2004	Apley test	Arthroscopic evaluation	High	Moderate	High
Pookarnjanamorakot 2004	Childress sign	Arthroscopic evaluation	High	Moderate	High
Juyal et al. 2013	Clinical assessment	Arthroscopic evaluation	High	Moderate	High
Akseki 2004	Ege's test	Arthroscopic evaluation	Very Low	Low	Very Low
Jah 2005	History	Arthroscopic evaluation	Very Low	Moderate	Very Low
Kocabey 2004	History	Arthroscopic evaluation	Moderate	Moderate	Moderate
Rayan 2009	History	Arthroscopic evaluation	Moderate	Moderate	Moderate
Akseki 2004	Joint line tenderness	Arthroscopic evaluation	Very Low	Moderate	Very Low
Pookarnjanamorakot 2004	Joint line tenderness	Arthroscopic evaluation	High	Moderate	High
Shelbourne 2009	Joint line tenderness	Arthroscopic evaluation	High	Moderate	High
Cooperman 1990	Lachman's test	Arthroscopic evaluation	Moderate	Moderate	Moderate
Pookarnjanamorakot 2004	McMurray test	Arthroscopic evaluation	High	Moderate	High
Akseki 2004	McMurray's test	Arthroscopic evaluation	Very Low	Moderate	Very Low
Pookarnjanamorakot 2004	Merke's sign	Arthroscopic evaluation	High	Moderate	High
Pookarnjanamorakot 2004	Steinmann I sign	Arthroscopic evaluation	High	Moderate	High

RESULTS

QUALITY AND APPLICABILITY

Table 16. Quality and Applicability of Diagnostic Test of History and Physical

●:Domain free of flaws

○:Domain flaws present

Study	Test	Reporting (Penalty)	Index Test	Reference Test	Participants	Information	Study Design	*Quality*	Participants	Index Test	Directness of Results	Analysis	*Applicability*
Pookarnjanamorakot 2004	Apley test	○	●	●	●	●	●	**High**	●	○	○	●	**Moderate**
Pookarnjanamorakot 2004	Childress sign	○	●	●	●	●	●	**High**	●	○	○	●	**Moderate**
Juyal et al. 2013	Clinical assessment	○	●	●	●	●	●	**High**	●	○	○	●	**Moderate**
Akseki 2009	Ege's test	○	●	●	●	●	●	**Very Low**	○	○	○	○	**Low**
Jah 2005	History	○	●	●	●	●	○	**Very Low**	●	○	○	●	**Moderate**
Kocabey 2004	History	○	●	○	●	●	●	**Moderate**	●	○	○	●	**Moderate**
Rayan 2008	History	○	●	●	●	●	○	**Moderate**	●	○	○	●	**Moderate**
Akseki 2009	Joint line tenderness	○	●	●	●	●	●	**Very Low**	●	○	○	●	**Moderate**

Table 16. Quality and Applicability of Diagnostic Test of History and Physical

●:Domain free of flaws

○:Domain flaws present

Study	Test	Reporting (Penalty)	Index Test	Reference Test	Participants	Information	Study Design	*Quality*	Participants	Index Test	Directness of Results	Analysis	*Applicability*
Pookarnjanamorakot 2004	Joint line tenderness	○	●	●	●	●	●	**High**	●	○	○	●	**Moderate**
Shelbourne 2009	Joint line tenderness	○	●	●	●	●	●	**High**	●	○	○	●	**Moderate**
Cooperman 1990	Lachman's test	○	●	●	●	○	●	**Moderate**	●	○	○	●	**Moderate**
Pookarnjanamorakot 2004	McMurray test	○	●	●	●	●	●	**High**	●	○	○	●	**Moderate**
Akseki 2009	McMurray's test	○	●	●	●	●	●	**Very Low**	●	○	○	○	**Moderate**
Pookarnjanamorakot 2004	Merke's sign	○	●	●	●	●	●	**High**	●	○	○	●	**Moderate**
Pookarnjanamorakot 2004	Steinmann I sign	○	●	●	●	●	●	**High**	●	○	○	●	**Moderate**

FINDINGS

Table 17. Diagnostic Results: Anterior Cruciate Ligament Injuries With History and Physical

Author	Study Strength	Diagnostic Test	Positive Likelihood Ratio (95% CI)	Negative Likelihood Ratio (95% CI)	Sensitivity	Specificity
Juyal et al. 2013	High	Clinical examination	11.92(3.13,45.37)	0.09(0.02,0.34)	91%	92%
Jah et al. 2005	High	History	15(4.96,45.37)	0.11(0.03,0.04)	90%	94%
Kocabey et al. 2004	Moderate	History and Physical	49.07(3.15,763.43)^	0.02(0.00,0.29)^	100%	100%
Rayan et al. 2009	High	History, Joint line tenderness, positive McMurray's test, Lachman test, and Anterior drawer's test	88.93(5.61,1404.94)	0.24(0.16,0.35)	77%	100%
Cooperman et al. 2012	Moderate	Lachman's trial one combined	1.32(0.75,2.30)	0.65(0.25,1.67)	69%	47%
Cooperman et al. 2012	Moderate	Lachman's trial one Orthopedic surgeons	1.62(0.93,2.84)	0.44(0.15,1.29)	77%	53%
Cooperman et al. 2012	Moderate	Lachman's trial one Physical therapists	1.11(0.64,1.92)	0.85(0.35,2.04)	64%	42%
Cooperman et al. 2012	Moderate	Lachman's trial two combined	1.83(1,3.35)	0.40(0.14,1.16)	77%	58%
Cooperman et al. 2012	Moderate	Lachman's trial two Orthopedic surgeons	1.62(0.73,1.62)	0.44(0.15,1.29)	85%	58%
Cooperman et al. 2012	Moderate	Lachman's trial two Physical therapists	1.46(0.8,2.65)	0.58(0.23,1.47)	69%	53%
Shelbourne et al. 2009	High	Lateral joint line tenderness	1.02(0.96,1.08)	0.98(0.90,1.06)	57%	44%
Shelbourne et al. 2009	High	Lateral joint line tenderness	0.96(0.89,1.03)	1.04(0.97,1.11)	46%	52%
Shelbourne et al. 2009	High	Medial joint line tenderness	0.93(0.86,1.01)	1.05(0.99,1.22)	41%	57%
Shelbourne et al. 2009	High	Medial joint line tenderness	1.10(1.03,1.17)	0.90(0.84,0.97)	55%	50%

Table 18. Diagnostic Results: Medial Ligament Injuries With History and Physical

Author	Study Strength	Diagnostic Test	Positive Likelihood Ratio (95% CI)	Negative Likelihood Ratio (95% CI)	Sensitivity	Specificity
Pookarnjanamorakot et al. 2004	High	Apley test	5(0.31,79.43)	0.86(0.75,0.98)	17%	99%
Pookarnjanamorakot et al. 2004	High	Childress sign	1.70(1.03,2.82)	0.52(0.34,0.84)	68%	60%
Juyal et al. 2013	High	Clinical examination (Lachman test, Anterior/posterior drawer test, McMurray test, Apley's gliding test, Apley's distraction test, Valgus stress instability, Varus stress test instability, Squat test)	1.93(1.28,2.9)	0.19(0.05,0.73)	90%	53%
Akseki et al. 2004	Moderate	Ege's test	3.64(2.04,6.48)	0.490.29,0.55)	67%	81%
Akseki et al. 2004	Moderate	Ege's test	6.45(3.51,11.88)	0.41(0.25,0.67)	64%	90%
Jah et al. 2005	High	History (onset of effusion, presence of pop, locking, giving way and subjective instability) and Clinical sign and physical examination (presence of effusion, range of motion, joint line tenderness, three plane stability, McMurray test, squat test, Apley test, anterior drawer test, Lachman test, posterior drawer test and quadriceps active test)	19.03(4.86,74.58)	0.18(0.08,0.4)	83%	96%
Kocabey et al. 2004	Moderate	History and Physical	2.76(1.40,5.42)	0.19(0.07,0.49)	87%	68%
Pookarnjanamorakot et al. 2004	High	History of Locking	3(0.75,12.03)	0.83(0.7,0.98)	24%	92%
Pookarnjanamorakot et al. 2004	High	History of Swelling	3(1,9.04)	0.73(0.58,0.91)	36%	88%
Rayan et al. 2009	High	History, Joint line tenderness, positive McMurray's test, Lachman test, and Anterior drawer's test	42.29(2.72,657.28)	0.18(0.08,0.41)	87%	87%
Akseki et al. 2004	Very low	Joint line tenderness	1.55(1.21,1.98)	0.29(0.15,0.53)	88%	44%
Akseki et al. 2004	Very low	Joint line tenderness	3.36(2.18,5.17)	0.490.24,0.68)	67%	80%
Pookarnjanamorakot et al. 2004	High	Joint line tenderness	6.67(0.94,47.17)	0.76(0.65,0.89)	27%	96%

Table 18. Diagnostic Results: Medial Ligament Injuries With History and Physical

Author	Study Strength	Diagnostic Test	Positive Likelihood Ratio (95% CI)	Negative Likelihood Ratio (95% CI)	Sensitivity	Specificity
Pookarnjanamorakot et al. 2004	High	McMurray	3.5(0.88,13.88)	0.78(0.65,0.94)	28%	92%
Akseki et al. 2004	Very low	McMurray test	2.22(1.44,3.42)	0.47(0.34,0.66)	67%	69%
Akseki et al. 2004	Very low	McMurray test	4.3(2.4,7.67)	0.54(0.38,0.77)	53%	88%
Pookarnjanamorakot et al. 2004	High	Merke's sign	3.37(1.36,8.59)	0.54(0.4,0.73)	54%	84%
Pookarnjanamorakot et al. 2004	High	Steinmann I sign	13.85(0.87,219.84)	0.73(0.62,0.85)	29%	100%

Table 19. Diagnostic Results: Lateral Ligament Injuries With History and Physical

Author	Study Strength	Diagnostic Test	Positive Likelihood Ratio (95% CI)	Negative Likelihood Ratio (95% CI)	Sensitivity	Specificity
Juyal et al. 2013	High	Clinical examination (Lachman test, Anterior/posterior drawer test, McMurray test, Apley's gliding test, Apley's distraction test, Valgus stress instability, Varus stress test instability, Squat test)	6.33(2.31,17.38)	0.37(0.17,0.84)	67%	89%
Jah et al. 2005	High	History (onset of effusion, presence of pop, locking, giving way and subjective instability) and Clinical sign and physical examination (presence of effusion, range of motion, joint line tenderness, three plane stability, McMurray test, squat test, Apley test, anterior drawer test, Lachman test, posterior drawer test and quadriceps active test)	18.56(4.58,75.25)	0.32(0.16,0.67)	69%	96%
Kocabey et al. 2004	Moderate	History and Physical	15.75(3.84,64.54)	0.26(0.08,0.87)	75%	95%
Rayan et al. 2009	High	History, Joint line tenderness, positive McMurray's test, Lachman test, and Anterior drawer's test	11.14(4.50,27.59)	0.46(0.31,0.68)	56%	94%

Table 20. Diagnostic Result: Posterior Cruciate Ligament Injury With History and Physical

Author	Study Strength	Diagnostic Test	Positive Likelihood Ratio (95% CI)	Negative Likelihood Ratio (95% CI)	Sensitivity	Specificity
Jah et al. 2005	High	History (onset of effusion, presence of pop, locking, giving way and subjective instability) and Clinical sign and physical examination (presence of effusion, range of motion, joint line tenderness, three plane stability, McMurray test, squat test, Apley test, anterior drawer test, Lachman test, posterior drawer test and quadriceps active test)	117.8(7.42,1869.28)	0.05(0.00,0.75)	95%	99%

ACL RADIOGRAPHS

In the absence of reliable evidence, it is the opinion of the work group that in the initial evaluation of a person with a knee injury and associated symptoms [giving way, pain, locking, catching] and signs [effusion, inability to bear weight, bone tenderness, loss of motion, and/or pathological laxity] that the practitioner obtain AP and lateral knee xrays to identify fractures or dislocations requiring emergent care.

Strength of Recommendation: Consensus

RATIONALE

While recognizing that various criteria for performing knee radiographs have been published, the consensus opinion recommends that practitioners initially evaluating a patient with an acute knee injury should obtain AP and lateral radiographs of the knee. In the setting of acute knee injury, radiographs may lead to the diagnosis of fracture, dislocation, ligament disruption, neoplasm, foreign body, and/or soft tissue injury that could lead to loss of the limb or limb function. Early diagnosis of these disorders may decrease morbidity from the injury.

If a MRI or CT scan is already available additional radiographs may not be necessary. This recommendation is consistent with current practice.

BENEFITS OF IMPLEMENTATION

Potential early recognition of clinically important knee injury enhances patient care.

POSSIBLE HARMS OF IMPLEMENTATION

X-ray exposure.

FUTURE RESEARCH

Adequately powered study to evaluate the sensitivity and specificity of methods used in the initial evaluation of acute knee injury; symptoms and physical signs, plain radiographs, MRI scan, and CT scan.

ACL MAGNETIC RESONANCE IMAGING (MRI)

Strong evidence supports that the MRI can provide confirmation of ACL injury and assist in identifying concomitant knee pathology such as other ligament, meniscal, or articular cartilage injury.

Strength of Recommendation: Strong ★★★★

RATIONALE

Fifteen high strength and two moderate strength studies demonstrated that MRI has a high sensitivity and specificity in diagnosing ACL tears, but somewhat lower sensitivity and specificity at identifying concomitant injuries and other problems.[2, 30, 38, 40, 41, 42, 55, 59, 65, 89, 91, 92, 97, 101, 105, 107, 116]

A combination of history, clinical examination (Lachman test), and radiographs has similar diagnostic accuracy as MRI for identifying ACL tears. An MRI could be used in conjunction with the history and physical examination.

POSSIBLE HARMS OF IMPLEMENTATION

There are no known harms associated with implementing this recommendation.

FUTURE RESEARCH

Evaluation of the severity and significance of cartilage and subchondral bone injury with regards to the risk of developing future arthritis

SUMMARY OF FINDINGS

Table 21. Summary of Findings: Diagnosing Ligament Injuries with MRI

Injury		Fischer et al. 1991 *(H)*	Grevitt et al. 1993 *(H)*	Gul-e-khanda et al. 2006 *(H)*	Ha et al. 1998 *(H)*	Jah et al. 2005 *(H)*	Rappeport et al. 1997 *(H)*	Rayan et al. 2009 *(M)*	Richards et al. 2012 *(H)*	Sampson et al. 2008 *(H)*	Singh et al. 2004 *(H)*	Siddiqui et al. 2013 *(H)*	Sharma et al. 2011 *(M)*	**Meta-Analysis**
ACL	***Rule in test***	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🟢	🟢	🟢		🟢
	Rule out test	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴		🔴
Lateral meniscus	***Rule in test***	🟢	🟢	🔴		🔴	🟢	🔴		🟢	🟢	🔴	🟢	🔴
	Rule out test	🔵	🔴	🔴		○	○	🔵		🔵	🔵	🔵	🔵	🔵
Medial meniscus	***Rule in test***	🔴	🔴	🔵		🔴	🔵	○		🟢	🟢	○	🟢	🔴
	Rule out test	🔴	🔴	🔴		🔴	🔵	🔵		🔴	🔴	🔵	🔴	🔴

QUALITY AND APPLICABILITY SUMMARY

Table 22. Diagnostic Quality and Applicability Summary: MRI

Study	Diagnostic Test	Reference Test	Quality	Applicability	Overall Strength of Evidence
Vaz 2005	Clinical sign and MRI	Arthroscopic evaluation	High	Moderate	High
Adalberth 1997	MRI	Arthroscopic evaluation	High	Moderate	High
Fischer 1991	MRI	Arthroscopic evaluation	High	Moderate	High
Grevitt 1992	MRI	Arthroscopic evaluation	High	Moderate	High
Gul-e-khanda	MRI	Arthroscopic evaluation	High	Moderate	High
Ha 1998	MRI	Arthroscopic evaluation	High	Moderate	High
Jah 2005	MRI	Arthroscopic evaluation	High	Moderate	High
Rappeport 1997	MRI	Arthroscopic evaluation	High	Moderate	High
Richards 2012	MRI	Arthroscopic evaluation	High	Moderate	High
Sampson 2008	MRI	Arthroscopic evaluation	High	Moderate	High
Singh 2004	MRI	Arthroscopic evaluation	High	Moderate	High
Siddiqui 2013	MRI 1.5T	Arthroscopic evaluation	High	Moderate	High
Kinnunen 1994	MRI and Radiograph	Arthroscopic evaluation	High	Moderate	High
Lundberg 1996	MRI and with unilateral knee hemarthrosis	Arthroscopic evaluation	High	Moderate	High
Gluckert 1992	MRI, Clinical, and Radiographs	Arthroscopic evaluation	High	Moderate	High

RESULTS

QUALITY AND APPLICABILITY

Table 23. Diagnostic Quality and Applicability: MRI

●:Domain free of flaws

○:Domain flaws present

Study	Test	Reporting (Penalty)	Index Test	Reference Test	Participants	Information	Study Design	*Quality*	Participants	Index Test	Directness of Results	Analysis	*Applicability*
Jah 2005	MRI	○	●	●	●	●	●	**High**	●	○	○	●	**Moderate**
Fischer 1991	MRI	○	●	●	●	●	●	**High**	●	○	○	●	**Moderate**
Rappeport 1997	MRI	○	●	●	●	●	●	**High**	●	○	○	●	**Moderate**
Sampson 2008	MRI	○	●	●	●	●	●	**High**	●	○	○	●	**Moderate**
Richards 2012	MRI	○	●	●	●	●	●	**High**	●	○	○	●	**Moderate**
Singh 2004	MRI	○	●	●	●	●	●	**High**	●	○	○	●	**Moderate**
Adalberth et al. 1997	MRI	○	●	●	●	●	●	**High**	●	○	○	●	**Moderate**
Ha et al. 1998	MRI	○	●	●	●	●	●	**High**	●	○	○	●	**Moderate**
Grevitt et al. 1992	MRI	○	●	●	●	●	●	**High**	●	○	○	●	**Moderate**
Gul-e-khanda et al.	MRI	○	●	●	●	●	●	**High**	●	○	○	●	**Moderate**
Vaz 2005	Clinical sign and MRI	○	●	●	●	●	●	**High**	●	○	○	●	**Moderate**

Table 23. Diagnostic Quality and Applicability: MRI

●:Domain free of flaws

○:Domain flaws present

Study	Test	Reporting (Penalty)	Index Test	Reference Test	Participants	Information	Study Design	*Quality*	Participants	Index Test	Directness of Results	Analysis	*Applicability*
Siddiqui et al. 2013	MRI 1.5T	○	●	●	●	●	●	**High**	●	○	○	●	**Moderate**
Kinnunen et al. 1994	MRI and Radiograph	○	●	●	●	●	●	**High**	●	○	○	●	**Moderate**
Gluckert et al. 1992	MRI, Clinical, and Radiographs	○	●	●	●	●	●	**High**	●	○	○	●	**Moderate**
Lundberg et al. 1996	MRI and with unilateral knee hemarthrosis	○	●	●	●	●	●	**High**	●	○	○	●	**Moderate**

FINDINGS

Table 24. Diagnostic Results Table: MRI

Author	Study Strength	Injury	Diagnostic Test	Positive Likelihood Ratio (95% CI)	Negative Likelihood Ratio (95% CI)	Sensitivity	Specificity
Adalberth et al. 1997	High	ACL with traumatic hemarthrosis	MRI	1.94(.87,4.33)	0.06(.007,.48)	97.0%	50.0%
Fischer et al. 1991	High	Anterior cruciate ligament	MRI	13.97(10.76,18.13)	0.07(0.04,0.13)	93.0%	93.0%
Grevitt et al. 1993	High	Anterior cruciate ligament	MRI	10.07(4.21,24.62)	0.06(0.00,0.91)	94.0%	91.0%
Gul-e-khanda et al. 2006	High	Anterior cruciate ligament	MRI(1.5T)	10.11(3.37,30.38)	0.15(0.04,0.53)	87.0%	91.0%
Jah et al. 2005	High	Anterior cruciate ligament	MRI	9(3.87,20.94)	0.11(0.03,0.42)	78.3%	95.7%
Kinnunen et al. 1994	High	Anterior cruciate ligament	MRI and radiograph	5.63(2.13,14.88)	0.2(0.03,1.18)	83.0%	85.0%
Lundberg et al. 1996	High	Anterior cruciate ligament	MRI and Knees with hemarthrosis	11.19(2.94,42.59)	0.15(0.01,0.32)	86.0%	92.0%
Rappeport et al. 1997	High	Anterior cruciate ligament	MRI	33.78(4.82,263.89)	0.11(0.02,0.72)	89.0%	97.0%
Rayan et al. 2009	Moderate	Anterior cruciate ligament	MRI	21.86(8.17,58.46)	0.20(0.08,0.48)	81.0%	96.0%
Sampson et al. 2008	High	Anterior cruciate ligament	MRI	66.83(4.26,1047.27)	0.02(0.00,0.27)	98.0%	99.0%
Vaz et al. 2005	High	Anterior cruciate ligament	MRI and Clinical sign	21.57(11.39,40.84)	0.01(0.00,0.07)	99.0%	95.4%
Siddiqui et al. 2013	High	Anterior cruciate ligament	Clinical sign (Lachman test, Anterior drawer test, Joint line tenderness, Apley test, McMurray's test)	33.44(4.67,239.41)	0.23(0.07,0.77)	78.0%	98.0%
Siddiqui et al. 2013	High	Anterior cruciate ligament	MRI 1.5	19.56(4.95,77.24)	0.12(0.02,0.74)	89.0%	95.0%
Richards et al. 2012	High	Anterior cruciate ligament (Partial/Complete tear)	MRI (1.0T)	18.05(9.64,33.80)	0.14(0.05,0.32)	86.0%	95.0%
Ha et al. 1998	High	Anterior cruciate ligament tear	MRI	50.14(16.33,153.96)	0.04(0.01,0.14)	96.0%	98.0%
Singh et al. 2004	High	Anterior cruciate ligament tears	MRI (0.5T)	93.78(13.35,659.05)	0.01(0.00,0.09)	99.0%	99.0%
Vaz et al. 2005	High	Articular cartilage	MRI and Clinical sign	14.89(7.20,30.8)	0.25(0.19,0.33)	76.1%	94.9%

Table 24. Diagnostic Results Table: MRI

Author	Study Strength	Injury	Diagnostic Test	Positive Likelihood Ratio (95% CI)	Negative Likelihood Ratio (95% CI)	Sensitivity	Specificity
Lundberg et al. 1996	High	Cartilage damage on condyles	MRI and Knees with hemarthrosis	11.80(1.18,118.29)	0.81(0.60,1.11)	20.0%	98.0%
Gluckert et al. 1992	High	Cartilage morphology	MRI, Clinical, and Radiograph	4.66(1.76,12.38)	0.65(0.45,0.93)	41.0%	91.5%
Gluckert et al. 1992	High	Cartilage signal inhomogeneity	MRI, Clinical, and Radiograph	4.57(1.77,11.8)	0.636(.453,.893)	41.0%	71.0%
Grevitt et al. 1994	High	Chondromalacia syndrome	MRI	5.67(1.48,21.71)	0.88(0.78,1.00)	14.0%	98.0%
Gluckert et al. 1992	High	Complete tears of the cruciate ligaments	MRI, Clinical, and Radiograph	63.00(8.90,445.87)	0.10(0.02,0.65)	90.0%	98.6%
Gluckert et al. 1992	High	Cruciate ligament lesions	MRI, Clinical, and Radiograph	34.5(8.8,135)	0.04(0,0.65)	100.0%	97.1%
Lundberg et al. 1996	High	Damage of patellar cartilage	MRI and Knees with hemarthrosis	34.42(1.90,623.94)	0.71(0.50,1.03)	29.0%	100.0%
Adalberth et al. 1997	High	Grade 3 or 4 tears of lateral meniscus	MRI	1.27(.965,1.67)	0.26(.036,1.94)	94.0%	27.0%
Adalberth et al. 1997	High	Grade 3 or 4 tears of medial meniscus	MRI	1.17	.275(.161,.428)	83.0%	29.0%
Kinnunen et al. 1994	High	Lateral collateral ligament	MRI and radiograph	7.07(1.98,25.27)	0.28(0.03,3.09)	75.0%	89.0%
Sampson et al. 2008	High	Lateral meniscal	MRI	10.45(3.41,32.06)	0.25(0.11,0.60)	76.0%	93.0%
Singh et al. 2004	High	Lateral meniscal tears	MRI (0.5T)	123.68(17.46,876.08)	0.13(0.05,0.32)	87.0%	99.0%
Siddiqui et al. 2013	High	Lateral meniscal tears	Clinical sign (Lachman test, Anterior drawer test, Joint line tenderness, Apley test, McMurray's test)	11.69(2.84,48.17)	0.41(0.20,0.81)	61.5%	94.7%
Siddiqui et al. 2013	High	Lateral meniscal tears	MRI 1.5	7.79(2.42,25.06)	0.42(0.2,0.84)	61.5%	92.1%
Fischer et al. 1991	High	Lateral meniscus	MRI	11.32(8.43,15.21)	0.34(0.28,0.41)	68.0%	94.0%
Grevitt et al. 1992	High	Lateral meniscus	MRI	40.89(5.80,288.05)	0.11(0.02,0.34)	89.0%	98.0%
Jah et al. 2005	High	Lateral meniscus	MRI	6.75(2.33,19.54)	0.54(0.33,0.89)	66.6%	86.2%
Kinnunen et	High	Lateral meniscus	MRI and radiograph	7.25(0.56,94.46)	0.78(0.44,1.37)	25.0%	97.0%

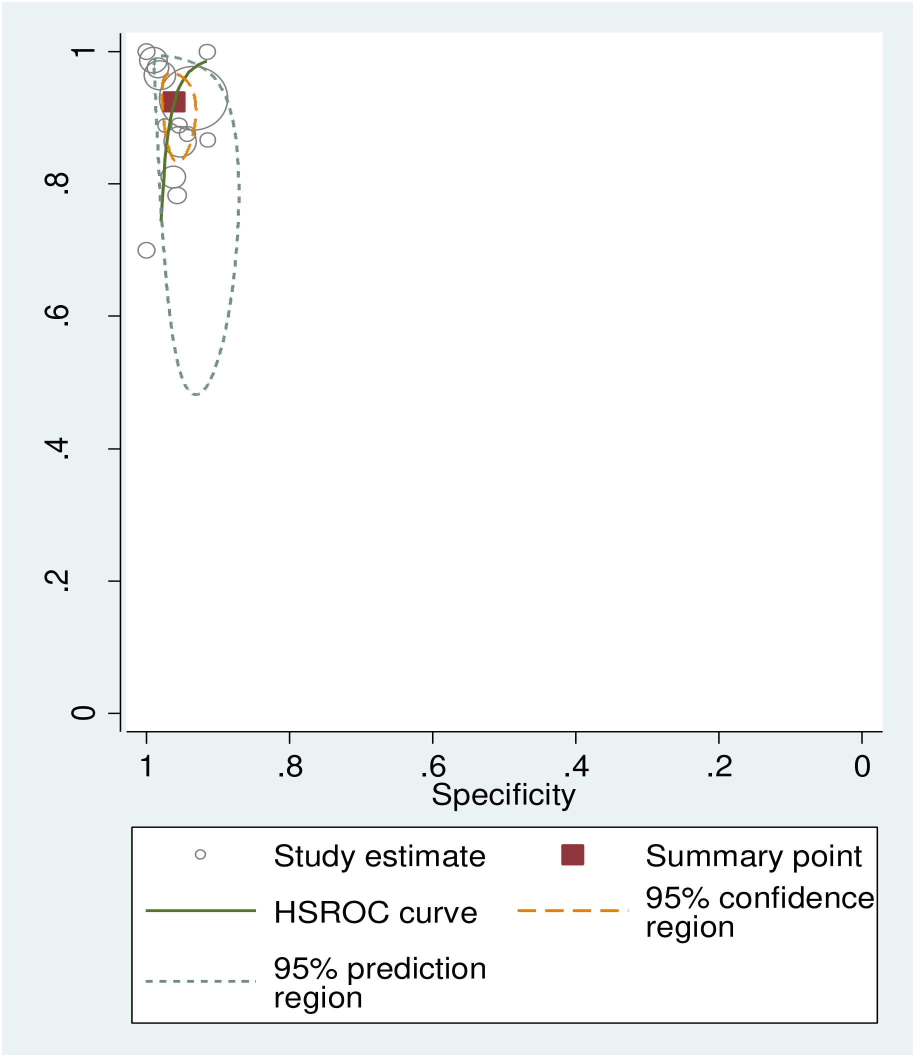
Table 24. Diagnostic Results Table: MRI

Author	Study Strength	Injury	Diagnostic Test	Positive Likelihood Ratio (95% CI)	Negative Likelihood Ratio (95% CI)	Sensitivity	Specificity
al. 1994							
Lundberg et al. 1996	High	Lateral meniscus	MRI and Knees with hemarthrosis	3.07(1.41,6.70)	0.60(0.40,0.90)	50.0%	84.0%
Rappeport et al. 1997	High	Lateral meniscus	MRI	16.8(1.84,153.79)	0.61(0.3,1.26)	40.0%	98.0%
Sharma et al. 2011	Moderate	Lateral meniscus	MRI	23.69(3.41,164.64)	0.16(0.04,0.57)	85.0%	96.0%
Vaz et al. 2005	High	Lateral meniscus	MRI and Clinical sign	14.76(8.08,26.94)	0.08(0.04,0.14)	93.0%	94.0%
Gul-e-khanda et al. 2006	High	Lateral meniscus	MRI(1.5T)	7.44(2.91,19.02)	0.14(0.04,0.52)	88.0%	88.0%
Rayan et al. 2009	Moderate	Lateral; meniscus	MRI	8.29(3.88,17.72)	0.42(0.28,0.63)	61.0%	92.0%
Lundberg et al. 1996	High	Loose body	MRI and Knees with hemarthrosis	25.60(2.78,236.01)	0.61(0.30,1.25)	40.0%	98.0%
Sampson et al. 2008	High	Medial and Lateral combined	MRI	11.37(5.2,24.85)	0.17(0.08,0.36)	84.0%	93.0%
Kinnunen et al. 1994	High	Medial collateral ligament	MRI and radiograph	5.50(1.70,17.79)	0.29(0.03,3.20)	75.0%	86.0%
Lundberg et al. 1996	High	Medial collateral ligament	MRI and Knees with hemarthrosis	8.21(2.61,25.84)	0.47(0.30,0.74)	56.0%	93.0%
Sampson et al. 2008	High	Medial meniscal	MRI	12.06(4.03,36.14)	0.10(0.03,0.39)	90.0%	93.0%
Singh et al. 2004	High	Medial meniscal tears	MRI (0.5T)	55.96 (14.15,221.31)	0.04(0.01,0.14)	96.0%	99.0%
Siddiqui et al. 2013	High	Medial meniscal tears	Clinical sign (Lachman test, Anterior drawer test, Joint line tenderness, Apley test, McMurray's test)	4.5(2,10.13)	0.2(0.08,0.51)	83.3%	81.5%
Siddiqui et al. 2013	High	Medial meniscal tears	MRI 1.5	1.56(0.9,2.45)	0.48(0.22,1.05)	75.0%	51.9%
Fischer et al. 1991	High	Medial meniscus	MRI	5.74(4.63,7.11)	0.08(0.06,0.12)	93.0%	84.0%
Grevitt et al. 1992	High	Medial meniscus	MRI	9.20(3.13,27.08)	0.09(0.02,0.34)	92.0%	90.0%
Gul-e-khanda	High	Medial meniscus	MRI(1.5T)	3.07(1.43,6.58)	0.02(0.00,0.31)	99.0%	68.0%

Table 24. Diagnostic Results Table: MRI

Author	Study Strength	Injury	Diagnostic Test	Positive Likelihood Ratio (95% CI)	Negative Likelihood Ratio (95% CI)	Sensitivity	Specificity
et al. 2006							
Jah et al. 2005	High	Medial meniscus	MRI	5.08(2.69-9.6)	0.09(0.02,0.36)	75.0%	94.7%
Kinnunen et al. 1994	High	Medial meniscus	MRI and radiograph	4.38(1.91,10)	0.16(0.02,0.99)	88.0%	80.0%
Lundberg et al. 1996	High	Medial meniscus	MRI and Knees with hemarthrosis	2.17(1.35,3.47)	0.40(0.18,0.87)	74.0%	66.0%
Rappeport et al. 1997	High	Medial meniscus	MRI	3.14(1.73,5.71)	0.21(0.05,0.72)	86.0%	73.0%
Rayan et al. 2009	Moderate	Medial meniscus	MRI	1.59(1.20,2.11)	0.46(0.27,0.76)	76.0%	52.0%
Sharma et al. 2011	Moderate	Medial meniscus	MRI	39.14(2.52,606.71)	0.07(0.01,0.33)	93.0%	98.0%
Vaz et al. 2005	High	Medial meniscus	MRI and Clinical sign	11.8(6.7,20.8)	(0.03(0.01,0.07)	98.0%	92.0%
Gluckert et al. 1992	High	Meniscus lesions	MRI, Clinical, and Radiograph	51.0(7.31,356)	0.04(0.01,0.26)	97.9%	97.3%
Fischer et al. 1991	High	Posterior cruciate ligament	MRI	113.87(56.88,315.04)	0.20(0.06,0.70)	80.0%	99.0%
Gul-e-khanda et al. 2006	High	Posterior cruciate ligament	MRI(1.5T)	16.33(4.41,60.49)	0.18(0.01,2.21)	83.0%	95.0%
Jah et al. 2005	High	Posterior cruciate ligament	MRI	23.56(6.94,80.01)	0.05(0.00,0.78)	81.8%	100.0%
Kinnunen et al. 1994	High	Posterior cruciate ligament	MRI and radiograph	11.33(0.92,139.17)	0.52(0.07,3.72)	50.0%	96.0%
Lundberg et al. 1996	High	Posterior cruciate ligament	MRI and Knees with hemarthrosis	10(1.93,51.88)	0.69(0.43,1.10)	33.0%	97.0%
Vaz et al. 2005	High	Posterior cruciate ligament	MRI and Clinical sign	532.8(32.89,8630.28)	0.1(0.01,1.39)	90.0%	100.0%
Lundberg et al. 1996	High	Rupture of patellar retinaculum	MRI and Knees with hemarthrosis	34.42(1.90,623.94)	0.71(0.50,1.03)	29.0%	100.0%

Figure 1. Meta-Analysis of Diagnosing ACL Injury with MRI



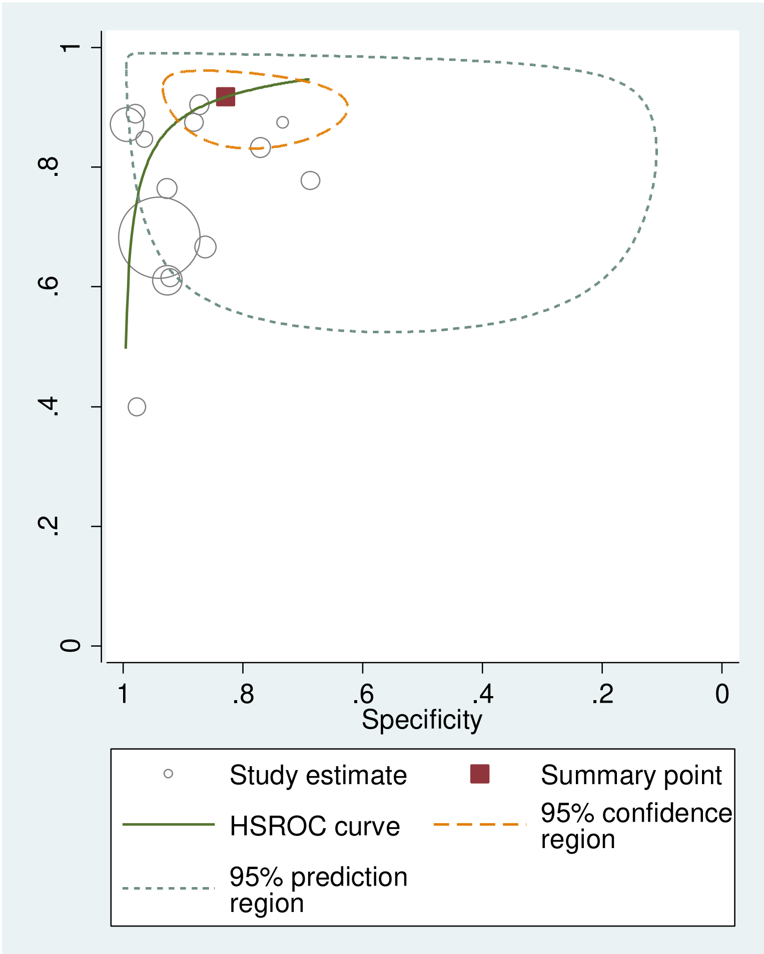
Meta-analysis of diagnostic accuracy

Log likelihood = -57.090092 Number of studies = 14

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Bivariate						
E(logitSe)	2.508949	.3218861			1.878064	3.139835
E(logitSp)	3.206843	.2169226			2.781682	3.632003
Var(logitSe)	.7552199	.5229146			.1944022	2.933903
Var(logitSp)	.1693672	.168288			.0241575	1.187427
Corr(logits)	.5215894	.5001601			-.6458479	.9583423
HSROC						
Lambda	6.386587	.8685117			4.684335	8.088838
Theta	-1.466736	.8681447			-3.168269	.2347958
beta	-.7474699	.5810236	-1.29	0.198	-1.886255	.3913154
s2alpha	1.088376	.8590147			.2317165	5.112116
s2theta	.0855504	.0901291			.0108509	.6744978
Summary pt.						
Se	.9247668	.0223946			.8673886	.9585063
Sp	.961091	.0081118			.9416779	.9742191
DOR	303.6247	128.0711			132.8293	694.0331
LR+	23.76741	5.098765			15.60902	36.18996
LR-	.0782789	.0234392			.043528	.1407736
1/LR-	12.77483	3.825185			7.103603	22.97373

Covariance between estimates of E(logitSe) & E(logitSp) .0136277

Figure 2. Meta-Analysis of Diagnosing Lateral Meniscus Injuries with MRI



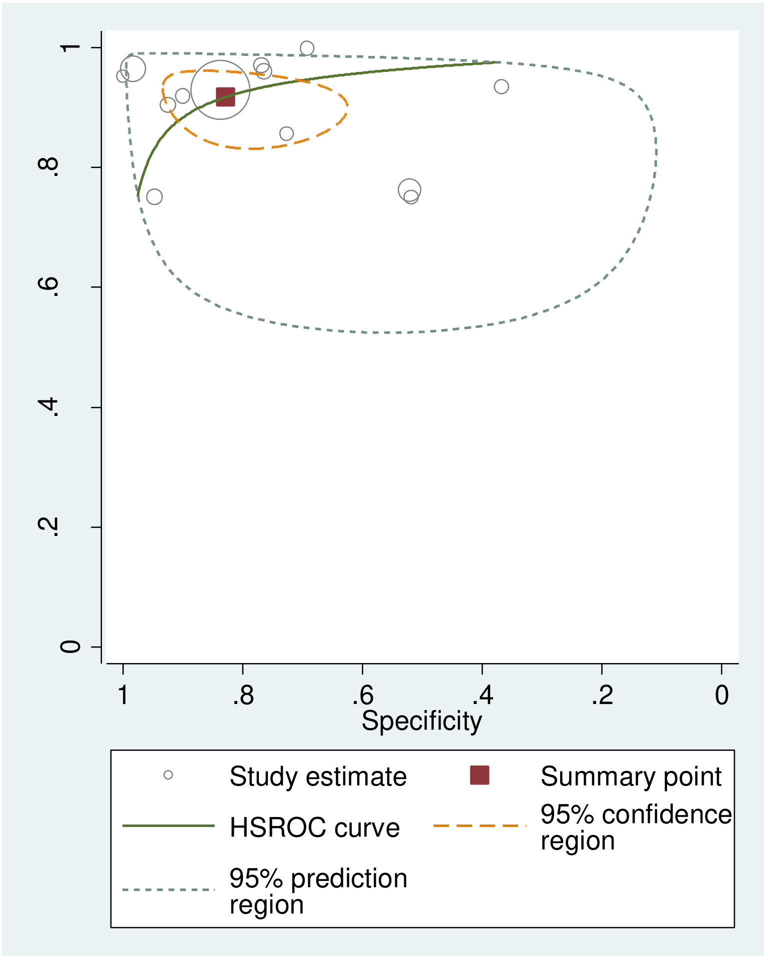
Meta-analysis of diagnostic accuracy

Log likelihood = -69.398366 Number of studies = 14

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Bivariate						
E(logitSe)	1.176548	.1967558			.7909138	1.562182
E(logitSp)	2.422711	.2830528			1.867937	2.977484
Var(logitSe)	.1435889	.1582056			.016568	1.244431
Var(logitSp)	.7855958	.4394841			.26243	2.351716
Corr(logits)	-.0735795	.5867122			-.8425524	.7941175
HSROC						
Lambda	3.383504	.3348207			2.727268	4.039741
Theta	.1076542	.4918258			-.8563066	1.071615
beta	.849744	.6180728	1.37	0.169	-.3616564	2.061144
s2alpha	.6222977	.5448672			.1118688	3.461685
s2theta	.1802869	.1501719			.0352328	.922532
Summary pt.						
Se	.7643266	.0354419			.6880275	.8266663
Sp	.9185428	.0211786			.8662194	.9515465
DOR	36.57112	12.35893			18.85738	70.92432
LR+	9.383168	2.460226			5.612652	15.68667
LR-	.2565732	.0387921			.1907723	.34507
1/LR-	3.897524	.5892793			2.897963	5.241851

Covariance between estimates of E(logitSe) & E(logitSp) -.0023134

Figure 3. Meta-Analysis of Diagnosing Lateral Meniscus Injuries with MRI



Meta-analysis of diagnostic accuracy

Log likelihood = -72.779592 Number of studies = 13

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Bivariate						
E(logitSe)	2.409785	.2883805			1.844569	2.975
E(logitSp)	1.580104	.3787985			.8376725	2.322535
Var(logitSe)	.5876693	.3934204			.1582299	2.182616
Var(logitSp)	1.55161	.7829117			.5771426	4.171402
Corr(logits)	.3787329	.3699952			-.4202824	.8469305
HSROC						
Lambda	4.31136	.6093292			3.117097	5.505623
Theta	.9161037	.4286858			.075895	1.756312
beta	.485442	.4034291	1.2[illegible]	0.229	-.3052644	1.276148
s2alpha	2.633103	1.376577			.9450675	7.336231
s2theta	.2966239	.2129096			.0726497	1.211095
Summary pt.						
Se	.9175704	.0218116			.8634882	.9514318
Sp	.8292192	.0536434			.6979748	.9107263
DOR	54.04887	28.77841			19.03544	153.4653
LR+	5.372797	1.725281			2.863305	10.08169
LR-	.0994063	.028658			.0564962	.1749075
1/LR-	10.05973	2.900137			5.717309	17.7003

Covariance between estimates of E(logitSe) & E(logitSp) .0284265

ACL PEDIATRIC

There is limited evidence in skeletally immature patients with torn ACLs, but it supports that the practitioner might perform surgical reconstruction because it reduces activity related disability and recurrent instability which may lead to additional injury.

Strength of Recommendation: Limited ★★☆☆

RATIONALE

There was one low and two very low strength studies comparing surgical reconstruction to non-operative treatment. [72, 88, 110] Surgical reconstruction demonstrated a significant advantage over non-operative treatment in objective knee stability (KT1000, pivot shift, Lachman), subjective knee function scores (IKDC, Zarins and Rowe score, Lysholm), and Tegner activity score. None of three studies reported a clinically significant valgus deformity or limb length discrepancy.

BENEFITS OF IMPLEMENTATION

Potential benefits of implementing this recommendation include: improving knee stability and functional outcomes in skeletally immature patients with ACL injury.

POSSIBLE HARMS OF IMPLEMENTATION

Potential harms include: physeal injury, graft failure and surgical complications.

FUTURE RESEARCH

Prospective studies on transphyseal versus all-epiphyseal reconstruction, intra-articular versus extra-articular techniques, and long-term outcomes of young patients following ACL reconstruction. Prospective comparative studies of non-operative treatment and ACL reconstruction in skeletally immature patients are necessary.

SUMMARY OF FINDINGS

Table 25. Summary of Findings: Treating Skeletally Immature Patients With Torn ACL

🟢 :Favors operative treatment

🔴 :Favors Non operative treatment

○ :Not significant treatment

	Scales/Measures	Moksnes et al. 2013 *(L)*	Pressman et al. 1997 *(V)*	Streich et al. 2010 *(V)*	Meta-Analysis
Patient satisfaction					NA
Function		○			NA
Pain		○			NA
	IKDC subjective			○	NA
	IKDC Normal			🟢	NA
	Lysholm Score		🟢	🟢	NA
Quality of life		○			NA
Activities of daily living		○			NA
Return to play		○			NA
	Tegner Activity			🟢	NA
Stability			🟢	🟢	NA
Strength		○			NA
Range of motion				○	NA

Overall strength of study; High: *(H)*, Moderate: *(M)*, Low: *(L)*, Very low: *(V)*

QUALITY AND APPLICABILITY SUMMARY

Table 26. Treatment Quality and Applicability Summary: Treatment of Skeletally Immature Patients With Torn ACL

Study	Outcome	Duration	Graft	Quality	Applicability	Overall Strength of Evidence
Moksnes et al. 2012	Function (Hop test)	2 years	NR	Low	Moderate	Low
Moksnes et al. 2012	Function (Hop test)	2 years	NR	Low	Moderate	Low
Streich et al. 2012	International knee documentation committee (IKDC)	70 months (41-85 months)	Semitendinosus tendon	Low	Moderate	Very Low
Streich et al. 2012	International knee documentation committee (IKDC)	70 months (41-85 months)	Semitendinosus tendon	Low	Moderate	Very Low
Pressman et al. 1997	Lysholm score	5.3 years (2-13)	Semitendinosus graft/Patellar graft	Very Low	Moderate	Very Low
Pressman et al. 1997	Lysholm score	5.3 years (2-13)	Semitendinosus graft/Patellar graft	Very Low	Moderate	Very Low
Streich et al. 2012	Lysholm score	70 months (41-85 months)	Semitendinosus tendon	Low	Moderate	Very Low
Streich et al. 2012	Lysholm score	70 months (41-85 months)	Semitendinosus tendon	Low	Moderate	Very Low
Streich et al. 2012	Stability (KT-1000 knee arthrometer)	70 months (41-85 months)	Semitendinosus tendon	Low	Moderate	Very Low
Streich et al. 2012	Stability (KT-1000 knee arthrometer)	70 months (41-85 months)	Semitendinosus tendon	Low	Moderate	Very Low
Pressman et al. 1997	Stability (Lachman, Pivot shift, KT 1000)	5.3 years (2-13)	Semitendinosus graft/Patellar graft	Very Low	Moderate	Very Low
Pressman et al. 1997	Stability (Lachman, Pivot shift, KT 1000)	5.3 years (2-13)	Semitendinosus graft/Patellar graft	Very Low	Moderate	Very Low
Streich et al. 2012	Tegner activity scores	70 months (41-85 months)	Semitendinosus tendon	Low	Moderate	Very Low

Table 26. Treatment Quality and Applicability Summary: Treatment of Skeletally Immature Patients With Torn ACL

Study	Outcome	Duration	Graft	Quality	Applicability	Overall Strength of Evidence
Streich et al. 2012	Tegner activity scores	70 months (41-85 months)	Semitendinosus tendon	Low	Moderate	Very Low
Pressman et al. 1997	Zarins and Rowe score	5.3 years (2-13)	Semitendinosus graft/Patellar graft	Very Low	Moderate	Very Low

Table 27. Quality and Applicability: Treatment of Skeletally Immature Patients With Torn ACL

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Moksnes et al. 2012	Function (Hop test)	●	○	○	○	○	●	●	**Low**	●	○	●	○	**Moderate**
Streich et al. 2012	International knee documentation committee (IKDC)	●	○	○	○	○	●	●	**Low**	●	○	●	●	**Moderate**
Streich et al. 2012	International knee documentation committee (IKDC)	●	○	○	○	○	●	●	**Low**	●	○	●	●	**Moderate**
Pressman et al. 1997	Lysholm score	○	○	○	○	○	●	○	**Very Low**	●	○	●	○	**Moderate**
Pressman et al. 1997	Lysholm score	○	○	○	○	○	●	○	**Very Low**	●	○	●	○	**Moderate**
Streich et al. 2012	Lysholm score	●	○	○	○	○	●	●	**Low**	●	○	●	●	**Moderate**
Streich et al. 2012	Lysholm score	●	○	○	○	○	●	●	**Low**	●	○	●	●	**Moderate**

Table 27. Quality and Applicability: Treatment of Skeletally Immature Patients With Torn ACL

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Streich et al. 2012	Stability (KT-1000 knee arthrometer)	●	○	○	○	○	●	●	**Low**	●	○	●	●	**Moderate**
Pressman et al. 1997	Stability (Lachman, Pivot shift, KT 1000)	○	○	○	○	○	●	○	**Very Low**	●	○	●	○	**Moderate**
Streich et al. 2012	Tegner activity scores	●	○	○	○	○	●	●	**Low**	●	○	●	●	**Moderate**
Pressman et al. 1997	Zarins and Rowe score	○	○	○	○	○	○	○	**Very Low**	●	○	●	○	**Moderate**

FINDINGS

Table 28. Treating Skeletally Immature Patients With ACL Injury: Operative Versus Non-Operative

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Moksnes et al. 2013	Low	Function 6m timed hop test (%)	Operative	10	95.4(10.4%)	Non-operative	34	95.1(9.5%)	NA	NS
Pressman et al. 1997	Very low	Injured side (max. force)	Intra-articular Reconstruction	23	12.5 (0.8)	Non-operatively	13	14.5 (1.0)	-2 (-2.6,-1.4)	Non-operative
Moksnes et al. 2013	Low	KOOS activities of daily living	Operative	10	98.1(3)	Non-operative	34	95.8(9.8)	2.3(-4.07,8.67)	NS
Moksnes et al. 2013	Low	KOOS pain	Operative	10	90(8.5)	Non-operative	34	89.6(13.1)	0.4(-8.48,9.28)	NS
Moksnes et al. 2014	Low	KOOS quality of life	Operative	10	71.4(18.7)	Non-operative	34	70.3(22.8)	1.1(-14.84,17)	NS
Moksnes et al. 2013	Low	KOOS sports and recreation	Operative	10	84.5(12.3)	Non-operative	34	79.1(23.7)	5.4(-10.38,21.18)	NS
Moksnes et al. 2013	Low	KOOS symptoms	Operative	10	85.7(10.6)	Non-operative	34	86.3(10.9)	-0.6(-8.45,7.25)	NS
Moksnes et al. 2013	Low	KOS-ADLS	Operative	10	93.4(6.7)	Non-operative	34	88.4(14.5)	5(-4.58,14.58)	NS
Streich et al. 2010	Very low	Lysholm (median)	Operative	16	93	Non-operative	12	84	NA	Operative
Pressman et al. 1997	Very low	Lysholm score	Intra-articular Reconstruction	23	85.9 (3.1)	Non-operatively	13	79.6 (3.9)	6.3 (3.9,8.7)	Intra-articular Reconstruction
Streich et al. 2010	Very low	Range of motion	Operative	16	NR	Non-operative	12	NR	NA	NS
Moksnes et al. 2013	Low	Single hop test (LSI(%)	Operative	10	95.1%(12.2%)	Non-operative	34	95.1%(13.1%)	NA	NA
Streich et al. 2010	Very low	Stability (Grade I instability)	Operative	16	3/16(19%)	Non-operative	12	6/12(50%)	0.37(0.12,1.2)	Operative
Streich et al. 2010	Very low	Stability (Grade II instability)	Operative	16	0/16(0%)	Non-operative	12	3/12(25%)	0.1(0.006,1.93)	Operative
Streich et al. 2010	Very low	Stability	Operative	16	1.8(1.4)	Non-	12	4.3(2.9)	-2.5(-4.19,-0.8)	Operative

Table 28. Treating Skeletally Immature Patients With ACL Injury: Operative Versus Non-Operative

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		(KT 1000 side to side difference)				operative				
Streich et al. 2010	Very low	Stability (Normal pivot shift)	Operative	16	13/16(81%)	Non-operative	12	3/12(25%)	3.25(1.18,8.9)	Operative
Moksnes et al. 2013	Low	Stability IKDC 2000	Operative	10	85(9.3)	Non-operative	34	82.9(17.6)	2.1(-9.63,13.83)	NS
Streich et al. 2010	Very low	Stability IKDC overall Normal	Operative	16	13/16(81%)	Non-operative	12	2/12(16%)	4.87(1.34,17.65)	Operative
Streich et al. 2010	Very low	Stability IKDC subjective (median)	Operative	16	95	Non-operative	12	87	NA	NS
Pressman et al. 1997	Very low	Stability KT injured side (20lbs)	Intra-articular Reconstruction	23	9.2 (0.5)	Non-operatively	13	8.9 (0.9)	0.3 (-0.17,0.77)	NS
Pressman et al. 1997	Very low	Stability KT injured side (30lbs)	Intra-articular Reconstruction	23	11.1 (0.6)	Non-operatively	13	11.7 (1.0)	-0.6 (-1.1,-0.06)	Intra-articular Reconstruction
Pressman et al. 1997	Very low	Stability KT side-to-side (20lbs)	Intra-articular Reconstruction	23	3.0 (0.5)	Non-operatively	13	2.1 (0.8)	0.9 (0.46,1.3)	Intra-articular Reconstruction
Pressman et al. 1997	Very low	Stability KT side-to-side (30lbs)	Intra-articular Reconstruction	23	3.7 (0.6)	Non-operatively	13	3.8 (0.1)	-0.1 (-0.44,0.24)	NS
Pressman et al. 1997	Very low	Stability KT side-to-side (max. force)	Intra-articular Reconstruction	23	4.3 (0.7)	Non-operatively	13	4.4 (1.3)	-0.1 (-0.77,0.57	NS
Pressman et al. 1997	Very low	Stability Lachman test	Intra-articular Reconstruction	23	1.4 (0.4)	Non-operatively	13	2.5 (0.3)	-1.1 (-1.4,-0.84)	Intra-articular Reconstruction
Pressman et al. 1997	Very low	Stability Pivot-shift test	Intra-articular Reconstruction	23	1.0 (0.2)	Non-operatively	13	2.2 (0.3)	-1.2 (-1.4,-1.0)	Intra-articular Reconstruction

Table 28. Treating Skeletally Immature Patients With ACL Injury: Operative Versus Non-Operative

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Moksnes et al. 2013	Low	Strength Hamstring muscle (nm/kg) *100)	Operative	10	109.6(19.6)	Non-operative	34	125(32.5)	-15.4(-37.29,6.5)	NS
Moksnes et al. 2013	Low	Strength Hamstring muscle, LSI (%)	Operative	10	87.4%(14.1%)	Non-operative	34	92.7%(11.5%)	NA	NA
Moksnes et al. 2013	Low	Strength Quadriceps muscle (nm/kg) *100)	Operative	10	222.7(36.3)	Non-operative	34	224(57.1)	-1.3(39.96,37.36)	NS
Moksnes et al. 2013	Low	Strength Quadriceps muscle, LSI (%)	Operative group	10	93.1%(12.1%)	Non-operative	34	94.5%(11.8%)	NA	NA
Streich et al. 2010	Very low	Tegner activity score	Operative	16	6.75(0.75)	Non-operative	12	6(0.57)	0.75(0.22,1.28)	Operative
Moksnes et al. 2013	Low	Triple crossover test, (%)	Operative	10	94.3%(9.1%)	Non-operative	34	93.4%(11.7%)	NA	NA
Moksnes et al. 2013	Low	Triple hop test (%)	Operative	10	95.8%(4.3%)	Non-operative	34	95.6%(8.7%)	NA	NA
Moksnes et al. 2013	Low	VAS	Operative	10	84.6(15.1)	Non-operative	34	85.3(18)	-0.7(-13.33,11.93)	NS
Pressman et al. 1997	Very low	Zarins and Rowe score	Intra-articular Reconstruction	23	79.89 (3.0)	Non-operatively	13	60.4 (3.8)	19.5 (17.2,21.8)	Intra-articular Reconstruction

ACL YOUNG ACTIVE ADULT

Moderate evidence supports surgical reconstruction in active young adult (18-35) patients with an ACL tear.

Strength of Recommendation: Moderate

RATIONALE

The recommendation is based on one study of one prospective randomized cohort and two studies of moderate strength.[33, 34, 67, 90] The evidence indicates that ACL reconstruction decreases pathologic laxity, as measured by the Lachman, KT-1000, and pivot shift tests, and reduces episodes of instability and the incidence of subsequent injuries including meniscal tears.

POSSIBLE HARMS OF IMPLEMENTATION

As with all surgical procedures, there are patient risk including but not limited to infection, anesthetic complications, phlebitis, and neurovascular injury.

FUTURE RESEARCH

Recommend increased attention to assessing factors important to potentially delay or prevent post-joint injury osteoarthritis such as outcomes of meniscus repair vs resection and outcomes assessing joint biology and homeostasis including restoration of normal joint biomechanics. Prospective comparative studies of nonoperative treatment and ACL reconstruction in skeletally immature patients are necessary.

SUMMARY OF FINDINGS

Table 29. Summary of Findings: Surgical Reconstruction for Young (18-35), Active Patients With an ACL Tear

●:Favors operative treatment ●:Favors Optional delay/Late ACLR ○:Not significant	**Scales/Measures**	Frobell et al. 2010 *(H)*	Marcacci et al. 1995 *(M)*	Raviraj et al. 2010 *(M)*	**Meta-Analysis**
Patient satisfaction					
Function		○	○		
Pain		○			
	IKDC subjective				
	IKDC normal		○		
	Lysholm score		○	○	
Failures		○			
Quality of life		○			
Activities of daily living		○			
Return to play			○		
	Tegner activity	○		○	
Complications		○		○	
Stability		●	○	○	
Strength					
Range of motion			○	○	

Overall strength of study; High: *(H)*, Moderate: *(M)*, Low: *(L)*, Very low: *(V)*

QUALITY AND APPLICABILITY

Table 30. Quality and Applicability Summary: Treatment of Young (18-35) Active Patient With ACL Tear

Study	Outcome	Graft	Duration	Quality	Applicability	Overall Strength of Evidence
Frobell et al. 2010	Complications	Surgeon preference (Patellar tendon or Hamstring)	2 years	Moderate	Moderate	Moderate
Frobell et al. 2013	Complications	Surgeon preference (Patellar tendon or Hamstring)	5 years	Moderate	Moderate	Moderate
Raviraj et al. 2010	Complications	Quadruple hamstring graft autograft	32 months (26 to 36)	Low	Moderate	Low
Marcacci et al. 1995	IKDC	One-third patellar tendon/ fascia lata graft & ligament augmentation device	5 year follow-up	Moderate	Moderate	Moderate
Frobell et al. 2010	KOOS	Surgeon preference (Patellar tendon or Hamstring)	2 years	High	Moderate	High
Frobell et al. 2013	KOOS	Surgeon preference (Patellar tendon or Hamstring)	5 years	High	Moderate	High
Marcacci et al. 1995	Lysholm score	One-third patellar tendon/ fascia lata graft & ligament augmentation device	5 year follow-up	Moderate	Moderate	Moderate
Raviraj et al. 2010	Lysholm score	Quadruple hamstring graft autograft	32 months (26 to 36)	Moderate	Moderate	Moderate

Table 30. Quality and Applicability Summary: Treatment of Young (18-35) Active Patient With ACL Tear

Study	Outcome	Graft	Duration	Quality	Applicability	Overall Strength of Evidence
Frobell et al. 2010	SF36 Short form health survey	Surgeon preference (Patellar tendon or Hamstring)	2 years	High	Moderate	High
Frobell et al. 2013	SF36 Short form health survey	Surgeon preference (Patellar tendon or Hamstring)	5 years	High	Moderate	High
Marcacci et al. 1995	Stability	One-third patellar tendon/ fascia lata graft & ligament augmentation device	5 year follow-up	Moderate	Moderate	Moderate
Frobell et al. 2010	Stability (Kt-1000, Lachman, Pivot shift)	Surgeon preference (Patellar tendon or Hamstring)	2 years	Moderate	Moderate	Moderate
Frobell et al. 2013	Stability (Kt-1000, Lachman, Pivot shift)	Surgeon preference (Patellar tendon or Hamstring)	5 years	Moderate	Moderate	Moderate
Frobell et al. 2010	Tegner activity score	Surgeon preference (Patellar tendon or Hamstring)	2 years	High	Moderate	High
Frobell et al. 2013	Tegner activity score	Surgeon preference (Patellar tendon or Hamstring)	5 years	High	Moderate	High
Raviraj et al. 2010	Tegner score	Quadruple hamstring graft autograft	32 months (26 to 36)	Moderate	Moderate	Moderate

Table 31. Quality and Applicability: Treatment of Young (18-35) Active Patient With ACL Tear

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Frobell et al. 2013	Complications	●	○	●	●	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Frobell et al. 2010	Complications	●	○	●	●	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Raviraj et al. 2010	Complications	●	○	●	○	●	○	○	**Low**	○	○	●	●	**Moderate**
Marcacci et al. 1995	IKDC	●	○	●	○	●	●	●	**Moderate**	●	○	●	●	**Moderate**
Frobell et al. 2010	KOOS	●	●	●	●	○	●	●	**High**	●	○	●	●	**Moderate**
Frobell et al. 2013	KOOS	●	●	●	●	○	●	●	**High**	●	○	●	●	**Moderate**
Marcacci et al. 1995	Lysholm score	●	○	●	○	●	●	●	**Moderate**	●	○	●	●	**Moderate**
Raviraj et al. 2010	Lysholm score	●	○	●	○	●	●	●	**Moderate**	○	○	●	●	**Moderate**

Table 31. Quality and Applicability: Treatment of Young (18-35) Active Patient With ACL Tear

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Frobell et al. 2010	SF36 Short form health survey	●	●	●	●	○	●	●	**High**	●	○	●	●	**Moderate**
Frobell et al. 2013	SF36 Short form health survey	●	●	●	●	○	●	●	**High**	●	○	●	●	**Moderate**
Marcacci et al. 1995	Stability	●	○	●	○	●	○	●	**Moderate**	●	○	●	●	**Moderate**
Frobell et al. 2010	Stability (Kt-1000, Lachman, Pivot shift)	●	○	●	●	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Frobell et al. 2013	Stability (Kt-1000, Lachman, Pivot shift)	●	○	●	●	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Frobell et al. 2010	Tegner activity score	●	●	●	●	○	●	●	**High**	●	○	●	●	**Moderate**
Frobell et al. 2013	Tegner activity score	●	●	●	●	○	●	●	**High**	●	○	●	●	**Moderate**
Raviraj et al. 2010	Tegner score	●	○	●	○	●	●	●	**Moderate**	○	○	●	●	**Moderate**

FINDINGS

Table 32. Treatment of Young (18-35) Active Patients

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Frobell et al. 2010	High	Failure	Rehabilitation plus early ACL reconstruction	62	3/62(5 %)	Rehabilitation plus optional delayed ACL reconstruction	59	1/59(2 %)	2.85(0.3,26.68)	NS
Frobell et al. 2010	High	Function in activities of daily living (KOOS)	Rehabilitation plus early ACL reconstruction	62	93.5(11.6)	Rehabilitation plus optional delayed ACL reconstruction	59	94.7(9.6)	-1.2(-5.04,2.64)	NS
Frobell et al. 2010	High	Function in sports and recreation (KOOS)	Rehabilitation plus early ACL reconstruction	62	71.8(27.2)	Rehabilitation plus optional delayed ACL reconstruction	59	71.2(28)	0.6(-9.33,10.53)	NS
Frobell et al. 2010	High	Knee-related quality of life (KOOS)	Rehabilitation plus early ACL reconstruction	62	67.3(23.6)	Rehabilitation plus optional delayed ACL reconstruction	59	63(23.6)	4.3(-4.19,12.8)	NS
Frobell et al. 2010	High	Mean change in KOOS from baseline	Rehabilitation plus early ACL reconstruction	62	39.2(18.3)	Rehabilitation plus optional delayed ACL reconstruction	59	39.4(18.2)	-0.2(-6.77,6.37)	NS
Frobell et al. 2010	High	Mental component SF-36	Rehabilitation plus early ACL reconstruction	62	88.3(13.2)	Rehabilitation plus optional delayed ACL reconstruction	59	83.8(15.7)	4.5(-0.71,9.71)	NS
Frobell et al.	High	Non-	Rehabilitation plus early	62	174	Rehabilitation plus optional delayed	59	147	NA	NS

Table 32. Treatment of Young (18-35) Active Patients

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
2010		serious adverse event	ACL reconstruction			ACL reconstruction				
Frobell et al. 2010	High	Pain (KOOS)	Rehabilitation plus early ACL reconstruction	62	87.2(15.5)	Rehabilitation plus optional delayed ACL reconstruction	59	87.7(14.6)	-0.5(-5.92,4.92)	NS
Frobell et al. 2010	High	Physical component SF-36	Rehabilitation plus early ACL reconstruction	62	82.1(19.3)	Rehabilitation plus optional delayed ACL reconstruction	59	78(17.4)	4.1(-2.52,10.72)	NS
Frobell et al. 2010	High	Return to pre-injury activity level or higher	Rehabilitation plus early ACL reconstruction	62	27/62(44%)	Rehabilitation plus optional delayed ACL reconstruction	59	21/59(36%)	1.22(0.78,1.9)	NS
Frobell et al. 2010	High	Serious adverse event	Rehabilitation plus early ACL reconstruction	62	36	Rehabilitation plus optional delayed ACL reconstruction	59	51	NA	NS
Frobell et al. 2010	High	Severely decreased knee related quality of life	Rehabilitation plus early ACL reconstruction	62	11/62(18%)	Rehabilitation plus optional delayed ACL reconstruction	59	16/59(27%)	0.65(0.33,1.29)	NS
Frobell et al. 2010	Moderate	Stability (KT-1000 mm)	Rehabilitation plus early ACL reconstruction	62	6.6(2.36)	Rehabilitation plus optional delayed ACL reconstruction	59	8.3(2.9)	-1.7(-2.65,-0.75)	Favors Optional delay
Frobell et al. 2010	Moderate	Stability (Normal Lachman test)	Rehabilitation plus early ACL reconstruction	62	39/62(65%)	Rehabilitation plus optional delayed ACL reconstruction	59	17/59(29%)	**2.18(1.4,3.4)**	Favors early ACLR
Frobell et al. 2010	Moderate	Stability (Normal pivot shift	Rehabilitation plus early ACL reconstruction	62	45/62(75%)	Rehabilitation plus optional delayed ACL reconstruction	59	27/59(47%)	1.58(1.55,2.18)	Favors early ACLR

Table 32. Treatment of Young (18-35) Active Patients

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		test)								
Frobell et al. 2010	High	Symptoms (KOOS)	Rehabilitation plus early ACL reconstruction	62	78.7(20.7)	Rehabilitation plus optional delayed ACL reconstruction	59	83(17.6)	-4.3(-11.23,2.63)	NS
Frobell et al. 2010	High	Tegner activity level (median and interquartile range)	Rehabilitation plus early ACL reconstruction	62	6.5(3-8)	Rehabilitation plus optional delayed ACL reconstruction	59	5(4-7)	NA	NS

Table 33. Treatment of Young (18-35) Active Patient: Post Hoc Analysis of Early ACLR and Delayed ACLR

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Frobell et al. 2010	Moderate	Function in activities of daily living (KOOS)	Rehabilitation plus early ACL reconstruction	60	93.5(11.42)	Delayed ACL reconstruction	23	94.4(8.67)	-0.9(-4.56,2.76)	NS
Frobell et al. 2010	Moderate	Function in sports and recreation (KOOS)	Rehabilitation plus early ACL reconstruction	60	71.8(26.7)	Delayed ACL reconstruction	23	68.5(27.4)	3.3(-6.43,13.04)	NS
Frobell et al. 2010	Moderate	Knee-related quality of life (KOOS)	Rehabilitation plus early ACL reconstruction	60	67.3(23.22)	Delayed ACL reconstruction	23	65.5(20.8)	1.8(-6.15,9.75)	NS
Frobell et al. 2010	Moderate	Mean change in KOOS from baseline	Rehabilitation plus early ACL reconstruction	60	39(18.4)	Delayed ACL reconstruction	23	39.8(17.9)	-0.8(-7.34,5.74)	NS
Frobell et al. 2010	Moderate	Mental componen t SF-36	Rehabilitation plus early ACL reconstruction	60	88.3(12.97)	Delayed ACL reconstruction	23	86(15.38)	2.3(-2.81,7.41)	NS
Frobell et al. 2010	Moderate	Pain (KOOS)	Rehabilitation plus early ACL reconstruction	60	87.2(15.29)	Delayed ACL reconstruction	23	86.6(14.1)	0.6(-4.7,5.74)	NS
Frobell et al. 2010	Moderate	Physical componen t SF-36	Rehabilitation plus early ACL reconstruction	60	82.1(12.97)	Delayed ACL reconstruction	23	76.7(18.8)	5.4(-0.39,11.19)	NS
Frobell et al. 2010	Moderate	Return to pre-injury activity level or higher	Rehabilitation plus early ACL reconstruction	60	27/60(44%)	Delayed ACL reconstruction	23	7/23(30%)	1.48(0.75,2.91)	NS
Frobell et	Moderate	Severely	Rehabilitation plus	60	11/60(18%)	Delayed ACL	23	11/23(48%)	0.38(0.19,0.76)	NS

Table 33. Treatment of Young (18-35) Active Patient: Post Hoc Analysis of Early ACLR and Delayed ACLR

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
al. 2010		decreased knee related quality of life	early ACL reconstruction			reconstruction				
Frobell et al. 2010	Moderate	Stability (KT-1000 mm)	Rehabilitation plus early ACL reconstruction	60	6.6(2.32)	Delayed ACL reconstruction	23	7.1(2.54)	-0.5(-1.37,0.37)	NS
Frobell et al. 2010	Moderate	Stability (Normal Lachman test)	Rehabilitation plus early ACL reconstruction	60	39/60(65%)	Delayed ACL reconstruction	23	15/23(65%)	0.99(0.7,1.42)	Favors early ACLR
Frobell et al. 2010	Moderate	Stability (Normal pivot shift test)	Rehabilitation plus early ACL reconstruction	60	45/60(75%)	Delayed ACL reconstruction	23	19/23(83%)	0.9(0.7,1.15)	Favors early ACLR
Frobell et al. 2010	Moderate	Symptoms (KOOS)	Rehabilitation plus early ACL reconstruction	60	78.7(20.32)	Delayed ACL reconstruction	23	81.2(16.76)	-2.5(-9.22,4.22)	NS
Frobell et al. 2010	Moderate	Tegner activity level (median and interquartile range)	Rehabilitation plus early ACL reconstruction	60	6.5(3-8)	Delayed ACL reconstruction	23	5(4-7)	NA	NS

Table 34. Treatment of Young (18-35) Active Patient: Post Hoc Analysis of Early ACLR Versus Rehab Alone

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Frobell et al. 2010	Moderate	Function in activities of daily living (KOOS)	Rehabilitation plus early ACL reconstruction	60	93.5(11.42)	Rehabilitation alone	36	94.9(9.9)	-1.4(5.95,3.15)	NS
Frobell et al. 2010	Moderate	Function in sports and recreation (KOOS)	Rehabilitation plus early ACL reconstruction	60	71.8(26.7)	Rehabilitation alone	36	72.9(28.4)	-1.1(-12.54,10.34)	NS

Table 34. Treatment of Young (18-35) Active Patient: Post Hoc Analysis of Early ACLR Versus Rehab Alone

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Frobell et al. 2010	Moderate	Knee-related quality of life (KOOS)	Rehabilitation plus early ACL reconstruction	60	67.3(23.22)	Rehabilitation alone	36	61.5(25.4)	5.8(-4.26,15.86)	NS
Frobell et al. 2010	Moderate	Mean change in KOOS from baseline	Rehabilitation plus early ACL reconstruction	60	39(18.4)	Rehabilitation alone	36	39.2(18.18)	-0.2(-7.86,7.46)	NS
Frobell et al. 2010	Moderate	Mental component SF-36	Rehabilitation plus early ACL reconstruction	60	88.3(12.97)	Rehabilitation alone	36	82.3(16.1)	6(0.05,11.95)	Favors Early ACLR
Frobell et al. 2010	Moderate	Pain (KOOS)	Rehabilitation plus early ACL reconstruction	60	87.2(15.29)	Rehabilitation alone	36	88.3(14.92)	-1.1(-7.44,5.24)	NS
Frobell et al. 2010	Moderate	Physical component SF-36	Rehabilitation plus early ACL reconstruction	60	82.1(12.97)	Rehabilitation alone	36	78.8(19.5)	3.3(-3.28,9.88)	NS
Frobell et al. 2010	Moderate	Return to pre-injury activity level or higher	Rehabilitation plus early ACL reconstruction	60	27/60(44%)	Rehabilitation alone	36	14/36(39%)	1.16(0.7,1.9)	NS
Frobell et al. 2010	Moderate	Severely decreased knee related quality of life	Rehabilitation plus early ACL reconstruction	60	11/60(18%)	Rehabilitation alone	36	5/36(14%)	1.32(0.5,3.49)	NS
Frobell et al. 2010	Moderate	Stability (KT-1000 mm)	Rehabilitation plus early ACL reconstruction	60	6.6(2.32)	Rehabilitation alone	36	9(2.95)	-2.4(-3.48,-1.32)	Favors Early ACLR
Frobell et al. 2010	Moderate	Stability (Normal Lachman test)	Rehabilitation plus early ACL reconstruction	60	39/60(65%)	Rehabilitation alone	36	2/36(6%)	**11.7(3,45.57)**	Favors Early ACLR
Frobell et al. 2010	Moderate	Stability (Normal pivot shift test)	Rehabilitation plus early ACL reconstruction	60	45/60(75%)	Rehabilitation alone	36	8/36(23%)	**3.37(1.8,6.32)**	Favors Early ACLR
Frobell et al. 2010	Moderate	Symptoms (KOOS)	Rehabilitation plus early ACL reconstruction	60	78.7(20.32)	Rehabilitation alone	36	84.1(18.3)	-5.4(-13.6,2.8)	NS
Frobell et al. 2010	Moderate	Tegner activity level (median and interquartile range)	Rehabilitation plus early ACL reconstruction	60	6.5(3-8)	Rehabilitation alone	36	5(4-8)	NA	NA

Table 35. Treatment of Young (18-35) Active Patients: 5 Year Follow-up

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Frobell et al. 2013	Moderate	KOOS	Early reconstruction <10 weeks	61	80 (15.6)	Delayed optional reconstruction	59	82 (17.3)	-2(-7.95,3.94)	NS

Table 35. Treatment of Young (18-35) Active Patients: 5 Year Follow-up

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Frobell et al. 2013	Moderate	KOOS - Activities of daily living	Early reconstruction <10 weeks	61	95 (9.8)	Delayed optional reconstruction	59	97 (7.7)	-2(-5.19,1.19)	NS
Frobell et al. 2013	Moderate	KOOS - knee related quality of life	Early reconstruction <10 weeks	61	71 (19.5)	Delayed optional reconstruction	59	69 (23.0)	2(-5.7,9.7)	NS
Frobell et al. 2013	Moderate	KOOS - Pain	Early reconstruction <10 weeks	61	91 (11.7)	Delayed optional reconstruction	59	91 (11.5)	0(-4.19,4.19)	NS
Frobell et al. 2013	Moderate	KOOS - sport and recreation	Early reconstruction <10 weeks	61	76 (23.4)	Delayed optional reconstruction	59	79 (24.9)	-3(-11.73,5.73)	NS
Frobell et al. 2013	Moderate	KOOS - Symptoms	Early reconstruction <10 weeks	61	83 (17.6)	Delayed optional reconstruction	59	87 (15.3)	-4(-9.97,1.97)	NS
Frobell et al. 2013	Moderate	Lachman - normal	Early reconstruction <10 weeks	61	76% (45/58)	Delayed optional reconstruction	59	33% (19/58)	2.37(1.6,3.51)	Favors early reconstruction
Frobell et al. 2013	Moderate	Pivot shift test - normal	Early reconstruction <10 weeks	61	76% (45/58)	Delayed optional reconstruction	59	40% (23/58)	1.95(1.38,2.77)	Favors early reconstruction
Frobell et al. 2013	Moderate	SF - 36 mental component	Early reconstruction <10 weeks	61	87 (13.7)	Delayed optional reconstruction	59	85 (13.4)	2(-2.9,6.9)	NS
Frobell et al. 2013	Moderate	SF- 36 physical component	Early reconstruction <10 weeks	61	85 (15.6)	Delayed optional reconstruction	59	84 (17.3)	1(-4.95,6.95)	NS

Table 36. Early Versus Late ACLR

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Marcacci et al. 1995	Moderate	Lysholm score excellent N (%)	Early <15 days	23	18 (78.3%)	Late reconstruction >3 months	59	52 (88.2%)	0.93(0.77,1.13)	NS
Marcacci et al. 1995	Moderate	Lysholm score fair N(%)	Early <15 days	23	5 (21.7%)	Late reconstruction >3 months	59	3 (5.1%)	11.03(2.86, 4247)	Favors Early <15 days
Marcacci et al. 1995	Moderate	Lysholm score good N (%)	Early <15 days	23	0 (0%)	Late reconstruction >3 months	59	3 (5.1%)	0.36(0.02,6.77)	NS
Marcacci et al. 1995	Moderate	Lysholm score poor N (%)	Early <15 days	23	0 (0%)	Late reconstruction >3 months	59	1 (1.6%)	0.83(0.03,19.75)	NS
Marcacci et al. 1995	Moderate	IKDC score excellent N (%)	Early <15 days	23	5 (21.5%)	Late reconstruction >3 months	59	10 (16.9%)	3.3(1.27,8.63)	NS
Marcacci et al. 1995	Moderate	IKDC score fair N (%)	Early <15 days	23	12 (52.2%)	Late reconstruction >3 months	59	28 (47.7%)	1.42(0.88,2.290	NS
Marcacci et al. 1995	Moderate	IKDC score good N (%)	Early <15 days	23	6 (26.1%)	Late reconstruction >3 months	59	20 (33.9%)	1.69(0.78,3.68)	NS
Marcacci et al. 1995	Moderate	N IKDC score poor N (%)	Early <15 days	23	0 (0%)	Late reconstruction >3 months	59	1 (1.6%)	0.83(0.03,19.75)	NS
Marcacci et al. 1995	Moderate	Stability excellent N (%)	Early <15 days	23	22 (96%)	Late reconstruction >3 months	59	54 (92%)	1.05(0.93,1.17)	NS
Marcacci et al. 1995	Moderate	Stability fair N (%)	Early <15 days	23	1 (4%)	Late reconstruction >3 months	59	5 (8%)	6.03(0.74,48.87)	NS
Marcacci et al. 1995	Moderate	Range of Motion (Flexion deficit < 5°)	Early <15 days	23	4 (17%)	Late reconstruction >3 months	59	9 (15%)	3.58(1.22,10.51)	NS
Marcacci et al. 1995	Moderate	Range of Motion (Flexion deficit between 6° and 15°)	Early <15 days	23	2 (9%)	Late reconstruction >3	59	4 (7%)	7.7(1.51,39.26)	NS

Table 36. Early Versus Late ACLR

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
						months				
Marcacci et al. 1995	Moderate	Range of Motion (Extension deficit < 3°)	Early <15 days	23	1 (4%)	Late reconstruction >3 months	59	8 (14%)	3.76(0.49,28.48)	NS
Marcacci et al. 1995	Moderate	Range of Motion (Extension deficit between 3° and 5°)	Early <15 days	23	1 (4%)	Late reconstruction >3 months	59	2 (3%)	15(1.43,158.360	NS
Marcacci et al. 1995	Moderate	Stability Lachman Negative	Early <15 days	23	11 (48%)	Late reconstruction >3 months	59	28 (48%)	1.3890.84,2.29)	NS
Marcacci et al. 1995	Moderate	Stability Lachman Slight	Early <15 days	23	11 (48%)	Late reconstruction >3 months	59	25 (42%)	1.55(0.92,2.6)	NS
Marcacci et al. 1995	Moderate	Stability Lachman Positive	Early <15 days	23	1 (4%)	Late reconstruction >3 months	59	6 (10%)	5.02(0.64,39.49)	NS
Marcacci et al. 1995	Moderate	Stability Pivot Shift Negative	Early <15 days	23	12 (52%)	Late reconstruction >3 months	59	24 (41%)	1.66(1,2.74)	NS
Marcacci et al. 1995	Moderate	Stability Pivot Shift Slight	Early <15 days	23	9 (39%)	Late reconstruction >3 months	59	26 (44%)	1.41(0.78,2.53)	NS
Marcacci et al. 1995	Moderate	Stability Pivot Shift Positive	Early <15 days	23	2 (9%)	Late reconstruction >3 months	59	9 (15%)	3.43(0.8,14.68)	NS
Marcacci et al. 1995	Moderate	Mean time to resume sports	Early <15 days	23	5.5 months	Late reconstruction >3 months	59	6 months	NA	NR
Marcacci et al. 1995	Moderate	Resumed sports at same level as before surgery	Early <15 days	23	21 (90%)	Late reconstruction >3 months	59	42 (71%)	1.29(1.05,1.590	NS
Marcacci et al. 1995	Moderate	Function (Single-legged hop test 0% to 10% difference)	Early <15 days	23	18 (78%)	Late reconstruction >3 months	59	49 (82%)	0.99(0.77,1.26)	NS

Table 36. Early Versus Late ACLR

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Marcacci et al. 1995	Moderate	Function (Single-legged hop test 10% to 24% difference)	Early <15 days	23	5 (22%)	Late reconstruction >3 months	59	10 (18%)	3.3(1.27,8.64)	NS
Marcacci et al. 1995	Moderate	Stability (KT-2000 passive displacement test < 3 mm)	Early <15 days	23	13 (56.6%)	Late reconstruction >3 months	59	26 (44.1%)	1.58(0.99,2.50	NS
Marcacci et al. 1995	Moderate	Stability (KT-2000 passive displacement test 3 to 5mm)	Early <15 days	23	5 (21.7%)	Late reconstruction >3 months	59	18 (30.5%)	1.84(0.77,2.5)	NS
Marcacci et al. 1995	Moderate	Stability (KT-2000 passive displacement test > 5 mm)	Early <15 days	23	5 (21.7%)	Late reconstruction >3 months	59	15 (25.4%)	2.2(0.09,5.370	NS
Marcacci et al. 1995	Moderate	Stability (KT-2000 manual maximum displacement test < 3 mm)	Early <15 days	23	17 (73.9%)	Late reconstruction >3 months	59	35 (59.3%)	1.33(00.96, 1.84)	NS
Marcacci et al. 1995	Moderate	Stability (KT-2000 manual maximum displacement test 3 to 5 mm)	Early <15 days	23	5 (21.9%)	Late reconstruction >3 months	59	16 (27.2%)	2.06(0.86,4.99)	NS
Marcacci et al. 1995	Moderate	Stability (KT-2000 manual maximum displacement test > 5 mm)	Early <15 days	23	1 (4.3%)	Late reconstruction >3 months	59	8 (13.5%)	3.77(0.5,28.48)	NS
Raviraj et al. 2010	Moderate	Lysholm score	Early <2 weeks	51	83.1(80-90)	Delayed 4 to 6 weeks	48	84.2(82-90)	NA	NS
Raviraj et al. 2010	Moderate	Activity Score Tegner Score	Early <2 weeks	51	6.1(5-8)	Delayed 4 to 6 weeks	48	5.9(5-8)	NA	NS
Raviraj et al. 2010	Moderate	Stability (KT-1000)	Early <2 weeks	51	NR	Delayed 4 to 6 weeks	48	NR	NA	NS
Raviraj et al. 2010	Moderate	Complications	Early <2 weeks	51	2/51(4%)	Delayed 4 to 6 weeks	48	1/48(2%)	1.88(0.18,20)	NS

ACL MENISCAL REPAIR

There is limited evidence in patients with combined ACL tears and reparable meniscus tears, but it supports that the practitioner might repair these meniscus tears when combined with ACL reconstruction because it improves patient outcomes.

Strength of Recommendation: Limited ★★☆☆

RATIONALE

Nine low strength and two very low strength studies were included in this recommendation.[6, 20, 45, 57, 68, 76, 102, 103, 106, 120, 121] One low strength study reported improved subjective knee function (Lysholm knee score and IKDC Score) and reduced activity related pain and swelling with repaired (51%)/stable (49%) menisci compared to meniscectomy at the time of ACL reconstruction.[121] Objective functional outcomes as evidenced by single leg hops scores were also improved in the repaired/stable meniscus group. One low strength study and one very low strength study reported reduced radiographic abnormalities in knees with repaired/stable menisci and a reduced incidence of osteophytes following repair compared to medial meniscectomy.[6, 121]Likewise, a very low strength study reported a reduction in pain following lateral meniscus repair compared to lateral meniscectomy combined with ACL reconstruction.[103] Several studies reported improved outcomes with ACL reconstruction and menisci repair, but the groups were not directly comparable.

POSSIBLE HARMS OF IMPLEMENTATION

As with all surgical procedures, there are patient risks including but not limited to infection, anesthetic complications, phlebitis, neurovascular injury, meniscal repair failure, and ACL reconstruction failure.

FUTURE RESEARCH

Long-term, prospective studies comparing ACL reconstruction in patients with normal menisci to patients with torn menisci having either meniscectomy or meniscal repair. Further, we can investigate the pattern of meniscal tear, biology of meniscal healing, and repair techniques to increase the chance of successful repair. When meniscectomy is necessary additional research should be performed in the fields of meniscal transplantations and meniscal regeneration.

SUMMARY OF FINDINGS

QUALITY AND APPLICABILITY SUMMARY

Table 37. Quality and Applicability Summary: Treatment of Patients With ACL and Meniscal Injuries

Study	Outcome	Graft	Duration	Quality	Applicability	Overall Strength of Evidence
Hart et al. 2005	Clinical OA	Bone-patellar tendon-bone	2 years	Low	Moderate	Low
Jorgensen et al. 2001	Complications	Iliotibial band	39 months (24	Low	Moderate	Low
Wu et al. 2002	Complications	10-mm bone-patellar tendon bone autograft	10.4 years (9-13)	Low	Moderate	Low
Wu et al. 2002	Failure	10-mm bone-patellar tendon bone autograft	10.4 years (9-13)	Low	Moderate	Low
Siebold et al. 2007	Failure rate	Quadruple hamstring with Endo-Button fixation	6 years (5-6.7)	Low	Moderate	Low
Jorgensen et al. 2001	IKDC	Iliotibial band	39 months (24	Low	Moderate	Low
McConville et al. 1993	IKDC	10-mm bone-patellar tendon bone autograft	2 years	Low	Moderate	Low
Noyes et al. 2011	IKDC	NR	4.2 years (2-10.2)	Low	Moderate	Low
Shelbourne et al. 2009	IKDC	Patellar tendon autograft	6 years	Low	Moderate	Low
Wu et al. 2002	IKDC	10-mm bone-patellar tendon bone autograft	10.4 years (9-13)	Low	Moderate	Low
Chiang et al.	Lysholm knee	All inside meniscal	3 years (2-4.16)	Low	Moderate	Low

Table 37. Quality and Applicability Summary: Treatment of Patients With ACL and Meniscal Injuries

Study	Outcome	Graft	Duration	Quality	Applicability	Overall Strength of Evidence
2011	score	repair with FasT-Fix and ACL reconstruction				
Hart et al. 2005	Lysholm score	Bone-patellar tendon-bone	2 years	Low	Moderate	Low
Jorgensen et al. 2001	Lysholm score	Iliotibial band	39 months (24	Low	Moderate	Low
McConville et al. 1993	Lysholm score	10-mm bone-patellar tendon bone autograft	2 years	Low	Moderate	Low
Wirth et al. 2002	Lysholm score	Mid-third patellar tendon autograft	14 years (12-15)	Low	Moderate	Low
Wu et al. 2002	Lysholm score	10-mm bone-patellar tendon bone autograft	10.4 years (9-13)	Low	Moderate	Low
Hart et al. 2005	OA on SPECT scan	Bone-patellar tendon-bone	2 years	Low	Moderate	Low
Jorgensen et al. 2001	Patient satisfaction	Iliotibial band	39 months (24	Low	Moderate	Low
Wu et al. 2002	Range of motion	10-mm bone-patellar tendon bone autograft	10.4 years (9-13)	Low	Moderate	Low
Hart et al. 2005	Severe radiographic OA number	Bone-patellar tendon-bone	2 years	Low	Moderate	Low
Wu et al. 2002	Tegner activity scale	10-mm bone-patellar tendon bone autograft	10.4 years (9-13)	Low	Moderate	Low
Chiang et al.	Tegner	All inside meniscal	3 years (2-4.16)	Low	Moderate	Low

Table 37. Quality and Applicability Summary: Treatment of Patients With ACL and Meniscal Injuries

Study	Outcome	Graft	Duration	Quality	Applicability	Overall Strength of Evidence
2011	activity score	repair with FasT-Fix and ACL reconstruction				
Hart et al. 2005	Tegner score	Bone-patellar tendon-bone	2 years	Low	Moderate	Low
McConville et al. 1993	Tegner score	10-mm bone-patellar tendon bone autograft	2 years	Low	Moderate	Low

Table 38. Quality and Applicability: Treatment of Patient With ACL and Meniscal Injuries

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Hart et al. 2005	Clinical OA	●	○	○	○	○	○	●	**Low**	●	○	●	○	**Moderate**
Jorgensen et al. 2001	Complications	●	○	○	○	○	●	●	**Low**	●	○	●	●	**Moderate**
Wu et al. 2002	Complications	●	○	○	○	○	●	●	**Low**	●	○	●	●	**Moderate**
Siebold et al. 2007	Failure rate	●	○	○	○	○	●	●	**Low**	●	○	●	○	**Moderate**
Wu et al. 2002	Failures	●	○	○	○	○	●	●	**Low**	●	○	●	●	**Moderate**
Jorgensen et al. 2001	IKDC	●	○	○	○	○	●	●	**Low**	●	○	●	●	**Moderate**
McConville et al. 1993	IKDC	●	○	○	○	○	●	○	**Low**	●	○	●	○	**Moderate**
Noyes et al. 2011	IKDC	●	○	○	○	○	●	●	**Low**	●	○	●	●	**Moderate**

Table 38. Quality and Applicability: Treatment of Patient With ACL and Meniscal Injuries

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Shelbourne et al. 2009	IKDC	●	○	○	○	○	●	●	**Low**	●	○	●	○	**Moderate**
Wu et al. 2002	IKDC	●	○	○	○	○	●	●	**Low**	●	○	●	●	**Moderate**
Chiang et al. 2011	Lysholm knee score	●	○	○	○	○	●	○	**Low**	●	○	●	●	**Moderate**
Chiang et al. 2011	Lysholm knee score	●	○	○	○	○	●	○	**Low**	●	○	●	●	**Moderate**
Hart et al. 2005	Lysholm score	●	○	○	○	○	●	●	**Low**	●	○	●	○	**Moderate**
Jorgensen et al. 2001	Lysholm score	●	○	○	○	○	●	●	**Low**	●	○	●	●	**Moderate**
McConville et al. 1993	Lysholm score	●	○	○	○	○	●	○	**Low**	●	○	●	●	**Moderate**
Wirth et al. 2002	Lysholm score	○	○	○	○	●	●	○	**Low**	●	○	●	●	**Moderate**
Wu et al. 2002	Lysholm score	●	○	○	○	○	●	●	**Low**	●	○	●	○	**Moderate**

Table 38. Quality and Applicability: Treatment of Patient With ACL and Meniscal Injuries

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Hart et al. 2005	OA on SPECT scan	●	○	○	○	○	○	●	**Low**	●	○	●	○	**Moderate**
Jorgensen et al. 2001	Patient satisfaction	●	○	○	○	○	○	●	**Low**	●	○	●	●	**Moderate**
Wu et al. 2002	Range of motion	●	○	○	○	○	○	●	**Low**	●	○	●	●	**Moderate**
Hart et al. 2005	Severe radiographic OA number	●	○	○	○	○	○	●	**Low**	●	○	●	○	**Moderate**
Noyes et al. 2011	Stability (Pivot shift)	●	○	○	○	○	●	●	**Low**	●	○	●	●	**Moderate**
Wu et al. 2002	Tegner activity scale	●	○	○	○	○	●	●	**Low**	●	○	●	●	**Moderate**
Chiang et al. 2011	Tegner activity score	●	○	○	○	○	●	○	**Low**	●	○	●	●	**Moderate**
Chiang et al. 2011	Tegner activity score	●	○	○	○	○	●	○	**Low**	●	○	●	●	**Moderate**
Hart et al. 2005	Tegner score	●	○	○	○	○	●	●	**Low**	●	○	●	○	**Moderate**

Table 38. Quality and Applicability: Treatment of Patient With ACL and Meniscal Injuries

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
McConville et al. 1993	Tegner score	●	○	○	○	○	●	○	**Low**	●	○	●	○	**Moderate**

FINDINGS

Table 39. Results: Treatment of Patient With ACLR and Meniscal Injuries

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR, OR)	Favors
Hart et al. 2005	Low	Mean Lysholm knee score	ACLR plus intact meniscus	15	96	ACLR with meniscectomy	16	95	NA	NR
Hart et al. 2005	Low	Mean Tegner activity level	ACLR plus intact meniscus	15	6	ACLR with meniscectomy	16	7	NA	NR
Hart et al. 2005	Low	Clinical OA (Ahlback score)	ACLR plus intact meniscus	15	1/15(7%)	ACLR with meniscectomy	16	2/16(13%)	0.5(0.04, 6.17)	NS
Hart et al. 2005	Low	Severe radiograp hic OA	ACLR plus intact meniscus	15	0/15(0%)	ACLR with meniscectomy	16	1/16(7%)	0.33(0.01,8.83)	NS
Hart et al. 2005	Low	OA on SPECT scan	ACLR plus intact meniscus	15	1/15(7%)	ACLR with meniscectomy	16	5/16(31%)	0.16(0.02,1.55)	NS
Jorgensen et al. 2001	Low	Lysholm score	Isolated ACLR	54	96.5(5.2)	ACLR plus meniscus (Repair/Cons/resecti on)	54	93.1(9.7)	3.4(0.43,6.37)	Favors Isolated ACLR
Jorgensen et al. 2001	Low	Tegner activity level	Isolated ACLR	54	7.7(1.9)	ACLR plus meniscus (Repair/Cons/resecti on	54	7.3(2.2)	0.4(-0.38,1.18)	NS
Wirth et al. 2002	Low	Lysholm score	Medial meniscal transplantation combined	23	75 (21)	ACL reconstruction and advancement of the medial collateral ligament (resected)	11	78 (15)	-3(-17.40,11.40)	NS
Wirth et al. 2002	Low	Lysholm score	Medial meniscal transplantation combined	23	75 (21)	ACL reconstruction but menisci intact (Intact)	10	86 (12)	-11(-25.5,3.5)	NS
Wu et al.	Low	IKDC	ACLR plus	NR	80(18)	ACL plus partial or	47	84(14)	-4(-10.9,2.9)	NS

Table 39. Results: Treatment of Patient With ACLR and Meniscal Injuries

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR, OR)	Favors
2002			Intact menisci group			complete meniscectomy				
Wu et al. 2002	Low	Lysholm score	ACLR plus Intact menisci group	NR	94(8)	ACL plus partial or complete meniscectomy	NR	88(10)	NA	Favors ACLR plus Intact menisci group
Wu et al. 2002	Low	Tegner score	ACLR plus Intact menisci group	NR	NR	ACL plus partial or complete meniscectomy	NR	NR	NA	NS
Wu et al. 2002	Low	Pain swelling	ACLR plus Intact menisci group	NR	NR	ACL plus partial or complete meniscectomy	NR	NR	NA	Favors ACLR and intact menisci
Wu et al. 2002	Low	Single legged hop test	ACLR plus Intact menisci group	25	22/25(90%)	ACL plus partial or complete meniscectomy	36	24/36(67%)	3.66(0.91,14.47)	Favors ACLR and intact menisci
Wu et al. 2002	Low	Range of motion degrees	ACLR plus Intact menisci group	NR	137(4)	ACL plus partial or complete meniscectomy	NR	120(7)	NA	NS
Wu et al. 2002	Low	Instrumented laxity differences	ACLR plus Intact menisci group	NR	1.8(1.9)	ACL plus partial or complete meniscectomy	NR	2.6(2.2)	NA	NS
McConville et al. 1993	Low	Lysholm knee score	Baseline	64	65	Final follow-up	64	90	NA	NA
McConville et al. 1993	Low	Tegner activity level	Baseline	64	3.9	Final follow-up	64	5.6	NA	NA
McConville et al. 1993	Low	Incidence of swelling with moderate activity	ACL plus Intact menisci group	18	4/18(22%)	Partial or complete meniscus	39	16/46(36%)	0.53(0.15,1.9)	NS
McConville et al. 1993	Low	Incidence of partial giving	ACL plus Intact menisci group	18	3/18(17%)	Partial or complete meniscus	39	19/46(41%)	0.34(0.08,1.35)	NS

Table 39. Results: Treatment of Patient With ACLR and Meniscal Injuries

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR, OR)	Favors
		way with moderate with moderate activity								
McConville et al. 1993	Low	Incidence of full giving way with moderate with moderate activity	ACL plus Intact menisci group	18	3/18(17%)	Partial or complete meniscus	39	14/46(31%)	0.46(0.11,1.83)	NS

Table 40. Results: Treatment of Patient With ACLR and Meniscal Injuries (All Inside Meniscal Repair With FasT-Fix)

Author	Study Strength	Graft	Surgical Technique	Outcome	n	Average follow-up Time (range)	Mean (sd)	Results	p<0.05
Chiang et al. 2011	Low	Hamstring autograft	All inside meniscal repair with FasT-Fix and ACL reconstruction	Lysholm knee score	13	Baseline	62.3(10)	-25.9(-36.18,15.62)	p<0.05
Chiang et al. 2011	Low	Hamstring autograft	All inside meniscal repair with FasT-Fix and ACL reconstruction	Lysholm knee score	13	3 years (2-4.16)	88.2(15)		
Chiang et al. 2011	Low	Hamstring autograft	All inside meniscal repair with FasT-Fix and ACL reconstruction	Tegner activity level	13	Baseline	2.7(1.1)	-3(-3.93,-2.07)	p<0.05
Chiang et al. 2011	Low	Hamstring autograft	All inside meniscal repair with FasT-Fix and ACL reconstruction	Tegner activity level	13	3 years (2-4.16)	5.7(1.2)		
Chiang et al. 2011	Low	Hamstring autograft	All inside meniscal repair with FasT-Fix and ACL reconstruction	Failure rate	31	3 years (2-4.16)	2/31(6%)	NA	NA

Table 41. Results: Treatment of Patient With ACLR and Meniscal Injuries (Red-White Longitudinal Meniscal Repairs)

Author	Study Strength	Outcome	n	Average Follow-up Time (range)	Mean (sd)
Noyes et al. 2011	Low	Meniscal healing Successful	23	4.2 years (2-10.2)	15/23(65%)
Noyes et al. 2011	Low	Meniscal healing Failure	23	4.2 years (2-10.2)	8/23(35%)
Noyes et al. 2011	Low	Normal IKDC Score	19	4.2 years (2-10.2)	6/19(32%)
Noyes et al. 2011	Low	Nearly Normal IKDC Score	19	4.2 years (2-10.2)	9/19(47%)
Noyes et al. 2011	Low	Abnormal IKDC Score	19	4.2 years (2-10.2)	2/19(11%)
Noyes et al. 2011	Low	Severely Abnormal IKDC Score	19	4.2 years (2-10.2)	2/19(11%)

Table 42. Results: Treatment of Patient With ACLR and Meniscal Injuries (All Inside Meniscal Repair)

Author	Study Strength	N	Graft	Surgical Technique	Outcome	n	Average Follow-up Time (range)	Mean (sd)
Siebold et al. 2007	Low	113	Quadruple hamstring with Endo-Button fixation	All-inside repair with meniscus arrow	Failure rate	75	2.8 years	11/75 (53%)
Siebold et al. 2007	Low	113	Quadruple hamstring with Endo-Button fixation	All-inside repair with meniscus arrow	Failure rate	75	6 years (5-6.7)	17/75(63%)

ACL RECURRENT INSTABILITY

There is limited evidence comparing non-operative treatment to ACL reconstruction in patients with recurrent instability, but it supports that the practitioner might perform ACL reconstruction because this procedure reduces pathologic laxity.

Strength of Recommendation: Limited ★★☆☆

RATIONALE

One prospective comparative study was included.[24] With respect to recurrent instability, this study compared two groups of interest – an ACL-unstable group that ultimately did not undergo ACL reconstruction despite persistent pathologic laxity (Group II in the article, considered "copers") as well as an ACL-unstable group that ultimately did undergo late ACL reconstruction following recurrent instability (Group IV in the article). The late ACL reconstructions in Group IV occurred 9 to 84 months after injury. Of the 147 patients in Group II, only 11 had meniscal surgery. Of the 46 patients in Group IV, 29 had meniscal surgery. The article also reports an ACL-stable group with hemarthrosis (Group I) and an ACL-unstable group that underwent early ACL reconstruction (Group III).

At final evaluation of symptoms, 18% of the non-ACL-reconstructed, unstable patients (Group II) reported giving way with sports while only 3% of the late-ACL-reconstructed patients (Group IV) reported giving way with sports. Similarly, 9% of the non-ACL-reconstructed, unstable patients (Group II) reported giving way with activities of daily life, while only 3% of the late-ACL-reconstructed patients (Group IV) reported giving way with activities of daily life. Objective instrumented and physical examination findings paralleled these subjective findings. This is without undergoing ACL reconstruction (Group II), 84% of patients demonstrated positive KT-1000 arthrometer measurements (>3 mm side-to-side difference with manual maximum testing) and 84% had positive pivot shift testing. Following late ACL reconstruction (Group IV), 70% of patients demonstrated positive KT-1000 arthrometer measurements and 52% had positive pivot shift testing.

POSSIBLE HARMS OF IMPLEMENTATION

As with all surgery procedures, there are surgical risks and complications including but not limited to graft failure, arthrofibrosis, infection, neurovascular injury, and anesthetic complications.

FUTURE RESEARCH

Further research is needed to assess the outcomes in patients with recurrent instability. Specifically, we need to follow these patients after non-operative treatment as well as after ACL reconstruction.

QUALITY AND APPLICABILITY SUMMARY

Table 43. Quality and Applicability Summary: ACL Reconstruction and Instability

Study:	Outcome	Graft	Duration	Quality	Applicability	Overall Strength of Evidence
Daniel et al. 1994	Function	Semitendinosus autograft, Patellar tendon autograft	5.3 years (46-113 months)	Moderate	Moderate	Moderate
Daniel et al. 1994	Sports level	Semitendinosus autograft, Patellar tendon autograft	5.3 years (46-113 months)	Low	Moderate	Low
Daniel et al. 1994	Stability	Semitendinosus autograft, Patellar tendon autograft	5.3 years (46-113 months)	Moderate	Moderate	Moderate
Daniel et al. 1994	Symptoms	Semitendinosus autograft, Patellar tendon autograft	5.3 years (46-113 months)	Moderate	Moderate	Moderate

Table 44. Quality and Applicability: ACL Reconstruction and Instability

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Daniel et al. 1994	Function	●	○	●	○	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Daniel et al. 1994	Sports level	●	○	●	○	●	○	○	**Low**	●	○	●	●	**Moderate**
Daniel et al. 1994	Stability	●	○	●	○	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Daniel et al. 1994	Symptoms	●	○	●	○	●	●	○	**Moderate**	●	○	●	●	**Moderate**

FINDINGS

Table 45. ACL Reconstruction and Instability

Author	Study Strength	Outcome Measured	Average Follow-up Time (range)	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Daniel et al. 1994	Low	Participate in basketball 50 hours per year or more	5.3 years (46-113 months)	Stable knee no reconstruction	53	5/53(9%)	Unstable knee no reconstruction	139	8/139(6%)	1.64(0.56,4.78)	NS
Daniel et al. 1994	Low	Participate in football 50 hours per year or more	5.3 years (46-113 months)	Stable knee no reconstruction	53	3/53(6%)	Unstable knee no reconstruction	139	0/139(0%)	18.15(0.95,345.55)	NS
Daniel et al. 1994	Low	Participate in football 50 hours per year or more	5.3 years (46-113 months)	Stable knee no reconstruction	53	1/53(2%)	Unstable knee no reconstruction	139	3/139(2%)	0.87(0.09,8.22)	NS
Daniel et al. 1994	Low	Participate in baseball 50 hours per year or more	5.3 years (46-113 months)	Stable knee no reconstruction	53	5/53(9%)	Unstable knee no reconstruction	139	13/139(9%)	1(0.38,2.69)	NS
Daniel et al. 1994	Low	Participate in racquet sports 50 hours per year or more	5.3 years (46-113 months)	Stable knee no reconstruction	53	3/53(6%)	Unstable knee no reconstruction	139	16/139(11%)	0.49(0.15,1.62)	NS
Daniel et al. 1994	Low	Participate in snow ski sports 50 hours per year or more	5.3 years (46-113 months)	Stable knee no reconstruction	53	1/53(2%)	Unstable knee no reconstruction	139	1/139(1%)	2.62(0.17,41.18)	NS

Table 45. ACL Reconstruction and Instability

Author	Study Strength	Outcome Measured	Average Follow-up Time (range)	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Daniel et al. 1994	Moderate	Pain (more than mild and infrequent)	5.3 years (46-113 months)	Stable knee no reconstruction	53	6/53(11%)	Unstable knee no reconstruction	139	29/139(21%)	0.54(0.24,1.23)	NS
Daniel et al. 1994	Moderate	Swelling (more than mild and infrequent)	5.3 years (46-113 months)	Stable knee no reconstruction	53	3/53(6%)	Unstable knee no reconstruction	139	25/139(18%)	0.31(0.09,0.99)	Favors stable knee
Daniel et al. 1994	Moderate	Giving way with sports	5.3 years (46-113 months)	Stable knee no reconstruction	53	2/53(4%)	Unstable knee no reconstruction	139	25/139(18%)	0.2(0.05,0.85)	Favors stable knee
Daniel et al. 1994	Moderate	Giving way with ADL	5.3 years (46-113 months)	Stable knee no reconstruction	53	0/53(0%)	Unstable knee no reconstruction	139	13/139(9%)	0.09(0,1.59)	NS
Daniel et al. 1994	Moderate	Walk impairment s	5.3 years (46-113 months)	Stable knee no reconstruction	53	4/53(8%)	Unstable knee no reconstruction	139	8/139(6%)	1.31(0.4,4.17)	NS
Daniel et al. 1994	Moderate	Climb impairment s	5.3 years (46-113 months)	Stable knee no reconstruction	53	5/53(9%)	Unstable knee no reconstruction	139	33/139(24%)	0.4(0.16,0.96)	Favors stable knee
Daniel et al. 1994	Moderate	Stairs impairment s	5.3 years (46-113 months)	Stable knee no reconstruction	53	7/53(13%)	Unstable knee no reconstruction	139	31/139(22%)	0.6(0.28,1.26)	NS
Daniel et al. 1994	Moderate	Kneel impairment s	5.3 years (46-113 months)	Stable knee no reconstruction	53	11/53(21%)	Unstable knee no reconstruction	139	51/139(37%)	0.56(0.32,0.9)	Favors stable knee
Daniel et al. 1994	Moderate	Squat impairment s	5.3 years (46-113 months)	Stable knee no reconstruction	53	10/53(19%)	Unstable knee no reconstruction	139	56/139(40%)	0.47(0.26,0.85)	Favors stable knee
Daniel et al. 1994	Moderate	Run impairment s	5.3 years (46-113 months)	Stable knee no reconstruction	53	8/53(15%)	Unstable knee no reconstruction	139	51/139(37%)	0.41(0.2,0.8)	Favors stable knee
Daniel et al. 1994	Moderate	Jump impairment	5.3 years (46-113	Stable knee no reconstruction	53	7/53(13%)	Unstable knee no	139	47/139(34%)	0.39(0.19,0.8)	Favors stable

Table 45. ACL Reconstruction and Instability

Author	Study Strength	Outcome Measured	Average Follow-up Time (range)	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		s	months)				reconstruction				knee
Daniel et al. 1994	Moderate	Cut impairments	5.3 years (46-113 months)	Stable knee no reconstruction	53	7/53(13%)	Unstable knee no reconstruction	139	78/139(56%)	0.23(0.12,0.48)	Favors stable knee
Daniel et al. 1994	Moderate	Walk impairments more than mild	5.3 years (46-113 months)	Stable knee no reconstruction	53	0/53(0%)	Unstable knee no reconstruction	139	0/139(0%)	2.59(0.05,129)	NS
Daniel et al. 1994	Moderate	Climb impairments more than mild	5.3 years (46-113 months)	Stable knee no reconstruction	53	0/53(0%)	Unstable knee no reconstruction	139	0/139(0%)	2.59(0.05,129)	NS
Daniel et al. 1994	Moderate	Stairs impairments more than mild	5.3 years (46-113 months)	Stable knee no reconstruction	53	0/53(0%)	Unstable knee no reconstruction	139	1/139(1%)	0.086(0.03,20.8)	NS
Daniel et al. 1994	Moderate	Kneel impairments more than mild	5.3 years (46-113 months)	Stable knee no reconstruction	53	1/53(2%)	Unstable knee no reconstruction	139	3/139(2%)	0.87(0.09,8.22)	NS
Daniel et al. 1994	Moderate	Squat impairments more than mild	5.3 years (46-113 months)	Stable knee no reconstruction	53	2/53(4%)	Unstable knee no reconstruction	139	6/139(4%)	0.88(0.18,4.19)	NS
Daniel et al. 1994	Moderate	Run impairments more than mild	5.3 years (46-113 months)	Stable knee no reconstruction	53	4/53(8%)	Unstable knee no reconstruction	139	17/139(12%)	0.62(0.22,1.75)	NS
Daniel et al. 1994	Moderate	Jump impairments more than mild	5.3 years (46-113 months)	Stable knee no reconstruction	53	4/53(8%)	Unstable knee no reconstruction	139	15/139(11%)	0.7(0.24,2)	NS

Table 45. ACL Reconstruction and Instability

Author	Study Strength	Outcome Measured	Average Follow-up Time (range)	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Daniel et al. 1994	Moderate	Cut impairments more than mild	5.3 years (46-113 months)	Stable knee no reconstruction	53	5/53(9%)	Unstable knee no reconstruction	139	43/139(31%)	0.3(0.13,0.73)	NS
Daniel et al. 1994	Moderate	Functional (Hop test ≥0.9)	5.3 years (46-113 months)	Stable knee no reconstruction	49	48/49(98%)	Unstable knee no reconstruction	123	95/123(77%)	1.27(1.14,1.40	NS
Daniel et al. 1994	Moderate	Functional (Quadriceps ≥0.8)	5.3 years (46-113 months)	Stable knee no reconstruction	49	49/49(100 %)	Unstable knee no reconstruction	123	113/123(92 %)	1(1.03,1.15)	NS
Daniel et al. 1994	Moderate	Functional (Hamstring ≥0.8)	5.3 years (46-113 months)	Stable knee no reconstruction	49	46/49(94%)	Unstable knee no reconstruction	123	113/123(92 %)	1.02(0.93,1.12)	NS
Daniel et al. 1994	Moderate	Stability (Quadriceps active KT-1000 <3mm 89N)	5.3 years (46-113 months)	Stable knee no reconstruction	53	47/53(89%)	Unstable knee no reconstruction	134	59/134(44%)	2(1.63,2.5)	NS
Daniel et al. 1994	Moderate	Stability (Quadriceps KT-1000 <3mm 89N)	5.3 years (46-113 months)	Stable knee no reconstruction	53	49/53(93%)	Unstable knee no reconstruction	134	74/134(39%)	1.67(1.4,1.98)	NS
Daniel et al. 1994	Moderate	Stability (Quadriceps KT-1000 <3mm 134N)	5.3 years (46-113 months)	Stable knee no reconstruction	53	49/53(93%)	Unstable knee no reconstruction	134	52/134(39%)	2.38(1.9,2.99)	NS
Daniel et al. 1994	Moderate	Stability (Quadriceps KT-1000 <3mm Max)	5.3 years (46-113 months)	Stable knee no reconstruction	53	48/53(91%)	Unstable knee no reconstruction	134	21/134(16%)	5.77(3.87,8.64)	NS

Table 45. ACL Reconstruction and Instability

Author	Study Strength	Outcome Measured	Average Follow-up Time (range)	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Daniel et al. 1994	Moderate	Stability (Pivot-shift)	5.3 years (46-113 months)	Stable knee no reconstruction	53	49/53(92%)	Unstable knee no reconstruction	134	21/134(16%)	**5.9(3.95,8.8)**	Favors stable knee
Daniel et al. 1994	Low	Participate in basketball 50 hours per year or more	5.3 years (46-113 months)	Early unstable knee no reconstruction	139	8/139(6%)	Late reconstruction >90 days	33	3/33(9%)	0.63(0.18,2.26)	NS
Daniel et al. 1994	Low	Participate in football 50 hours per year or more	5.3 years (46-113 months)	Early unstable knee no reconstruction	139	0/139(0%)	Late reconstruction >90 days	33	0/33(0%)	0(0,0)	NS
Daniel et al. 1994	Low	Participate in football 50 hours per year or more	5.3 years (46-113 months)	Early unstable knee no reconstruction	139	3/139(2%)	Late reconstruction >90 days	33	0/33(0%)	1.7(0.09,32.14)	NS
Daniel et al. 1994	Low	Participate in baseball 50 hours per year or more	5.3 years (46-113 months)	Early unstable knee no reconstruction	139	13/139(9%)	Late reconstruction >90 days	33	2/33(6%)	1.54(0.37,6.51)	NS
Daniel et al. 1994	Low	Participate in racquet sports 50 hours per year or more	5.3 years (46-113 months)	Early unstable knee no reconstruction	139	16/139(11 %)	Late reconstruction >90 days	33	6/33(18%)	0.63(0.27,1.49)	NS
Daniel et al. 1994	Low	Participate in snow ski sports 50 hours per	5.3 years (46-113 months)	Early unstable knee no reconstruction	139	1/139(1%)	Late reconstruction >90 days	33	2/33(6%)	0.12(0.01,1.27)	NS

Table 45. ACL Reconstruction and Instability

Author	Study Strength	Outcome Measured	Average Follow-up Time (range)	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		year or more									
Daniel et al. 1994	Moderate	Pain (more than mild and infrequent)	5.3 years (46-113 months)	Early unstable knee no reconstruction	139	29/139(21 %)	Late reconstruction >90 days	33	8/33(24%)	0.86(0.43,1.71)	NS
Daniel et al. 1994	Moderate	Swelling (more than mild and infrequent)	5.3 years (46-113 months)	Early unstable knee no reconstruction	139	25/139(18 %)	Late reconstruction >90 days	33	11/33(33%)	0.54(0.3,0.98)	Favors unstable knee no reconstruc tion
Daniel et al. 1994	Moderate	Giving way with sports	5.3 years (46-113 months)	Early unstable knee no reconstruction	139	25/139(18 %)	Late reconstruction >90 days	33	1/33(3%)	5.94(0.83,42.24)	NS
Daniel et al. 1994	Moderate	Giving way with ADL	5.3 years (46-113 months)	Early unstable knee no reconstruction	139	13/139(9%)	Late reconstruction >90 days	33	1/33(3%)	3.09(0.42,22.76)	NS
Daniel et al. 1994	Moderate	Walk impairment s	5.3 years (46-113 months)	Early unstable knee no reconstruction	139	8/139(6%)	Late reconstruction >90 days	33	4/33(12%)	0.47(0.15,1.48)	NS
Daniel et al. 1994	Moderate	Climb impairment s	5.3 years (46-113 months)	Early unstable knee no reconstruction	139	33/139(24 %)	Late reconstruction >90 days	33	8/33(24%)	0.98(0.5,1.92)	NS
Daniel et al. 1994	Moderate	Stairs impairment s	5.3 years (46-113 months)	Early unstable knee no reconstruction	139	31/139(22 %)	Late reconstruction >90 days	33	8/33(24%)	0.92(0.47,1.81)	NS
Daniel et al. 1994	Moderate	Kneel impairment s	5.3 years (46-113 months)	Early unstable knee no reconstruction	139	51/139(37 %)	Late reconstruction >90 days	33	21/33(64%)	0.58(0.41,0.81)	
Daniel et al. 1994	Moderate	Squat impairment s	5.3 years (46-113 months)	Early unstable knee no reconstruction	139	56/139(40 %)	Late reconstruction >90 days	33	18/33(55%)	0.74(0.51,1.07)	NS
Daniel et al. 1994	Moderate	Run impairment	5.3 years (46-113	Early unstable knee no	139	51/139(37 %)	Late reconstruction	33	13/33(39%)	0.93(0.58,1.5)	NS

Table 45. ACL Reconstruction and Instability

Author	Study Strength	Outcome Measured	Average Follow-up Time (range)	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		s	months)	reconstruction			>90 days				
Daniel et al. 1994	Moderate	Jump impairments	5.3 years (46-113 months)	Early unstable knee no reconstruction	139	47/139(34%)	Late reconstruction >90 days	33	12/33(36%)	0.93(0.56,1.55)	NS
Daniel et al. 1994	Moderate	Cut impairments	5.3 years (46-113 months)	Early unstable knee no reconstruction	139	78/139(56%)	Late reconstruction >90 days	33	17/33(52%)	1.09(0.76,1.56)	NS
Daniel et al. 1994	Moderate	Walk impairments more than mild	5.3 years (46-113 months)	Early unstable knee no reconstruction	139	0/139(0%)	Late reconstruction >90 days	33	0/33(0%)	NA	NS
Daniel et al. 1994	Moderate	Climb impairments more than mild	5.3 years (46-113 months)	Early unstable knee no reconstruction	139	0/139(0%)	Late reconstruction >90 days	33	0/33(0%)	NA	NS
Daniel et al. 1994	Moderate	Stairs impairments more than mild	5.3 years (46-113 months)	Early unstable knee no reconstruction	139	1/139(1%)	Late reconstruction >90 days	33	1/33(3%)	0.24(0.02,3.7)	NS
Daniel et al. 1994	Moderate	Kneel impairments more than mild	5.3 years (46-113 months)	Early unstable knee no reconstruction	139	3/139(2%)	Late reconstruction >90 days	33	4/33(12%)	0.18(0.04,0.76)	Favors unstable knee no reconstruction
Daniel et al. 1994	Moderate	Squat impairments more than mild	5.3 years (46-113 months)	Early unstable knee no reconstruction	139	6/139(4%)	Late reconstruction >90 days	33	3/33(9%)	0.47(0.13,1.8)	NS
Daniel et al. 1994	Moderate	Run impairments more than mild	5.3 years (46-113 months)	Early unstable knee no reconstruction	139	17/139(12%)	Late reconstruction >90 days	33	6/33(18%)	0.67(0.29,1.57)	NS
Daniel et al. 1994	Moderate	Jump impairment	5.3 years (46-113	Early unstable knee no	139	15/139(11%)	Late reconstruction	33	3/33(9%)	1.19(0.36,3.86)	NS

Table 45. ACL Reconstruction and Instability

Author	Study Strength	Outcome Measured	Average Follow-up Time (range)	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		s more than mild	months)	reconstruction			>90 days				
Daniel et al. 1994	Moderate	Cut impairment s more than mild	5.3 years (46-113 months)	Early unstable knee no reconstruction	139	43/139(31 %)	Late reconstruction >90 days	33	10/33(30%)	1.02(0.58,1.81)	NS
Daniel et al. 1994	Moderate	Functional (Hop test ≥0.9)	5.3 years (46-113 months)	Early unstable knee no reconstruction	123	95/123(77 %)	Late reconstruction >90 days	33	19/33(59%)	1.34(0.99,1.83)	NS
Daniel et al. 1994	Moderate	Functional (Quadricep s ≥0.8)	5.3 years (46-113 months)	Early unstable knee no reconstruction	123	113/123(92 %)	Late reconstruction >90 days	33	27/33(84%)	1.12(0.95,1.33)	NS
Daniel et al. 1994	Moderate	Functional (Hamstring ≥0.8)	5.3 years (46-113 months)	Early unstable knee no reconstruction	123	113/123(92 %)	Late reconstruction >90 days	33	30/33(94%)	1.01(0.9,1.14)	NS
Daniel et al. 1994	Moderate	Stability (Quadricep s active KT-1000 <3mm 89N)	5.3 years (46-113 months)	Early unstable knee no reconstruction	134	59/134(44 %)	Late reconstruction >90 days	33	18/33(55%)	0.81(0.56,1.16)	NS
Daniel et al. 1994	Moderate	Stability (Quadricep s KT-1000 <3mm 89N)	5.3 years (46-113 months)	Early unstable knee no reconstruction	134	74/134(39 %)	Late reconstruction >90 days	33	20/33(61%)	0.91(0.67,1.25)	NS
Daniel et al. 1994	Moderate	Stability (Quadricep s KT-1000 <3mm 134N)	5.3 years (46-113 months)	Early unstable knee no reconstruction	134	52/134(39 %)	Late reconstruction >90 days	33	15/33(45%)	0.85(0.56,1.31)	NS
Daniel et al. 1994	Moderate	Stability (Quadricep s KT-1000	5.3 years (46-113 months)	Early unstable knee no reconstruction	134	21/134(16 %)	Late reconstruction >90 days	33	10/33(30%)	0.52(0.27,0.99)	Favors late reconstruc

Table 45. ACL Reconstruction and Instability

Author	Study Strength	Outcome Measured	Average Follow-up Time (range)	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		<3mm Max)									tion
Daniel et al. 1994	Moderate	Stability (Pivot-shift)	5.3 years (46-113 months)	Early unstable knee no reconstruction	134	21/134(16%)	Late reconstruction >90 days	33	16/33(48%)	0.32(0.19,0.55)	Favors late reconstruction

ACL CONSERVATIVE TREATMENT

There is limited evidence to support non-surgical management for less active patients with less laxity.

Strength of Recommendation: Limited ★★☆☆

RATIONALE

This recommendation is based on one moderate-strength, one low strength and three very low strength studies .[24, 31, 71, 93, 29] Patients were classified based on activity level and knee laxity at initial injury. The following three groups were considered particularly low risk: (1) Patients participating in less than 50 hours of jumping or cutting sports and less than 5 mm of side to side difference based on KT-1000 or manual maximal testing, (2) Patients participating in 50-199 hours of jumping or cutting sports with less than 5 mm of side to side difference based on KT-1000 or manual maximal testing, and (3) Patients participating in less than 50 hours of jumping or cutting sports with 5-7 mm of side to side difference based on KT-1000 or manual maximal testing.[31] Collectively, these low risk groups were found to have lower rates of late meniscal surgery and ACL reconstruction than patients in the high risk groups treated non-operatively.[31] Thus, low risk patients may do well with non-operative treatment. However, 25% of the low risk patients ultimately required surgery, including ACL reconstruction or meniscal surgery.[31]

BENEFITS OF IMPLEMENTATION

Lower risk patients, based on activity and/or index laxity criteria, may tolerate an ACL deficient knee, and therefore may be spared exposure to the risks of surgical intervention such as infection, risks of anesthesia, arthrofibrosis, etc.

POSSIBLE HARMS OF IMPLEMENTATION

Despite being categorized as low risk, these patients may still require late ACL reconstruction and/or meniscal surgery and could sustain further damage to the ACL deficient knee.

FUTURE RESEARCH

Future research should attempt to define which patients may be safely treated conservatively after ACL injury, and what specific risk factors contribute to this decision making process.

SUMMARY OF FINDINGS

Table 46. Summary of Findings: Operative Versus Non-Operative

● :Favors Operative treatment

● :Favors Non-operative

○ :Not significant

	Scales/Measures	Mihelic et al. 2011 *(V)*	Fithian et al. 2005 *(M)*	Richter et al. 2002 *(V)*	**Meta-Analysis**
Patient satisfaction					NA
Function			●		NA
Pain			○		NA
	IKDC subjective	●			NA
	IKDC Normal		●	○	NA
	Lysholm Score	●	●	●	NA
	OAK				NA
Quality of life					NA
Activities of daily living				○	NA
	Tegner Activity	○	●	●	NA
Stability			●		NA
Osteoarthritis		●			NA
Range of motion				○	NA
Strength					NA
Swelling			○		NA

Overall strength of study; High: *(H)*, Moderate: *(M)*, Low: *(L)*, Very low: *(V)*

QUALITY AND APPLICABILITY SUMMARY

Table 47. Quality and Applicability Summary: Non-Surgical Management of Patients With Torn ACL

Study	Outcome	Graft	Duration	Quality	Applicability	Overall Strength of Evidence
Daniel et al. 1994	Function	Semitendinosus autograft, Patellar tendon autograft	5.3 years (46-113 months)	Moderate	Moderate	Moderate
Fithian et al. 2005	Function	Mid-third of patellar tendon autograft	6.6 years (3-10)	Low	Moderate	Low
Fithian et al. 2005	IKDC	Mid-third of patellar tendon autograft	6.6 years (3-10)	Moderate	Moderate	Moderate
Mihelic et al. 2011	IKDC	Patellar tendon bone tendon bone autograft	17-20 years	Very Low	Moderate	Very Low
Richter et al. 2002	IKDC	Repair or Reconstruction	8 years (2	Very Low	Moderate	Very Low
Fithian et al. 2005	Instability	Mid-third of patellar tendon autograft	6.6 years (3-10)	Moderate	Moderate	Moderate
Richter et al. 2002	Jager and Wirth	Repair or Reconstruction	8 years (2	Very Low	Moderate	Very Low
Fithian et al. 2005	Lysholm score	Mid-third of patellar tendon autograft	6.6 years (3-10)	Moderate	Moderate	Moderate
Mihelic et al. 2011	Lysholm score	Patellar tendon bone tendon bone autograft	17-20 years	Very Low	Moderate	Very Low
Richter et al. 2002	Lysholm score	Repair or Reconstruction	8 years (2	Very Low	Moderate	Very Low
Mihelic et al. 2011	Osteoarthritis	Patellar tendon bone tendon bone autograft	17-20 years	Very Low	Moderate	Very Low
Richter et al. 2002	Range of motion	Repair or Reconstruction	8 years (2	Very Low	Moderate	Very Low
Fithian et al.	SF-36 scores	Mid-third of patellar tendon	6.6 years (3-10)	Moderate	Moderate	Moderate

Table 47. Quality and Applicability Summary: Non-Surgical Management of Patients With Torn ACL

Study	Outcome	Graft	Duration	Quality	Applicability	Overall Strength of Evidence
2005		autograft				
Daniel et al. 1994	Sports level	Semitendinosus autograft, Patellar tendon autograft	5.3 years (46-113 months)	Low	Moderate	Low
Daniel et al. 1994	Stability	Semitendinosus autograft, Patellar tendon autograft	5.3 years (46-113 months)	Moderate	Moderate	Moderate
Richter et al. 2002	Stability	Repair or Reconstruction	8 years (2	Very Low	Moderate	Very Low
Daniel et al. 1994	Symptoms	Semitendinosus autograft, Patellar tendon autograft	5.3 years (46-113 months)	Moderate	Moderate	Moderate
Fithian et al. 2005	Symptoms	Mid-third of patellar tendon autograft	6.6 years (3-10)	Moderate	Moderate	Moderate
Mihelic et al. 2011	Tegner activity scale	Patellar tendon bone tendon bone autograft	17-20 years	Very Low	Moderate	Very Low
Fithian et al. 2005	Tegner activity score	Mid-third of patellar tendon autograft	6.6 years (3-10)	Moderate	Moderate	Moderate
Richter et al. 2002	Tegner activity score	Repair or Reconstruction	8 years (2	Very Low	Moderate	Very Low

Table 48. Quality and Applicability: Non-Surgical Management of Patients With Torn ACL

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Daniel et al. 1994	Function	●	○	●	○	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Fithian et al. 2005	Function	●	○	●	○	○	○	●	**Low**	●	○	●	○	**Moderate**
Fithian et al. 2005	IKDC	●	○	●	○	○	●	●	**Moderate**	●	○	●	○	**Moderate**
Mihelic et al. 2011	IKDC	○	○	○	○	○	●	○	**Very Low**	●	○	●	○	**Moderate**
Richter et al. 2002	IKDC	○	○	○	○	○	●	○	**Very Low**	●	○	●	●	**Moderate**
Fithian et al. 2005	Instability	●	○	●	○	○	●	●	**Moderate**	●	○	●	○	**Moderate**
Richter et al. 2002	Jager and Wirth	○	○	○	○	○	○	○	**Very Low**	●	○	●	●	**Moderate**
Fithian et al. 2005	Lysholm score	●	○	●	○	○	●	●	**Moderate**	●	○	●	○	**Moderate**

Table 48. Quality and Applicability: Non-Surgical Management of Patients With Torn ACL

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Mihelic et al. 2011	Lysholm score	○	○	○	○	○	●	○	**Very Low**	●	○	●	●	**Moderate**
Richter et al. 2002	Lysholm score	○	○	○	○	○	●	○	**Very Low**	●	○	●	●	**Moderate**
Mihelic et al. 2011	Osteoarthritis	○	○	○	○	○	●	○	**Very Low**	●	○	●	○	**Moderate**
Richter et al. 2002	Range of motion	○	○	○	○	○	○	○	**Very Low**	●	○	●	●	**Moderate**
Fithian et al. 2005	SF-36 scores	●	○	●	○	○	●	●	**Moderate**	●	○	●	○	**Moderate**
Daniel et al. 1994	Sports level	●	○	●	○	●	○	○	**Low**	●	○	●	●	**Moderate**
Daniel et al. 1994	Stability	●	○	●	○	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Richter et al. 2002	Stability	○	○	○	○	○	●	○	**Very Low**	●	○	●	●	**Moderate**
Daniel et al. 1994	Symptoms	●	○	●	○	●	●	○	**Moderate**	●	○	●	●	**Moderate**

Table 48. Quality and Applicability: Non-Surgical Management of Patients With Torn ACL

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Fithian et al. 2005	Symptoms	●	○	●	○	○	●	●	**Moderate**	●	○	●	○	**Moderate**
Mihelic et al. 2011	Tegner activity scale	○	○	○	○	○	●	○	**Very Low**	●	○	●	○	**Moderate**
Fithian et al. 2005	Tegner activity score	●	○	●	○	○	●	●	**Moderate**	●	○	●	○	**Moderate**
Richter et al. 2002	Tegner activity score	○	○	○	○	○	●	○	**Very Low**	●	○	●	●	**Moderate**

FINDINGS

Table 49. Result: Non-Surgical Management of Patients With Torn ACL: Operative Versus Conservative

Author	Study Strength	Outcome Measured	Average Follow-up Time (range)	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Mihelic et al. 2010	Very low	IKDC Median	17-20 years	ACL reconstruction	36	83.15	Conservative treatment	18	64.6	NA	Favors ACLR
Mihelic et al. 2010	Very low	Tegner activity level	17-20 years	ACL reconstruction	36	NR	Conservative treatment	18	NR	NA	NS
Mihelic et al. 2010	Very low	Lysholm score	17-20 years	ACL reconstruction	36	84.3	Conservative treatment	18	53.3	NA	Favors ACLR
Mihelic et al. 2010	Very low	Degenerative OA	17-20 years	ACL reconstruction	36	NR	Conservative treatment	18	NR	NA	Favors ACLR
Richter et al. 2002	Very low	Lysholm score	8 years (2-25 years)	Surgical (Reconstruction or Repair)	59	78.3(13.4)	Nonsurgical	18	64.8(16.3)	13.5(9.56,17.43)	Favors ACLR
Richter et al. 2002	Very low	Tegner sore	8 years (2-25 years)	Surgical (Reconstruction or Repair)	59	4(1.2)	Nonsurgical	18	2.7(1.7)	1.3(0.76,1.84)	Favors ACLR
Richter et al. 2002	Very low	IKDC A (Normal)	8 years (2-25 years)	Surgical (Reconstruction or Repair)	59	0/59(0%)	Nonsurgical	18	0/18(0%)	NA	NA
Richter et al. 2002	Very low	IKDC B (Nearly normal)	8 years (2-25 years)	Surgical (Reconstruction or Repair)	59	14/59(14%)	Nonsurgical	18	1/18(6%)	4.27(0.60,30.3)	NS
Richter et al. 2002	Very low	IKDC C (Abnormal)	8 years (2-25 years)	Surgical (Reconstruction or Repair)	59	32/59(54%)	Nonsurgical	18	10/18(53%)	0.98(0.6,1.57)	NS
Richter et al. 2002	Very low	IKDC D (Severely Abnormal)	8 years (2-25 years)	Surgical (Reconstruction or Repair)	59	14/59(14%)	Nonsurgical	18	7/18(41%)	0.6(0.29,1.28)	NS
Richter et al. 2002	Very low	IKDC activity level I (Intensive)	8 years (2-25 years)	Surgical (Reconstruction or Repair)	59	11/59(19%)	Nonsurgical	18	0/18(0%)	7.28(0.45,17.88)	NS
Richter et al. 2002	Very low	IKDC activity level II (Moderate)	8 years (2-25 years)	Surgical (Reconstruction or Repair)	59	29/59(50%)	Nonsurgical	18	5/18(29%)	1.76(0.8,3.89)	NS

Table 49. Result: Non-Surgical Management of Patients With Torn ACL: Operative Versus Conservative

Author	Study Strength	Outcome Measured	Average Follow-up Time (range)	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Richter et al. 2002	Very low	IKDC activity level III (Light)	8 years (2-25 years)	Surgical (Reconstruction or Repair)	59	13/59(22%)	Nonsurgical	18	9/18(53%)	0.44(0.22,0.86)	NS
Richter et al. 2002	Very low	IKDC activity level IV (Sedentary)	8 years (2-25 years)	Surgical (Reconstruction or Repair)	59	5/59(9%)	Nonsurgical	18	3/18(17%)	0.5(0.13,1.92)	NS
Richter et al. 2002	Very low	Jager and Wirth 0	8 years (2-25 years)	Surgical (Reconstruction or Repair)	59	0/59(0%)	Nonsurgical	18	0/18(0%)	NA	NA
Richter et al. 2002	Very low	Jager and Wirth I	8 years (2-25 years)	Surgical (Reconstruction or Repair)	59	9/59(15%)	Nonsurgical	18	0/18(0%)	NA	NA
Richter et al. 2002	Very low	Jager and Wirth II	8 years (2-25 years)	Surgical (Reconstruction or Repair)	59	21/59(35%)	Nonsurgical	18	3/18(18%)	2.13(0.72,6.34)	NS
Richter et al. 2002	Very low	Jager and Wirth III	8 years (2-25 years)	Surgical (Reconstruction or Repair)	59	24/59(41%)	Nonsurgical	18	8/18(47%)	0.9(0.5,1.67)	NS
Richter et al. 2002	Very low	Jager and Wirth IV	8 years (2-25 years)	Surgical (Reconstruction or Repair)	59	5/59(9%)	Nonsurgical	18	6/18(35%)	0.25(0.08,0.74)	NS
Richter et al. 2002	Very low	Lachman 20 pound (mm)	8 years (2-25 years)	Surgical (Reconstruction or Repair)	NR	5.1(2.4)	Nonsurgical	NR	8.2(3.4)	NA	NA
Richter et al. 2002	Very low	Lachman 20 pound (mm)	8 years (2-25 years)	Surgical (Reconstruction or Repair)	NR	4(1.7)	Nonsurgical	NR	5.4(2.8)	NA	NA
Richter et al. 2002	Very low	Range of motion (Lack of extension 0-2)	8 years (2-25 years)	Surgical (Reconstruction or Repair)	59	30/59(51%)	Nonsurgical	18	8/18(47%)	1.14(0.64,2.03)	NS
Richter et al. 2002	Very low	Range of motion (Lack of extension 3-5)	8 years (2-25 years)	Surgical (Reconstruction or Repair)	59	22/59(38%)	Nonsurgical	18	5/18(29%)	1.34(0.59,3.03)	NS
Richter et al.	Very low	Range of motion	8 years (2-25	Surgical	59	4/59(7	Nonsurgical	18	4/18(24	0.3(0.08,1.1	NS

Table 49. Result: Non-Surgical Management of Patients With Torn ACL: Operative Versus Conservative

Author	Study Strength	Outcome Measured	Average Follow-up Time (range)	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
2002		(Lack of extension 6-10)	years)	(Reconstruction or Repair)		%)			%)	)	
Richter et al. 2002	Very low	Range of motion (Lack of extension >10)	8 years (2-25 years)	Surgical (Reconstruction or Repair)	59	2/59(4%)	Nonsurgical	18	0/18(0%)	1.58(0.08,31.5)	NS
Richter et al. 2002	Very low	Range of motion (Lack of flexion 0-2)	8 years (2-25 years)	Surgical (Reconstruction or Repair)	59	15/59(26%)	Nonsurgical	18	2/18(12%)	2.29(0.58,9.07)	NS
Richter et al. 2002	Very low	Range of motion (Lack of flexion 0-2)	8 years (2-25 years)	Surgical (Reconstruction or Repair)	59	22/59(38%)	Nonsurgical	18	4/18(24%)	1.68(0.66,4.23)	NS
Richter et al. 2002	Very low	Range of motion (Lack of flexion 0-2)	8 years (2-25 years)	Surgical (Reconstruction or Repair)	59	11/59(18%)	Nonsurgical	18	7/18(41%)	0.48(0.22,1.05)	NS
Richter et al. 2002	Very low	Range of motion (Lack of flexion 0-2)	8 years (2-25 years)	Surgical (Reconstruction or Repair)	59	11/59(18%)	Nonsurgical	18	1/18(24%)	3.35(0.46,24.25)	NS
Richter et al. 2002	Very low	Percentage working ability	8 years (2-25 years)	Surgical (Reconstruction or Repair)	59	85%	Nonsurgical	18	53%	NA	NA
Richter et al. 2002	Very low	Percentage sports ability	8 years (2-25 years)	Surgical (Reconstruction or Repair)	59	56%	Nonsurgical	18	17%	NA	NA

Table 50. Conservative Treatment of Patient With Torn ACL

Author	Study Strength	Outcome Measured	Average Follow-up Time (range)	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Daniel et al. 1994	Moderate	Participate in basketball 50 hours per year or more	5.3 years (46-113 months)	Stable knee no reconstruction	53	5/53(9%)	Unstable knee no reconstruction	139	8/139(6%)	1.64(0.56,4.7 8)	NS
Daniel et al. 1994	Moderate	Participate in football 50 hours per year or more	5.3 years (46-113 months)	Stable knee no reconstruction	53	3/53(6%)	Unstable knee no reconstruction	139	0/139(0%)	18.15(0.95,3 45.55)	NS
Daniel et al. 1994	Moderate	Participate in football 50 hours per year or more	5.3 years (46-113 months)	Stable knee no reconstruction	53	1/53(2%)	Unstable knee no reconstruction	139	3/139(2%)	0.87(0.09,8.2 2)	NS
Daniel et al. 1994	Moderate	Participate in baseball 50 hours per year or more	5.3 years (46-113 months)	Stable knee no reconstruction	53	5/53(9%)	Unstable knee no reconstruction	139	13/139(9%)	1(0.38,2.69)	NS
Daniel et al. 1994	Moderate	Participate in racquet sports 50 hours per year or more	5.3 years (46-113 months)	Stable knee no reconstruction	53	3/53(6%)	Unstable knee no reconstruction	139	16/139(11%)	0.49(0.15,1.6 2)	NS
Daniel et al. 1994	Moderate	Participate in snow ski sports 50 hours per year or more	5.3 years (46-113 months)	Stable knee no reconstruction	53	1/53(2%)	Unstable knee no reconstruction	139	1/139(1%)	2.62(0.17,41. 18)	NS
Daniel et al. 1994	Moderate	Pain (more than mild and infrequent)	5.3 years (46-113 months)	Stable knee no reconstruction	53	6/53(11 %)	Unstable knee no reconstruction	139	29/139(21%)	0.54(0.24,1.2 3)	NS
Daniel et al. 1994	Moderate	Swelling (more than mild and infrequent)	5.3 years (46-113 months)	Stable knee no reconstruction	53	3/53(6%)	Unstable knee no reconstruction	139	25/139(18%)	0.31(0.09,0.9 9)	Favors stable knee
Daniel et al. 1994	Moderate	Giving way with sports	5.3 years (46-113 months)	Stable knee no reconstruction	53	2/53(4%)	Unstable knee no reconstruction	139	25/139(18%)	0.2(0.05,0.85)	Favors stable knee
Daniel et al. 1994	Moderate	Giving way with ADL	5.3 years (46-113 months)	Stable knee no reconstruction	53	0/53(0%)	Unstable knee no reconstruction	139	13/139(9%)	0.09(0,1.59)	NS

Table 50. Conservative Treatment of Patient With Torn ACL

Author	Study Strength	Outcome Measured	Average Follow-up Time (range)	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Daniel et al. 1994	Moderate	Walk impairments	5.3 years (46-113 months)	Stable knee no reconstruction	53	4/53(8%)	Unstable knee no reconstruction	139	8/139(6%)	1.31(0.4,4.17)	NS
Daniel et al. 1994	Moderate	Climb impairments	5.3 years (46-113 months)	Stable knee no reconstruction	53	5/53(9%)	Unstable knee no reconstruction	139	33/139(24%)	0.4(0.16,0.96)	Favors stable knee
Daniel et al. 1994	Moderate	Stairs impairments	5.3 years (46-113 months)	Stable knee no reconstruction	53	7/53(13 %)	Unstable knee no reconstruction	139	31/139(22%)	0.6(0.28,1.26)	NS
Daniel et al. 1994	Moderate	Kneel impairments	5.3 years (46-113 months)	Stable knee no reconstruction	53	11/53(21 %)	Unstable knee no reconstruction	139	51/139(37%)	0.56(0.32,0.9)	Favors stable knee
Daniel et al. 1994	Moderate	Squat impairments	5.3 years (46-113 months)	Stable knee no reconstruction	53	10/53(19 %)	Unstable knee no reconstruction	139	56/139(40%)	0.47(0.26,0.8 5)	Favors stable knee
Daniel et al. 1994	Moderate	Run impairments	5.3 years (46-113 months)	Stable knee no reconstruction	53	8/53(15 %)	Unstable knee no reconstruction	139	51/139(37%)	0.41(0.2,0.8)	Favors stable knee
Daniel et al. 1994	Moderate	Jump impairments	5.3 years (46-113 months)	Stable knee no reconstruction	53	7/53(13 %)	Unstable knee no reconstruction	139	47/139(34%)	0.39(0.19,0.8)	Favors stable knee
Daniel et al. 1994	Moderate	Cut impairments	5.3 years (46-113 months)	Stable knee no reconstruction	53	7/53(13 %)	Unstable knee no reconstruction	139	78/139(56%)	0.23(0.12,0.4 8)	Favors stable knee
Daniel et al. 1994	Moderate	Walk impairments more than mild	5.3 years (46-113 months)	Stable knee no reconstruction	53	0/53(0%)	Unstable knee no reconstruction	139	0/139(0%)	2.59(0.05,12 9)	NS
Daniel et al. 1994	Moderate	Climb impairments more than mild	5.3 years (46-113 months)	Stable knee no reconstruction	53	0/53(0%)	Unstable knee no reconstruction	139	0/139(0%)	2.59(0.05,12 9)	NS
Daniel et al. 1994	Moderate	Stairs impairments more than mild	5.3 years (46-113 months)	Stable knee no reconstruction	53	0/53(0%)	Unstable knee no reconstruction	139	1/139(1%)	0.086(0.03,2 0.8)	NS
Daniel et al. 1994	Moderate	Kneel impairments more than mild	5.3 years (46-113 months)	Stable knee no reconstruction	53	1/53(2%)	Unstable knee no reconstruction	139	3/139(2%)	0.87(0.09,8.2 2)	NS

Table 50. Conservative Treatment of Patient With Torn ACL

Author	Study Strength	Outcome Measured	Average Follow-up Time (range)	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Daniel et al. 1994	Moderate	Squat impairments more than mild	5.3 years (46-113 months)	Stable knee no reconstruction	53	2/53(4%)	Unstable knee no reconstruction	139	6/139(4%)	0.88(0.18,4.1 9)	NS
Daniel et al. 1994	Moderate	Run impairments more than mild	5.3 years (46-113 months)	Stable knee no reconstruction	53	4/53(8%)	Unstable knee no reconstruction	139	17/139(12%)	0.62(0.22,1.7 5)	NS
Daniel et al. 1994	Moderate	Jump impairments more than mild	5.3 years (46-113 months)	Stable knee no reconstruction	53	4/53(8%)	Unstable knee no reconstruction	139	15/139(11%)	0.7(0.24,2)	NS
Daniel et al. 1994	Moderate	Cut impairments more than mild	5.3 years (46-113 months)	Stable knee no reconstruction	53	5/53(9%)	Unstable knee no reconstruction	139	43/139(31%)	0.3(0.13,0.73)	NS
Daniel et al. 1994	Moderate	Functional (Hop test ≥0.9)	5.3 years (46-113 months)	Stable knee no reconstruction	49	48/49(98 %)	Unstable knee no reconstruction	123	95/123(77%)	1.27(1.14,1.4 0	NS
Daniel et al. 1994	Moderate	Functional (Quadriceps ≥0.8)	5.3 years (46-113 months)	Stable knee no reconstruction	49	49/49(10 0%)	Unstable knee no reconstruction	123	113/123(92 %)	1(1.03,1.15)	NS
Daniel et al. 1994	Moderate	Functional (Hamstring ≥0.8)	5.3 years (46-113 months)	Stable knee no reconstruction	49	46/49(94 %)	Unstable knee no reconstruction	123	113/123(92 %)	1.02(0.93,1.1 2)	NS
Daniel et al. 1994	Moderate	Stability (Quadriceps active KT-1000 <3mm 89N)	5.3 years (46-113 months)	Stable knee no reconstruction	53	47/53(89 %)	Unstable knee no reconstruction	134	59/134(44%)	2(1.63,2.5)	NS
Daniel et al. 1994	Moderate	Stability (Quadriceps KT-1000 <3mm 89N)	5.3 years (46-113 months)	Stable knee no reconstruction	53	49/53(93 %)	Unstable knee no reconstruction	134	74/134(39%)	1.67(1.4,1.98)	NS
Daniel et al. 1994	Moderate	Stability (Quadriceps KT-1000 <3mm 134N)	5.3 years (46-113 months)	Stable knee no reconstruction	53	49/53(93 %)	Unstable knee no reconstruction	134	52/134(39%)	2.38(1.9,2.99)	NS
Daniel et al. 1994	Moderate	Stability (Quadriceps KT-1000 <3mm Max)	5.3 years (46-113 months)	Stable knee no reconstruction	53	48/53(91 %)	Unstable knee no reconstruction	134	21/134(16%)	5.77(3.87,8.6 4)	NS

Table 50. Conservative Treatment of Patient With Torn ACL

Author	Study Strength	Outcome Measured	Average Follow-up Time (range)	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Daniel et al. 1994	Moderate	Stability (Pivot-shift)	5.3 years (46-113 months)	Stable knee no reconstruction	53	49/53(92 %)	Unstable knee no reconstruction	134	21/134(16%)	**5.9(3.95,8.8)**	Favors stable knee

ACL SURGERY TIMING

When ACL reconstruction is indicated, moderate evidence supports reconstruction within five months of injury to protect the articular cartilage and menisci.

Strength of Recommendation: Moderate

RATIONALE

With respect to performing ACL reconstruction early following injury, three moderate strength studies evaluated the effect of timing on outcome following ACL reconstruction.[17, 56, 76] Post-operative range of motion was not different if surgery was performed within 48 hours of injury, within 3-7 days of injury, or within 2 weeks of injury; or if surgery was delayed more than 3 weeks of injury, delayed for a minimum of 6 weeks of injury, or delayed for 8-12 weeks of injury. [17, 56, 76] Strength and stability by KT 1000 were also not different between early and delayed ACL reconstruction.[56, 76] However, performing ACL reconstruction early, within three weeks of injury, increased the rate of re-operation form 0% to 8%. Complications included pain with extension (n=11), meniscus tear (n=1), and failed ACL reconstruction (n=2;).[56]

With respect to delaying ACL reconstruction to a time point past the injury, there were two high-strength studies of same cohort of patients and three moderate-strength studies that compared early (within 3-5 months from injury) versus late (after 3-5 months from injury) ACL reconstruction. [10, 24, 33, 35, 36] Early reconstruction improved objective knee stability as measured by the Lachman test and pivot shift test.[83, 84] Three studies demonstrated a higher activity level in the patients that underwent early ACL reconstruction. [10, 33, 35, 36] One study reported higher function in patients that underwent early ACL reconstruction.[24]

Early reconstruction also decreased the incidence of meniscus tears from 62% to 37% and decreased the incidence of subsequent meniscectomy surgery from 44% to 8%.[10, 35] One moderate-strength study stratified outcome by meniscus injury, which was not emphasized in the high-strength study but was supported by their data.[10,35] Further, in the setting of meniscus treatment, the rate of meniscal repair was 29% with early ACL reconstruction and 12% when ACL reconstruction was delayed beyond 3 months.

The importance of this recommendation was based on improving patient function and protecting the knee with ACL injury from further meniscus injury, which could reduce the risk for premature osteoarthritis

POSSIBLE HARMS OF IMPLEMENTATION

The decision to perform early ACL reconstruction could lead to loss of motion, joint stiffness, and reoperation if sound history and physical examination is not performed.

FUTURE RESEARCH

Randomized control trials should be performed to better understand the effect of timing of ACL reconstruction on range of motion, rate of reoperation, and clinical outcome of patients.

SUMMARY OF FINDINGS

Table 51. Summary of Findings: ACLR Early Versus Late: Six Month Follow-up

○:Not significant ●:Favors Early ACLR ●:Favors Late ACLR	Meighan et al. 2003 *(M)*	Hunter et al. 1996 *(M)**
Range of Motion	○	○
Meniscal Co-Morbidities: Meniscal Tears Found		
Function		
Strength	○	
Complications		
Stability: KT		○

*Combined groups 1,2 and 3 <3 weeks Versus >3 weeks

Table 52. Summary of Findings: ACLR Early Versus Late: One Year Follow-up

○:Not significant

🟢:Favors Early ACLR

🔴:Favors Late ACLR

	Bottoni et al. 2008 *(M)*	Meighan et al. 2003 *(M)*	Hunter et al. 1996 *(M)**
Range of Motion	○	○	
Meniscal Co-Morbidities: Meniscal Tears Found	🔴		
Function	○		
Strength		○	
Complications			🔴
Stability: KT			○

*Combined groups 1,2 and 3 <3 weeks versus >3 weeks

Table 53. Summary of Findings: ACLR Early Versus Late 2 Year Follow-up

🟢:Favors Early ACLR

🔴:Favors Late ACLR

○:Not significant

	Scales/Measures	Barenius et al. 2010 *(M)*	Daniel et al. 1994 *(M)*	Fithian et al. 2005 *(M)*	Frobell et al. 2010 *(H)*	Frobell et al. 2013 *(H)*	**Meta-Analysis**
Patient satisfaction							NA
Function		○	🟢	○	○	○	NA
Pain		○	○	○	○	○	NA
	IKDC subjective			○			NA
	IKDC Normal						NA
	Lysholm Score			○			NA
Quality of life		○			○	○	NA

Table 53. Summary of Findings: ACLR Early Versus Late 2 Year Follow-up

●:Favors Early ACLR

●:Favors Late ACLR

○:Not significant

Scales/Measures	Barenius et al. 2010 *(M)*	Daniel et al. 1994 *(M)*	Fithian et al. 2005 *(M)*	Frobell et al. 2010 *(H)*	Frobell et al. 2013 *(H)*	Meta-Analysis
Activities of daily living	●			○	○	NA
Return to sport				○	○	NA
Meniscal Co-morbidities	●					NA
Tegner Activity	●		●	●		NA
Stability			○	●	●	NA
Complications						NA
Range of motion				○		NA
Swelling		○		○		NA

Overall strength of study; High: *(H)*, Moderate: *(M)*, Low: *(L)*, Very low: *(V)*

QUALITY AND APPLICABILITY SUMMARY

Table 54. Quality and Applicability Summary: Early Versus Late

Study	Outcome	Graft	Early Versus Late	Duration	Quality	Applicability	Overall Strength of Evidence
Bottoni et al. 2007	Range of motion	Quadrupled hamstring autograft	**Early:** Earliest possible date **Late:** Minimum of 6 weeks	1 year (180-708 days)	Moderate	Moderate	Moderate
Hunter et al. 1996	Range of motion	Bone-tendon-bone autograft	**Group 1:** Surgery w/in 48 hours of injury **Group 2:** Surgery w/in 3-7 days of injury **Group 3:** Surgery w/in 1-3 weeks of injury **Group 4:** Surgery more than 3 weeks after injury	6 and 12 months	Moderate	Moderate	Moderate
Meighan et al. 2003	Range of motion	NR	**Early:** Within 2 weeks **Late:** 8-12 weeks	6 and 12 months	Moderate	Moderate	Moderate

Table 55. Quality and Applicability Summary: Ideal Time for ACLR 2 Year Follow-up

Study	Outcome	Graft	Duration	Quality	Applicability	Overall Strength of Evidence
Barenius et al. 2010	Clinical assessment	Patellar tendon/Quadrupled semitendinosus graft	8 years	Moderate	Moderate	Moderate
Frobell et al. 2010	Complications	Surgeon preference (Patellar tendon or Hamstring)	2 years	Moderate	Moderate	Moderate
Frobell et al. 2013	Complications	Surgeon preference (Patellar tendon or Hamstring)	5 years	Moderate	Moderate	Moderate
Daniel et al. 1994	Function	Semitendinosus autograft, Patellar tendon autograft	5.3 years (46-113 months)	Moderate	Moderate	Moderate
Fithian et al. 2005	Function	Mid-third of patellar tendon autograft	6.6 years (3-10)	Low	Moderate	Low
Barenius et al. 2010	IKDC	Patellar tendon/Quadrupled semitendinosus graft	8 years	Moderate	Moderate	Moderate
Fithian et al. 2005	IKDC	Mid-third of patellar tendon autograft	6.6 years (3-10)	Moderate	Moderate	Moderate
Fithian et al. 2005	Instability	Mid-third of patellar tendon autograft	6.6 years (3-10)	Moderate	Moderate	Moderate
Barenius et al. 2010	KOOS	Patellar tendon/Quadrupled semitendinosus graft	8 years	Moderate	Moderate	Moderate
Frobell et al. 2010	KOOS	Surgeon preference (Patellar tendon or Hamstring)	2 years	High	Moderate	High
Frobell et al. 2013	KOOS	Surgeon preference (Patellar tendon or Hamstring)	5 years	High	Moderate	High
Barenius et al. 2010	Lysholm score	Patellar tendon/Quadrupled semitendinosus graft	8 years	Moderate	Moderate	Moderate
Fithian et al. 2005	Lysholm score	Mid-third of patellar tendon	6.6 years (3-10)	Moderate	Moderate	Moderate

Table 55. Quality and Applicability Summary: Ideal Time for ACLR 2 Year Follow-up

Study	Outcome	Graft	Duration	Quality	Applicability	Overall Strength of Evidence
		autograft				
Barenius et al. 2010	Patellofemoral pain score	Patellar tendon/Quadrupled semitendinosus graft	8 years	Moderate	Moderate	Moderate
Fithian et al. 2005	SF-36 scores	Mid-third of patellar tendon autograft	6.6 years (3-10)	Moderate	Moderate	Moderate
Frobell et al. 2010	SF36 Short form health survey	Surgeon preference (Patellar tendon or Hamstring)	2 years	High	Moderate	High
Frobell et al. 2013	SF36 Short form health survey	Surgeon preference (Patellar tendon or Hamstring)	5 years	High	Moderate	High
Daniel et al. 1994	Sports level	Semitendinosus autograft, Patellar tendon autograft	5.3 years (46-113 months)	Low	Moderate	Low
Daniel et al. 1994	Stability	Semitendinosus autograft, Patellar tendon autograft	5.3 years (46-113 months)	Moderate	Moderate	Moderate
Frobell et al. 2010	Stability (Kt-1000, Lachman, Pivot shift)	Surgeon preference (Patellar tendon or Hamstring)	2 years	Moderate	Moderate	Moderate
Frobell et al. 2013	Stability (Kt-1000, Lachman, Pivot shift)	Surgeon preference (Patellar tendon or Hamstring)	5 years	Moderate	Moderate	Moderate
Daniel et al. 1994	Symptoms	Semitendinosus autograft, Patellar tendon autograft	5.3 years (46-113 months)	Moderate	Moderate	Moderate
Fithian et al. 2005	Symptoms	Mid-third of patellar tendon autograft	6.6 years (3-10)	Moderate	Moderate	Moderate
Barenius et al. 2010	Tegner activity score	Patellar tendon/Quadrupled semitendinosus graft	8 years	Moderate	Moderate	Moderate
Fithian et al. 2005	Tegner activity score	Mid-third of patellar tendon autograft	6.6 years (3-10)	Moderate	Moderate	Moderate
Frobell et al. 2010	Tegner activity score	Surgeon preference	2 years	High	Moderate	High

Table 55. Quality and Applicability Summary: Ideal Time for ACLR 2 Year Follow-up

Study	Outcome	Graft	Duration	Quality	Applicability	Overall Strength of Evidence
		(Patellar tendon or Hamstring)				
Frobell et al. 2013	Tegner activity score	Surgeon preference (Patellar tendon or Hamstring)	5 years	High	Moderate	High

Table 56. Quality and Applicability: Delay of ACLR Until Extension and Flexion has Returned

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Meighan et al. 2003	Range of motion	●	○	●	○	●	●	●	**Moderate**	●	○	●	●	**Moderate**
Bottoni et al. 2007	Range of motion	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Hunter et al. 1996	Range of motion	●	○	●	○	●	●	○	**Moderate**	●	○	●	●	**Moderate**

Table 57. Quality and Applicability: Ideal Time for ACLR 2 Year Follow- up

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Barenius et al. 2010	Clinical assessment	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Frobell et al. 2010	Complications	●	○	●	●	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Daniel et al. 1994	Function	●	○	●	○	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Fithian et al. 2005	Function	●	○	●	○	○	○	●	**Low**	●	○	●	○	**Moderate**
Barenius et al. 2010	IKDC	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Fithian et al. 2005	IKDC	●	○	●	○	○	●	●	**Moderate**	●	○	●	●	**Moderate**
Fithian et al. 2005	Instability	●	○	●	○	○	●	●	**Moderate**	●	○	●	○	**Moderate**
Barenius et al. 2010	KOOS	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Frobell et al. 2010	KOOS	●	●	●	●	○	●	●	**High**	●	○	●	●	**Moderate**

Table 57. Quality and Applicability: Ideal Time for ACLR 2 Year Follow- up

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Barenius et al. 2010	Lysholm score	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Fithian et al. 2005	Lysholm score	●	○	●	○	○	●	●	**Moderate**	●	○	●	●	**Moderate**
Barenius et al. 2010	Patellofemoral pain score	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Fithian et al. 2005	SF-36 scores	●	○	●	○	○	●	●	**Moderate**	●	○	●	○	**Moderate**
Frobell et al. 2010	SF36 Short form health survey	●	●	●	●	○	●	●	**High**	●	○	●	●	**Moderate**
Daniel et al. 1994	Sports level	●	○	●	○	●	○	○	**Low**	●	○	●	●	**Moderate**
Daniel et al. 1994	Stability	●	○	●	○	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Frobell et al. 2010	Stability (Kt-1000, Lachman, Pivot shift)	●	○	●	●	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Daniel et al. 1994	Symptoms	●	○	●	○	●	●	○	**Moderate**	●	○	●	●	**Moderate**

Table 57. Quality and Applicability: Ideal Time for ACLR 2 Year Follow- up

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Fithian et al. 2005	Symptoms	●	○	●	○	○	●	●	**Moderate**	●	○	●	●	**Moderate**
Barenius et al. 2010	Tegner activity score	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Fithian et al. 2005	Tegner activity score	●	○	●	○	○	●	●	**Moderate**	●	○	●	○	**Moderate**
Frobell et al. 2010	Tegner activity score	●	●	●	●	○	●	●	**High**	●	○	●	●	**Moderate**

FINDINGS

Table 58. Results: Early Versus Late

Author	Study Strength	Outcome Measured	Treatment Group 1	N1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	N2	Mean (sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Bottoni et al. 2008	Moderate	Range of Motion: Extension Deficit (deg)	Acute surgery: earliest possible date	34	0.6(1.6)	Delayed Surgery: Minimum 6 weeks from injury	35	1.5(4.2)	-0.9(-2.44,0.64)	NS
Bottoni et al. 2008	Moderate	Range of Motion: Flexion Deficit (deg)	Acute surgery: earliest possible date	34	2.1(3.9)	Delayed Surgery: Minimum 6 weeks from injury	35	2.6(4.8)	-0.5(-2.60,1.60)	NS
Bottoni et al. 2008	Moderate	Stability: KT-1000 (mm)	Acute surgery: earliest possible date	34	1.2(1.8)	Delayed Surgery: Minimum 6 weeks from injury	35	0.88(1.1)	0.32(-0.39,1.03)	NS
Bottoni et al. 2008	Moderate	Meniscal Co-Morbidities: Meniscal Tears Found	Acute surgery: earliest possible date	34	32/34(0.91)	Delayed Surgery: Minimum 6 weeks from injury	35	24/35(69%)	1.37(1.08,1.74)	Favors Delayed
Bottoni et al. 2008	Moderate	Function: SANE Score	Acute surgery: earliest possible date	34	83.1(NR)	Delayed Surgery: Minimum 6 weeks from injury	35	81.4(NR)	Reported p=0.66	Reported NS
Bottoni et al. 2008	Moderate	Function: Lysholm Score	Acute surgery: earliest possible date	34	80.6(NR)	Delayed Surgery: Minimum 6 weeks from injury	35	83.4(NR)	Reported p=0.61	Reported NS
Bottoni et al. 2008	Moderate	Function: Tegner Score	Acute surgery: earliest possible date	34	5.8(NR)	Delayed Surgery: Minimum 6 weeks from injury	35	4.9(NR)	Reported p=0.34	Reported NS

Table 59. Results: Early Versus Late 12 Month Follow-up

Author	Study Strength	Outcome Measured	Duration	Treatment Group 1	N1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	N2	Mean(sd) 2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Meighan et al. 2003	Moderate	Range of Motion: Range of knee movement (deg)	52 weeks	Early Surgery: within 2 weeks	13	(-0-131)	Delayed Surgery: 8-12 weeks	18	(-2-131)	NA	Reported NS
Meighan et al. 2003	Moderate	Range of Motion: Incidence of clinically significant residual stiffness (fixed flexion deformity >5deg, flexion<120deg)	52 weeks	Early Surgery: within 2 weeks	13	1/13(7.7%)	Delayed Surgery: 8-12 weeks	17	1/17(6%)	1.31(0.09,19. 0)	NS
Meighan et al. 2003	Moderate	Strength: Total Work Deficit (percentage of uninjured side)	52 weeks	Early Surgery: within 2 weeks	13	11(NR)	Delayed Surgery: 8-12 weeks	17	4(NR)	NA	Reported NS
Meighan et al. 2003	Moderate	Strength: Mean quadriceps power deficit (percentage of uninjured side)	52 weeks	Early Surgery: within 2 weeks	13	10(NR)	Delayed Surgery: 8-12 weeks	17	4(NR)	NA	Reported NS
Meighan et al. 2003	Moderate	Strength: Peak torque deficit (percentage of uninjured side)	52 weeks	Early Surgery: within 2 weeks	13	13(NR)	Delayed Surgery: 8-12 weeks	17	4(NR)	NA	Reported NS
Hunter et al. 1996	Moderate	Stability: Postoperative KT-1000 30lb measurement, (-	12 months	Groups 1, 2, and 3 (<3 weeks)	148	140/148(94%)	Group 4: Surgery more than 3 weeks after injury	37	37/37(100 %)	0.95(0.9,1)	NS

Table 59. Results: Early Versus Late 12 Month Follow-up

Author	Study Strength	Outcome Measured	Duration	Treatment Group 1	N1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	N2	Mean(sd) 2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		3,3mm)									
Hunter et al. 1996	Moderate	Stability: Postoperative KT-1000 30lb measurement, (>3mm to less than or equal to 5mm)	12 months	Groups 1, 2, and 3 (<3 weeks)	148	8/148(5%)	Group 4: Surgery more than 3 weeks after injury	37	0/37(0%)	0.95(0.9,1.00 8)	NS
Hunter et al. 1996	Moderate	Complications: patients undergoing repeat surgical intervention for complications	12 months	Groups 1, 2, and 3 (<3 weeks)	148	10/148(7.5%)	Group 4: Surgery more than 3 weeks after injury	37	0/37(0%)	0.94(0.88,0.9 9)	Favors surgery more than 3 weeks after injury
Hunter et al. 1996	Moderate	Stability: Postoperative KT-1000 30lb measurement, (-3,3mm)	12 months	Group 1: Surgery w/in 48 hours of injury	44	44/44(100%)	Group 2: Surgery w/in 3-7 days of injury	53	45/53(85 %)	0.85(0.76,0.9 6)	Favors surgery w/in 48 hours
Hunter et al. 1996	Moderate	Stability: Postoperative KT-1000 30lb measurement, (-3,3mm)	12 months	Group 1: Surgery w/in 48 hours of injury	44	44/44(100%)	Group 3: Surgery w/in 1-3 weeks of injury	51	51/51(100 %)	NA	NS
Hunter et al. 1996	Moderate	Stability: Postoperative KT-1000 30lb measurement, (-3,3mm)	12 months	Group 1: Surgery w/in 48 hours of injury	44	44/44(100%)	Group 4: Surgery more than 3 weeks after injury	37	37/37(100 %)	NA	NS
Hunter et al. 1996	Moderate	Stability: Postoperative KT-1000 30lb measurement, (-3,3mm)	12 months	Group 2: Surgery w/in 3-7 days of injury	53	45/53(85%)	Group 3: Surgery w/in 1-3 weeks of injury	51	51/51(100 %)	0.85(0.76,0.9 6)	Favors surgery w/in 1-3 weeks
Hunter et al.	Moderate	Stability:	12 months	Group 2:	53	45/53(85%)	Group 4:	37	37/37(100	0.85(0.76,0.9	Favors surgery

Table 59. Results: Early Versus Late 12 Month Follow-up

Author	Study Strength	Outcome Measured	Duration	Treatment Group 1	N1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	N2	Mean(sd) 2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
1996		Postoperative KT-1000 30lb measurement, (-3,3mm)		Surgery w/in 3-7 days of injury			Surgery more than 3 weeks after injury		%)	6)	more than 3 weeks after injury
Hunter et al. 1996	Moderate	Stability: Postoperative KT-1000 30lb measurement, (-3,3mm)	12 months	Group 3: Surgery w/in 1-3 weeks of injury	51	51/51(100%)	Group 4: Surgery more than 3 weeks after injury	37	37/37(100 %)	NA	NS
Hunter et al. 1996	Moderate	Stability: Postoperative KT-1000 30lb measurement, (>3mm to less than or equal to 5mm)	12 months	Group 1: Surgery w/in 48 hours of injury	44	0/44(0%)	Group 2: Surgery w/in 3-7 days of injury	53	8/53(15%)	0.85(0.76,0.9 6)	Favors surgery w/in 48 hours
Hunter et al. 1996	Moderate	Stability: Postoperative KT-1000 30lb measurement, (>3mm to less than or equal to 5mm)	12 months	Group 1: Surgery w/in 48 hours of injury	44	0/44(0%)	Group 3: Surgery w/in 1-3 weeks of injury	51	0/51(0%)	NA	NS
Hunter et al. 1996	Moderate	Stability: Postoperative KT-1000 30lb measurement, (>3mm to less than or equal to 5mm)	12 months	Group 1: Surgery w/in 48 hours of injury	44	0/44(0%)	Group 4: Surgery more than 3 weeks after injury	37	0/37(0%)	NA	NS
Hunter et al. 1996	Moderate	Stability: Postoperative KT-1000 30lb measurement, (>3mm to less than or equal to	12 months	Group 2: Surgery w/in 3-7 days of injury	53	8/53(15%)	Group 3: Surgery w/in 1-3 weeks of injury	51	0/51(0%)	0.85(0.76,0.9 6)	Favors surgery w/in 1-3 weeks

Table 59. Results: Early Versus Late 12 Month Follow-up

Author	Study Strength	Outcome Measured	Duration	Treatment Group 1	N1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	N2	Mean(sd) 2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		5mm)									
Hunter et al. 1996	Moderate	Stability: Postoperative KT-1000 30lb measurement, (>3mm to less than or equal to 5mm)	12 months	Group 2: Surgery w/in 3-7 days of injury	53	8/53(15%)	Group 4: Surgery more than 3 weeks after injury	37	0/37(0%)	0.85(0.76,0.96)	Favors surgery more than 3 weeks after injury
Hunter et al. 1996	Moderate	Stability: Postoperative KT-1000 30lb measurement, (>3mm to less than or equal to 5mm)	12 months	Group 3: Surgery w/in 1-3 weeks of injury	51	0/51(0%)	Group 4: Surgery more than 3 weeks after injury	37	0/37(0%)	NA	NS
Hunter et al. 1996	Moderate	Complications: patients undergoing repeat surgical intervention for complications	12 months	Group 1: Surgery w/in 48 hours of injury	44	3/44(6.8%)	Group 2: Surgery w/in 3-7 days of injury	53	4/53(7.5%)	0.90(0.21,3.82)	NS
Hunter et al. 1996	Moderate	Complications: patients undergoing repeat surgical intervention for complications	12 months	Group 1: Surgery w/in 48 hours of injury	44	3/44(6.8%)	Group 3: Surgery w/in 1-3 weeks of injury	51	4/51(7.8%)	0.87(0.21,3.68)	NS
Hunter et al. 1996	Moderate	Complications: patients undergoing repeat surgical intervention for complications	12 months	Group 1: Surgery w/in 48 hours of injury	44	3/44(6.8%)	Group 4: Surgery more than 3 weeks after injury	37	0/37(0%)	0.93(0.85,1.03)	NS
Hunter et al. 1996	Moderate	Complications: patients	12 months	Group 2: Surgery w/in 3-	53	4/53(7.5%)	Group 3: Surgery w/in	51	4/51(7.8%)	0.96(0.25,3.64)	NS

Table 59. Results: Early Versus Late 12 Month Follow-up

Author	Study Strength	Outcome Measured	Duration	Treatment Group 1	N1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	N2	Mean(sd) 2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		undergoing repeat surgical intervention for complications		7 days of injury			1-3 weeks of injury				
Hunter et al. 1996	Moderate	Complications: patients undergoing repeat surgical intervention for complications	12 months	Group 2: Surgery w/in 3-7 days of injury	53	4/53(7.5%)	Group 4: Surgery more than 3 weeks after injury	37	0/37(0%)	0.93(0.85,1.01)	NS
Hunter et al. 1996	Moderate	Complications: patients undergoing repeat surgical intervention for complications	12 months	Group 3: Surgery w/in 1-3 weeks of injury	51	4/51(7.8%)	Group 4: Surgery more than 3 weeks after injury	37	0/37(0%)	0.93(0.84,1.01)	NS

Table 60. Results: Early Versus Late 6 Month Follow-up

Author	Study Strength	Outcome Measured	Duration	Treatment Group 1	N1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	N2	Mean (sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Meighan et al. 2003	Moderate	Range of Motion: Range of knee movement (deg)	24 weeks	Early Surgery: within 2 weeks	13	(0-131)	Delayed Surgery: 8-12 weeks	18	(-1-131)	NA	Reported NS
Meighan et al. 2003	Moderate	Strength: Total Work Deficit (percentage of uninjured side)	24 weeks	Early Surgery: within 2 weeks	13	16(NR)	Delayed Surgery: 8-12 weeks	17	9(NR)	NA	Reported NS
Meighan et al. 2003	Moderate	Strength: Mean quadriceps power deficit (percentage of uninjured side)	24 weeks	Early Surgery: within 2 weeks	13	13(NR)	Delayed Surgery: 8-12 weeks	17	7(NR)	NA	Reported NS
Meighan et al. 2003	Moderate	Strength: Peak torque deficit (percentage of uninjured side)	24 weeks	Early Surgery: within 2 weeks	13	19(NR)	Delayed Surgery: 8-12 weeks	17	11(NR)	NA	Reported NS
Hunter et al. 1996	Moderate	Stability: Postoperative KT-1000 30lb measurement, (-3,3mm)	6 months	Groups 1, 2, and 3 (<3 weeks)	148	3/148(94%)	Group 4: Surgery more than 3 weeks after injury	37	37/37(100%)	0.95(0.9,1)	NS
Hunter et al. 1996	Moderate	Stability: Postoperative KT-1000 30lb measurement, (>3mm to less than or equal to 5mm)	6 months	Groups 1, 2, and 3 (<3 weeks)	148	3/148(5%)	Group 4: Surgery more than 3 weeks after injury	37	0/37(0%)	0.99(0.94,1.03)	NS
Hunter et al. 1996	Moderate	Range of Motion: Postoperative knee flexion	6 months	Group 2: Surgery w/in 3-7 days of injury	148	148/148(100%)	Group 4: Surgery more than 3 weeks after injury	37	37/37(100%)	1(0.97,1.05)	NS

Table 60. Results: Early Versus Late 6 Month Follow-up

Author	Study Strength	Outcome Measured	Duration	Treatment Group 1	N1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	N2	Mean (sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		>135 deg									
Hunter et al. 1996	Moderate	Range of Motion: Postoperative knee flexion >125 deg	6 months	Group 1: Surgery w/in 48 hours of injury	44	44/44(100 %)	Group 2: Surgery w/in 3-7 days of injury	53	53/53(100 %)	NA	NS
Hunter et al. 1996	Moderate	Range of Motion: Postoperative knee flexion >125 deg	6 months	Group 1: Surgery w/in 48 hours of injury	44	44/44(100 %)	Group 3: Surgery w/in 1-3 weeks of injury	51	51/51(100 %)	NA	NS
Hunter et al. 1996	Moderate	Range of Motion: Postoperative knee flexion >125 deg	6 months	Group 1: Surgery w/in 48 hours of injury	44	44/44(100 %)	Group 4: Surgery more than 3 weeks after injury	37	37/37(100 %)	NA	NS
Hunter et al. 1996	Moderate	Range of Motion: Postoperative knee flexion >125 deg	6 months	Group 2: Surgery w/in 3-7 days of injury	53	53/53(100 %)	Group 3: Surgery w/in 1-3 weeks of injury	51	51/51(100 %)	NA	NS
Hunter et al. 1996	Moderate	Range of Motion: Postoperative knee flexion >125 deg	6 months	Group 2: Surgery w/in 3-7 days of injury	53	53/53(100 %)	Group 4: Surgery more than 3 weeks after injury	37	37/37(100 %)	NA	NS
Hunter et al. 1996	Moderate	Range of Motion: Postoperative knee flexion >125 deg	6 months	Group 3: Surgery w/in 1-3 weeks of injury	51	51/51(100 %)	Group 4: Surgery more than 3 weeks after injury	37	37/37(100 %)	NA	NS
Hunter et al. 1996	Moderate	Range of Motion:	6 months	Group 1: Surgery w/in 48	44	44/44(100 %)	Group 2: Surgery w/in 3-7 days of	53	50/53(94%)	1.06(0.99,1.13)	NS

Table 60. Results: Early Versus Late 6 Month Follow-up

Author	Study Strength	Outcome Measured	Duration	Treatment Group 1	N1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	N2	Mean (sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		Postoperative knee flexion >135 deg		hours of injury			injury				
Hunter et al. 1996	Moderate	Range of Motion: Postoperative knee flexion >135 deg	6 months	Group 1: Surgery w/in 48 hours of injury	44	44/44(100 %)	Group 3: Surgery w/in 1-3 weeks of injury	51	48/51(94%)	1.06(0.99,1.14)	NS
Hunter et al. 1996	Moderate	Range of Motion: Postoperative knee flexion >135 deg	6 months	Group 1: Surgery w/in 48 hours of injury	44	44/44(100 %)	Group 4: Surgery more than 3 weeks after injury	37	37/37(100 %)	NA	NS
Hunter et al. 1996	Moderate	Range of Motion: Postoperative knee flexion >135 deg	6 months	Group 2: Surgery w/in 3-7 days of injury	53	50/53(94%)	Group 3: Surgery w/in 1-3 weeks of injury	51	48/51(94%)	1.00(0.91,1.10)	NS
Hunter et al. 1996	Moderate	Range of Motion: Postoperative knee flexion >135 deg	6 months	Group 2: Surgery w/in 3-7 days of injury	53	50/53(94%)	Group 4: Surgery more than 3 weeks after injury	37	37/37(100 %)	0.94(0.88,1.01)	NS
Hunter et al. 1996	Moderate	Range of Motion: Postoperative knee flexion >135 deg	6 months	Group 3: Surgery w/in 1-3 weeks of injury	51	48/51(94%)	Group 4: Surgery more than 3 weeks after injury	37	37/37(100 %)	0.94(0.88,1.01)	NS
Hunter et al. 1996	Moderate	Stability: Postoperative KT-1000 30lb measurement, (-3,3mm)	6 months	Group 1: Surgery w/in 48 hours of injury	44	44/44(100 %)	Group 2: Surgery w/in 3-7 days of injury	53	50/53(95%)	1.06(0.99,1.13)	NS

Table 60. Results: Early Versus Late 6 Month Follow-up

Author	Study Strength	Outcome Measured	Duration	Treatment Group 1	N1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	N2	Mean (sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Hunter et al. 1996	Moderate	Stability: Postoperative KT-1000 30lb measurement, (-3,3mm)	6 months	Group 1: Surgery w/in 48 hours of injury	44	44/44(100 %)	Group 3: Surgery w/in 1-3 weeks of injury	51	48/51(94%)	1.06(0.99,1.14)	NS
Hunter et al. 1996	Moderate	Stability: Postoperative KT-1000 30lb measurement, (-3,3mm)	6 months	Group 1: Surgery w/in 48 hours of injury	44	44/44(100 %)	Group 4: Surgery more than 3 weeks after injury	37	37/37(100 %)	NA	NS
Hunter et al. 1996	Moderate	Stability: Postoperative KT-1000 30lb measurement, (-3,3mm)	6 months	Group 2: Surgery w/in 3-7 days of injury	53	50/53(95%)	Group 3: Surgery w/in 1-3 weeks of injury	51	48/51(94%)	1.00(0.91,1.10)	NS
Hunter et al. 1996	Moderate	Stability: Postoperative KT-1000 30lb measurement, (-3,3mm)	6 months	Group 2: Surgery w/in 3-7 days of injury	53	50/53(95%)	Group 4: Surgery more than 3 weeks after injury	37	37/37(100 %)	0.94(0.88,1.01)	NS
Hunter et al. 1996	Moderate	Stability: Postoperative KT-1000 30lb measurement, (-3,3mm)	6 months	Group 3: Surgery w/in 1-3 weeks of injury	51	48/51(94%)	Group 4: Surgery more than 3 weeks after injury	37	37/37(100 %)	0.94(0.88,1.01)	NS
Hunter et al. 1996	Moderate	Stability: Postoperative KT-1000 30lb measurement, (>3mm to less than or equal to 5mm)	6 months	Group 1: Surgery w/in 48 hours of injury	44	0/44(0%)	Group 2: Surgery w/in 3-7 days of injury	53	3/53(5%)	0.17(0.009,3.23)	NS
Hunter et	Moderate	Stability:	6 months	Group 1:	44	0/44(0%)	Group 3: Surgery	51	0/51(0%)	NA	NS

Table 60. Results: Early Versus Late 6 Month Follow-up

Author	Study Strength	Outcome Measured	Duration	Treatment Group 1	N1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	N2	Mean (sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
al. 1996		Postoperative KT-1000 30lb measurement, (>3mm to less than or equal to 5mm)		Surgery w/in 48 hours of injury			w/in 1-3 weeks of injury				
Hunter et al. 1996	Moderate	Stability: Postoperative KT-1000 30lb measurement, (>3mm to less than or equal to 5mm)	6 months	Group 1: Surgery w/in 48 hours of injury	44	0/44(0%)	Group 4: Surgery more than 3 weeks after injury	37	0/37(0%)	NA	NS
Hunter et al. 1996	Moderate	Stability: Postoperative KT-1000 30lb measurement, (>3mm to less than or equal to 5mm)	6 months	Group 2: Surgery w/in 3-7 days of injury	53	3/53(5%)	Group 3: Surgery w/in 1-3 weeks of injury	51	0/51(0%)	6.74(0.35,127.34)	NS
Hunter et al. 1996	Moderate	Stability: Postoperative KT-1000 30lb measurement, (>3mm to less than or equal to 5mm)	6 months	Group 2: Surgery w/in 3-7 days of injury	53	3/53(5%)	Group 4: Surgery more than 3 weeks after injury	37	0/37(0%)	4.92(0.26,92.62)	NS
Hunter et al. 1996	Moderate	Stability: Postoperative KT-1000 30lb measurement, (>3mm to less than or equal to	6 months	Group 3: Surgery w/in 1-3 weeks of injury	51	0/51(0%)	Group 4: Surgery more than 3 weeks after injury	37	0/37(0%)	NA	NS

Table 60. Results: Early Versus Late 6 Month Follow-up

Author	Study Strength	Outcome Measured	Duration	Treatment Group 1	N1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	N2	Mean (sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		5mm)									
Hunter et al. 1996	Moderate	Stability: Postoperative KT-1000 30lb measurement, (>5mm)	6 months	Group 1: Surgery w/in 48 hours of injury	44	0/44(0%)	Group 2: Surgery w/in 3-7 days of injury	53	0/53(0%)	NA	NS
Hunter et al. 1996	Moderate	Stability: Postoperative KT-1000 30lb measurement, (>5mm)	6 months	Group 1: Surgery w/in 48 hours of injury	44	0/44(0%)	Group 3: Surgery w/in 1-3 weeks of injury	51	3/51(6%)	0.94(0.87,1.02)	NS
Hunter et al. 1996	Moderate	Stability: Postoperative KT-1000 30lb measurement, (>5mm)	6 months	Group 1: Surgery w/in 48 hours of injury	44	0/44(0%)	Group 4: Surgery more than 3 weeks after injury	37	0/37(0%)	NA	NS
Hunter et al. 1996	Moderate	Stability: Postoperative KT-1000 30lb measurement, (>5mm)	6 months	Group 2: Surgery w/in 3-7 days of injury	53	0/53(0%)	Group 3: Surgery w/in 1-3 weeks of injury	51	3/51(6%)	0.94(0.87,1.02)	NS
Hunter et al. 1996	Moderate	Stability: Postoperative KT-1000 30lb measurement, (>5mm)	6 months	Group 2: Surgery w/in 3-7 days of injury	53	0/53(0%)	Group 4: Surgery more than 3 weeks after injury	37	0/37(0%)	NA	NS
Hunter et al. 1996	Moderate	Stability: Postoperative KT-1000 30lb measurement, (>5mm)	6 months	Group 3: Surgery w/in 1-3 weeks of injury	51	3/51(6%)	Group 4: Surgery more than 3 weeks after injury	37	0/37(0%)	0.95(0.87,1.03)	NS

Table 61. Result: Early Versus Late ACLR 2 Year Follow-up

Author	Study Strength	Outcome Measured	Treatment Group 1	N1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Barenius et al. 2010	Moderate	Meniscal injury	Early reconstruction <5 months	46	17/46(37%)	Late reconstruction >5 months	107	66/107(62%)	0.599(0.399,0.899)	Favors early reconstruction
Barenius et al. 2010	Moderate	Tegner activity level	Early reconstruction <5 months	46	5.74(2.25)	Late reconstruction >5 months	107	4.01(1.3)	1.73(1.16,2.30)	Favors early reconstruction
Barenius et al. 2010	Moderate	Activities of daily living (KOOS)	Early reconstruction <5 months	46	NR	Late reconstruction >5 months	107	NR	NA	Favors early reconstruction
Barenius et al. 2010	Moderate	KOOS (Pain, Symptoms, Sport, QoL)	Early reconstruction <5 months	46	NR	Late reconstruction >5 months	107	NR	NA	NS
Barenius et al. 2010	Moderate	SF-35(Physical functioning, Bodily pain, Social functioning)	Early reconstruction <5 months	46	NR	Late reconstruction >5 months	107	NR	NA	Favors early reconstruction
Barenius et al. 2010	Moderate	SF-36(RP, GH, VT, RE,MH)	Early reconstruction <5 months	46	NR	Late reconstruction >5 months	107	NR	NA	NS
Daniel et al. 1994	Moderate	Participate in basketball 50 hours per year or more	Early reconstruction <90 days	45	5/45(11%)	Late reconstruction >90 days	33	3/33(9%)	1.22(0.31,4.75)	NS
Daniel et al. 1994	Moderate	Participate in football 50 hours per year or more	Early reconstruction <90 days	45	0/45(0%)	Late reconstruction >90 days	33	0/33(0%)	0.74(0.01,36.33)	NS
Daniel et al. 1994	Moderate	Participate in football 50 hours per year or more	Early reconstruction <90 days	45	1/45(2%)	Late reconstruction >90 days	33	0/33(0%)	2.22(0.09,52.78)	NS
Daniel et al. 1994	Moderate	Participate in baseball 50 hours per year or more	Early reconstruction <90 days	45	4/45(9%)	Late reconstruction >90 days	33	2/33(6%)	1.47(0.28,7.53	NS
Daniel et al. 1994	Moderate	Participate in racquet sports 50 hours per year or more	Early reconstruction <90 days	45	6/45(13%)	Late reconstruction >90 days	33	6/33(18%)	0.73(0.26,2.07)	NS
Daniel et al. 1994	Moderate	Participate in snow ski sports 50 hours per	Early reconstruction	45	1/45(2%)	Late reconstruction	33	2/33(6%)	0.36(0.03,3.8)	NS

Table 61. Result: Early Versus Late ACLR 2 Year Follow-up

Author	Study Strength	Outcome Measured	Treatment Group 1	N1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		year or more	<90 days			>90 days				
Daniel et al. 1994	Moderate	Pain (more than mild and infrequent)	Early reconstruction <90 days	45	12/45(27 %)	Late reconstruction >90 days	33	8/33(24 %)	1.1(0.5,2.07)	NS
Daniel et al. 1994	Moderate	Swelling (more than mild and infrequent)	Early reconstruction <90 days	45	16/45(36 %)	Late reconstruction >90 days	33	11/33(3 3%)	1.06(0.57,1.9 9)	NS
Daniel et al. 1994	Moderate	Giving way with sports	Early reconstruction <90 days	45	9/45(20 %)	Late reconstruction >90 days	33	1/33(3 %)	6.6(0.88,49.5 8)	NS
Daniel et al. 1994	Moderate	Giving way with ADL	Early reconstruction <90 days	45	7/45(16 %)	Late reconstruction >90 days	33	1/33(3 %)	5.13(0.66,39. 74)	NS
Daniel et al. 1994	Moderate	Walk impairments	Early reconstruction <90 days	45	5/45(11 %)	Late reconstruction >90 days	33	4/33(12 %)	0.91(0.26,3.1 5)	NS
Daniel et al. 1994	Moderate	Climb impairments	Early reconstruction <90 days	45	16/45(36 %)	Late reconstruction >90 days	33	8/33(24 %)	1.46(0.71,3.0 1)	NS
Daniel et al. 1994	Moderate	Stairs impairments	Early reconstruction <90 days	45	11/45(24 %)	Late reconstruction >90 days	33	8/33(24 %)	1.0(0.45,2.2)	NS
Daniel et al. 1994	Moderate	Kneel impairments	Early reconstruction <90 days	45	29/45(64 %)	Late reconstruction >90 days	33	21/33(6 4%)	1.0(0.72,1.42)	NS
Daniel et al. 1994	Moderate	Squat impairments	Early reconstruction <90 days	45	18/45(40 %)	Late reconstruction >90 days	33	18/33(5 5%)	0.73(0.45,1.1 8)	NS
Daniel et al. 1994	Moderate	Run impairments	Early reconstruction <90 days	45	15/45(33 %)	Late reconstruction >90 days	33	13/33(3 9%)	0.84(0.47,1.5 3)	NS
Daniel et al. 1994	Moderate	Jump impairments	Early reconstruction <90 days	45	15/45(33 %)	Late reconstruction >90 days	33	12/33(3 6%)	0.91(0.5,1.69)	NS
Daniel et al. 1994	Moderate	Cut impairments	Early	45	19/45(42	Late	33	17/33(5	0.82(0.5,1.32)	NS

Table 61. Result: Early Versus Late ACLR 2 Year Follow-up

Author	Study Strength	Outcome Measured	Treatment Group 1	N1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
			reconstruction <90 days		%)	reconstruction >90 days		2%)		
Daniel et al. 1994	Moderate	Walk impairments more than mild	Early reconstruction <90 days	45	0/45(0%)	Late reconstruction >90 days	33	0/33(0%)	0.74(0.01,36.3)	NS
Daniel et al. 1994	Moderate	Climb impairments more than mild	Early reconstruction <90 days	45	2/45(4%)	Late reconstruction >90 days	33	0/33(0%)	3.7(0.18,74.52)	NS
Daniel et al. 1994	Moderate	Stairs impairments more than mild	Early reconstruction <90 days	45	0/45(0%)	Late reconstruction >90 days	33	1/33(3%)	0.25(0.01,5.86)	NS
Daniel et al. 1994	Moderate	Kneel impairments more than mild	Early reconstruction <90 days	45	7/45(16%)	Late reconstruction >90 days	33	4/33(12%)	1.28(0.4,4)	NS
Daniel et al. 1994	Moderate	Squat impairments more than mild	Early reconstruction <90 days	45	6/45(13%)	Late reconstruction >90 days	33	3/33(9%)	1.47(0.39,5.4)	NS
Daniel et al. 1994	Moderate	Run impairments more than mild	Early reconstruction <90 days	45	4/45(9%)	Late reconstruction >90 days	33	6/33(18%)	0.49(0.39,5.44)	NS
Daniel et al. 1994	Moderate	Jump impairments more than mild	Early reconstruction <90 days	45	4/45(9%)	Late reconstruction >90 days	33	3/33(9%)	0.98(0.23,40	NS
Daniel et al. 1994	Moderate	Cut impairments more than mild	Early reconstruction <90 days	45	6/45(13%)	Late reconstruction >90 days	33	10/33(30%)	0.44(0.177,1.09)	NS
Daniel et al. 1994	Moderate	Functional (Hop test ≥0.9)	Early reconstruction <90 days	41	34/41(83%)	Late reconstruction >90 days	33	19/33(59%)	0.75(0.64,0.89)	Favors early reconstruction
Daniel et al. 1994	Moderate	Functional (Quadriceps ≥0.8)	Early reconstruction <90 days	41	37/41(90%)	Late reconstruction >90 days	33	27/33(84%)	0.82(0.71,0.94)	Favors early reconstruction
Daniel et al. 1994	Moderate	Functional (Hamstring ≥0.8)	Early reconstruction <90 days	41	36/41(92%)	Late reconstruction >90 days	33	30/33(94%)	0.8(0.69,0.92)	Favors early reconstruction

Table 61. Result: Early Versus Late ACLR 2 Year Follow-up

Author	Study Strength	Outcome Measured	Treatment Group 1	N1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Daniel et al. 1994	Moderate	Stability (Quadriceps active KT-1000 <3mm 89N)	Early reconstruction <90 days	43	21/43(49%)	Late reconstruction >90 days	33	18/33(55%)	0.47(0.34,0.64)	Favors early reconstruction
Daniel et al. 1994	Moderate	Stability (Quadriceps KT-1000 <3mm 89N)	Early reconstruction <90 days	43	27/43(63%)	Late reconstruction >90 days	33	20/33(61%)	0.6(0.47,0.76)	Favors early reconstruction
Daniel et al. 1994	Moderate	Stability (Quadriceps KT-1000 <3mm 134N)	Early reconstruction <90 days	43	21/43(49%)	Late reconstruction >90 days	33	15/33(45%)	0.47(0.34,0.64)	Favors early reconstruction
Daniel et al. 1994	Moderate	Stability (Quadriceps KT-1000 <3mm Max)	Early reconstruction <90 days	43	14/43(33%)	Late reconstruction >90 days	33	10/33(30%)	0.3(0.2,0.48)	Favors early reconstruction
Daniel et al. 1994	Moderate	Stability (Pivot-shift)	Early reconstruction <90 days	43	28/43(64%)	Late reconstruction >90 days	33	10/33(30%)	0.62(0.49,0.78)	Favors early reconstruction
Fithian et al. 2005	Moderate	IKDC	Early reconstruction <3 months	63	NR	Late reconstruction >3 months	33	NR	NA	NS
Fithian et al. 2005	Moderate	Lysholm score	Early reconstruction <3 months	63	91(10)	Late reconstruction >3 months	33	91(8)	0(-3.9,3.9)	NS
Fithian et al. 2005	Moderate	Tegner activity level	Early reconstruction <3 months	63	NR	Late reconstruction >3 months	33	NR	NA	Favor of early reconstruction
Fithian et al. 2005	Moderate	SF-36 Physical function	Early reconstruction <3 months	63	92(13)	Late reconstruction >3 months	33	87(19)	5(-1.53,11.53)	NS
Fithian et al. 2005	Moderate	SF-36 Role physical	Early reconstruction <3 months	63	92(24)	Late reconstruction >3 months	33	94(20)	-2(-11.6,7.69)	NS
Fithian et al. 2005	Moderate	SF-36 Pain	Early reconstruction <3 months	63	64(30)	Late reconstruction >3 months	33	64(29)	0(-12.63,12.65)	NS
Fithian et al. 2005	Moderate	SF-36 General health	Early reconstruction <3 months	63	83(14)	Late reconstruction >3 months	33	78(18)	5(-1.6,11.6)	NS

Table 61. Result: Early Versus Late ACLR 2 Year Follow-up

Author	Study Strength	Outcome Measured	Treatment Group 1	N1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Fithian et al. 2005	Moderate	SF-36 Vitality	Early reconstruction <3 months	63	71(15)	Late reconstruction >3 months	33	68(19)	3(-4.002,10.02)	NS
Fithian et al. 2005	Moderate	SF-36 Social function	Early reconstruction <3 months	63	95(12)	Late reconstruction >3 months	33	91(14)	4(-1.42,9.42)	NS
Fithian et al. 2005	Moderate	SF-36 Mental health	Early reconstruction <3 months	63	84(10)	Late reconstruction >3 months	33	78(18)	6(0.34,11.66)	NS
Fithian et al. 2005	Moderate	SF-36 Emotion	Early reconstruction <3 months	63	95(17)	Late reconstruction >3 months	33	94(18)	1(-6.4,8.39)	NS
Fithian et al. 2005	Moderate	Instability	Early reconstruction <3 months	63	NR	Late reconstruction >3 months	33	NR	NA	NS

Table 62. Treatment of Young (18-35) Active Patient: Post-Hoc Analysis of Early ACLR and Delayed ACLR 2 Year Follow-up

Author	Study Strength	Outcome	Treatment Group 1	N1	Mean(sd) 1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd) 2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Frobell et al. 2010	Moderate	Function in activities of daily living (KOOS)	Rehabilitation plus early ACL reconstruction	60	93.5(11.42)	Delayed ACL reconstruction	23	94.4(8.67)	-0.9(-4.56,2.76)	NS
Frobell et al. 2010	Moderate	Function in sports and recreation (KOOS)	Rehabilitation plus early ACL reconstruction	60	71.8(26.7)	Delayed ACL reconstruction	23	68.5(27.4)	3.3(-6.43,13.04)	NS
Frobell et al. 2010	Moderate	Knee-related quality of life (KOOS)	Rehabilitation plus early ACL reconstruction	60	67.3(23.22)	Delayed ACL reconstruction	23	65.5(20.8)	1.8(-6.15,9.75)	NS
Frobell et al. 2010	Moderate	Mean change in KOOS from baseline	Rehabilitation plus early ACL reconstruction	60	39(18.4)	Delayed ACL reconstruction	23	39.8(17.9)	-0.8(-7.34,5.74)	NS
Frobell et al. 2010	Moderate	Mental component SF-36	Rehabilitation plus early ACL reconstruction	60	88.3(12.97)	Delayed ACL reconstruction	23	86(15.38)	2.3(-2.81,7.41)	NS
Frobell et al. 2010	Moderate	Pain (KOOS)	Rehabilitation plus early ACL reconstruction	60	87.2(15.29)	Delayed ACL reconstruction	23	86.6(14.1)	0.6(-4.7,5.74)	NS
Frobell et al. 2010	Moderate	Physical component SF-36	Rehabilitation plus early ACL reconstruction	60	82.1(12.97)	Delayed ACL reconstruction	23	76.7(18.8)	5.4(-0.39,11.19)	NS
Frobell et al. 2010	Moderate	Return to pre-injury activity level or higher	Rehabilitation plus early ACL reconstruction	60	27/60(44%)	Delayed ACL reconstruction	23	7/23(30%)	1.48(0.75,2.91)	NS
Frobell et al. 2010	Moderate	Severely decreased knee related quality of life	Rehabilitation plus early ACL reconstruction	60	11/60(18%)	Delayed ACL reconstruction	23	11/23(48%)	0.38(0.19,0.76)	NS
Frobell et al. 2010	Moderate	Stability (KT-1000 mm)	Rehabilitation plus early ACL reconstruction	60	6.6(2.32)	Delayed ACL reconstruction	23	7.1(2.54)	-0.5(-1.37,0.37)	NS
Frobell et al. 2010	Moderate	Stability (Normal Lachman test)	Rehabilitation plus early ACL reconstruction	60	39/60(65%)	Delayed ACL reconstruction	23	15/23(65%)	0.99(0.7,1.42)	Favors early ACLR
Frobell et al.	Moderate	Stability (Normal pivot	Rehabilitation plus	60	45/60(75%	Delayed ACL	23	19/23(83%	0.9(0.7,1.15)	Favors early

Table 62. Treatment of Young (18-35) Active Patient: Post-Hoc Analysis of Early ACLR and Delayed ACLR 2 Year Follow-up

Author	Study Strength	Outcome	Treatment Group 1	N1	Mean(sd) 1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd) 2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
2010		shift test)	early ACL reconstruction		)	reconstruction		)		ACLR
Frobell et al. 2010	Moderate	Symptoms (KOOS)	Rehabilitation plus early ACL reconstruction	60	78.7(20.32)	Delayed ACL reconstruction	23	81.2(16.76)	-2.5(-9.22,4.22)	NS
Frobell et al. 2010	Moderate	Tegner activity level (median and interquartile range)	Rehabilitation plus early ACL reconstruction	60	6.5(1.25)	Delayed ACL reconstruction	23	5(0.75)	1.5(1.13,1.86)	Favors early

ACL COMBINED MCL

There is limited evidence in patients with acute ACL tear and MCL tear to support that the practitioner might perform reconstruction of the ACL and non-operative treatment of the MCL tear.

Strength of Recommendation: Limited ★★☆☆

RATIONALE

Two low strength studies evaluated isolated reconstruction of the ACL in acute ACL/MCL and chronic ACL/MCL injuries in which the MCL injury was high grade, but not complete (no or minimal valgus laxity when tested in full extension).[43, 75] Both used hinged braces in the post-operative period. Their results for ACL laxity and function are comparable to ACL reconstruction in isolated ACL tears. Valgus laxity was reduced from pre-operative status, but still present. This did not seem to alter functional status.

POTENTIAL BENEFITS OF IMPLEMENTATION

Potential benefits include reduction of surgery with decreased OR time and less likelihood of motion limitations.

POTENTIAL HARMS OF IMPLEMENTATION

Potential harms may include the late loss of function or recurrent ACL injury from the residual valgus laxity.

FUTURE RESEARCH

Long term follow-up studies of ACL reconstructed patients with partial MCL tears treated non-operatively at the time of ACL reconstruction, compared to isolated ACL injuries treated with ACL reconstruction would establish if there is potential harm associated with this strategy of treatment for complete ACL tears with associated partial MCL tears.

SUMMARY OF FINDINGS

QUALITY AND APPLICABILITY SUMMARY

Table 63. Quality and Applicability Summary: Treating Patients With ACL and MCL Tears

Study	Outcome	Graft	Duration	Quality	Applicability	Overall Strength of Evidence
Noyes et al. 1995	Activities of daily living	Allograft	5.3 years (2-8.9)	Low	Moderate	Low
Hara et al. 2008	Extensor muscle strength, % control side	Quadrupled semitendinosus tendon	2 years	Low	Moderate	Low
Hara et al. 2008	IKDC	Quadrupled semitendinosus tendon	2 years	Low	Moderate	Low
Hara et al. 2008	Interval until return to sport	Quadrupled semitendinosus tendon	2 years	Low	Moderate	Low
Hara et al. 2008	Lysholm knee scale	Quadrupled semitendinosus tendon	2 years	Low	Moderate	Low
Noyes et al. 1995	Overall rating	Allograft	5.3 years (2-8.9)	Low	Moderate	Low
Noyes et al. 1995	Pain	Allograft	5.3 years (2-8.9)	Low	Moderate	Low
Hara et al. 2008	Return to sports	Quadrupled semitendinosus tendon	2 years	Low	Moderate	Low
Hara et al. 2008	Subjective satisfaction	Quadrupled semitendinosus tendon	2 years	Low	Moderate	Low
Noyes et al. 1995	Swelling	Allograft	5.3 years (2-8.9)	Low	Moderate	Low

RESULTS

QUALITY AND APPLICABILITY

Table 64. Quality and Applicability: Treating Patients With ACL and MCL Tears

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Noyes et al. 1995	Activities of daily living	●	○	●	○	○	○	○	**Low**	●	○	●	●	**Moderate**
Hara et al. 2008	Extensor muscle strength, % control side	●	○	○	○	●	○	○	**Low**	●	○	●	●	**Moderate**
Hara et al. 2008	IKDC	●	○	○	○	●	○	○	**Low**	●	○	●	●	**Moderate**
Hara et al. 2008	Interval until return to sport	●	○	○	○	●	○	○	**Low**	●	○	●	●	**Moderate**
Hara et al. 2008	Lysholm knee scale	●	○	○	○	●	○	○	**Low**	●	○	●	●	**Moderate**
Noyes et al. 1995	Overall rating	●	○	●	○	○	○	○	**Low**	●	○	●	●	**Moderate**
Noyes et al. 1995	Pain	●	○	●	○	○	○	○	**Low**	●	○	●	●	**Moderate**
Hara et al. 2008	Return to sports	●	○	○	○	●	○	○	**Low**	●	○	●	●	**Moderate**

Table 64. Quality and Applicability: Treating Patients With ACL and MCL Tears

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Hara et al. 2008	Subjective satisfaction	●	○	○	○	●	○	○	**Low**	●	○	●	●	**Moderate**
Noyes et al. 1995	Swelling	●	○	●	○	○	○	○	**Low**	●	○	●	●	**Moderate**

Table 65. Results: Treating Patients With ACL and MCL Tear

Author	Study Strength	Treatment	Outcome Measured	n	Average Follow-up Time (range)	N1/n1(%)
Noyes et al. 1995	Low	ACLR and conservative treatment of MCL injury	Noyes questionnaire = Excellent	12	5.3 years (2-8.9)	1/12(8%)
Noyes et al. 1995	Low	ACLR and conservative treatment of MCL injury	Noyes questionnaire = Good	12	5.3 years (2-8.9)	9/12(75%)
Noyes et al. 1995	Low	ACLR and conservative treatment of MCL injury	Noyes questionnaire = Fair	12	5.3 years (2-8.9)	1/12(8%)
Noyes et al. 1995	Low	ACLR and conservative treatment of MCL injury	Failure rate	12	5.3 years (2-8.9)	1/12(8%)
Noyes et al. 1995	Low	ACLR and MCL injury treated surgically	Noyes questionnaire = Excellent	33	5.3 years (2-8.9)	2/33(6%)
Noyes et al. 1995	Low	ACLR and MCL injury treated surgically	Noyes questionnaire = Good	33	5.3 years (2-8.9)	17/33(51%)
Noyes et al. 1995	Low	ACLR and MCL injury treated surgically	Noyes questionnaire = Fair	33	5.3 years (2-8.9)	7/33(21%)
Noyes et al. 1995	Low	ACLR and MCL injury treated surgically	Noyes questionnaire = Poor	33	5.3 years (2-8.9)	7/33(21%)
Noyes et al. 1995	Low	ACLR and MCL injury treated surgically	Failure rate	33	5.3 years (2-8.9)	6/33(18%)
Hara et al. 2008	Low	ACLR(Maeda et al.) and conservative treatment of MCL injury	Lysholm scale	53	2 years	95.5(5.9)
Hara et al. 2008	Low	ACLR(Maeda et al.) and conservative treatment of MCL injury	Extensor muscle strength, % control side	53	2 years	82.8(17.6)
Hara et al. 2008	Low	ACLR(Maeda et al.) and conservative treatment of MCL injury	Interval until return to sports in month	53	2 years	10.3(3.9)
Hara et al. 2008	Low	ACLR(Maeda et al.) and conservative treatment of MCL injury	Subjective satisfaction	53	2 years	78.7(17.7)
Hara et al. 2008	Low	ACLR(Maeda et al.) and conservative treatment of MCL injury	IKDC score of A	53	Baseline	0/53 (0%)
Hara et al. 2008	Low	ACLR(Maeda et al.) and conservative treatment of MCL injury	IKDC score of A	53	2 years	46/53(87%)
Hara et al. 2008	Low	ACLR(Maeda et al.) and conservative treatment of MCL injury	IKDC score of B	53	Baseline	21/53 (40%)
Hara et al. 2008	Low	ACLR(Maeda et al.) and conservative treatment of MCL injury	IKDC score of B	53	2 years	6/53(11%)
Hara et al.	Low	ACLR(Maeda et al.) and conservative treatment of	IKDC score of c	53	Baseline	27/53(40%)

Table 65. Results: Treating Patients With ACL and MCL Tear

Author	Study Strength	Treatment	Outcome Measured	n	Average Follow-up Time (range)	N1/n1(%)
2008		MCL injury				
Hara et al. 2008	Low	ACLR(Maeda et al.) and conservative treatment of MCL injury	IKDC score of C	53	2 years	1/53(2%)

ACL LOCKED KNEE

In the absence of reliable evidence, it is the opinion of the work group that patients with an ACL tear and a locked knee secondary to a displaced meniscal tear have prompt treatment to unlock the knee in order to avoid a fixed flexion contracture.

Strength of Recommendation: Consensus ★☆☆☆

RATIONALE

There were no published studies that met the criteria for this recommendation. The work group felt that, if left untreated for a sufficient period of time, a locked knee may lead to a fixed flexion contracture that may no longer be recoverable and could thus threaten the functional viability of the leg.

The torn meniscus is also more likely to be repairable if the meniscus is reduced early. Prolonged knee flexion may lead to articular cartilage damage as well.

POTENTIAL HARMS OF IMPLEMENTATION

As with all surgical procedures, there are patient risks including but not limited to infection, anesthetic complications, phlebitis, neurovascular injury, meniscal repair failure, and ACL reconstruction failure.

FUTURE RESEARCH

Evaluation of the relative risk of arthrofibrosis if the ACL is reconstructed at the same time or as a staged procedure

ACL SINGLE OR DOUBLE BUNDLE RECONSTRUCTION

Strong evidence supports that in patients undergoing intra-articular ACL reconstruction the practitioner should use either single bundle or double bundle technique, because the measured outcomes are similar.

Strength of Recommendation: Strong ★★★★

RATIONALE

There are four high and eight moderate strength studies that compare single to double bundle ACL reconstruction.[1, 3, 5, 51, 53, 56, 77, 79, 83, 99, 114, 123] The majority of the studies demonstrate no statistically significant difference in any outcome parameters. Meta-analysis demonstrated no statistically significant difference between single and double bundle reconstruction in post-operative pain, Lysholm or IKDC subjective knee scores.

POTENTIAL HARMS OF IMPLEMENTATION

As with all surgery procedures, there are surgical risks and complications including but not limited to, graft failure, arthrofibrosis, infection, neurovascular injury, and anesthetic complications.

FUTURE RESEARCH

Long-term prospective, randomized studies comparing single and double bundle reconstruction should be performed to document clinical outcomes, degree of tunnel enlargement, traumatic arthritis, and incidence and results of subsequent revision surgeries. Double bundle surgery may include additional expense, and may increase the complexity of revision ACL surgery; future studies may analyze this surgical approach.

SUMMARY OF FINDINGS

Table 66. Summary of Findings: Single Bundle Versus Double Bundle

🟢:Favors Single Bundle

🔴:Favors Double Bundle

○:Not significant

	Scales/Measures	Adachi et al. 2003 *(M)*	Aglietti et al. 2007 *(M)*	Aglietti et al. 2010 *(H)*	Hussein et al. 2012 *(M)*	Ibrahim et al. 2009 *(M)*	Jarvela et al. 2008 *(M)*	Nunez et al. 2012 *(H)*	Ochiai et al. 2011 *(M)*	Park et al. 2010 *(H)*	Sastre et al. 2010 *(H)*	Suomalainen et al. 2011 *(M)*	Zhang et al. 2013 *(M)*	**Meta-Analysis**
Patient satisfaction														NA
Function								○	○					NA
Pain			○	○				○	○				○	○
	IKDC subjective	○	🔴	○	○	○		○		🔴	○			○
	IKDC Normal				○		○					○		NA
	Lysholm Score				○	○	○		○			○	○	○
Failure			○									○		NA
Quality of life			○	○									○	NA
Activities of daily living			○	🔴									○	*NA*
Return to play			○	○										NA
	Tegner Activity					○				○			○	NA
Stability		○	○									○		NA
Strength													○	NA

Overall strength of study; High: *(H)*, Moderate: *(M)*, Low: *(L)*, Very low: *(V)*

QUALITY AND APPLICABILITY SUMMARY

Table 67. Quality and Applicability Summary: Single Bundle Versus Double Bundle

Study	Outcome	Graft	Surgical Technique	Duration	Quality	Applicability	Overall Strength of Evidence
Suomalainen et al. 2011	Failure	Semitendinosus and gracilis	Double bundle or single bundle with metallic or bioabsorbable screws	2 years	Moderate	Moderate	Moderate
Aglietti et al. 2007	IKDC	Autologous semitendinosus and gracilis tendon	Transtibial and double bundle with two incision	2 years	Moderate	Moderate	Moderate
Aglietti et al. 2010	IKDC	Semitendinosus and gracilis	Transtibial	2 years	High	Moderate	High
Hussein et al. 2012	IKDC	Semitendinosus and the gracilis autograft	Anatomic single-double bundle	2 years (39-63 months)	Moderate	Moderate	Moderate
Hussein et al. 2012	IKDC	Semitendinosus and the gracilis autograft	Anatomic single-double bundle	2 years (39-63 months)	Moderate	Moderate	Moderate
Ibrahim et al. 2009	IKDC	Hamstring tendon	Single or double bundle	2 years (25-38 months)	Moderate	Moderate	Moderate
Jarvela et al. 2008 (B)	IKDC	Hamstring autograft	Single or double bundle	2 years (24-36 months)	Moderate	Moderate	Moderate
Nunez et al. 2012	IKDC	Semitendinosus and the gracilis autograft	Single bundle or double bundle	2 years	High	Moderate	High
Park et al. 2010	IKDC	Hamstring tendon autograft	Single or double bundle	2 year	High	Moderate	High
Sastre et al. 2010	IKDC	Hamstring tendon	Single or double bundle	2 year	Moderate	Moderate	Moderate
Suomalainen et al. 2011	IKDC	Semitendinosus and gracilis	Double bundle or single bundle with metallic or bioabsorbable screws	2 years	Low	Moderate	Low
Suomalainen et al. 2012	IKDC	Semitendinosus and gracilis	Double bundle or single bundle with metallic or bioabsorbable screws	5 years	Moderate	Moderate	Moderate

Table 67. Quality and Applicability Summary: Single Bundle Versus Double Bundle

Study	Outcome	Graft	Surgical Technique	Duration	Quality	Applicability	Overall Strength of Evidence
Suomalainen et al. 2011	IKDC	Semitendinosus and gracilis	Double bundle or single bundle with metallic or bioabsorbable screws	2 years	Moderate	Moderate	Moderate
Jarvela et al. 2008(A)	IKDC function	Hamstring autograft	Single or double bundle	2 years (24-36 months)	Moderate	Moderate	Moderate
Jarvela et al. 2008 (A)	IKDC overall	Hamstring autograft	Single or double bundle	2 years (24-36 months)	Moderate	Moderate	Moderate
Aglietti et al. 2010	IKDC sports activity	Semitendinosus and gracilis	Transtibial	2 years	High	Moderate	High
Adachi et al. 2003	Knee joint stability	Multi-strand hamstring	Single or double bundle	2.5 years	Moderate	Moderate	Moderate
Aglietti et al. 2007	KOOS	Autologous semitendinosus and gracilis tendon	Transtibial and double bundle with two incision		High	Moderate	High
Zhang et al. 2013	KOOS	Semitendinosus and gracilis	NR	2 years	Moderate	Moderate	Moderate
Aglietti et al. 2010	KOOS activities of daily living	Semitendinosus and gracilis	Transtibial	2 years	High	Moderate	High
Aglietti et al. 2010	KOOS pain	Semitendinosus and gracilis	Transtibial	2 years	High	Moderate	High
Aglietti et al. 2010	KOOS quality of life	Semitendinosus and gracilis	Transtibial	2 years	High	Moderate	High
Aglietti et al. 2010	KOOS sports activity	Semitendinosus and gracilis	Transtibial	2 years	High	Moderate	High
Aglietti et al. 2010	KOOS symptoms	Semitendinosus and gracilis	Transtibial	2 years	High	Moderate	High
Suomalainen et al. 2011	Lysholm knee score	Semitendinosus and gracilis	Double bundle or single bundle with metallic or	2 years	Moderate	Moderate	Moderate

Table 67. Quality and Applicability Summary: Single Bundle Versus Double Bundle

Study	Outcome	Graft	Surgical Technique	Duration	Quality	Applicability	Overall Strength of Evidence
			bioabsorbable screws				
Suomalainen et al. 2011	Lysholm knee score	Semitendinosus and gracilis	Double bundle or single bundle with metallic or bioabsorbable screws	2 years	Low	Moderate	Low
Ibrahim et al. 2009	Lysholm knee scores	Hamstring tendon	Single or double bundle	2 years (25-38 months)	Moderate	Moderate	Moderate
Hussein et al. 2012	Lysholm score	Semitendinosus and the gracilis autograft	Anatomic single-double bundle	2 years (39-63 months)	Moderate	Moderate	Moderate
Hussein et al. 2012	Lysholm score	Semitendinosus and the gracilis autograft	Anatomic single-double bundle	2 years (39-63 months)	Moderate	Moderate	Moderate
Jarvela et al. 2008 (A)	Lysholm score	Hamstring autograft	Single or double bundle	2 years (24-36 months)	Low	Moderate	Low
Jarvela et al. 2008 (B)	Lysholm score	Hamstring autograft	Single or double bundle	2 years (24-36 months)	Moderate	Moderate	Moderate
Ochiai et al. 2012	Lysholm score	Semitendinosus and the gracilis autograft	Single bundle or double bundle	2 years	Moderate	Moderate	Moderate
Song et al. 2009	Lysholm score	Tibialis anterior allografts	Inside-out	2 years	Moderate	Moderate	Moderate
Suomalainen et al. 2012	Lysholm score	Semitendinosus and gracilis	Double bundle or single bundle with metallic or bioabsorbable screws	5 years	Moderate	Moderate	Moderate
Zhang et al. 2013	Lysholm score	Semitendinosus and gracilis	NR	2 years	Moderate	Moderate	Moderate
Ochiai et al. 2012	SF36	Semitendinosus and the gracilis autograft	Single bundle or double bundle	2 years	High	Moderate	High
Nunez et al. 2012	SF-36 (HRQL)	Semitendinosus and the gracilis autograft	Single bundle or double bundle	2 years	Moderate	Moderate	Moderate
Ibrahim et al. 2009	Stability	Hamstring tendon	Single or double bundle	2 years (25-38 months)	High	Moderate	High

Table 67. Quality and Applicability Summary: Single Bundle Versus Double Bundle

Study	Outcome	Graft	Surgical Technique	Duration	Quality	Applicability	Overall Strength of Evidence
Suomalainen et al. 2011	Stability	Semitendinosus and gracilis	Double bundle or single bundle with metallic or bioabsorbable screws	2 years	Moderate	Moderate	Moderate
Jarvela et al. 2008 (A)	Stability (KT-1000 arthrometer)	Hamstring autograft	Single or double bundle	2 years (24-36 months)	Moderate	Moderate	Moderate
Hussein et al. 2012	Stability (Pivot shift)	Semitendinosus and the gracilis autograft	Anatomic single-double bundle	2 years (39-63 months)	Moderate	Moderate	Moderate
Zhang et al. 2013	Strength	Semitendinosus and gracilis	NR	2 years	Moderate	Moderate	Moderate
Park et al. 2010	Tegner activity scale	Hamstring tendon autograft	Single or double bundle	2 year	High	Moderate	High
Song et al. 2009	Tegner activity score	Tibialis anterior allografts	Inside-out	2 years	Low	Moderate	Low
Zhang et al. 2013	Tegner activity score	Semitendinosus and gracilis	NR	2 years	Moderate	Moderate	Moderate
Ibrahim et al. 2009	Tegner activity scores	Hamstring tendon	Single or double bundle	2 years (25-38 months)	Moderate	Moderate	Moderate
Aglietti et al. 2010	VAS	Semitendinosus and gracilis	Transtibial	2 years	High	Moderate	High

Table 68. Quality and Applicability: Single Bundle Versus Double Bundle

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Suomalainen et al. 2011	Failure	●	○	●	○	●	○	○	**Low**	●	○	●	○	**Moderate**
Aglietti et al. 2007	IKDC	●	○	●	○	●	●	●	**Moderate**	●	○	●	●	**Moderate**
Aglietti et al. 2010	IKDC	●	○	●	●	●	●	●	**High**	●	○	●	●	**Moderate**
Hussein et al. 2012	IKDC	●	○	●	●	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Hussein et al. 2012	IKDC	●	○	●	●	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Ibrahim et al. 2009	IKDC	●	○	●	●	○	●	●	**Moderate**	●	○	●	●	**Moderate**
Jarvela et al. 2008 (B)	IKDC	●	○	●	○	○	●	●	**Moderate**	●	○	●	○	**Moderate**

Table 68. Quality and Applicability: Single Bundle Versus Double Bundle

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Nunez et al. 2012	IKDC	●	○	●	●	●	●	●	**High**	●	○	●	○	**Moderate**
Park et al. 2010	IKDC	●	○	●	●	●	●	●	**High**	●	○	●	●	**Moderate**
Sastre et al. 2010	IKDC	●	○	●	●	●	●	●	**High**	●	○	●	●	**Moderate**
Suomalainen et al. 2011	IKDC	●	○	○	○	○	●	○	**Low**	●	○	●	○	**Moderate**
Suomalainen et al. 2012	IKDC	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Suomalainen et al. 2011	IKDC	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Jarvela et al. 2008(A)	IKDC function	●	○	●	○	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Jarvela et al. 2008 (A)	IKDC overall	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**

Table 68. Quality and Applicability: Single Bundle Versus Double Bundle

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Aglietti et al. 2010	IKDC sports activity	●	○	●	●	●	●	●	**High**	●	○	●	●	**Moderate**
Adachi et al. 2003	Knee joint stability	●	○	●	●	●	○	●	**Moderate**	●	○	●	○	**Moderate**
Aglietti et al. 2007	KOOS	●	○	●	○	●	●	●	**Moderate**	●	○	●	●	**Moderate**
Zhang et al. 2013	KOOS	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Aglietti et al. 2010	KOOS activities of daily living	●	○	●	●	●	●	●	**High**	●	○	●	●	**Moderate**
Aglietti et al. 2010	KOOS pain	●	○	●	●	●	●	●	**High**	●	○	●	●	**Moderate**
Aglietti et al. 2010	KOOS quality of life	●	○	●	●	●	●	●	**High**	●	○	●	●	**Moderate**
Aglietti et al. 2010	KOOS sports activity	●	○	●	●	●	●	●	**High**	●	○	●	●	**Moderate**

Table 68. Quality and Applicability: Single Bundle Versus Double Bundle

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Aglietti et al. 2010	KOOS symptoms	●	○	●	●	●	●	●	**High**	●	○	●	●	**Moderate**
Suomalainen et al. 2011	Lysholm knee score	●	○	○	○	○	●	○	**Low**	●	○	●	○	**Moderate**
Suomalainen et al. 2011	Lysholm knee score	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Ibrahim et al. 2009	Lysholm knee scores	●	○	●	●	●	●	●	**High**	●	○	●	●	**Moderate**
Hussein et al. 2012	Lysholm score	●	○	●	●	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Hussein et al. 2012	Lysholm score	●	○	●	●	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Jarvela et al. 2008 (A)	Lysholm score	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Jarvela et al. 2008 (B)	Lysholm score	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**

Table 68. Quality and Applicability: Single Bundle Versus Double Bundle

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Ochiai et al. 2012	Lysholm score	●	○	●	○	●	●	●	**Moderate**	●	○	●	●	**Moderate**
Song et al. 2009	Lysholm score	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Suomalainen et al. 2012	Lysholm score	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Zhang et al. 2013	Lysholm score	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Ochiai et al. 2012	SF36	●	○	●	○	●	●	●	**Moderate**	●	○	●	●	**Moderate**
Nunez et al. 2012	SF-36 (HRQL)	●	○	●	●	●	●	●	**High**	●	○	●	○	**Moderate**
Ibrahim et al. 2009	Stability	●	○	●	●	○	●	●	**Moderate**	●	○	●	●	**Moderate**
Suomalainen et al. 2011	Stability	●	○	●	○	●	○	●	**Moderate**	●	○	●	○	**Moderate**

Table 68. Quality and Applicability: Single Bundle Versus Double Bundle

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Jarvela et al. 2008 (A)	Stability (KT-1000 arthrometer)	●	○	●	○	●	○	○	**Low**	●	○	●	○	**Moderate**
Hussein et al. 2012	Stability (Pivot shift)	●	○	●	●	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Zhang et al. 2013	Strength	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Park et al. 2010	Tegner activity scale	●	○	●	●	●	●	●	**High**	●	○	●	●	**Moderate**
Song et al. 2009	Tegner activity score	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Zhang et al. 2013	Tegner activity score	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Ibrahim et al. 2009	Tegner activity scores	●	○	●	●	○	●	●	**Moderate**	●	○	●	●	**Moderate**
Aglietti et al. 2010	VAS	●	○	●	●	●	●	●	**High**	●	○	●	●	**Moderate**

FINDINGS

Table 69. Results: Single Bundle Versus Double Bundle

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean (sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Aglietti et al. 2007	Moderate	Failure	Double bundle single incision	25	1/25 (4%)	Single bundle single incision	25	2/25 (8%)	0.500(0.048,5.168)	NS
Aglietti et al. 2007	Moderate	IKDC sports I highly competitive	Double bundle single incision	25	10/25 (40%)	Single bundle single incision	25	10/25 (40%)	1.000(0.507,1.972)	NS
Aglietti et al. 2007	Moderate	IKDC sports II well trained and frequently in sporting	Double bundle single incision	25	7/25 (28%)	Single bundle single incision	25	7/25 (28%)	1.000(0.411,2.433)	NS
Aglietti et al. 2007	Moderate	IKDC sports III sporting sometimes	Double bundle single incision	25	5/25 (20%)	Single bundle single incision	25	5/25 (20%)	1.000(0.330,3.03)	NS
Aglietti et al. 2007	Moderate	IKDC sports IV non-sporting	Double bundle single incision	25	3/25 (12%)	Single bundle single incision	25	3/25 (12%)	1.000(0.223,4.487)	NS
Aglietti et al. 2007	Moderate	IKDC subjective	Double bundle single incision	25	79	Single bundle single incision	25	75	NA	NS
Aglietti et al. 2007	Moderate	KOOS activities of daily living	Double bundle single incision	25	95(8)	Single bundle single incision	25	97(4)	-2(-5.593,1.5930)	NS
Aglietti et al. 2007	Moderate	KOOS pain	Double bundle single incision	25	91(10)	Single bundle single incision	25	91(10)	0(-5.681,5.6810)	NS
Aglietti et al. 2007	Moderate	KOOS quality of life	Double bundle single incision	25	71(24)	Single bundle single incision	25	69(24)	2(-11.63,15.634)	NS
Aglietti et al. 2007	Moderate	KOOS sports activity	Double bundle single incision	25	81(21)	Single bundle single incision	25	81(15)	0(-10.36,10.366)	NS
Aglietti et al. 2007	Moderate	KOOS symptoms	Double bundle single incision	25	87(9)	Single bundle single incision	25	87(11)	0(-5.709,5.7093)	NS
Aglietti et al. 2007	Moderate	Kt-1000 0-2 mm	Double bundle single incision	25	16/25 (64%)	Single bundle single incision	24	14/24 (58%)	1.097(0.701,1.717)	NS
Aglietti et al.	Moderate	Kt-1000 > 6	Double bundle	25	1/25 (4%)	Single bundle	24	2/24 (8%)	0.480(0.047,4.954)	NS

Table 69. Results: Single Bundle Versus Double Bundle

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean (sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
2007		mm	single incision			single incision				
Aglietti et al. 2007	Moderate	Kt-1000 3-5 mm	Double bundle single incision	25	8/25 (32%)	Single bundle single incision	24	8/24 (33%)	0.960(0.43,2.145)	NS
Aglietti et al. 2007	Moderate	Pivot Shift Sign Absent	Double bundle single incision	25	19/25 (76%)	Single bundle single incision	24	14/24 (58%)	1.303(0.87,1.951)	NS
Aglietti et al. 2007	Moderate	Pivot Shift Sign Clunk	Double bundle single incision	25	1/25 (4%)	Single bundle single incision	24	2/24 (8%)	0.480(0.047,4.954)	NS
Aglietti et al. 2007	Moderate	Pivot Shift Sign Glide	Double bundle single incision	25	5/25 (20%)	Single bundle single incision	24	8/24 (33%)	0.600(0.228,1.578)	NS
Aglietti et al. 2010	High	IKDC subjective	Double bundle	35	83(15)	Single bundle	35	78(13)	5(-1.69,11.69)	NS
Aglietti et al. 2010	High	KOOS activities of daily living	Double bundle	35	98(2)	Single bundle	35	95(7)	3(0.54,5.45)	Favors DB
Aglietti et al. 2010	High	KOOS pain	Double bundle	35	93(8)	Single bundle	35	93(7)	0(-3.58,3.58)	NS
Aglietti et al. 2010	High	KOOS quality of life	Double bundle	35	77(17)	Single bundle	35	80(18)	-3(-11.34,5.34)	NS
Aglietti et al. 2010	High	KOOS sports activity	Double bundle	35	86(16)	Single bundle	35	88(12)	-2(-8.74,4.74)	NS
Aglietti et al. 2010	High	KOOS symptoms	Double bundle	35	90(9)	Single bundle	35	90(8)	0(-4.06,4.06)	NS
Aglietti et al. 2010	High	Pain (VAS)	Double bundle	35	8.6 (2.2)	Single bundle	35	7.6 (2.2)	1(-0.04,2.04)	NS
Aglietti et al. 2010	High	Sport activity level I	Double bundle	35	17/35(48%)	Single bundle	35	10/35(29%)	1.7(0.91,3.176)	NS
Aglietti et al. 2010	High	Sport activity level II	Double bundle	35	6/35(17%)	Single bundle	35	7/35(20%)	0.857(0.32,2.294)	NS
Aglietti et al. 2010	High	Sport activity level III	Double bundle	35	10/35(26%)	Single bundle	35	14/35(40%)	0.714(0.368,1.386)	NS
Aglietti et al. 2010	High	Sport activity level IV	Double bundle	35	2/35(6%)	Single bundle	35	4/35(11%)	0.5(0.098,2.556)	NS
Hussein et	Moderate	IKDC no. A	Double bundle	64	56/64(88%)	Single bundle	30	26/30(87%)	1(0.85,1.19)	NS

Table 69. Results: Single Bundle Versus Double Bundle

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean (sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
al. 2012		(%)								
Hussein et al. 2012	Moderate	IKDC no. B (%)	Double bundle	64	8/64(13%)	Single bundle	30	4/30(13%)	0.93(0.3,2.87)	NS
Hussein et al. 2012	Moderate	IKDC subjective	Double bundle	64	93.3(5.9)	Single bundle	30	93.1(5.2)	0.2(-2.10,2.51)	NS
Hussein et al. 2012	Moderate	Lysholm score	Double bundle	64	93.9(4.3)	Single bundle	30	93.5(3.3)	0.4(-1.25,2.50)	NS
Ibrahim et al. 2009	Moderate	IKDC subjective	Double bundle	50	NR	Single bundle	50	NR	NA	NS
Ibrahim et al. 2009	Moderate	Lysholm overall	Double bundle	50	NR	Single bundle	50	NR	NA	NS
Ibrahim et al. 2009	Moderate	Tegner activity	Double bundle	50	NR	Single bundle	50	NR	NA	NS
Jarvela et al. 2008 (b)	Moderate	IKDC objective	Double bundle	32	17/32(53%)	Single bundle	21	11/21(52%)	1.014(0.602,1.709)	NS
Jarvela et al. 2008 (b)	Moderate	IKDC objective	Double bundle	32	13/32(41%)	Single bundle	21	8/21(39%)	1.066(0.536,2.121)	NS
Jarvela et al. 2008 (b)	Moderate	IKDC objective	Double bundle	32	2/32(6%)	Single bundle	21	2/21(9%)	0.656(0.1,4.305)	NS
Jarvela et al. 2008 (b)	Moderate	Lysholm score	Double bundle	32	91(8)	Single bundle	21	94(6)	-3(-7.1,1.1)	NS
Nunez et al. 2012	High	IKDC subjective	Double bundle	29	70(10.5)	Single bundle	23	69.7(10.6)	0.3(-5.6,6.2)	NS
Nunez et al. 2012	High	SF-36 bodily pain	Double bundle	29	79.8(18.2)	Single bundle	23	84.6(15.5)	-4.8(-14.36,4.76)	NS
Nunez et al. 2012	High	SF-36 emotional role	Double bundle	29	92.0(23.0)	Single bundle	23	98.6(7.0)	-6.6(-16.58,3.39)	NS
Nunez et al. 2012	High	SF-36 general health	Double bundle	29	85.5(14.1)	Single bundle	23	89.7(10.8)	-4.2(-11.34,2.94)	NS
Nunez et al. 2012	High	SF-36 mental health	Double bundle	29	78.1(19.2)	Single bundle	23	83(14)	-4.9(-14.48,4.68)	NS
Nunez et al.	High	SF-36	Double bundle	29	90.9(11.6)	Single bundle	23	89.8(12.4)	1.1(-5.6,7.8)	NS

Table 69. Results: Single Bundle Versus Double Bundle

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean (sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
2012		physical function								
Nunez et al. 2012	High	SF-36 physical role	Double bundle	29	84.5(31.6)	Single bundle	23	90.2(25.8)	-5.7(-22.0,10.65)	NS
Nunez et al. 2012	High	SF-36 social function	Double bundle	29	91.8(13.9)	Single bundle	23	95.1(8.2)	-3.3(-9.87,3.27)	NS
Nunez et al. 2012	High	SF-36 vitality	Double bundle	29	83.6(15.5)	Single bundle	23	83.3(14.9)	0.3(-8.23,8.83)	NS
Ochiai et al. 2011	Moderate	Lysholm score	Double bundle	40	96.4(4.8)	Single bundle	44	97.1(5.6)	-0.7(-2.97,1.57)	NS
Ochiai et al. 2011	Moderate	SF-36 bodily pain	Double bundle	40	NR	Single bundle	44	NR	NA	NS
Ochiai et al. 2011	Moderate	SF-36 general health	Double bundle	40	NR	Single bundle	44	NR	NA	NS
Ochiai et al. 2011	Moderate	SF-36 mental health	Double bundle	40	NR	Single bundle	44	NR	NA	NS
Ochiai et al. 2011	Moderate	SF-36 physical functioning	Double bundle	40	NR	Single bundle	44	NR	NA	NS
Ochiai et al. 2011	Moderate	SF-36 role emotional	Double bundle	40	NR	Single bundle	44	NR	NA	NS
Ochiai et al. 2011	Moderate	SF-36 role physical	Double bundle	40	NR	Single bundle	44	NR	NA	NS
Ochiai et al. 2011	Moderate	SF-36 social functioning	Double bundle	40	NR	Single bundle	44	NR	NA	NS
Ochiai et al. 2011	Moderate	SF-36 vitality	Double bundle	40	NR	Single bundle	44	NR	NA	NS
Park et al. 2010	High	IKDC subjective	Double bundle	63	76.8(15.3)	Single bundle	50	69.8(19.8)	7(0.46,13.54)	Favors DB
Park et al. 2010	High	Orthopadische Arbeitsgruppe Knie (OAK)	Double bundle	63	89.5(6)	Single bundle	50	89.4(7.7)	0.1(-2.45,2.26)	NS

Table 69. Results: Single Bundle Versus Double Bundle

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean (sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Park et al. 2010	High	Tegner activity	Double bundle	63	5.4(2.0)	Single bundle	50	5.6(2.2)	-0.2(-0.98,0.584)	NS
Sastre et al. 2010	High	IKDC subjective	Double bundle	20	80(4)	Single bundle	20	81(3)	-1(-3.26,1.26)	NS
Suomalainen et al. 2011	Moderate	Failure	Double bundle	61	1/61 (2%)	Single bundle	60	7/60 (12%)	0.141 (0.018,1.108)	NS
Suomalainen et al. 2011	Moderate	IKDC score abnormal	Double bundle	61	11/61 (18%)	Single bundle	60	10/60 (17%)	1.082 (0.497,2.357)	NS
Suomalainen et al. 2011	Moderate	IKDC score nearly normal	Double bundle	61	23/61 (38%)	Single bundle	60	26/60 (43%)	0.870 (0.564,1.342)	NS
Suomalainen et al. 2011	Moderate	IKDC score normal	Double bundle	61	25/61 (41%)	Single bundle	60	24/60 (40%)	1.025 (0.665,1.578)	NS
Suomalainen et al. 2011	Moderate	IKDC score severely abnormal	Double bundle	61	2/61 (3%)	Single bundle	60	0/60 (0%)	4.919 (0.241,100.373)	NS
Suomalainen et al. 2011	Moderate	Lysholm score	Double bundle	61	88	Single bundle	60	88	NA	NS
Suomalainen et al. 2011	Moderate	Stability KT-1000 (IKDC) Abnormal	Double bundle	61	9/61 (15%)	Single bundle	60	7/60	1.265 (0.503,3.177)	NS
Suomalainen et al. 2011	Moderate	Stability KT-1000 (IKDC) Nearly Normal	Double bundle	61	12/61 (20%)	Single bundle	60	16/60 (27%)	0.738 (0.382,1.425)	NS
Suomalainen et al. 2011	Moderate	Stability KT-1000 (IKDC) Normal	Double bundle	61	40/61 (66%)	Single bundle	60	37/60 (62%)	1.063 (0.812,1.393)	NS
Suomalainen et al. 2011	Moderate	Stability KT-1000 (IKDC) Severely Abnormal	Double bundle	61	0/61 (0%)	Single bundle	60	0/60 (0%)	NA	NS
Suomalainen et al. 2011	Moderate	Stability KT-1000 Mean	Double bundle	61	2.0 (3.0)	Single bundle	60	2.0 (2.4)	0(-0.98,0.98)	NS

Table 69. Results: Single Bundle Versus Double Bundle

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean (sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Suomalainen et al. 2011	Moderate	Stability Pivot-Shift Test Abnormal	Double bundle	61	3/61 (5%)	Single bundle	60	4/60 (7%)	0.738 (0.172,3.157)	NS
Suomalainen et al. 2011	Moderate	Stability Pivot-Shift Test Nearly Normal	Double bundle	61	17/61 (28%)	Single bundle	60	18/60 (30%)	0.929 (0.531,1.625)	NS
Suomalainen et al. 2011	Moderate	Stability Pivot-Shift Test Normal	Double bundle	61	41/61 (67%)	Single bundle	60	38/60 (63%)	1.061 (0.818,1.377)	NS
Suomalainen et al. 2011	Moderate	Stability Pivot-Shift Test Severely Abnormal	Double bundle	61	0/61 (0%)	Single bundle	60	0/60 (0%)	NA	NS
Zhang et al. 2013	Moderate	Tegner activity score	Double bundle	45	7.73 (0.41)	Single bundle	49	7.93 (0.03)	-0.2(-0.31,-0.08)	Favors SB
Zhang et al. 2013	Moderate	Lysholm score	Double bundle	45	92.2 (7.8)	Single bundle	49	90.7 (8.0)	1.5(-1.74,4.74)	NS
Zhang et al. 2013	Moderate	KOOS - pain	Double bundle	45	97.3 (9.5)	Single bundle	49	95.7 (8.3)	1.6(-1.7,4.9)	NS
Zhang et al. 2013	Moderate	KOOS - symptoms	Double bundle	45	92.3 (3.5)	Single bundle	49	90.6 (7.2)	1.7(-0.56,4.05)	NS
Zhang et al. 2013	Moderate	KOOS - activities of daily living	Double bundle	45	96.4 (2.9)	Single bundle	49	93.7 (3.3)	2.7(1.42(3.97)	Favors DB
Zhang et al. 2013	Moderate	KOOS - sports	Double bundle	45	88.5 (2.2)	Single bundle	49	90.6 (5.3)	-2.1(-3.78,-0.41)	Favors SB
Zhang et al. 2013	Moderate	KOOS - quality of life	Double bundle	45	83.7 (4.3)	Single bundle	49	80.9 (7.7)	2.8(0.21,5.38)	Favors DB
Zhang et al. 2013	Moderate	Muscle Strength - peak flexion	Double bundle	45	6.5 N/m	Single bundle	49	6.7 N/m	NA	NS

Table 69. Results: Single Bundle Versus Double Bundle

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean (sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		torque reduction (compared to uninjured knee)								
Adachi et al. 2004	Moderate	Difference in anterior laxity relative to normal knee at 20° of flexion in mm	Double-bundle	53	1.3 (2.5)	Single-bundle	55	1.2 (2.5)	(-0.854, 1.05)	NS
Adachi et al. 2004	Moderate	Side-to-Side differences of anterior laxity with the knee at 70° of flexion in mm	Double-bundle	53	1.2 (1.6)	Single-bundle	55	1.5 (2.0)	(-0.992, 0.392)	NS
Adachi et al. 2004	Moderate	Final inaccuracy at low angles in degrees	Double-bundle	53	0.68 (1.4)	Single-bundle	55	0.75 (1.4)	(-0.604, 0.464)	NS
Adachi et al. 2004	Moderate	Final inaccuracy at greater angles in degrees	Double-bundle	53	0.67 (1.1)	Single-bundle	55	0.64 (1.1)	(-0.39, 0.45)	NS
Adachi et al. 2004	Moderate	Incidence of notchplasty	Double-bundle	53	10/53 (19%)	Single-bundle	55	20/55 (36%)	P = 0.0454	Favors single-bundle

Table 70. Results: Single Bundle Versus Double Bundle (3 and 5 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Suomalainen et al. 2012	Moderate	Failure	Single bundle with bioabsorbable screw	28	7/28 (25%)	Single bundle with metallic screw	27	3/27 (11%)	2.250(0.648,7. 813)	NS
Suomalainen et al. 2012	Moderate	Failure	Double bundle	21	1/21 (5%)	Single bundle with bioabsorbable screw	28	7/28 (25%)	0.190(0.025,1. 432)	NS
Suomalainen et al. 2012	Moderate	Failure	Double bundle	21	1/21 (5%)	Single bundle with metallic screw	27	3/27 (11%)	0.429(0.048,3. 83)	NS
Suomalainen et al. 2012	Moderate	IKDC A(normal)	Double bundle	20	5/20 (25%)	Single bundle with bioabsorbable screw	21	3/21 (14%)	1.750(0.480,6. 381)	NS
Suomalainen et al. 2012	Moderate	IKDC A(normal)	Double bundle	20	5/20 (25%)	Single bundle with metallic screw	24	3/24 (13%)	2.000(0.544,7. 357)	NS
Suomalainen et al. 2012	Moderate	IKDC A(normal)	Single bundle with bioabsorbable screw	21	3/21 (14%)	Single bundle with metallic screw	24	3/24 (13%)	1.143(0.258,5. 067)	NS
Suomalainen et al. 2012	Moderate	IKDC B(nearly normal)	Double bundle	20	11/20 (55%)	Single bundle with bioabsorbable screw	21	13/21 (62%)	0.888(0.529,1. 493)	NS
Suomalainen et al. 2012	Moderate	IKDC B(nearly normal)	Double bundle	20	11/20 (55%)	Single bundle with metallic screw	24	12/24 (50%)	1.100(0.626,1. 932)	NS
Suomalainen et al. 2012	Moderate	IKDC B(nearly normal)	Single bundle with bioabsorbable screw	21	13/21(62%)	Single bundle with metallic screw	24	12/24(50%)	1.238(0.734,2. 087)	NS
Suomalainen et al. 2012	Moderate	IKDC C(abnormal)	Double bundle	20	4/20(20%)	Single bundle with bioabsorbable screw	21	5/21(24%)	0.840(0.262,2. 689)	NS
Suomalainen et al. 2012	Moderate	IKDC C(abnormal)	Double bundle	20	4/20(20%)	Single bundle with metallic screw	24	9/24	0.533(0.193,1. 475)	NS
Suomalainen	Moderate	IKDC C(abnormal)	Single bundle	21	5/21(24%)	Single bundle with	24	9/24(38%)	0.635(	NS

Table 70. Results: Single Bundle Versus Double Bundle (3 and 5 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
et al. 2012			with bioabsorbable screw			metallic screw			0.252,1.598)	
Suomalainen et al. 2012	Moderate	Lateral femorotibial compartment (Grade I arthrosis)	Double bundle	20	1/20(5%)	Single bundle with bioabsorbable screw	21	2/21(10%)	0.525(0.052,5.348)	NS
Suomalainen et al. 2012	Moderate	Lateral femorotibial compartment (Grade I arthrosis)	Double bundle	20	1/20(5%)	Single bundle with metallic screw	24	3/24(13%)	0.400(0.045,3.553)	NS
Suomalainen et al. 2012	Moderate	Lateral femorotibial compartment (Grade I arthrosis)	Single bundle with bioabsorbable screw	21	2/21(10%)	Single bundle with metallic screw	24	3/24(13%)	0.762(0.140,4.132)	NS
Suomalainen et al. 2012	Moderate	Lateral femorotibial compartment (Grade II arthrosis)	Double bundle	20	1/20(5%)	Single bundle with bioabsorbable screw	21	2/21(10%)	0.525(0.052,5.348)	NS
Suomalainen et al. 2012	Moderate	Lateral femorotibial compartment (Grade II arthrosis)	Double bundle	20	1/20(5%)	Single bundle with metallic screw	24	0/24(0%)	3.571(0.153,83 .142)	NS
Suomalainen et al. 2012	Moderate	Lateral femorotibial compartment (Grade II arthrosis)	Single bundle with bioabsorbable screw	21	2/21(10%)	Single bundle with metallic screw	24	0/24(0%)	5.682(0.288,11 2.066)	NS
Suomalainen et al. 2012	Moderate	Lateral femorotibial compartment (Grade III-IV arthrosis)	Double bundle	20	0/20(0%)	Single bundle with bioabsorbable screw	21	0/21(0%)	NA	NS
Suomalainen et al. 2012	Moderate	Lateral femorotibial compartment (Grade III-IV arthrosis)	Double bundle	20	0/20(0%)	Single bundle with metallic screw	24	1/24(4%)	0.397(0.017,9. 238)	NS
Suomalainen et al. 2012	Moderate	Lateral femorotibial compartment (Grade III-IV arthrosis)	Single bundle with bioabsorbable screw	21	0/21(0%)	Single bundle with metallic screw	24	1/24(4%)	0.379(0.016,8. 83)	NS
Suomalainen	Moderate	Lateral femorotibial	Double bundle	20	18/20(90%)	Single bundle with	21	17/21(81%)	1.112(0.863,1.	NS

Table 70. Results: Single Bundle Versus Double Bundle (3 and 5 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
et al. 2012		compartment (Normal)				bioabsorbable screw			433)	
Suomalainen et al. 2012	Moderate	Lateral femorotibial compartment (Normal)	Double bundle	20	18/20(90%)	Single bundle with metallic screw	24	20/24(83%)	1.080(0.857,1. 361)	NS
Suomalainen et al. 2012	Moderate	Lateral femorotibial compartment (Normal)	Single bundle with bioabsorbable screw	21	17/21(81%)	Single bundle with metallic screw	24	20/24(83%)	0.971(0.739,1. 278)	NS
Suomalainen et al. 2012	Moderate	Lysholm score	Double bundle	20	90 (9)	Single bundle with bioabsorbable screw	21	86 (13)	4(-3.08,11.08)	NS
Suomalainen et al. 2012	Moderate	Lysholm score	Double bundle	20	90 (9)	Single bundle with metallic screw	24	87 (17)	3(-5.52,11.52)	NS
Suomalainen et al. 2012	Moderate	Lysholm score	Single bundle with bioabsorbable screw	21	86 (13)	Single bundle with metallic screw	24	87 (17)	-1(-1019,8.19)	NS
Suomalainen et al. 2012	Moderate	Medial femorotibial compartment (Grade I arthrosis)	Double bundle	20	3/20 (15%)	Single bundle with bioabsorbable screw	21	5/21 (24%)	0.630(0.173,2. 297)	NS
Suomalainen et al. 2012	Moderate	Medial femorotibial compartment (Grade I arthrosis)	Double bundle	20	3/20 (15%)	Single bundle with metallic screw	24	6/24 (25%)	0.600(0.171,2. 099)	NS
Suomalainen et al. 2012	Moderate	Medial femorotibial compartment (Grade I arthrosis)	Single bundle with bioabsorbable screw	21	5/21 (24%)	Single bundle with metallic screw	24	6/24 (25%)	0.952(0.339,2. 674)	NS
Suomalainen et al. 2012	Moderate	Medial femorotibial compartment (Grade II arthrosis)	Double bundle	20	1/20 (5%)	Single bundle with bioabsorbable screw	21	1/21 (5%)	1.050(0.070,15 .676)	NS
Suomalainen et al. 2012	Moderate	Medial femorotibial compartment (Grade II arthrosis)	Double bundle	20	1/20 (5%)	Single bundle with metallic screw	24	1/24 (4%)	1.200(0.080,17 .991)	NS

Table 70. Results: Single Bundle Versus Double Bundle (3 and 5 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Suomalainen et al. 2012	Moderate	Medial femorotibial compartment (Grade II arthrosis)	Single bundle with bioabsorbable screw	21	1/21 (5%)	Single bundle with metallic screw	24	1/24 (4%)	1.143(0.076,17.163)	NS
Suomalainen et al. 2012	Moderate	Medial femorotibial compartment (Grade III-IV arthrosis)	Double bundle	20	0/20 (0%)	Single bundle with bioabsorbable screw	21	0/21 (0%)	NA	NS
Suomalainen et al. 2012	Moderate	Medial femorotibial compartment (Grade III-IV arthrosis)	Double bundle	20	0/20 (0%)	Single bundle with metallic screw	24	1/24 (4%)	0.397(0.017,9.238)	NS
Suomalainen et al. 2012	Moderate	Medial femorotibial compartment (Grade III-IV arthrosis)	Single bundle with bioabsorbable screw	21	0/21 (0%)	Single bundle with metallic screw	24	1/24 (4%)	0.379(0.016,8.830)	NS
Suomalainen et al. 2012	Moderate	Medial femorotibial compartment (Normal)	Double bundle	20	16/20 (80%)	Single bundle with bioabsorbable screw	21	15/21 (71%)	1.120(0.791,1.586)	NS
Suomalainen et al. 2012	Moderate	Medial femorotibial compartment (Normal)	Double bundle	20	16/20 (80%)	Single bundle with metallic screw	24	15/24 (63%)	1.280(0.876,1.871)	NS
Suomalainen et al. 2012	Moderate	Medial femorotibial compartment (Normal)	Single bundle with bioabsorbable screw	21	15/21 (71%)	Single bundle with metallic screw	24	15/24 (63%)	1.143(0.757,1.724)	NS
Suomalainen et al. 2012	Moderate	Patellofemoral compartment (Grade I arthrosis)	Double bundle	20	4/20 (20%)	Single bundle with bioabsorbable screw	21	7/21 (33%)	0.600(0.207,1.740)	NS
Suomalainen et al. 2012	Moderate	Patellofemoral compartment (Grade I arthrosis)	Double bundle	20	4/20 (20%)	Single bundle with metallic screw	24	4/24 (17%)	1.200(0.343,4.199)	NS
Suomalainen et al. 2012	Moderate	Patellofemoral compartment (Grade I arthrosis)	Single bundle with bioabsorbable screw	21	7/21 (33%)	Single bundle with metallic screw	24	4/24 (17%)	2.000(0.679,5.889)	NS

Table 70. Results: Single Bundle Versus Double Bundle (3 and 5 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Suomalainen et al. 2012	Moderate	Patellofemoral compartment (Grade II arthrosis)	Double bundle	20	1/20 (5%)	Single bundle with bioabsorbable screw	21	1/21 (5%)	1.050(0.070,15 .676)	NS
Suomalainen et al. 2012	Moderate	Patellofemoral compartment (Grade II arthrosis)	Double bundle	20	1/20 (5%)	Single bundle with metallic screw	24	2/24 (8%)	0.600(0.059,6. 142)	NS
Suomalainen et al. 2012	Moderate	Patellofemoral compartment (Grade II arthrosis)	Single bundle with bioabsorbable screw	21	1/21 (5%)	Single bundle with metallic screw	24	2/24 (8%)	0.571(0.056,5. 861)	NS
Suomalainen et al. 2012	Moderate	Patellofemoral compartment (Grade III-IV arthrosis)	Double bundle	20	0/20 (0%)	Single bundle with bioabsorbable screw	21	0/21 (0%)	NA	NS
Suomalainen et al. 2012	Moderate	Patellofemoral compartment (Grade III-IV arthrosis)	Double bundle	20	0/20 (0%)	Single bundle with metallic screw	24	0/24 (0%)	NA	NS
Suomalainen et al. 2012	Moderate	Patellofemoral compartment (Grade III-IV arthrosis)	Single bundle with bioabsorbable screw	21	0/21 (0%)	Single bundle with metallic screw	24	0/24 (0%)	NA	NS
Suomalainen et al. 2012	Moderate	Patellofemoral compartment (Normal)	Double bundle	20	15/20 (75%)	Single bundle with bioabsorbable screw	21	13/21 (62%)	1.212(0.796,1. 844)	NS
Suomalainen et al. 2012	Moderate	Patellofemoral compartment (Normal)	Double bundle	20	15/20 (75%)	Single bundle with metallic screw	24	18/24 (75%)	1.000(0.710,1. 409)	NS
Suomalainen et al. 2012	Moderate	Patellofemoral compartment (Normal)	Single bundle with bioabsorbable screw	21	13/21 (62%)	Single bundle with metallic screw	24	18/24 (75%)	0.825(0.549,1. 240)	NS
Suomalainen et al. 2012	Moderate	Stability KT-1000 mean	Double bundle	20	1.6 (3.0)	Single bundle with bioabsorbable screw	21	2.2 (2.8)	-0.6(- 2.42,1.41)	NS
Suomalainen	Moderate	Stability KT-1000	Double bundle	20	1.6 (3.0)	Single bundle with	24	2.3 (3.8)	-0.7(-	NS

Table 70. Results: Single Bundle Versus Double Bundle (3 and 5 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
et al. 2012		mean				metallic screw			2.81,1.41)	
Suomalainen et al. 2012	Moderate	Stability KT-1000 mean	Single bundle with bioabsorbable screw	21	2.2 (2.8)	Single bundle with metallic screw	24	2.3 (3.8)	0.5(-1.53,2.53)	NS
Suomalainen et al. 2012	Moderate	Stability Pivot-Shift Test (Abnormal)	Double bundle	20	3/20 (15%)	Single bundle with bioabsorbable screw	21	2/21 (10%)	1.575(0.293,8.460)	NS
Suomalainen et al. 2012	Moderate	Stability Pivot-Shift Test (Abnormal)	Double bundle	20	3/20 (15%)	Single bundle with metallic screw	24	6/24 (25%)	0.600(0.171,2.099)	NS
Suomalainen et al. 2012	Moderate	Stability Pivot-Shift Test (Abnormal)	Single bundle with bioabsorbable screw	21	2/21	Single bundle with metallic screw	24	6/24 (25%)	0.381(0.086,1.689)	NS

Table 71. Results: Single Bundle Versus Double Bundle (Tibialis Anterior Allograft)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Song et al. 2009	Moderate	Extension limitation ROM	Double bundle	19	0.8 (1.9)	Single bundle	19	0.5 (1.6)	0.3(-0.85,1.45)	NS
Song et al. 2009	Moderate	Lachman stability: Grade 0	Double bundle	19	14/19 (73%)	Single bundle	19	12/19 (63%)	1.167(0.754,1.8 04)	NS
Song et al. 2009	Moderate	Lachman stability: Grade 1+	Double bundle	19	4/19 (21%)	Single bundle	19	5/19 (26%)	0.800(0.253,2.5 29)	NS
Song et al. 2009	Moderate	Lachman stability: Grade 2+	Double bundle	19	1/19 (5%)	Single bundle	19	2/19 (11%)	0.500(0.049,5.0 61)	NS
Song et al. 2009	Moderate	Lachman stability: Grade 3+	Double bundle	19	0/19 (0%)	Single bundle	19	0/19 (0%)	NA	NS
Song et al. 2009	Moderate	Lysholm score	Double bundle	19	93.3 (6.2)	Single bundle	19	92.5 (7.7)	0.8(-3.79,5.39)	NS
Song et al. 2009	Moderate	Pivot-Shift stability: Grade 0	Double bundle	19	14/19 (73%)	Single bundle	19	11/19 (58%)	1.273 (0.797,2.033)	NS
Song et al. 2009	Moderate	Pivot-Shift stability: Grade 1+	Double bundle	19	4/19 (21%)	Single bundle	19	6/19 (32%)	0.667 (0.223,1.990)	NS
Song et al. 2009	Moderate	Pivot-Shift stability: Grade 2+	Double bundle	19	1/19 (5%)	Single bundle	19	2/19 (11%)	0.500 (0.049,5.061)	NS
Song et al. 2009	Moderate	Pivot-Shift stability: Grade 3+	Double bundle	19	0/19 (0%)	Single bundle	19	0/19 (0%)	NA	NS
Song et al. 2009	Moderate	Side-to-Side difference ROM	Double bundle	19	2.7 (1.9)	Single bundle	19	2.8 (2.0)	-0.1(-1.38,1.18)	NS
Song et al. 2009	Moderate	Tegner activity score	Double bundle	19	6.9 (1.1)	Single bundle	19	6.9 (1.3)	0(-0.79,0.790	NS

Table 72. Results: Augmentation Versus Double Bundle

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Park et al. 2012	High	VAS score	Augmentation	55	1.9 (1.0)	Double Bundle	45	2.0 (1.0)	-0.1(-0.50,0.30)	NS
Park et al. 2012	High	Lysholm Score	Augmentation	55	88.3 (4.9)	Double Bundle	45	86.4 (4.4)	1.9(0.03,3.77)	Favors augmentation
Park et al. 2012	High	Tegner activity score	Augmentation	55	7.3 (1.3)	Double Bundle	45	6.9 (1.2)	0.4(-0.10,0.90)	NS
Park et al. 2012	High	IKDC Subjective Knee Evaluation Form Score	Augmentation	55	83.3 (8.4)	Double Bundle	45	82.8 (4.4)	0.5(-2.01,3.01)	NS
Park et al. 2012	High	Anterior Drawer Test: 0	Augmentation	55	53/55(96.4%)	Double Bundle	45	38/45(84.4%)	1.14(1.0,1.31)	Favors Augmentation
Park et al. 2012	High	Range of Motion (ROM)	Augmentation	55	143.6° (9.8°)	Double Bundle	45	146° (6.4°)	-2.4(-5.77,0.97)	NS
Park et al. 2012	High	Lachman (negative)	Augmentation	55	50/55(90.9%)	Double Bundle	45	36/45(80%)	1.14(0.96,1.34)	NS
Park et al. 2012	High	Pivot-shift negative	Augmentation	55	50/55(90.9%)	Double Bundle	45	40/45(88.9%)	1.02(0.90,1.17)	NS
Park et al. 2012	High	KT-100	Augmentation	55	1.5 (1.5)	Double Bundle	45	1.7 (1.4)	-0.2(-0.78,0.38)	NS
Park et al. 2012	High	Telos Stress Radiography	Augmentation	55	2.7 (1.2)	Double Bundle	45	2.6 (0.8)	0.1(-0.31,0.51)	NS
Park et al. 2012	High	Medial meniscal tear incidence	Augmentation	55	19/55(34.5%)	Double Bundle	45	35/45(77.8%)	0.44(0.30,0.66)	Favors Augmentation
Park et al. 2012	High	Lateral meniscal tear incidence	Augmentation	55	22/55(40%)	Double Bundle	45	20/45(44.4%)	0.9(0.57,1.43)	NS

Figure 4. Meta-Analysis Forest Plot of Double Bundle Versus Single Bundle (Pain)

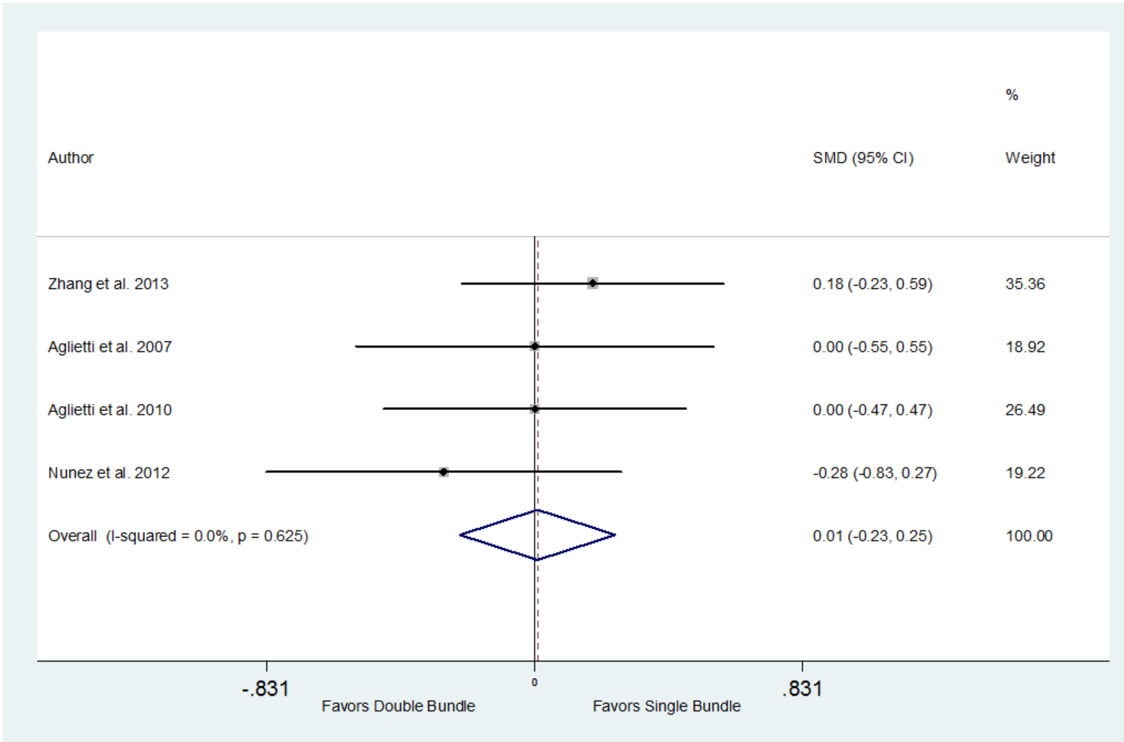


Figure 5. Meta-Analysis Forest Plot of Double Bundle Versus Single Bundle (IKDC Subjective)

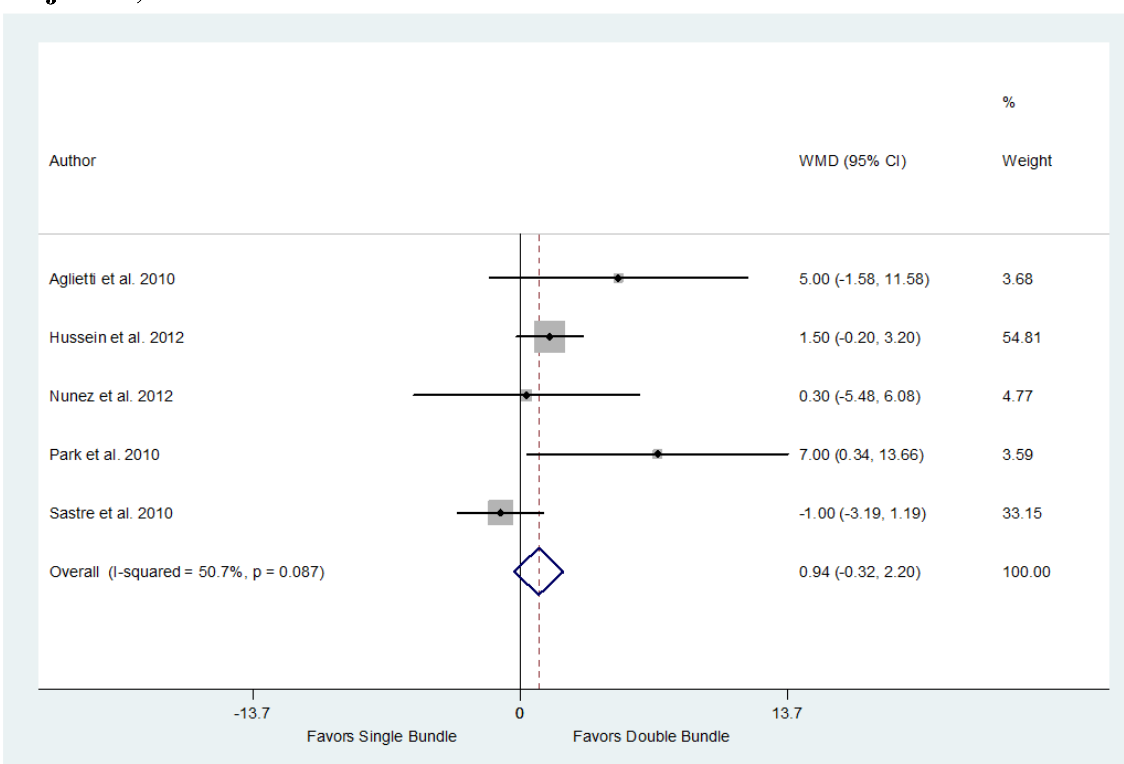
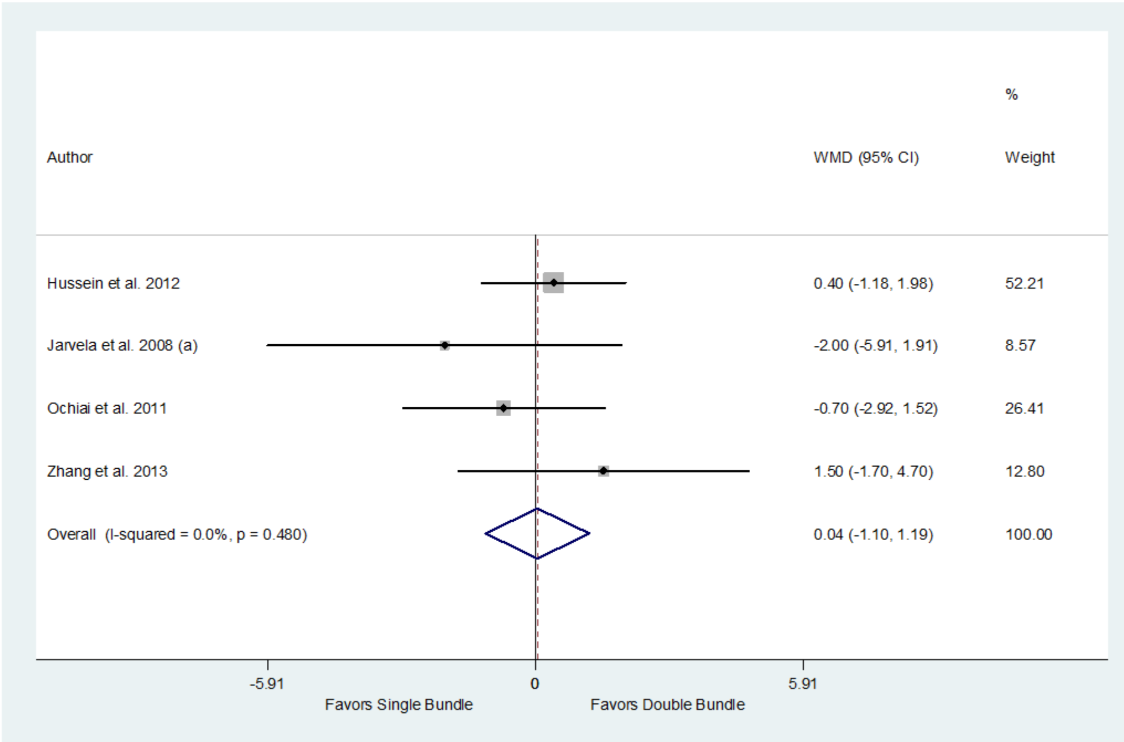


Figure 6. Meta-Analysis: Forest Plot of Double Bundle Versus Single Bundle Lysholm Score



ACL AUTOGRAFT SOURCE

Strong evidence supports that in patients undergoing intra-articular ACL reconstruction using autograft tissue the practitioner should use bone-patellar tendon-bone or hamstring-tendon grafts, because the measured outcomes are similar.

Strength of Recommendation: Strong ★★★★

RATIONALE

There were four high-strength, and 19 moderate-strength studies included in this recommendation.[3, 7,10, 10, 13, 22, 27, , 28, 34, **Error! Reference source not found.**, 49, 52, 63, 64, 86, 95, 96, 100, 115, 118, 119, 122] Graft choice did not matter with respect to stability testing in three high-strength studies and ten moderate-strength studies.[10, 16, 26, 48, 72, 111, 159, 165, 243, 287,294, 308] Patient satisfaction, normal IKDC score , and graft failure were also not different between the two graft choices.[10, 10, 13, 22, 27, 28, **Error! Reference source not found.** 49, 52, 63, 64, 96, 115]

However, significantly more post-operative kneeling pain was present in the patella tendon group as demonstrated by two high-strength studies and one moderate-strength study.[28, 52, 96]

POTENTIAL HARMS OF IMPLEMENTATION

Possible graft failure in either graft is possible and reported

FUTURE RESEARCH

Recommend evaluation of radiographic and symptomatic osteoarthritis as mid to long term outcome measures in comparison studies between extensor mechanism grafts (patellar and quad tendons) and hamstring grafts. Additional research comparing ipsilateral grafts to contralateral grafts is also needed.

SUMMARY OF FINDINGS

Table 73. Summary of Findings: Patellar Tendon Versus Hamstring Tendon 2 Year

🟢:Favors Patellar tendon 🔴:Favors Hamstring tendon ○:Not significant	**Scales/Measures**	Aglietti et al. 2004 *(M)*	Andersson et al. 2001 *(M)*	Comba et al. 1999 *(M)*	Ejerhed et al. 2003 *(M)*	Feller et al. 2003 *(H)*	Leal-Blanquet et al. 2011 *(M)*	Shaieb et al. 2002 *(M)*	Tow et al. 2005 *(M)*	**Meta-Analysis**
Patient satisfaction							○			NA
Function			🟢		○		○			NA
Pain		○				🔴	○	○		NA
	IKDC subjective	○				○				NA
	IKDC Normal		○	○	○		○		○	○
	Lysholm Score				○			○		NA
	Cincinnati knee Score					○				NA
Failure								○		NA
Quality of life		○								NA
Activities of daily living		○	○							NA
Return to play						○				NA
	Tegner Activity				○					NA
Stability			○	○	○	🟢	○		○	NA
Osteoarthritis			○							NA
Complications								○		NA
Strength		○					○		○	NA
Range of motion			○			🟢		🔴		NA

Table 74. Patellar Tendon Versus Hamstring Tendon 3 Years

🟢:Favors Patellar tendon

🔴:Favors Hamstring tendon

○:Not significant

Scales/Measures	Beynnon et al. 2002 *(M)*	Feller et al. 2003 *(H)*	Ibrahim et al. 2005 *(M)*	Meta- Analysis
Patient satisfaction	○			NA
Function				NA
Pain		🔴	🔴	NA
IKDC subjective		○		NA
IKDC Normal	○	○	○	○
Lysholm Score			○	NA
Cincinnati knee Score		○		NA
Activities of daily living			○	NA
Return to play				NA
Tegner Activity	○		○	NA
Stability	🟢	○	○	NA
Osteoarthritis		○		NA
Complications		○		NA
Strength	○			NA
Range of motion		○		NA

Overall strength of study; High: *(H)*, Moderate: *(M)*, Low: *(L)*, Very low: *(V)*

Table 75. Patellar Tendon Versus Hamstring Tendon 5-11 Year Follow-up

🟢:Favors Patellar tendon 🔴:Favors Hamstring tendon ○:Not significant	**Scales/Measures**	Sajovic et al. 2006 *(M)*	Harilainen et al. 2006 *(M)*	Volpi et al. 2009 *(M)*	Zaffagnini et al. 2006 *(M)*	Liden et al. 2007 *(H)*	Ahlden et al. 2009 *(M)*	Barenius et al. 2010 *(M)*	Holm et al. 2010 *(M)*	Sajovic et al. 2011 *(H)*	**Meta-Analysis**
Patient satisfaction											NA
Function						○	○	○	○		NA
Pain					○				○	○	NA
	IKDC Normal		○			○		○		○	NA
	Lysholm Score	○	○	○		🔴		○	○	○	○
	Cincinnati knee Score								○		NA
Failure									○		NA
Quality of life								○			NA
Activities of daily living								○			NA
Return to play									○		NA
	Tegner Activity		○	○	○	🔴	○	🟢			*NA*
Stability		🟢	○		○	○	○	○		○	NA
Osteoarthritis							○		○	🔴	NA
Strength			○						○		NA
Range of motion						○	○	○			NA

Overall strength of study; High: *(H)*, Moderate: *(M)*, Low: *(L)*, Very low: *(V)*

Table 76. Patellar Tendon Versus Quadrupled Hamstring Tendon

🟢:Favors Patellar tendon

🔴:Favors quadrupled tendon

○:Not significant

	Scales/Measures	Eriksson et al. 2001*(M)*	Webster et al. 2001 *(M)*	Zaffagnini et al. 2006 *(M)*	Roe et al. 2005 *(M)*	Pinczewski et al. 2007 *(M)*	Meta-Analysis
Patient satisfaction							NA
Function		○				○	NA
Pain		🟢			🔴	🔴	NA
	IKDC subjective				○		NA
	IKDC Normal	○	○	○			NA
	Lysholm Score	○			○	○	NA
	Cincinnati knee Score		○				NA
Failure		○			○	○	NA
Activities of daily living		○					NA
	Tegner Activity	○		○			NA
Stability		○	○	○	○		NA
Osteoarthritis					🔴	🔴	NA
Complications		○				○	NA
Range of motion		○	○		○	○	NA

Overall strength of study; High: *(H)*, Moderate: *(M)*, Low: *(L)*, Very low: *(V)*

QUALITY AND APPLICABILITY SUMMARY

Table 77. Quality and Applicability Summary: Bone Patellar Tendon Bone Versus Hamstring, Other

Study	Outcome	Graft	Surgical Technique	Duration	Quality	Applicability	Overall Strength of Evidence
Adachi et al. 2003	Strength	Allogeneic fascia lata/ Autologous semitendinosus tendon/ Combination of semitendinosus and gracilis tendon	Arthroscopically assisted one-incision technique	>2 year	Very Low	Moderate	Very Low
Aglietti et al. 2004	IKDC	Bone-patellar tendon bone/ Doubled hamstring tendon autograft	NR (Mariani et al. and Howell and Gottlieb et al.)	2 years	Moderate	Moderate	Moderate
Aglietti et al. 2004	Range of motion	Bone-patellar tendon bone/ Doubled hamstring tendon autograft	NR (Mariani et al. and Howell and Gottlieb et al.)	2 years	Moderate	Moderate	Moderate
Aglietti et al. 2004	Pain (VAS)	Bone-patellar tendon bone/ Doubled hamstring tendon autograft	NR (Mariani et al. and Howell and Gottlieb et al.)	2 years	Moderate	Moderate	Moderate
Aglietti et al. 2004	Muscle strength	Bone-patellar tendon bone/ Doubled hamstring tendon autograft	NR (Mariani et al. and Howell and Gottlieb et al.)	2 years	Moderate	Moderate	Moderate
Aglietti et al. 2004	Pain (KOOS)	Bone-patellar tendon bone/ Doubled hamstring tendon autograft	NR (Mariani et al. and Howell and Gottlieb et al.)	2 years	Moderate	Moderate	Moderate
Aglietti et al. 2004	Symptoms (KOOS)	Bone-patellar tendon bone/ Doubled hamstring tendon autograft	NR (Mariani et al. and Howell and Gottlieb et al.)	2 years	Moderate	Moderate	Moderate
Aglietti et al. 2004	Activities of daily living (KOOS)	Bone-patellar tendon bone/ Doubled hamstring tendon autograft	NR (Mariani et al. and Howell and Gottlieb et al.)	2 years	Moderate	Moderate	Moderate
Aglietti et al. 2004	Sports activities (KOOS)	Bone-patellar tendon bone/ Doubled hamstring tendon autograft	NR (Mariani et al. and Howell and Gottlieb et al.)	2 years	Moderate	Moderate	Moderate
Aglietti et al. 2004	Quality of life (KOOS)	Bone-patellar tendon bone/ Doubled hamstring tendon autograft	NR (Mariani et al. and Howell and Gottlieb et al.)	2 years	Moderate	Moderate	Moderate
Aglietti et al. 2004	Clinical/Instrumental testing	Bone-patellar tendon bone/ Doubled hamstring tendon autograft	NR (Mariani et al. and Howell and Gottlieb et al.)	2 years	Moderate	Moderate	Moderate
Ahlden et al. 2009	Clinical assessments	Bone patellar tendon bone autograft and Semitendinosus graft	Transtibial	7 years	Moderate	Moderate	Moderate
Ahlden et al. 2009	One leg hop test	Bone patellar tendon bone autograft and Semitendinosus graft	Transtibial	7 years	Moderate	Moderate	Moderate
Ahlden et al. 2009	Lysholm knee score	Bone patellar tendon bone autograft and Semitendinosus graft	Transtibial	7 years	Moderate	Moderate	Moderate
Ahlden et al. 2009	Tegner activity scale	Bone patellar tendon bone autograft and Semitendinosus graft	Transtibial	7 years	Moderate	Moderate	Moderate
Anderson et al. 2001	IKDC	Patellar tendon graft/ semitendinosus and gracilis	Single incision/Extra-articular procedure lateral incision 3cm and 5cm	2 years	Moderate	Moderate	Moderate
Anderson et al. 2001	Complications	Patellar tendon graft/ semitendinosus and gracilis	Single incision/Extra-articular procedure lateral incision 3cm and 5cm	2 years	Moderate	Moderate	Moderate
Anderson et al. 2001	Activity level	Patellar tendon graft/ semitendinosus and gracilis	Single incision/Extra-articular procedure lateral incision 3cm and 5cm	2 years	Moderate	Moderate	Moderate

Table 77. Quality and Applicability Summary: Bone Patellar Tendon Bone Versus Hamstring, Other

Study	Outcome	Graft	Surgical Technique	Duration	Quality	Applicability	Overall Strength of Evidence
Anderson et al. 2001	Hospital for special surgery knee scores	Patellar tendon graft/ semitendinosus and gracilis	Single incision/Extra-articular procedure lateral incision 3cm and 5cm	2 years	Moderate	Moderate	Moderate
Barenius et al. 2010	IKDC	Patellar tendon/Quadrupled semitendinosus graft	Longitudinal incision over the pes anserinus	8 years	Moderate	Moderate	Moderate
Barenius et al. 2010	Lysholm score	Patellar tendon/Quadrupled semitendinosus graft	Longitudinal incision over the pes anserinus	8 years	Moderate	Moderate	Moderate
Barenius et al. 2010	Tegner activity score	Patellar tendon/Quadrupled semitendinosus graft	Longitudinal incision over the pes anserinus	8 years	Moderate	Moderate	Moderate
Barenius et al. 2010	Clinical assessment	Patellar tendon/Quadrupled semitendinosus graft	Longitudinal incision over the pes anserinus	8 years	Moderate	Moderate	Moderate
Barenius et al. 2010	KOOS	Patellar tendon/Quadrupled semitendinosus graft	Longitudinal incision over the pes anserinus	8 years	Moderate	Moderate	Moderate
Barenius et al. 2010	Patellofemoral pain score	Patellar tendon/Quadrupled semitendinosus graft	Longitudinal incision over the pes anserinus	8 years	Moderate	Moderate	Moderate
Beynnon et al. 2002	Strength	Bone-patellar tendon bone/Semitendinosus-gracilis grafting	Two-incision technique	3 years	Moderate	Moderate	Moderate
Beynnon et al. 2002	Function	Bone-patellar tendon bone/Semitendinosus-gracilis grafting	Two-incision technique	3 years	Moderate	Moderate	Moderate
Beynnon et al. 2002	Patient satisfaction	Bone-patellar tendon bone/Semitendinosus-gracilis grafting	Two-incision technique	3 years	Moderate	Moderate	Moderate
Beynnon et al. 2002	Tegner activity level	Bone-patellar tendon bone/Semitendinosus-gracilis grafting	Two-incision technique	3 years	Moderate	Moderate	Moderate
Beynnon et al. 2002	Function	Bone-patellar tendon bone/Semitendinosus-gracilis grafting	Two-incision technique	3 years	Moderate	Moderate	Moderate
Comba et al. 1999	IKDC	Bone patellar tendon bone/ Double looped semitendinosus and gracilis tendons	Uni-tunnel technique with bioabsorbable aperture fixation	2 years	Moderate	Moderate	Moderate
Comba et al. 1999	Stability	Bone patellar tendon bone/ Double looped semitendinosus and gracilis tendons	Uni-tunnel technique with bioabsorbable aperture fixation	2 years	Moderate	Moderate	Moderate
Comba et al. 1999	Functional one leg hop test	Bone patellar tendon bone/ Double looped semitendinosus and gracilis tendons	Uni-tunnel technique with bioabsorbable aperture fixation	2 years	Moderate	Moderate	Moderate
Ejerhed et al. 2003	IKDC	Bone patellar tendon bone autograft and Semitendinosus graft	Transtibial technique	2 years	Moderate	Moderate	Moderate
Ejerhed et al. 2003	Lysholm score	Bone patellar tendon bone autograft and Semitendinosus graft	Transtibial technique	2 years	High	Moderate	High
Ejerhed et al. 2003	Tegner activity level	Bone patellar tendon bone autograft and Semitendinosus graft	Transtibial technique	2 years	High	Moderate	High
Ejerhed et al.	Single-legged hop test	Bone patellar tendon bone autograft	Transtibial technique	2 years	Moderate	Moderate	Moderate

Table 77. Quality and Applicability Summary: Bone Patellar Tendon Bone Versus Hamstring, Other

Study	Outcome	Graft	Surgical Technique	Duration	Quality	Applicability	Overall Strength of Evidence
2003		and Semitendinosus graft					
Ejerhed et al. 2003	Knee-walking test	Bone patellar tendon bone autograft and Semitendinosus graft	Transtibial technique	2 years	Moderate	Moderate	Moderate
Ejerhed et al. 2003	KT-1000 laxity measurement	Bone patellar tendon bone autograft and Semitendinosus graft	Transtibial technique	2 years	Moderate	Moderate	Moderate
Eriksson et al. 2001	IKDC	Patellar tendon/ Quadruple semitendinosus	Longitudinal incision over the pes anserinus	2 years (24-59 months)	Moderate	Moderate	Moderate
Eriksson et al. 2001	Lysholm score	Patellar tendon/ Quadruple semitendinosus	Longitudinal incision over the pes anserinus	2 years (24-59 months)	Moderate	Moderate	Moderate
Eriksson et al. 2001	Pain (VAS)	Patellar tendon/ Quadruple semitendinosus	Longitudinal incision over the pes anserinus	2 years (24-59 months)	Moderate	Moderate	Moderate
Feller et al. 2003	IKDC	Patellar tendon and Hamstring tendon	Single-incision	2 and 3 years	High	Moderate	High
Feller et al. 2003	Range of motion	Patellar tendon and Hamstring tendon	Single-incision	2 and 3 years	Moderate	Moderate	Moderate
Feller et al. 2003	Pain	Patellar tendon and Hamstring tendon	Single-incision	2 and 3 years	High	Moderate	High
Feller et al. 2003	Cincinnati knee score	Patellar tendon and Hamstring tendon	Single-incision	2 and 3 years	High	Moderate	High
Feller et al. 2003	Knee laxity	Patellar tendon and Hamstring tendon	Single-incision	2 and 3 years	High	Moderate	High
Feller et al. 2003	Radiographic OA	Patellar tendon and Hamstring tendon	Single-incision	2 and 3 years	Moderate	Moderate	Moderate
Feller et al. 2003	Rate of return to preinjury activity	Patellar tendon and Hamstring tendon	Single-incision	2 and 3 years	High	Moderate	High
Harilainen et al. 2006	IKDC	Bone patellar tendon bone/ Semitendinosus and gracilis tendon	BPTB: Outside-in arthroscopically assisted two-incision, STG: One-incision transtibial technique	5 years (3-6 years)	Moderate	Moderate	Moderate
Harilainen et al. 2006	Lysholm score	Bone patellar tendon bone/ Semitendinosus and gracilis tendon	BPTB: Outside-in arthroscopically assisted two-incision, STG: One-incision transtibial technique	5 years (3-6 years)	Moderate	Moderate	Moderate
Harilainen et al. 2006	Complications	Bone patellar tendon bone/ Semitendinosus and gracilis tendon	BPTB: Outside-in arthroscopically assisted two-incision, STG: One-incision transtibial technique	5 years (3-6 years)	Moderate	Moderate	Moderate
Harilainen et al. 2006	Tegner activity score	Bone patellar tendon bone/ Semitendinosus and gracilis tendon	BPTB: Outside-in arthroscopically assisted two-incision, STG: One-incision transtibial technique	5 years (3-6 years)	Moderate	Moderate	Moderate

Table 77. Quality and Applicability Summary: Bone Patellar Tendon Bone Versus Hamstring, Other

Study	Outcome	Graft	Surgical Technique	Duration	Quality	Applicability	Overall Strength of Evidence
Harilainen et al. 2006	Radiographic evaluation	Bone patellar tendon bone/ Semitendinosus and gracilis tendon	BPTB: Outside-in arthroscopically assisted two-incision, STG: One-incision transtibial technique	5 years (3-6 years)	Moderate	Moderate	Moderate
Harilainen et al. 2006	Kujala patellofemoral score	Bone patellar tendon bone/ Semitendinosus and gracilis tendon	BPTB: Outside-in arthroscopically assisted two-incision, STG: One-incision transtibial technique	5 years (3-6 years)	Moderate	Moderate	Moderate
Harilainen et al. 2006	Clinical data and instrumented testing	Bone patellar tendon bone/ Semitendinosus and gracilis tendon	BPTB: Outside-in arthroscopically assisted two-incision, STG: One-incision transtibial technique	5 years (3-6 years)	Moderate	Moderate	Moderate
Holm et al. 2010	Lysholm score	Patellar tendon-bone/4-strand hamstring autograft	Medial tibial	10 years	Moderate	Moderate	Moderate
Holm et al. 2010	Pain				Moderate	Moderate	Moderate
Holm et al. 2010	Failure	Patellar tendon-bone/4-strand hamstring autograft	Medial tibial	10 years	Moderate	Moderate	Moderate
Holm et al. 2010	Cincinnati knee score	Patellar tendon-bone/4-strand hamstring autograft	Medial tibial	10 years	Moderate	Moderate	Moderate
Holm et al. 2010	Clinical assessment	Patellar tendon-bone/4-strand hamstring autograft	Medial tibial	10 years	Moderate	Moderate	Moderate
Holm et al. 2010	Kellgren and Lawrence classification	Patellar tendon-bone/4-strand hamstring autograft	Medial tibial	10 years	Moderate	Moderate	Moderate
Holm et al. 2010	Function (VAS)	Patellar tendon-bone/4-strand hamstring autograft	Medial tibial	10 years	Moderate	Moderate	Moderate
Ibrahim et al. 2005	IKDC	Patellar tendon/Gracilis and semitendinosus	Tibial	3 years	Moderate	Moderate	Moderate
Ibrahim et al. 2005	Tegner activity score	Patellar tendon/Gracilis and semitendinosus	Tibial	3 years	Moderate	Moderate	Moderate
Ibrahim et al. 2005	Lysholm knee score	Patellar tendon/Gracilis and semitendinosus	Tibial	3 years	Moderate	Moderate	Moderate
Ibrahim et al. 2005	Patient satisfaction	Patellar tendon/Gracilis and semitendinosus	Tibial	3 years	Moderate	Moderate	Moderate
Ibrahim et al. 2005	Anterior knee pain	Patellar tendon/Gracilis and semitendinosus	Tibial	3 years	Low	Moderate	Low
Ibrahim et al. 2005	Clinical examination (ligament)	Patellar tendon/Gracilis and semitendinosus	Tibial	3 years	Moderate	Moderate	Moderate
Ibrahim et al. 2005	Activity	Patellar tendon/Gracilis and semitendinosus	Tibial	3 years	Moderate	Moderate	Moderate
Leal-	IKDC	Bone patellar tendon bone autograft/	Transtibial	2 years	Moderate	Moderate	Moderate

Table 77. Quality and Applicability Summary: Bone Patellar Tendon Bone Versus Hamstring, Other

Study	Outcome	Graft	Surgical Technique	Duration	Quality	Applicability	Overall Strength of Evidence
Blanquet et al. 2011		Hamstring semitendinosus gracilis tendon autograft/					
Leal-Blanquet et al. 2011	Strength	Bone patellar tendon bone autograft/ Hamstring semitendinosus gracilis tendon autograft/	Transtibial	2 years	Moderate	Moderate	Moderate
Leal-Blanquet et al. 2011	Symptoms	Bone patellar tendon bone autograft/ Hamstring semitendinosus gracilis tendon autograft/	Transtibial	2 years	Moderate	Moderate	Moderate
Leal-Blanquet et al. 2011	Clinical evaluation	Bone patellar tendon bone autograft/ Hamstring semitendinosus gracilis tendon autograft/	Transtibial	2 years	Moderate	Moderate	Moderate
Leal-Blanquet et al. 2011	Satisfaction (VAS)	Bone patellar tendon bone autograft/ Hamstring semitendinosus gracilis tendon autograft/	Transtibial	2 years	Moderate	Moderate	Moderate
Liden et al. 2007	IKDC	Bone patellar tendon autograft and Semitendinosus group	Transtibial technique and interference screw fixation	7 year	High	Moderate	High
Liden et al. 2007	Lysholm score	Bone patellar tendon autograft and Semitendinosus group	Transtibial technique and interference screw fixation	7 year	High	Moderate	High
Liden et al. 2007	Range of motion	Bone patellar tendon autograft and Semitendinosus group	Transtibial technique and interference screw fixation	7 year	High	Moderate	High
Liden et al. 2007	Tegner activity level	Bone patellar tendon autograft and Semitendinosus group	Transtibial technique and interference screw fixation	7 year	High	Moderate	High
Liden et al. 2007	Clinical assessments	Bone patellar tendon autograft and Semitendinosus group	Transtibial technique and interference screw fixation	7 year	High	Moderate	High
Pinczewski et al. 2002	IKDC	Patellar tendon/Four-strand hamstring tendon	Single-incision endoscopic technique	2 and 5 years	Moderate	Moderate	Moderate
Pinczewski et al. 2002	Range of motion	Patellar tendon/Four-strand hamstring tendon	Single-incision endoscopic technique	2 and 5 years	Low	Moderate	Low
Pinczewski et al. 2002	Function	Patellar tendon/Four-strand hamstring tendon	Single-incision endoscopic technique	2 and 5 years	Moderate	Moderate	Moderate
Pinczewski et al. 2002	Lysholm knee score	Patellar tendon/Four-strand hamstring tendon	Single-incision endoscopic technique	2 and 5 years	Moderate	Moderate	Moderate
Pinczewski et al. 2002	Kneeling pain	Patellar tendon/Four-strand hamstring tendon	Single-incision endoscopic technique	2 and 5 years	Low	Moderate	Low
Pinczewski et al. 2002	Single-legged hop test	Patellar tendon/Four-strand hamstring tendon	Single-incision endoscopic technique	2 and 5 years	Low	Moderate	Low
Pinczewski et al. 2002	Symptoms	Patellar tendon/Four-strand hamstring tendon	Single-incision endoscopic technique	2 and 5 years	Moderate	Moderate	Moderate
Pinczewski et al. 2002	Instrumented testing	Patellar tendon/Four-strand hamstring tendon	Single-incision endoscopic technique	2 and 5 years	Moderate	Moderate	Moderate
Pinczewski	Donor site symptoms at	Patellar tendon/Four-strand hamstring	Single-incision endoscopic	2 and 5	Low	Moderate	Low

Table 77. Quality and Applicability Summary: Bone Patellar Tendon Bone Versus Hamstring, Other

Study	Outcome	Graft	Surgical Technique	Duration	Quality	Applicability	Overall Strength of Evidence
et al. 2002	rest	tendon	technique	years			
Pinczewski et al. 2002	Thigh atrophy	Patellar tendon/Four-strand hamstring tendon	Single-incision endoscopic technique	2 and 5 years	Low	Moderate	Low
Pinczewski et al. 2002	Compartment loading	Patellar tendon/Four-strand hamstring tendon	Single-incision endoscopic technique	2 and 5 years	Low	Moderate	Low
Pinczewski et al. 2002	Pivot shift	Patellar tendon/Four-strand hamstring tendon	Single-incision endoscopic technique	2 and 5 years	Moderate	Moderate	Moderate
Pinczewski et al. 2002	Failure and Complications	Patellar tendon/Four-strand hamstring tendon	Single-incision endoscopic technique	2 and 5 years	Moderate	Moderate	Moderate
Pinczewski et al. 2007	Range of motion	Patellar tendon/Four-strand hamstring tendon	Single-incision endoscopic technique	2 and 5 years	Moderate	Moderate	Moderate
Pinczewski et al. 2007	Complications	Patellar tendon/Four-strand hamstring tendon	Single-incision endoscopic technique	2 and 5 years	Moderate	Moderate	Moderate
Pinczewski et al. 2007	Lysholm knee score	Patellar tendon/Four-strand hamstring tendon	Single-incision endoscopic technique	2 and 5 years	Moderate	Moderate	Moderate
Pinczewski et al. 2007	Activity level	Ipsilateral middle third patellar tendon/ 4-strand gracilis and semitendinosus tendon	Single-incision endoscopic technique	10 years	Moderate	Moderate	Moderate
Pinczewski et al. 2007	Failure	Ipsilateral middle third patellar tendon/ 4-strand gracilis and semitendinosus tendon	Single-incision endoscopic technique	10 years	Moderate	Moderate	Moderate
Pinczewski et al. 2007	Kneeling pain	Ipsilateral middle third patellar tendon/ 4-strand gracilis and semitendinosus tendon	Single-incision endoscopic technique	10 years	Moderate	Moderate	Moderate
Pinczewski et al. 2007	Single-legged hop test	Ipsilateral middle third patellar tendon/ 4-strand gracilis and semitendinosus tendon	Single-incision endoscopic technique	10 years	Moderate	Moderate	Moderate
Pinczewski et al. 2007	Clinical ligament evaluation	Ipsilateral middle third patellar tendon/ 4-strand gracilis and semitendinosus tendon	Single-incision endoscopic technique	10 years	Moderate	Moderate	Moderate
Pinczewski et al. 2007	Function (IKDC)	Ipsilateral middle third patellar tendon/ 4-strand gracilis and semitendinosus tendon	Single-incision endoscopic technique	10 years	Moderate	Moderate	Moderate
Pinczewski et al. 2007	Subjective symptoms with activity	Ipsilateral middle third patellar tendon/ 4-strand gracilis and semitendinosus tendon	Single-incision endoscopic technique	10 years	Moderate	Moderate	Moderate
Pinczewski et al. 2007	Harvest site symptoms	Ipsilateral middle third patellar tendon/ 4-strand gracilis and semitendinosus tendon	Single-incision endoscopic technique	10 years	Moderate	Moderate	Moderate
Pinczewski et al. 2007	IKDC (Overall)	Ipsilateral middle third patellar tendon/ 4-strand gracilis and semitendinosus	Single-incision endoscopic technique	10 years	Moderate	Moderate	Moderate

Table 77. Quality and Applicability Summary: Bone Patellar Tendon Bone Versus Hamstring, Other

Study	Outcome	Graft	Surgical Technique	Duration	Quality	Applicability	Overall Strength of Evidence
		tendon					
Pinczewski et al. 2007	Radiographic assessment	Ipsilateral middle third patellar tendon/ 4-strand gracilis and semitendinosus tendon	Single-incision endoscopic technique	10 years	Moderate	Moderate	Moderate
Roe et al. 2005	Lysholm score	Ipsilateral middle-third patellar tendon or the 4-strand gracilis and semitendinosus tendons	Single-incision endoscopic technique	7 years	Moderate	Moderate	Moderate
Roe et al. 2005	Complications	Ipsilateral middle-third patellar tendon or the 4-strand gracilis and semitendinosus tendons	Single-incision endoscopic technique	7 years	Moderate	Moderate	Moderate
Roe et al. 2005	Function	Ipsilateral middle-third patellar tendon or the 4-strand gracilis and semitendinosus tendons	Single-incision endoscopic technique	7 years	Moderate	Moderate	Moderate
Roe et al. 2005	Activity level	Ipsilateral middle-third patellar tendon or the 4-strand gracilis and semitendinosus tendons	Single-incision endoscopic technique	7 years	Moderate	Moderate	Moderate
Roe et al. 2005	Kneeling pain	Ipsilateral middle-third patellar tendon or the 4-strand gracilis and semitendinosus tendons	Single-incision endoscopic technique	7 years	Moderate	Moderate	Moderate
Roe et al. 2005	Clinical ligament evaluation	Ipsilateral middle-third patellar tendon or the 4-strand gracilis and semitendinosus tendons	Single-incision endoscopic technique	7 years	Moderate	Moderate	Moderate
Roe et al. 2005	Instrumental testing	Ipsilateral middle-third patellar tendon or the 4-strand gracilis and semitendinosus tendons	Single-incision endoscopic technique	7 years	Moderate	Moderate	Moderate
Roe et al. 2005	Donor site symptoms at rest	Ipsilateral middle-third patellar tendon or the 4-strand gracilis and semitendinosus tendons	Single-incision endoscopic technique	7 years	Moderate	Moderate	Moderate
Roe et al. 2005	IKDC overall	Ipsilateral middle-third patellar tendon or the 4-strand gracilis and semitendinosus tendons	Single-incision endoscopic technique	7 years	Moderate	Moderate	Moderate
Roe et al. 2005	Radiographic OA (IKDC)	Ipsilateral middle-third patellar tendon or the 4-strand gracilis and semitendinosus tendons	Single-incision endoscopic technique	7 years	Moderate	Moderate	Moderate
Roe et al. 2005	Range of motion	Ipsilateral middle-third patellar tendon or the 4-strand gracilis and semitendinosus tendons	Single-incision endoscopic technique	7 years	Low	Moderate	Low
Sajovic et al. 2011	IKDC	Patellar tendon and Hamstring tendon autograft (semitendinosus and gracilis)	Single-incision	11 years	High	Moderate	High
Sajovic et al. 2011	Lysholm score	Patellar tendon and Hamstring tendon autograft (semitendinosus and gracilis)	Single-incision	11 years	High	Moderate	High

Table 77. Quality and Applicability Summary: Bone Patellar Tendon Bone Versus Hamstring, Other

Study	Outcome	Graft	Surgical Technique	Duration	Quality	Applicability	Overall Strength of Evidence
Sajovic et al. 2011	Clinical evaluation	Patellar tendon and Hamstring tendon autograft (semitendinosus and gracilis)	Single-incision	11 years	High	Moderate	High
Sajovic et al. 2011	IKDC	Patellar tendon and Hamstring tendon autograft (semitendinosus and gracilis)	Single-incision	11 years	Moderate	Moderate	Moderate
Sajovic et al. 2011	Lysholm score	Patellar tendon and Hamstring tendon autograft (semitendinosus and gracilis)	Single-incision	11 years	Moderate	Moderate	Moderate
Sajovic et al. 2011	Clinical assessment	Patellar tendon and Hamstring tendon autograft (semitendinosus and gracilis)	Single-incision	11 years	Moderate	Moderate	Moderate
Sajovic et al. 2011	Anterior knee pain	Patellar tendon and Hamstring tendon autograft (semitendinosus and gracilis)	Single-incision	11 years	Moderate	Moderate	Moderate
Sajovic et al. 2011	SF-36	Patellar tendon and Hamstring tendon autograft (semitendinosus and gracilis)	Single-incision	11 years	Moderate	Moderate	Moderate
Shaieb et al. 2002	Lysholm score	Patellar tendon/ Semitendinosus and gracilis tendon autografts	Single incision technique with a notchplasty	2 years	Moderate	Moderate	Moderate
Shaieb et al. 2002	Range of motion	Patellar tendon/ Semitendinosus and gracilis tendon autografts	Single incision technique with a notchplasty	2 years	Moderate	Moderate	Moderate
Shaieb et al. 2002	Failure	Patellar tendon/ Semitendinosus and gracilis tendon autografts	Single incision technique with a notchplasty	2 years	Moderate	Moderate	Moderate
Shaieb et al. 2002	Cincinnati knee score	Patellar tendon/ Semitendinosus and gracilis tendon autografts	Single incision technique with a notchplasty	2 years	Moderate	Moderate	Moderate
Shaieb et al. 2002	KT-1000 arthrometer (Stability)	Patellar tendon/ Semitendinosus and gracilis tendon autografts	Single incision technique with a notchplasty	2 years	Moderate	Moderate	Moderate
Shaieb et al. 2002	Thigh circumference	Patellar tendon/ Semitendinosus and gracilis tendon autografts	Single incision technique with a notchplasty	2 years	Moderate	Moderate	Moderate
Shaieb et al. 2002	Pivot shift test	Patellar tendon/ Semitendinosus and gracilis tendon autografts	Single incision technique with a notchplasty	2 years	Moderate	Moderate	Moderate
Shaieb et al. 2002	Lachman test	Patellar tendon/ Semitendinosus and gracilis tendon autografts	Single incision technique with a notchplasty	2 years	Moderate	Moderate	Moderate
Tow et al. 2005	IKDC	Patellar-tendon/ Semitendinosus tendon	Longitudinal incision over the pes anserinus	2 years	Moderate	Moderate	Moderate
Tow et al. 2005	Strength	Patellar-tendon/ Semitendinosus tendon	Longitudinal incision over the pes anserinus	2 years	Low	Moderate	Low
Tow et al. 2005	Function	Patellar-tendon/ Semitendinosus tendon	Longitudinal incision over the pes anserinus	2 years	Moderate	Moderate	Moderate
Tow et al. 2005	Laxity	Patellar-tendon/ Semitendinosus tendon	Longitudinal incision over the pes anserinus	2 years	Low	Moderate	Low
Webster et al. 2001	IKDC	Central third bone patellar tendon bone autograft/ Four strand (doubled semitendinosus doubled gracilis) hamstring autograft	Single incision	2 years	Moderate	Moderate	Moderate
Webster et	Cincinnati knee score	Central third bone patellar tendon bone	Single incision	2 years	Moderate	Moderate	Moderate

Table 77. Quality and Applicability Summary: Bone Patellar Tendon Bone Versus Hamstring, Other

Study	Outcome	Graft	Surgical Technique	Duration	Quality	Applicability	Overall Strength of Evidence
al. 2001		autograft/ Four strand (doubled semitendinosus doubled gracilis) hamstring autograft					
Webster et al. 2001	Instrumental testing	Central third bone patellar tendon bone autograft/ Four strand (doubled semitendinosus doubled gracilis) hamstring autograft	Single incision	2 years	Moderate	Moderate	Moderate
Wipfler et al. 2011	IKDC	Bone patella tendon/ Quadrupled hamstring tendon	Two-incision 2cm technique	9 years (7.41-10 years)	Moderate	Moderate	Moderate
Wipfler et al. 2011	Lysholm score	Bone patella tendon/ Quadrupled hamstring tendon	Two-incision 2cm technique	9 years (7.41-10 years)	Moderate	Moderate	Moderate
Wipfler et al. 2011	Tegner score	Bone patella tendon/ Quadrupled hamstring tendon	Two-incision 2cm technique	9 years (7.41-10 years)	Moderate	Moderate	Moderate
Wipfler et al. 2011	Clinical examination	Bone patella tendon/ Quadrupled hamstring tendon	Two-incision 2cm technique	9 years (7.41-10 years)	Moderate	Moderate	Moderate
Wipfler et al. 2011	Functional tests	Bone patella tendon/ Quadrupled hamstring tendon	Two-incision 2cm technique	9 years (7.41-10 years)	Moderate	Moderate	Moderate
Wipfler et al. 2011	Patient satisfaction (VAS)	Bone patella tendon/ Quadrupled hamstring tendon	Two-incision 2cm technique	9 years (7.41-10 years)	Moderate	Moderate	Moderate
Wipfler et al. 2011	Subjective function (VAS)	Bone patella tendon/ Quadrupled hamstring tendon	Two-incision 2cm technique	9 years (7.41-10 years)	Moderate	Moderate	Moderate
Zaffagnini et al. 2006	IKDC	Bone patellar tendon-bone/ Four strand hamstrings and ST-G	Over the top	5 years	Moderate	Moderate	Moderate
Zaffagnini et al. 2006	Range of motion	Bone patellar tendon-bone/ Four strand hamstrings and ST-G	Over the top	5 years	Moderate	Moderate	Moderate
Zaffagnini et al. 2006	Tegner activity score	Bone patellar tendon-bone/ Four strand hamstrings and ST-G	Over the top	5 years	Moderate	Moderate	Moderate
Zaffagnini et al. 2006	Stability	Bone patellar tendon-bone/ Four strand hamstrings and ST-G	Over the top	5 years	Moderate	Moderate	Moderate
Zaffagnini et al. 2006	Kneeling pain	Bone patellar tendon-bone/ Four strand hamstrings and ST-G	Over the top	5 years	Moderate	Moderate	Moderate
Zaffagnini et al. 2006	Anterior knee pain	Bone patellar tendon-bone/ Four strand hamstrings and ST-G	Over the top	5 years	Low	Moderate	Low
Zaffagnini et	Return to sport	Bone patellar tendon-bone/ Four strand	Over the top	5 years	Moderate	Moderate	Moderate

Table 77. Quality and Applicability Summary: Bone Patellar Tendon Bone Versus Hamstring, Other

Study	Outcome	Graft	Surgical Technique	Duration	Quality	Applicability	Overall Strength of Evidence
al. 2006		hamstrings and ST-G					

Table 78. Quality and Applicability: Bone Patellar Tendon Bone Versus Hamstring, Other

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Adachi et al. 2003	Strength	○	○	○	○	○	●	○	**Very Low**	●	○	●	●	**Moderate**
Aglietti et al. 2004	IKDC	●	○	●	○	●	●	●	**Moderate**	●	○	●	●	**Moderate**
Aglietti et al. 2004	Range of motion	●	○	●	○	●	●	●	**Moderate**	●	○	●	●	**Moderate**
Aglietti et al. 2004	Pain (VAS)	●	○	●	○	●	●	●	**Moderate**	●	○	●	●	**Moderate**
Aglietti et al. 2004	Muscle strength	●	○	●	○	●	●	●	**Moderate**	●	○	●	●	**Moderate**
Aglietti et al. 2004	Pain (KOOS)	●	○	●	○	●	●	●	**Moderate**	●	○	●	●	**Moderate**
Aglietti et al. 2004	Symptoms (KOOS)	●	○	●	○	●	●	●	**Moderate**	●	○	●	●	**Moderate**
Aglietti et al. 2004	Activities of daily living (KOOS)	●	○	●	○	●	●	●	**Moderate**	●	○	●	●	**Moderate**

Table 78. Quality and Applicability: Bone Patellar Tendon Bone Versus Hamstring, Other

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Aglietti et al. 2004	Sports activities (KOOS)	●	○	●	○	●	●	●	**Moderate**	●	○	●	●	**Moderate**
Aglietti et al. 2004	Quality of life (KOOS)	●	○	●	○	●	●	●	**Moderate**	●	○	●	●	**Moderate**
Aglietti et al. 2004	Clinical/Instrumental testing	●	○	●	○	●	●	●	**Moderate**	●	○	●	●	**Moderate**
Anderson et al. 2001	IKDC	●	○	●	●	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Anderson et al. 2001	Complications	●	○	●	●	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Anderson et al. 2001	Activity level	●	○	●	●	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Anderson et al. 2001	Hospital for special surgery knee scores	●	○	●	●	●	○	○	**Moderate**	●	○	●	○	**Moderate**
Barenius et al. 2010	IKDC	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Barenius et al. 2010	Lysholm score	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**

Table 78. Quality and Applicability: Bone Patellar Tendon Bone Versus Hamstring, Other

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Barenius et al. 2010	Tegner activity score	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Barenius et al. 2010	Clinical assessment	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Barenius et al. 2010	KOOS	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Barenius et al. 2010	Patellofemoral pain score	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Beynnon et al. 2002	Strength	●	○	●	○	●	○	●	**Moderate**	●	○	●	○	**Moderate**
Beynnon et al. 2002	Function	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Beynnon et al. 2002	Patient satisfaction	●	○	●	○	●	○	●	**Moderate**	●	○	●	○	**Moderate**
Beynnon et al. 2002	Tegner activity level	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Beynnon et al. 2002	Function	●	○	●	○	●	○	●	**Moderate**	●	○	●	○	**Moderate**

Table 78. Quality and Applicability: Bone Patellar Tendon Bone Versus Hamstring, Other

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Comba et al. 1999	IKDC	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Comba et al. 1999	Stability	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Comba et al. 1999	Functional one leg hop test	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Ejerhed et al. 2003	IKDC	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Ejerhed et al. 2003	Lysholm score	●	●	●	○	●	●	●	**High**	●	○	●	○	**Moderate**
Ejerhed et al. 2003	Tegner activity level	●	●	●	○	●	●	●	**High**	●	○	●	○	**Moderate**
Ejerhed et al. 2003	Single-legged hop test	●	●	●	○	●	○	●	**Moderate**	●	○	●	○	**Moderate**
Ejerhed et al. 2003	Knee-walking test	●	○	●	○	●	○	●	**Moderate**	●	○	●	○	**Moderate**
Ejerhed et al. 2003	KT-1000 laxity measurement	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**

Table 78. Quality and Applicability: Bone Patellar Tendon Bone Versus Hamstring, Other

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Eriksson et al. 2001	IKDC	●	○	●	○	○	●	●	**Moderate**	●	○	●	○	**Moderate**
Eriksson et al. 2001	Lysholm score	●	○	●	○	○	●	●	**Moderate**	●	○	●	○	**Moderate**
Eriksson et al. 2001	Pain (VAS)	●	○	●	○	○	●	●	**Moderate**	●	○	●	○	**Moderate**
Feller et al. 2003	IKDC	●	○	●	●	●	●	●	**High**	●	○	●	○	**Moderate**
Feller et al. 2003	Range of motion	●	○	●	●	●	○	●	**Moderate**	●	○	●	○	**Moderate**
Feller et al. 2003	Pain	●	○	●	●	●	●	●	**High**	●	○	●	○	**Moderate**
Feller et al. 2003	Cincinnati knee score	●	○	●	●	●	●	●	**High**	●	○	●	○	**Moderate**
Feller et al. 2003	Knee laxity	●	○	●	●	●	●	●	**High**	●	○	●	○	**Moderate**
Feller et al. 2003	Radiographic OA	●	○	●	●	●	○	●	**Moderate**	●	○	●	○	**Moderate**

Table 78. Quality and Applicability: Bone Patellar Tendon Bone Versus Hamstring, Other

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Feller et al. 2003	Rate of return to preinjury activity	●	○	●	●	●	●	●	**High**	●	○	●	○	**Moderate**
Harilainen et al. 2006	IKDC	●	○	●	●	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Harilainen et al. 2006	Lysholm score	●	○	●	●	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Harilainen et al. 2006	Complications	●	○	●	●	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Harilainen et al. 2006	Tegner activity score	●	○	●	●	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Harilainen et al. 2006	Radiographic evaluation	●	○	●	●	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Harilainen et al. 2006	Kujala patellofemoral score	●	○	●	●	●	○	○	**Moderate**	●	○	●	○	**Moderate**
Harilainen et al. 2006	Clinical data and instrumented testing	●	○	●	●	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Holm et al. 2010	Lysholm score	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**

Table 78. Quality and Applicability: Bone Patellar Tendon Bone Versus Hamstring, Other

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Holm et al. 2010	Pain	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Holm et al. 2010	Failure	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Holm et al. 2010	Cincinnati knee score	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Holm et al. 2010	Clinical assessment	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Holm et al. 2010	Kellgren and Lawrence classification	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Holm et al. 2010	Function (VAS)	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Ibrahim et al. 2005	IKDC	●	○	●	○	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Ibrahim et al. 2005	Tegner activity score	●	○	●	○	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Ibrahim et al. 2005	Lysholm knee score	●	○	●	○	●	●	○	**Moderate**	●	○	●	●	**Moderate**

Table 78. Quality and Applicability: Bone Patellar Tendon Bone Versus Hamstring, Other

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Ibrahim et al. 2005	Patient satisfaction	●	○	●	○	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Ibrahim et al. 2005	Anterior knee pain	●	○	●	○	●	○	○	**Low**	●	○	●	●	**Moderate**
Ibrahim et al. 2005	Clinical examination (ligament)	●	○	●	○	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Ibrahim et al. 2005	Activity	●	○	●	○	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Leal-Blanquet et al. 2011	IKDC	●	○	●	○	○	●	●	**Moderate**	●	○	●	●	**Moderate**
Leal-Blanquet et al. 2011	Strength	●	○	●	○	○	●	●	**Moderate**	●	○	●	●	**Moderate**
Leal-Blanquet et al. 2011	Symptoms	●	○	●	○	○	●	●	**Moderate**	●	○	●	●	**Moderate**
Leal-Blanquet et al. 2011	Clinical evaluation	●	○	●	○	○	●	●	**Moderate**	●	○	●	●	**Moderate**

Table 78. Quality and Applicability: Bone Patellar Tendon Bone Versus Hamstring, Other

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Leal-Blanquet et al. 2011	Satisfaction (VAS)	●	○	●	○	○	●	●	**Moderate**	●	○	●	●	**Moderate**
Liden et al. 2007	IKDC	●	●	●	●	●	●	○	**High**	●	●	●	○	**Moderate**
Liden et al. 2007	Lysholm score	●	●	●	●	●	●	○	**High**	●	○	●	○	**Moderate**
Liden et al. 2007	Range of motion	●	●	●	●	●	●	○	**High**	●	○	●	○	**Moderate**
Liden et al. 2007	Tegner activity level	●	●	●	●	●	●	○	**High**	●	○	●	○	**Moderate**
Liden et al. 2007	Clinical assessments	●	●	●	●	●	●	○	**High**	●	○	●	●	**Moderate**
Pinczewski et al. 2002	IKDC	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Pinczewski et al. 2002	Range of motion	●	○	●	○	●	○	○	**Low**	●	○	●	○	**Moderate**
Pinczewski et al. 2002	Function	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**

Table 78. Quality and Applicability: Bone Patellar Tendon Bone Versus Hamstring, Other

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Pinczewski et al. 2002	Lysholm knee score	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Pinczewski et al. 2002	Kneeling pain	●	○	●	○	●	○	○	**Low**	●	○	●	○	**Moderate**
Pinczewski et al. 2002	Single-legged hop test	●	○	●	○	●	○	○	**Low**	●	○	●	○	**Moderate**
Pinczewski et al. 2002	Symptoms	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Pinczewski et al. 2002	Instrumented testing	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Pinczewski et al. 2002	Donor site symptoms at rest	●	○	●	○	●	○	○	**Low**	●	○	●	○	**Moderate**
Pinczewski et al. 2002	Thigh atrophy	●	○	●	○	●	○	○	**Low**	●	○	●	○	**Moderate**
Pinczewski et al. 2002	Compartment loading	●	○	●	○	●	○	○	**Low**	●	○	●	○	**Moderate**
Pinczewski et al. 2002	Pivot shift	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**

Table 78. Quality and Applicability: Bone Patellar Tendon Bone Versus Hamstring, Other

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Pinczewski et al. 2002	Failure and Complications	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Pinczewski et al. 2007	Range of motion	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Pinczewski et al. 2007	Complications	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Pinczewski et al. 2007	Lysholm knee score	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Pinczewski et al. 2007	Activity level	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Pinczewski et al. 2007	Failure	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Pinczewski et al. 2007	Kneeling pain	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Pinczewski et al. 2007	Single-legged hop test	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Pinczewski et al. 2007	Clinical ligament evaluation	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**

Table 78. Quality and Applicability: Bone Patellar Tendon Bone Versus Hamstring, Other

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Pinczewski et al. 2007	Function (IKDC)	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Pinczewski et al. 2007	Subjective symptoms with activity	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Pinczewski et al. 2007	Harvest site symptoms	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Pinczewski et al. 2007	IKDC (Overall)	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Pinczewski et al. 2007	Radiographic assessment	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Roe et al. 2005	Lysholm score	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Roe et al. 2005	Complications	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Roe et al. 2005	Function	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Roe et al. 2005	Activity level	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**

Table 78. Quality and Applicability: Bone Patellar Tendon Bone Versus Hamstring, Other

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Roe et al. 2005	Kneeling pain	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Roe et al. 2005	Clinical ligament evaluation	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Roe et al. 2005	Instrumental testing	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Roe et al. 2005	Donor site symptoms at rest	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Roe et al. 2005	IKDC overall	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Roe et al. 2005	Radiographic OA (IKDC)	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Roe et al. 2005	Range of motion	●	○	●	○	●	○	○	**Low**	●	○	●	○	**Moderate**
Sajovic et al.	IKDC	●	○	●	●	●	●	●	**High**	●	○	●	○	**Moderate**
Sajovic et al.	Lysholm score	●	○	●	●	●	●	●	**High**	●	○	●	●	**Moderate**

Table 78. Quality and Applicability: Bone Patellar Tendon Bone Versus Hamstring, Other

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Sajovic et al.	Clinical evaluation	●	○	●	●	●	●	●	**High**	●	○	●	○	**Moderate**
Sajovic et al. 2011	IKDC	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Sajovic et al. 2011	Lysholm score	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Sajovic et al. 2011	Clinical assessment	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Sajovic et al. 2011	Anterior knee pain	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Sajovic et al. 2011	SF-36	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Shaieb et al. 2002	Lysholm score	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Shaieb et al. 2002	Range of motion	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Shaieb et al. 2002	Failure	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**

Table 78. Quality and Applicability: Bone Patellar Tendon Bone Versus Hamstring, Other

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Shaieb et al. 2002	Cincinnati knee score	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Shaieb et al. 2002	KT-1000 arthrometer (Stability)	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Shaieb et al. 2002	Thigh circumference	●	○	●	○	●	○	●	**Moderate**	●	○	●	○	**Moderate**
Shaieb et al. 2002	Pivot shift test	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Shaieb et al. 2002	Lachman test	●	○	●	○	●	○	●	**Moderate**	●	○	●	○	**Moderate**
Siebold et al. 2006	IKDC	●	○	●	●	●	●	●	**High**	●	●	●	●	**High**
Siebold et al. 2006	Range of motion	●	○	●	●	●	○	●	**Moderate**	●	○	●	●	**Moderate**
Siebold et al. 2006	Complications	●	○	●	●	●	○	●	**Moderate**	●	○	●	●	**Moderate**
Siebold et al. 2006	Pain	●	○	●	●	●	●	●	**High**	●	○	●	●	**Moderate**

Table 78. Quality and Applicability: Bone Patellar Tendon Bone Versus Hamstring, Other

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Siebold et al. 2006	Ligament examination	●	○	●	●	●	●	●	**High**	●	○	●	●	**Moderate**
Siebold et al. 2006	Cincinnati sports activity scale	●	○	●	●	●	●	●	**High**	●	○	●	●	**Moderate**
Tow et al. 2005	IKDC	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Tow et al. 2005	Strength	●	○	●	○	●	○	○	**Low**	●	○	●	○	**Moderate**
Tow et al. 2005	Function	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Tow et al. 2005	Laxity	●	○	●	○	●	○	○	**Low**	●	○	●	○	**Moderate**
Webster et al. 2001	IKDC	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Webster et al. 2001	Cincinnati knee score	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Webster et al. 2001	Instrumental testing	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**

Table 78. Quality and Applicability: Bone Patellar Tendon Bone Versus Hamstring, Other

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Zaffagnini et al. 2006	IKDC	●	○	●	○	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Zaffagnini et al. 2006	Range of motion	●	○	●	○	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Zaffagnini et al. 2006	Tegner activity score	●	○	●	○	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Zaffagnini et al. 2006	Stability	●	○	●	○	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Zaffagnini et al. 2006	Kneeling pain	●	○	●	○	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Zaffagnini et al. 2006	Anterior knee pain	●	○	●	○	●	○	○	**Low**	●	○	●	●	**Moderate**
Zaffagnini et al. 2006	Return to sport	●	○	●	○	●	●	○	**Moderate**	●	○	●	●	**Moderate**

FINDINGS

Table 79. Results: Bone Patellar Tendon Versus Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Aglietti et al. 2004	Moderate	IKDC Mean	Bone patellar tendon bone	60	82	Double-looped semitendinosus and gracilis tendon	60	85	NA	NS
Aglietti et al. 2004	Moderate	Pain VAS	Bone patellar tendon bone	60	8	Double-looped semitendinosus and gracilis tendon	60	9	NA	NS
Aglietti et al. 2004	Moderate	Pain (KOOS)	Bone patellar tendon bone	60	92	Double-looped semitendinosus and gracilis tendon	60	95	NA	NS
Aglietti et al. 2004	Moderate	Symptoms (KOOS)	Bone patellar tendon bone	60	88	Double-looped semitendinosus and gracilis tendon	60	90	NA	NS
Aglietti et al. 2004	Moderate	Activities of daily living (KOOS)	Bone patellar tendon bone	60	97	Double-looped semitendinosus and gracilis tendon	60	97	NA	NS
Aglietti et al. 2004	Moderate	Sports activities (KOOS)	Bone patellar tendon bone	60	84	Double-looped semitendinosus and gracilis tendon	60	87	NA	NS
Aglietti et al. 2004	Moderate	Quality of life (KOOS)	Bone patellar tendon bone	60	79	Double-looped semitendinosus and gracilis tendon	60	83	NA	NS
Aglietti et al. 2004	Moderate	Strength (60 degrees/sec Quadriceps flexor-extensor strength deficit (%))	Bone patellar tendon bone	60	0.5	Double-looped semitendinosus and gracilis tendon	60	1	NA	NS
Aglietti et al. 2004	Moderate	Strength (120 degrees/sec Quadriceps flexor-extensor strength deficit (%))	Bone patellar tendon bone	60	1	Double-looped semitendinosus and gracilis tendon	60	0	NA	NS
Aglietti et al. 2004	Moderate	Strength (180 degrees/sec Quadriceps flexor-	Bone patellar tendon bone	60	-1	Double-looped semitendinosus and gracilis tendon	60	-1	NA	NS

Table 79. Results: Bone Patellar Tendon Versus Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		extensor strength deficit (%))								
Aglietti et al. 2004	Moderate	Strength (60 degrees/sec Hamstring flexor-extensor strength deficit (%))	Bone patellar tendon bone	60	-2	Double-looped semitendinosus and gracilis tendon	60	-3	NA	NS
Aglietti et al. 2004	Moderate	Strength (120 degrees/sec Hamstring flexor-extensor strength deficit (%)	Bone patellar tendon bone	60	-2	Double-looped semitendinosus and gracilis tendon	60	-1	NA	NS
Aglietti et al. 2004	Moderate	Strength (180 degrees/sec Hamstring flexor-extensor strength deficit (%)	Bone patellar tendon bone	60	-3	Double-looped semitendinosus and gracilis tendon	60	0	NA	NS
Aglietti et al. 2004	Moderate	Strength (30 degrees/sec internal rotation muscle strength deficit (%)	Bone patellar tendon bone	60	1	Double-looped semitendinosus and gracilis tendon	60	6	NA	NS
Aglietti et al. 2004	Moderate	Strength (60 degrees/sec internal rotation muscle strength deficit (%)	Bone patellar tendon bone	60	1	Double-looped semitendinosus and gracilis tendon	60	6	NA	NS
Aglietti et al. 2004	Moderate	Strength (180 degrees/sec internal rotation muscle strength deficit (%)	Bone patellar tendon bone	60	2	Double-looped semitendinosus and gracilis tendon	60	7	NA	NS
Aglietti et al. 2004	Moderate	Strength (30 degrees/sec external rotation muscle strength deficit (%)	Bone patellar tendon bone	60	2	Double-looped semitendinosus and gracilis tendon	60	2	NA	NS
Aglietti et al. 2004	Moderate	Strength (60 degrees/sec external rotation muscle strength deficit (%)	Bone patellar tendon bone	60	3	Double-looped semitendinosus and gracilis tendon	60	2	NA	NS
Aglietti et al. 2004	Moderate	Strength (180 degrees/sec external	Bone patellar tendon bone	60	3	Double-looped semitendinosus	60	3	NA	NS

Table 79. Results: Bone Patellar Tendon Versus Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		rotation muscle strength deficit (%)				and gracilis tendon				
Aglietti et al. 2004	Moderate	Activities (Level I Activity (IKDC))	Bone patellar tendon bone	60	27/60(45%)	Double-looped semitendinosus and gracilis tendon	60	29/60(48%)	0.931(0.635, 1.136)	NS
Aglietti et al. 2004	Moderate	Activities (Level II Activity (IKDC))	Bone patellar tendon bone	60	7/60((12%)	Double-looped semitendinosus and gracilis tendon	60	13/60(22%)	0.538(0.231, 1.255)	NS
Aglietti et al. 2004	Moderate	Activities (Level III Activity (IKDC))	Bone patellar tendon bone	60	22/60(37%)	Double-looped semitendinosus and gracilis tendon	60	11/60(18%)	2(1.066,3.75)	Favors BPTB
Aglietti et al. 2004	Moderate	Activities (Level IV Activity (IKDC)	Bone patellar tendon bone	60	4/60(7%)	Double-looped semitendinosus and gracilis tendon	60	7/60(12%)	0.57(0.176,1 .85)	NS
Anderson et al. 2001	High	Patellofemoral crepitation 0	Patellar tendon	35	26/35 (66%)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	23/34 (68%)	1.098(0.811, 1.487)	NS
Anderson et al. 2001	High	Patellofemoral crepitation 1+	Patellar tendon	35	8/35 (23%)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	9/34 (26%)	0.863(0.378, 1.975)	NS
Anderson et al. 2001	High	Patellofemoral crepitation 2+	Patellar tendon	35	1/35 (3%)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	2/34 (6%)	0.486(0.046, 5.111)	NS
Anderson et al. 2001	High	Patellofemoral crepitation 3+	Patellar tendon	35	0/35 (0%)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	0/34 (0%)	NA	NS
Anderson et al. 2001	High	Patellofemoral crepitation 0	Patellar tendon	35	26/35 (66%)	Semitendinosus and gracilis tendon graft extra-articular procedure	33	30/33 (91%)	0.817(0.654, 1.021)	NS
Anderson et	High	Patellofemoral	Patellar tendon	35	8/35 (23%)	3cm long Semitendinosus	30	3/30 (10%)	2.286(0.665,	NS

Table 79. Results: Bone Patellar Tendon Versus Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
al. 2001		crepitation 1+				and gracilis tendon graft extra-articular procedure 3cm long			7.852)	
Anderson et al. 2001	High	Patellofemoral crepitation 2+	Patellar tendon	35	1/35 (3%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	30	0/30 (0%)	2.583(0.109, 61.158)	NS
Anderson et al. 2001	High	Patellofemoral crepitation 3+	Patellar tendon	35	0/35(0%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	30	0/30 (0%)	NA	NS
Anderson et al. 2001	High	Strength (Quadriceps muscle strength 60deg/sec (mean and range: % of normal side))	Patellar tendon	35	86(53-111)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	83(70-103)	NA	NS
Anderson et al. 2001	High	Strength (Quadriceps muscle strength 60deg/sec (mean and range: % of normal side))	Patellar tendon	35	86(53-111)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	96(76-116)	NA	NS
Anderson et al. 2001	High	Strength (Quadriceps muscle strength 180 deg/sec (mean and range: % of normal side))	Patellar tendon	35	91(65-111)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	87(60-118)	NA	NS
Anderson et al. 2001	High	Strength (Quadriceps muscle strength 180 deg/sec (mean and range: % of normal side))	Patellar tendon	35	91(65-111)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	99(69-123)	NA	NS
Anderson et al. 2001	High	Strength (Hamstring muscle strength	Patellar tendon	35	96(59-111)	Semitendinosus and gracilis tendon	34	94(60-125)	NA	NS

Table 79. Results: Bone Patellar Tendon Versus Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		60deg/sec (mean and range: % of normal side))				graft extra-articular procedure				
Anderson et al. 2001	High	Strength (Hamstring muscle strength 60deg/sec (mean and range: % of normal side))	Patellar tendon	35	96(59-111)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	96(69-123)	NA	NS
Anderson et al. 2001	High	Strength (Hamstring muscle strength 180 deg/sec (mean and range: % of normal side))	Patellar tendon	35	100(66-147)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	94(70-131)	NA	NS
Anderson et al. 2001	High	Strength (Hamstring muscle strength 180 deg/sec (mean and range: % of normal side))	Patellar tendon	35	100(66-147)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	94(63-133)	NA	NS
Anderson et al. 2001	High	Stability Objective (mm)	Patellar tendon	35	2.1(2)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	2.6(2.2)	-0.5(-1.618,0.618)	NS
Anderson et al. 2001	High	Stability Objective (mm)	Patellar tendon	35	2.1(2)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	3.1(2.3)	-1(-2.14,0.14)	NS
Anderson et al. 2001	High	Stability No. of patients with <3mm side to side difference	Patellar tendon	35	25/35 (71%)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	21/34 (62%)	1.156(0.825, 1.621)	Favors patellar tendon
Anderson et al. 2001	High	Stability No. of patients with <3mm side to side difference	Patellar tendon	35	25/35 (71%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	17/34 (50%)	1.387(0.937, 2.051)	NS

Table 79. Results: Bone Patellar Tendon Versus Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Anderson et al. 2001	High	Stability pivot shift 0	Patellar tendon	35	23/35 (71%)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	23/34 (68%)	1.394(1.089, 1.783)	NS
Anderson et al. 2001	High	Stability pivot shift 0	Patellar tendon	35	26/35 (74%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	20/34 (59%)	1.226(0.875, 1.717)	NS
Anderson et al. 2001	High	Stability pivot shift 1+	Patellar tendon	35	2/35 (6%)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	4/34 (12%)	0.486(0.095, 2.48)	NS
Anderson et al. 2001	High	Stability pivot shift 1+	Patellar tendon	35	2/35 (6%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	5/34 (15%)	0.377(0.079, 1.812)	NS
Anderson et al. 2001	High	Stability pivot shift 2+	Patellar tendon	35	5/35 (14%)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	5/34 (15%)	0.971(0.309, 3.056)	NS
Anderson et al. 2001	High	Stability pivot shift 2+	Patellar tendon	35	5/35 (14%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	4/34 (12%)	1.179(0.346, 4.015)	NS
Anderson et al. 2001	High	Stability pivot shift 3+	Patellar tendon	35	2/35 (6%)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	2/34 (6%)	0.971(0.145, 6.51)	NS
Anderson et al. 2001	High	Stability pivot shift 3+	Patellar tendon	35	2/35 (6%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	4/34 (12%)	0.471(0.092, 2.405)	NS

Table 79. Results: Bone Patellar Tendon Versus Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Anderson et al. 2001	High	Hospital for special knee scores subjective scores	Patellar tendon	35	13.1(3.3)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	15.1(4.8)	-2(-3.97,-0.27)	Favors semitendinosus tendon
Anderson et al. 2001	High	Hospital for special knee scores subjective scores	Patellar tendon	35	13.1(3.3)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	14.0(3.9)	-0.9(-2.640.84)	NS
Anderson et al. 2001	High	Function (Hospital for special knee scores)	Patellar tendon	35	19.3(1.2)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	17.5(3.8)	1.8(0.45,3.14)	Favors patellar tendon
Anderson et al. 2001	High	Function (Hospital for special knee scores)	Patellar tendon	35	19.3(1.2)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	18.8(1.8)	0.5(-0.24,1.24)	NS
Anderson et al. 2001	High	Hospital for special knee scores objective scores	Patellar tendon	35	46(5.6)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	44.3(7)	1.7(-1.34,4.74)	NS
Anderson et al. 2001	High	Hospital for special knee scores objective scores	Patellar tendon	35	46(5.6)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	48.4(12.2)	-2.4(-6.95,2.15)	NS
Anderson et al. 2001	High	Hospital for special knee scores objective scores	Patellar tendon	35	77.4(7.0)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	75.8(13.2)	1.6(-3.45,6.65)	NS
Anderson et al. 2001	High	Hospital for special knee scores objective scores	Patellar tendon	35	77.4(7.0)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	80.0(6.9)	-2.6(-5.96,0.76)	NS

Table 79. Results: Bone Patellar Tendon Versus Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Anderson et al. 2001	High	Activity level I (IKDC)	Patellar tendon	35	29/35 (83%)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	25/34 (73%)	1.127(0.876, 1.449)	NS
Anderson et al. 2001	High	Activity level I (IKDC)	Patellar tendon	35	29/35 (83%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	29/33 (88%)	0.943(0.774, 1.148)	NS
Anderson et al. 2001	High	Activity level II (IKDC)	Patellar tendon	35	5/35 (14%)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	7/34 (20%)	0.694(0.244, 1.975)	NS
Anderson et al. 2001	High	Activity level II (IKDC)	Patellar tendon	35	5/35 (14%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	2/33 (6%)	2.357(0.491, 11.323)	NS
Anderson et al. 2001	High	Activity level III (IKDC)	Patellar tendon	35	1/35 (3%)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	2/34 (6%)	0.486(0.046, 5.111)	NS
Anderson et al. 2001	High	Activity level III (IKDC)	Patellar tendon	35	1/35 (3%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	2/33 (6%)	0.471(0.045, 4.957)	NS
Anderson et al. 2001	High	Subjective assessment normal (IKDC)	Patellar tendon	35	17/35 (48%)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	15/34 (44%)	1.101(0.662, 1.832)	NS
Anderson et al. 2001	High	Subjective assessment normal (IKDC)	Patellar tendon	35	17/35 (48%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	17/34 (50%)	0.943(0.586, 1.516)	NS

Table 79. Results: Bone Patellar Tendon Versus Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Anderson et al. 2001	High	Subjective assessment nearly normal (IKDC)	Patellar tendon	35	18/35 (51%)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	17/34 (50%)	1.029(0.646, 1.638)	NS
Anderson et al. 2001	High	Subjective assessment nearly normal (IKDC)	Patellar tendon	35	18/35 (51%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	13/33 (39%)	1.305(0.767, 2.222)	NS
Anderson et al. 2001	High	Subjective assessment abnormal (IKDC)	Patellar tendon	35	0/35 (0%)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	2/34 (6%)	0.194(0.01,3 .907)	NS
Anderson et al. 2001	High	Subjective assessment abnormal (IKDC)	Patellar tendon	35	0/35 (0%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	3/33 (9%)	0.135(0.007, 2.516)	NS
Anderson et al. 2001	High	Symptoms normal (IKDC)	Patellar tendon	35	26/35 (74%)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	23/34 (68%)	1.098(0.811, 1.487)	NS
Anderson et al. 2001	High	Symptoms normal (IKDC)	Patellar tendon	35	26/35 (74%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	23/33 (70%)	1.066(0.791, 1.435)	NS
Anderson et al. 2001	High	Symptoms nearly normal (IKDC)	Patellar tendon	35	8/35 (23%)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	8/34 (23%)	0.971(0.412, 2.293)	NS
Anderson et al. 2001	High	Symptoms nearly normal (IKDC)	Patellar tendon	35	8/35 (23%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	9/33 (27%)	0.838(0.367, 1.913)	NS

Table 79. Results: Bone Patellar Tendon Versus Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Anderson et al. 2001	High	Symptoms abnormal (IKDC)	Patellar tendon	35	1/35 (3%)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	1/34 (3%)	0.971(0.063, 14.915)	NS
Anderson et al. 2001	High	Symptoms abnormal (IKDC)	Patellar tendon	35	1/35 (3%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	1/33 (3%)	0.943(0.061, 14.467)	NS
Anderson et al. 2001	High	Symptoms severely abnormal (IKDC)	Patellar tendon	35	0/35 (0%)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	2/34 (6%)	0.194(0.01,3 .907)	NS
Anderson et al. 2001	High	Symptoms severely abnormal (IKDC)	Patellar tendon	35	0/35 (0%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	0/33 (0%)	NA	NS
Anderson et al. 2001	High	Range of motion normal (IKDC)	Patellar tendon	35	33/35 (94%)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	23/34 (68%)	1.394(1.089, 1.783)	NS
Anderson et al. 2001	High	Range of motion normal (IKDC)	Patellar tendon	35	33/35 (94%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	29/33 (88%)	1.073(0.923, 1.247)	NS
Anderson et al. 2001	High	Range of motion nearly normal (IKDC)	Patellar tendon	35	2/35 (6%)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	11/34 (32%)	0.177(0.042, 0.739)	NS
Anderson et al. 2001	High	Range of motion nearly normal (IKDC)	Patellar tendon	35	2/35 (6%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	4/33 (12%)	0.471(0.092, 2.405)	NS

Table 79. Results: Bone Patellar Tendon Versus Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Anderson et al. 2001	High	Ligament examination normal (IKDC)	Patellar tendon	35	24/35 (69%)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	17/35 (49%)	1.371(0.916, 2.054)	NS
Anderson et al. 2001	High	Ligament examination normal (IKDC)	Patellar tendon	35	24/35 (69%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	16/33 (46%)	1.414(0.932, 2.146)	NS
Anderson et al. 2001	High	Ligament examination nearly normal (IKDC)	Patellar tendon	35	11/35 (31%)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	11/34 (32%)	0.971(0.487, 1.936)	NS
Anderson et al. 2001	High	Ligament examination nearly normal (IKDC)	Patellar tendon	35	11/35 (31%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	10/33 (30%)	1.037(0.509, 2.114)	NS
Anderson et al. 2001	High	Ligament examination abnormal (IKDC)	Patellar tendon	35	0/35 (0%)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	6/34 (15%)	0.075(0.004, 1.278)	NS
Anderson et al. 2001	High	Ligament examination abnormal (IKDC)	Patellar tendon	35	0/35 (0%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	7/33 (21%)	0.063(0.004, 1.061)	NS
Anderson et al. 2001	High	Osteoarthritis (compartment findings normal (IKDC))	Patellar tendon	35	32/35 (91%)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	26/34 (76%)	1.196(0.967, 1.478)	NS
Anderson et al. 2001	High	Osteoarthritis (compartment findings normal (IKDC))	Patellar tendon	35	32/35 (91%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	31/33 (94%)	0.973(0.852, 1.112)	NS

Table 79. Results: Bone Patellar Tendon Versus Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Anderson et al. 2001	High	Osteoarthritis (compartment findings nearly normal (IKDC))	Patellar tendon	35	3/35 (8%)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	8/34 (23%)	0.364(0.105, 1.259)	NS
Anderson et al. 2001	High	Osteoarthritis (compartment findings nearly normal (IKDC))	Patellar tendon	35	3/35 (8%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	2/33(6%)	1.414(0.252, 7.936)	NS
Anderson et al. 2001	High	Final rating normal (IKDC)	Patellar tendon	35	11/35 (31%)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	6/34 (18%)	1.781(0.742, 4.275)	NS
Anderson et al. 2001	High	Final rating normal (IKDC)	Patellar tendon	35	11/35 (31%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	8/33 (24%)	1.296(0.596, 2.819)	NS
Anderson et al. 2001	High	Final rating nearly normal (IKDC)	Patellar tendon	35	23/35 (66%)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	17/34 (50%)	1.314(0.87,1 .986)	NS
Anderson et al. 2001	High	Final rating nearly normal (IKDC)	Patellar tendon	35	23/35 (66%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	18/33 (54%)	1.205(0.813, 1.784)	NS
Anderson et al. 2001	High	Final rating abnormal (IKDC)	Patellar tendon	35	1/35 (3%)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	9/34 (26%)	0.108(0.014, 0.807)	NS
Anderson et al. 2001	High	Final rating abnormal (IKDC)	Patellar tendon	35	1/35 (3%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	7/33 (21%)	0.135(0.018, 1.037)	NS

Table 79. Results: Bone Patellar Tendon Versus Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Anderson et al. 2001	High	Final rating severely abnormal (IKDC)	Patellar tendon	35	0/35 (0%)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	2/34 (6%)	0.194(0.01,3.907)	NS
Anderson et al. 2001	High	Final rating severely abnormal (IKDC)	Patellar tendon	35	0/35 (0%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	0/33 (0%)	NA	NS
Aune et al. 2001	Moderate	Stability (KT-1000 arthrometer manual maximum difference (mm))	Patellar tendon group	29	2.7(2.2)	Hamstring tendon	32	2.7(2.1)	0(-1.1,1.1)	NS
Aune et al. 2001	Moderate	Patient satisfaction (VAS)	Patellar tendon group	29	78.4(26.4)	Hamstring tendon	32	84.8(27.5)	-6.4(-20.23,7.43)	NS
Aune et al. 2001	Moderate	Cincinnati score	Patellar tendon group	29	85.9(12.2)	Hamstring tendon	32	87.8(13)	-1.9(-8.37,4.57)	NS
Aune et al. 2001	Moderate	Anterior knee pain (incidence %)	Patellar tendon group	29	16.10%	Hamstring tendon	32	12.50%	NA	NS
Aune et al. 2001	Moderate	Kneeling problems (VAS)	Patellar tendon group	29	35.5(33.6)	Hamstring tendon	32	18.9(26.2)	16.6(1.25,31.95)	Favors hamstring tendon
Aune et al. 2001	Moderate	Function Stairs hopple test (% loss compared with uninvolved)	Patellar tendon group	29	6.5%(13.7%)	Hamstring tendon	32	2.6% (13.7%)	NA	NS
Aune et al. 2001	Moderate	Function Single-legged hop test (% loss compared with uninvolved)	Patellar tendon group	29	4.3%(7.3%)	Hamstring tendon	32	0.7%(6.9)	NA	NS
Comba et al. 1999	Moderate	Stability (Lachman 1-2mm)	Bone patellar tendon bone	44	31/44(70%)	Double looped Semitendinosus and gracilis tendons	48	28/48(58%)	1.20(0.89,1.64)	NS
Comba et al. 1999	Moderate	Stability (Lachman 3-5mm)	Bone patellar tendon bone	44	13/44(29%)	Double looped Semitendinosus and gracilis	48	19/48(39%)	0.75(0.42,1.33)	NS

Table 79. Results: Bone Patellar Tendon Versus Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
						tendons				
Comba et al. 1999	Moderate	Stability (Lachman 6-10mm)	Bone patellar tendon bone	44	0/44(0%)	Double looped Semitendinosus and gracilis tendons	48	1/48(2%)	NA	NS
Comba et al. 1999	Moderate	Stability (Lachman >10mm)	Bone patellar tendon bone	44	0/44(0%)	Double looped Semitendinosus and gracilis tendons	48	0/48(0%)	NA	NS
Comba et al. 1999	Moderate	Stability (Pivot shift equal)	Bone patellar tendon bone	44	41/44(93%)	Double looped Semitendinosus and gracilis tendons	48	44/48(92%)	1.02(0.90,1.14)	NS
Comba et al. 1999	Moderate	Stability (Pivot shift glide +)	Bone patellar tendon bone	44	3/44(7%)	Double looped Semitendinosus and gracilis tendons	48	3/48(6%)	1.09(0.23,5.13)	NS
Comba et al. 1999	Moderate	Stability (Pivot shift marked ++)	Bone patellar tendon bone	44	0/44(0%)	Double looped Semitendinosus and gracilis tendons	48	1/48(2%)	NA	NS
Comba et al. 1999	Moderate	Stability (Pivot shift gross +++)	Bone patellar tendon bone	44	0/44(0%)	Double looped Semitendinosus and gracilis tendons	48	0/48(0%)	NA	NS
Comba et al. 1999	Moderate	Stability (Kt-1000 at 30lb 0-2mm)	Bone patellar tendon bone	44	23/44(52%)	Double looped Semitendinosus and gracilis tendons	48	25/48(52%)	1.00(0.68,1.48)	NS
Comba et al. 1999	Moderate	Stability (Kt-1000 at 30lb 3-4mm)	Bone patellar tendon bone	44	16/44(36%)	Double looped Semitendinosus and gracilis tendons	48	17/48(35%)	1.03(0.59,1.77)	NS
Comba et al. 1999	Moderate	Stability (Kt-1000 at 30lb >5mm)	Bone patellar tendon bone	44	5/44(11%)	Double looped Semitendinosus and gracilis	48	6/48(12%)	0.91(0.30,2.77)	NS

Table 79. Results: Bone Patellar Tendon Versus Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
						tendons				
Comba et al. 1999	Moderate	Stability (Kt-1000 at manual maximum 0-2mm)	Bone patellar tendon bone	44	21/44(48%)	Double looped Semitendinosus and gracilis tendons	48	23/48(48%)	1.00(0.65,1.53)	NS
Comba et al. 1999	Moderate	Stability (Kt-1000 at manual maximum 3-4mm)	Bone patellar tendon bone	44	16/44(36%)	Double looped Semitendinosus and gracilis tendons	48	16/48(33%)	1.09(0.62,1.91)	NS
Comba et al. 1999	Moderate	Stability (Kt-1000 at manual maximum >5mm)	Bone patellar tendon bone	44	7/44(16%)	Double looped Semitendinosus and gracilis tendons	48	9/48(19%)	0.85(0.35,2.08)	NS
Comba et al. 1999	Moderate	IKDC A normal final evaluation	Bone patellar tendon bone	44	8/44(18%)	Double looped Semitendinosus and gracilis tendons	48	4/48(8%)	2.18(0.71,6.74)	NS
Comba et al. 1999	Moderate	IKDC B nearly normal final evaluation	Bone patellar tendon bone	44	28/44(64%)	Double looped Semitendinosus and gracilis tendons	48	36/48(75%)	0.85(0.64,1.12)	NS
Comba et al. 1999	Moderate	IKDC C abnormal final evaluation	Bone patellar tendon bone	44	5/44(11%)	Double looped Semitendinosus and gracilis tendons	48	6/48(12%)	0.91(0.30,2.77)	NS
Comba et al. 1999	Moderate	IKDC D severely abnormal final evaluation	Bone patellar tendon bone	44	3/44(7%)	Double looped Semitendinosus and gracilis tendons	48	2/48(4%)	1.64(0.29,9.34)	NS
Ejerhed et al. 2003	High	Lysholm score	Bone patellar tendon bone	34	83.68(13.5)	Semitendinosus tendon	37	82.55(12.5)	1.13(-5.02,7.28)	NS
Ejerhed et al. 2003	High	Tegner activity level	Bone patellar tendon bone	34	5.48(2)	Semitendinosus tendon	37	6.24(1.5)	-0.76(-1.59,0.07)	NS
Ejerhed et al. 2003	High	Function (single-legged hop test)	Bone patellar tendon bone	34	92%	Semitendinosus tendon	37	93%	NA	NS
Ejerhed et al.	High	Stability (laxity	Bone patellar	34	2.0(-5-	Semitendinosus	37	2.25(-4-10.5)	NA	NS

Table 79. Results: Bone Patellar Tendon Versus Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
2003		assessment of KT-1000 side-to-side difference at 89N)	tendon bone		11.5)	tendon				
Ejerhed et al. 2003	High	Stability (laxity assessment of KT-1000 anterior translation at 89N)	Bone patellar tendon bone	34	9.0(4-16.5)	Semitendinosus tendon	37	9.5(2.5-17)	NA	NS
Ejerhed et al. 2003	High	Stability (manual Lachman test (0))	Bone patellar tendon bone	34	18/34(53%)	Semitendinosus tendon	37	16/37(43%)	1.224(0.753, 1.991)	NS
Ejerhed et al. 2003	High	Stability (manual Lachman test (+))	Bone patellar tendon bone	34	12/34(68%)	Semitendinosus tendon	37	17/37(46%)	0.768(0.433, 1.364)	NS
Ejerhed et al. 2003	High	Stability (manual Lachman test (++))	Bone patellar tendon bone	34	2/34(6%)	Semitendinosus tendon	37	0/37(0%)	5.429(0.27,1 09.193)	NS
Ejerhed et al. 2003	High	Stability (manual Lachman test (+++))	Bone patellar tendon bone	34	0/34(0%)	Semitendinosus tendon	37	0/37(0%)	NA	NS
Ejerhed et al. 2003	High	IKDC normal or nearly normal	Bone patellar tendon bone	32	17/32 (53%)	Semitendinosus tendon	34	20/34 (59%)	0.903(0.587, 1.389)	NS
Ejerhed et al. 2003	High	IKDC normal or nearly normal	Bone patellar tendon bone	32	15/32 (47%)	Semitendinosus tendon	34	14/34 (41%)	1.138(0.66,1 .964)	NS
Ejerhed et al. 2003	High	Function (knee walking ability (Normal)	Bone patellar tendon bone	32	6/32 (19%)	Semitendinosus tendon	34	21/34 (62%)	0.304(0.141, 0.654)	Favors semitendinos us tendon
Ejerhed et al. 2003	High	Function (knee walking ability (Unpleasant)	Bone patellar tendon bone	32	9/32 (28%)	Semitendinosus tendon	34	5/34 (15%)	1.913(0.717, 5.1)	NS
Ejerhed et al. 2003	High	Function (knee walking ability (Difficult)	Bone patellar tendon bone	32	5/32 (16%)	Semitendinosus tendon	34	6/34 (18%)	0.885(0.299, 2.618)	NS
Ejerhed et al. 2003	High	Function (knee walking ability (Impossible)	Bone patellar tendon bone	32	12/32 (37%)	Semitendinosus tendon	34	2/34 (6%)	6.375(1.546, 26.295)	Favors semitendinos us tendon
Feller et al. 2003	High	Anterior knee pain (VAS)	Patellar tendon	29	2.4(2.1)	Hamstring tendon	23	3.6(2.1)	-1.2(-2.37,-0.023)	Favors patellar tendon
Feller et al. 2003	High	Pain on kneeling (VAS)	Patellar tendon	29	4.0(2.6)	Hamstring tendon	23	2.9(2.1)	1.1(-0.24,2.44)	NS

Table 79. Results: Bone Patellar Tendon Versus Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Feller et al. 2003	High	Cincinnati knee score	Patellar tendon	29	90.9(10.3)	Hamstring tendon	23	91.9(9.3)	-1(-6.53,4.53)	NS
Feller et al. 2003	High	Sports activity level I (%)	Patellar tendon	29	10/29 (35%)	Hamstring tendon	23	5/23 (21%)	1.586(0.63,727)	NS
Feller et al. 2003	High	Sports activity level II (%)	Patellar tendon	29	14/29 (48%)	Hamstring tendon	23	11/23 (48%)	1.009(0.571,727)	NS
Feller et al. 2003	High	Sports activity level III (%)	Patellar tendon	29	1/29 (4%)	Hamstring tendon	23	3/23 (14%)	0.264(0.029,727)	NS
Feller et al. 2003	High	Sports activity level IV (%)	Patellar tendon	29	4/29 (13%)	Hamstring tendon	23	4/23 (17%)	0.793(0.222,727)	NS
Feller et al. 2003	High	IKDC score (Median)	Patellar tendon	29	85	Hamstring tendon	23	80	NA	NS
Feller et al. 2003	High	67 NKT-1000 side to side differences in anterior knee laxity	Patellar tendon	23	0.7(0.8)	Hamstring tendon	29	1.4(0.9)	-0.7(-1.8,-0.22)	Favors patellar tendon
Feller et al. 2003	High	134N KT-1000 side to side differences in anterior knee laxity	Patellar tendon	23	1.1(1.1)	Hamstring tendon	29	1.7(1.0)	-0.6(-1.19,-0.01)	Favors patellar tendon
Feller et al. 2003	High	Range of motion extension deficit	Patellar tendon	23	3.0(2.7)	Hamstring tendon	29	1.4(1.9)	1.6(0.32,2.88)	Favors patellar tendon
Feller et al. 2003	High	Range of motion active flexion	Patellar tendon	23	1.5(2.3)	Hamstring tendon	29	6.7(5.0)	-5.2(-7.46,-2.93)	Favors patellar tendon
Feller et al. 2003	High	Range of motion passive flexion	Patellar tendon	23	7.0(7.3)	Hamstring tendon	29	5.4(5.0)	1.6(-1.83,5.03)	NS
Leal-Blanquet et al. 2011	Moderate	VAS satisfaction	Bone patellar tendon bone	15	8.5(1.3)	Hamstring (semitendinosus gracilis)	20	8.9(1.8)	-0.4(-1.51,0.71)	NS
Leal-Blanquet et al. 2011	Moderate	Anterior knee pain (VAS)	Bone patellar tendon bone	15	4/15(26.7%)	Hamstring (semitendinosus gracilis)	20	2/20(10%)	2.667(0.56,12.687)	NS
Leal-Blanquet et al. 2011	Moderate	Swelling (VAS)	Bone patellar tendon bone	15	0/15(0%)	Hamstring (semitendinosus gracilis)	20	0/20(0%)	NA	NS
Leal-Blanquet	Moderate	Crepitation (VAS)	Bone patellar	15	3/15(20%)	Hamstring	20	4/20(20%)	1(0.262,3.81	NS

Table 79. Results: Bone Patellar Tendon Versus Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
et al. 2011			tendon bone			(semitendinosus gracilis)			5)	
Leal-Blanquet et al. 2011	Moderate	Instability (VAS)	Bone patellar tendon bone	15	1/15(7%)	Hamstring (semitendinosus gracilis)	20	1/20(5%)	1.333(0.091, 19.637)	NS
Leal-Blanquet et al. 2011	Moderate	Strength hamstring 60 deg/s (Isokinetic knee strength)	Bone patellar tendon bone	15	6(23.8)	Hamstring (semitendinosus gracilis)	20	1.8(11)	4.2(- 8.,16.41)	NS
Leal-Blanquet et al. 2011	Moderate	Strength hamstring 180 deg/s (Isokinetic knee strength)	Bone patellar tendon bone	15	4.6(24.4)	Hamstring (semitendinosus gracilis)	20	-6.4(17.1)	11(- 3.22,25.22)	NS
Leal-Blanquet et al. 2011	Moderate	Strength quadriceps 60 deg/s (Isokinetic knee strength)	Bone patellar tendon bone	15	-7(22.8)	Hamstring (semitendinosus gracilis)	20	1.2(26)	-8.2(- 25.32,8.92)	NS
Leal-Blanquet et al. 2011	Moderate	Strength quadriceps 180 deg/s (Isokinetic knee strength)	Bone patellar tendon bone	15	-3(20.4)	Hamstring (semitendinosus gracilis)	20	-5.3(17.2)	2.3(- 10.61,15.21)	NS
Leal-Blanquet et al. 2011	Moderate	KT-1000 neutral position (0-30min value)	Bone patellar tendon bone	15	-0.43(1.05)	Hamstring (semitendinosus gracilis)	20	-0.23(1.31)	-0.2(- 1.03,0.63)	NS
Leal-Blanquet et al. 2011	Moderate	KT-1000 external rotation (0-30min value)	Bone patellar tendon bone	15	-0.9(1.33)	Hamstring (semitendinosus gracilis)	20	-0.03(1.62)	-0.87(- 1.91,0.17)	NS
Leal-Blanquet et al. 2011	Moderate	Lachman test (positive) (n%)	Bone patellar tendon bone	15	3/15(20%)	Hamstring (semitendinosus gracilis)	20	7/20(35%)	0.571(0.176, 1.851)	NS
Leal-Blanquet et al. 2011	Moderate	Lachman test (negative) (n%)	Bone patellar tendon bone	15	12/15(80%)	Hamstring (semitendinosus gracilis)	20	15/20(75%)	1.067(0.746,1.526)	NS
Leal-Blanquet et al. 2011	Moderate	Pivot shift sign (positive) (n%)	Bone patellar tendon bone	15	3/15(20%)	Hamstring (semitendinosus gracilis)	20	7/20(35%)	0.571(0.176,1.851)	NS
Leal-Blanquet et al. 2011	Moderate	Pivot shift sign (negative) (n%)	Bone patellar tendon bone	15	12/15(80%)	Hamstring (semitendinosus gracilis)	20	15/20(75%)	1.067(0.746,1.526)	NS
Leal-Blanquet	Moderate	IKDC A, (n%)	Bone patellar	15	7/15(46.7%	Hamstring	20	9/20(45%)	1.037(	NS

Table 79. Results: Bone Patellar Tendon Versus Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
et al. 2011			tendon bone		)	(semitendinosus gracilis)			0.502,2.144)	
Leal-Blanquet et al. 2011	Moderate	IKDC B, (n%)	Bone patellar tendon bone	15	8/15(53.3%)	Hamstring (semitendinosus gracilis)	20	11/20(55%)	0.97(0.523,1.798)	NS
Shaieb et al. 2002	Moderate	Failure	Patellar tendon	33	2/33(6%)	Hamstring tendon	37	2/37(5%)	1.121(0.167, 7.518)	NS
Shaieb et al. 2002	Moderate	Lysholm score Excellent (95-100)	Patellar tendon	33	16/33(49%)	Hamstring tendon	37	16/37(43%)	1.121(0.673, 1.867)	NS
Shaieb et al. 2002	Moderate	Lysholm score Good (84-94)	Patellar tendon	33	11/33(33%)	Hamstring tendon	37	17/37(46%)	0.725(0.4,1. 316)	NS
Shaieb et al. 2002	Moderate	Lysholm score Fair (65-83)	Patellar tendon	33	2/33(6%)	Hamstring tendon	37	2/37(5%)	1.121(0.167, 7.518)	NS
Shaieb et al. 2002	Moderate	Lysholm score Poor (<65)	Patellar tendon	33	4/33(12%)	Hamstring tendon	37	2/37(5%)	2.242(0.439, 11.459)	NS
Shaieb et al. 2002	Moderate	Patient with patellofemoral pain n(%)	Patellar tendon	33	13/33(42%)	Hamstring tendon	37	7/37(19%)	1.922(0.859, 4.301)	NS
Shaieb et al. 2002	Moderate	Patients with loss of motion n(%)	Patellar tendon	33	14/33(52%	Hamstring tendon	37	7/37(19%)	2.242(1.032, 4.875)	Favors hamstring tendon
Shaieb et al. 2002	Moderate	Average loss of flexion (deg)	Patellar tendon	33	3.4	Hamstring tendon	37	0.97	NA	NA
Tow et al. 2005	Moderate	Laxity at 134N	Patella-tendon	17	13/17(76.5 %)	Semitendinosus-tendon autograft	15	13/15(86.7)	0.88(0.63,1. 23)	NS
Tow et al. 2005	Moderate	IKDC good or excellent score	Patella-tendon	17	8/17(47.1%)	Semitendinosus-tendon autograft	15	9/15(60%)	0.784(0.40,1 .0)	NS
Tow et al. 2005	Moderate	Strength	Patella-tendon	17	NR	Semitendinosus-tendon autograft	15	NR	NA	NS

Table 80. Results: Bone Patellar Tendon Versus Quadrupled Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Eriksson et al. 2001	Moderate	Tegner activity level	Patellar tendon	80	5.75(1.5)	Semitendinosus tendon	74	5.75(1.5)	0(-0.47,0.47)	NS
Eriksson et al. 2001	Moderate	Tegner activity level 0-3 (%)	Patellar tendon	80	19/80 (23%)	Semitendinosus tendon	74	19/74 (24%)	0.925(0.53,1 .60)	NS
Eriksson et al. 2001	Moderate	Tegner activity level 4-6 (%)	Patellar tendon	80	34/80 (42%)	Semitendinosus tendon	74	34/74 (42%)	0.925(0.65,1 .32)	NS
Eriksson et al. 2001	Moderate	Tegner activity level 7-10 (%)	Patellar tendon	80	28/80 (35%)	Semitendinosus tendon	74	22/74 (27%)	1.17(0.74,1. 86)	NS
Eriksson et al. 2001	Moderate	Lysholm score	Patellar tendon	80	79.19(9.17)	Semitendinosus tendon	74	78.93(9)	0.26(- 2.63,3.15)	NS
Eriksson et al. 2001	Moderate	Function VAS (How does your knee function?)	Patellar tendon	80	65.31(16.6 6)	Semitendinosus tendon	74	61.84(16.66)	3.47(- 1.83,8.77)	NS
Eriksson et al. 2001	Moderate	Activities VAS (How does your knee affect level of activity?)	Patellar tendon	80	64.82(16.6 6)	Semitendinosus tendon	74	65.80(16.66)	-0.98(- 6.28,4.32)	NS
Eriksson et al. 2001	Moderate	IKDC A (%)	Patellar tendon	80	2/80 (3%)	Semitendinosus tendon	74	3/74 (4%)	0.617(0.106, 3.588)	NS
Eriksson et al. 2001	Moderate	IKDC B (%)	Patellar tendon	80	36/80 (45%)	Semitendinosus tendon	74	30/74 (37%)	1.11(0.769,1 .602)	NS
Eriksson et al. 2001	Moderate	IKDC C (%)	Patellar tendon	80	14/80 (17%)	Semitendinosus tendon	74	15/74 (19%)	0.863(0.448, 1.664)	NS
Eriksson et al. 2001	Moderate	IKDC D (%)	Patellar tendon	80	12/80 (15%)	Semitendinosus tendon	74	11/74 (14%)	1.009(0.474, 2.146)	NS
Eriksson et al. 2001	Moderate	Extension deficit	Patellar tendon	80	50/80 (62%)	Semitendinosus tendon	74	59/74 (80%)	0.784(0.639, 0.962)	Favors Patellar tendon

Table 80. Results: Bone Patellar Tendon Versus Quadrupled Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		(degrees) <3								
Eriksson et al. 2001	Moderate	Extension deficit (degrees) 3 to 5	Patellar tendon	80	30/80 (37%)	Semitendinosus tendon	74	15/74 (20%)	1.85(1.086,3 .153)	NS
Eriksson et al. 2001	Moderate	Flexion deficit (degrees) 0-5	Patellar tendon	80	65/80 (81%)	Semitendinosus tendon	74	53/74 (72%)	1.134(0.95,1 .355)	NS
Eriksson et al. 2001	Moderate	Flexion deficit (degrees) 6-10	Patellar tendon	80	15/80 (19%)	Semitendinosus tendon	74	21/74 (28%)	0.661(0.369, 1.183)	NS
Eriksson et al. 2001	Moderate	Flexion deficit (degrees) 0-5	Patellar tendon	80	65/80 (81%)	Semitendinosus tendon	74	53/74 (72%)	1.134(0.95,1 .355)	NS
Eriksson et al. 2001	Moderate	Lachman test 0 (0-2)(mm)	Patellar tendon	80	40/80 (50%)	Semitendinosus tendon	74	34/74 (46%)	1.088(0.782, 1.514)	NS
Eriksson et al. 2001	Moderate	Lachman test 0 (0-2)(mm)	Patellar tendon	80	39/80 (49%)	Semitendinosus tendon	74	38/74 (51%)	0.949(0.692, 1.302)	NS
Eriksson et al. 2001	Moderate	Lachman test 0 (0-2)(mm)	Patellar tendon	80	1/80 (1%)	Semitendinosus tendon	74	2/74 (3%)	0.463(0.043, 4.995)	NS
Eriksson et al. 2001	Moderate	Stability (pivot shift test 0)	Patellar tendon	80	56/80 (70%)	Semitendinosus tendon	74	50/74 (68%)	1.036(0.837, 1.282)	NS
Eriksson et al. 2001	Moderate	Stability (pivot shift test +1)	Patellar tendon	80	23/80 (29%)	Semitendinosus tendon	74	22/74 (30%)	0.967(0.591, 1.581)	NS
Eriksson et al. 2001	Moderate	Stability (pivot shift test +2)	Patellar tendon	80	1/80 (1%)	Semitendinosus tendon	74	2/74 (3%)	0.463(0.043, 4.995)	NS
Eriksson et al. 2001	Moderate	Stryker laxity test <-1 (side to side difference (9.08 kg))	Patellar tendon	80	1/80 (1%)	Semitendinosus tendon	74	1/74 (1%)	0.925(0.059, 14.523)	NS
Eriksson et al.	Moderate	Stryker laxity	Patellar tendon	80	58/80	Semitendinosus	74	45/74 (61%)	1.192(0.95,1	NS

Table 80. Results: Bone Patellar Tendon Versus Quadrupled Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
2001		test -1 to 2 (side to side difference (9.08 kg))			(72%)	tendon			.496)	
Eriksson et al. 2001	Moderate	Stryker laxity test 3 to 5 (side to side difference (9.08 kg))	Patellar tendon	80	21/80(26%)	Semitendinosus tendon	74	25/74 (34%)	0.777(0.478, 1.264)	NS
Eriksson et al. 2001	Moderate	Stryker laxity test >5 (side to side difference (9.08 kg))	Patellar tendon	80	0/80 (26%)	Semitendinosus tendon	74	3/74 (4%)	0.132(0.007, 2.518)	NS
Eriksson et al. 2001	Moderate	Stryker laxity test <-1 (side to side difference (18.16 kg))	Patellar tendon	80	4/80 (5%)	Semitendinosus tendon	74	1/74 (1%)	3.7(0.423,32 .353)	NS
Eriksson et al. 2001	Moderate	Stryker laxity test -1 to 2 (side to side difference (18.16 kg))	Patellar tendon	80	35/80 (44%)	Semitendinosus tendon	74	31/74 (42%)	1.044(0.724, 1.505)	NS
Eriksson et al. 2001	Moderate	Stryker laxity test 3 to 5 (side to side difference (18.16 kg))	Patellar tendon	80	38/80 (47%)	Semitendinosus tendon	74	37/74 (50%)	0.95(0.687,1 .314)	NS
Eriksson et al. 2001	Moderate	Stryker laxity test >5 (side to side difference (18.16 kg))	Patellar tendon	80	3/80 (4%)	Semitendinosus tendon	74	5/74 (7%)	0.555(0.137, 2.242)	NS
Eriksson et al. 2001	Moderate	Patellofemora l pain score	Patellar tendon	80	40.74(5.5)	Semitendinosus tendon	73	38.69(6.83)	2.05(0.82,4. 01)	Favors patellar tendon

Table 80. Results: Bone Patellar Tendon Versus Quadrupled Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		overall (Werner et al.)								
Eriksson et al. 2001	Moderate	Patellofemoral pain (0-5)(Werner et al.)	Patellar tendon	80	2.75(0.83)	Semitendinosus tendon	73	2.75(0.83)	0(-0.26,0.26)	NS
Eriksson et al. 2001	Moderate	Patellofemoral pain occasional (0-20) (Werner et al.)	Patellar tendon	80	12.47(3.33)	Semitendinosus tendon	73	12.47(3.33)	0(-1.06,1.06)	NS
Eriksson et al. 2001	Moderate	Patellofemoral pain stair-walking, up (0-5) (Werner et al.)	Patellar tendon	80	4.24(0.5)	Semitendinosus tendon	73	4.24(0.5)	0(-1.06,1.06)	NS
Eriksson et al. 2001	Moderate	Patellofemoral pain stair-walking, down (0-5) (Werner et al.)	Patellar tendon	80	4.75(0.16)	Semitendinosus tendon	73	4.24(0.5)	0(-0.16,0.16)	NS
Eriksson et al. 2001	Moderate	Patellofemoral pain sitting with bent knees (0-5) (Werner et al.)	Patellar tendon	80	3.24(0.83)	Semitendinosus tendon	73	3.24(0.83)	0(-0.264,0.264	NS
Eriksson et al. 2001	Moderate	Patellofemoral pain squatting (0-5) (Werner et al.)	Patellar tendon	80	3.24(0.83)	Semitendinosus tendon	73	3.24(0.83)	0(-0.264,0.264	NS
Eriksson et al. 2001	Moderate	Patellofemoral pain	Patellar tendon	80	2.25(0.83)	Semitendinosus tendon	73	3.24(0.83)	-0.99(-1.25,-0.72)	Favors semitendinosus

Table 80. Results: Bone Patellar Tendon Versus Quadrupled Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		kneeling (0-5) (Werner et al.)								tendon
Eriksson et al. 2001	Moderate	Patellofemoral pain catching (0-5) (Werner et al.)	Patellar tendon	80	3.73(0.83)	Semitendinosus tendon	73	4.49(0.3)	-0.76(-0.96,-0.55)	Favors semitendinosus tendon
Eriksson et al. 2001	Moderate	ACL revision	Patellar tendon	80	1/80 (1%)	Semitendinosus tendon	80	2/80 (25%)	0.500(0.046, 5.404)	NS
Eriksson et al. 2001	Moderate	Arthroscopy with or without shaving	Patellar tendon	80	12/80 (15%)	Semitendinosus tendon	80	11/80 (14%)	1.091(0.512, 2.326)	NS
Eriksson et al. 2001	Moderate	With notchplasty	Patellar tendon	80	4/80 (5%)	Semitendinosus tendon	80	1/80 (1%)	4.000(0.457, 35.008)	NS
Eriksson et al. 2001	Moderate	With meniscal surgery	Patellar tendon	80	5/80 (6%)	Semitendinosus tendon	80	4/80 (5%)	1.250(0.348, 4.486)	NS
Eriksson et al. 2001	Moderate	Screw removal	Patellar tendon	80	2/80 (2%)	Semitendinosus tendon	80	2/80 (2%)	1.000(0.144, 6.926)	NS
Pinczewski et al. 2002 (2 year)	Moderate	Pain (no pain with strenuous activity moderate activity)	Patellar tendon	77	69/77(95%)	Hamstring tendon	77	73/77 (97%)	0.95(0.86,1.04)	NS
Pinczewski et al. 2002 (2 year)	Moderate	Knee swelling with strenuous or moderate activity	Patellar tendon	77	74/77(91%)	Hamstring tendon	77	75/77 (97%)	0.99(0.93,1.05)	NS
Pinczewski et al. 2002 (2 year)	Moderate	Stability (No partial or full giving way during	Patellar tendon	77	76/77(99%)	Hamstring tendon	77	75/77 (97%)	1.01(0.97,1.06)	NS

Table 80. Results: Bone Patellar Tendon Versus Quadrupled Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		strenuous or moderate activity								
Pinczewski et al. 2002 (2 year)	Moderate	Range of motion: Extension deficit greater than 5	Patellar tendon	77	71/77(92%)	Hamstring tendon	77	62/77 (83%)	1.15(1.01,1. 30)	Favors hamstring tendon
Pinczewski et al. 2002 (2 year)	Moderate	Range of motion: Less than 5 loss of flexion	Patellar tendon	77	76/77(99%)	Hamstring tendon	77	76/77 (99%)	1(0.96,1.04)	NS
Pinczewski et al. 2002 (2 year)	Moderate	IKDC Radiologic grade A n(%)	Patellar tendon	77	71/77(92%)	Hamstring tendon	77	69/77(90%)	1.03(0.93,1. 34)	NS
Pinczewski et al. 2002 (2 year)	Moderate	IKDC Radiologic grade B n(%)	Patellar tendon	77	1/77(1%)	Hamstring tendon	77	1/77(1%)		NS
Pinczewski et al. 2002 (2 year)	Moderate	IKDC Radiologic grade C n(%)	Patellar tendon	77	0/77(0%)	Hamstring tendon	77	0(0%)	NA	NS
Pinczewski et al. 2002 (2 year)	Moderate	Patellofemora l crepitus or pain on testing	Patellar tendon	77	92%	Hamstring tendon	77	99%	NA	
Pinczewski et al. 2002 (2 year)	Moderate	Medial crepitus or pain on testing	Patellar tendon	77	99%	Hamstring tendon	77	92%	NA	
Pinczewski et al. 2002 (2 year)	Moderate	Lateral crepitus or pain on testing	Patellar tendon	77	97%	Hamstring tendon	77	98%	NA	
Pinczewski et al. 2002 (2 year)	Moderate	Single-legged hop test	Patellar tendon	77	70/77 (92%)	Hamstring tendon	77	68/77(94%)	1.03(0.92,1. 15)	NS

Table 80. Results: Bone Patellar Tendon Versus Quadrupled Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Pinczewski et al. 2002 (2 year)	Moderate	Overall IKDC score	Patellar tendon	77	NR	Hamstring tendon	77	NR	NA	NS
Pinczewski et al. 2002 (2 year)	Moderate	Lysholm knee score	Patellar tendon	77	82.84(9.66)	Hamstring tendon	77	86.39(7.33)	-3.55(-6.28,-0.82)	Favors hamstring tendon
Pinczewski et al. 2002 (2 year)	Moderate	Kneeling pain	Patellar tendon	77	24/77 (31%)	Hamstring tendon	77	5/77 (6%)	4.8(1.93,11.93)	Favors hamstring tendon
Pinczewski et al. 2002 (5 year)	Moderate	Failure	Patellar tendon	80	3/80(4%)	Hamstring tendon	75	7/75 (9%)	0.40(0.12,1.50)	NS
Pinczewski et al. 2002 (5 year)	Moderate	Subjective functional assessment (IKDC)	Patellar tendon	80	NR	Hamstring tendon	75	NR	NA	NS
Pinczewski et al. 2002 (5 year)	Moderate	Pain (no pain with strenuous activity moderate activity)	Patellar tendon	80	73/80(91%)	Hamstring tendon	75	74/75 (91%)	0.92(0.86,0.99)	NS
Pinczewski et al. 2002 (5 year)	Moderate	Knee swelling with strenuous or moderate activity	Patellar tendon	80	79/80(99%)	Hamstring tendon	75	71/75 (95%)	1.04(0.98,1.11)	NS
Pinczewski et al. 2002 (5 year)	Moderate	Stability (No partial or full giving way during strenuous or moderate activity	Patellar tendon	80	79/80(99%)	Hamstring tendon	75	73/75 (97%)	1.01(0.97,1.06)	NS
Pinczewski et al. 2002 (5	Moderate	Range of motion: Less	Patellar tendon	80	75(100%)	Hamstring tendon	75	79(99%)		NS

Table 80. Results: Bone Patellar Tendon Versus Quadrupled Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
year)		than 5 loss of flexion								
Pinczewski et al. 2002 (5 year)	Moderate	Ligament evaluation	Patellar tendon	80	NR	Hamstring tendon	75	NR	NA	NS
Pinczewski et al. 2002 (5 year)	Moderate	IKDC Radiologic grade A n(%)	Patellar tendon	80	49/80(82%)	Hamstring tendon	50	43/50(96%)	0.71(0.58,0. 88)	Favors patellar tendon
Pinczewski et al. 2002 (5 year)	Moderate	IKDC Radiologic grade B n(%)	Patellar tendon	80	9(15%)	Hamstring tendon	50	1(2%)		
Pinczewski et al. 2002 (5 year)	Moderate	IKDC Radiologic grade C n(%)	Patellar tendon	80	2(3%)	Hamstring tendon	50	1(2%)		
Pinczewski et al. 2002 (5 year)	Moderate	Patellofemora l crepitus or pain on testing	Patellar tendon	80	91%	Hamstring tendon	75	91%	NA	NS
Pinczewski et al. 2002 (5 year)	Moderate	Medial crepitus or pain on testing	Patellar tendon	80	100%	Hamstring tendon	75	90%	NA	NS
Pinczewski et al. 2002 (5 year)	Moderate	Lateral crepitus or pain on testing	Patellar tendon	80	98%	Hamstring tendon	75	97%	NA	NS
Pinczewski et al. 2002 (5 year)	Moderate	IKDC level of activity I and II	Patellar tendon	80	NR	Hamstring tendon	75	NR	NA	NS
Pinczewski et al. 2002 (5 year)	Moderate	Single-legged hop test	Patellar tendon	80	71/80(89%)	Hamstring tendon	75	73/75(97%)	0.91(0.84,0. 99)	Favors hamstring tendon
Pinczewski et al. 2002 (5 year)	Moderate	Overall IKDC score	Patellar tendon	80	NR	Hamstring tendon	75	NR	NA	NS
Pinczewski et	Moderate	Lysholm knee	Patellar tendon	80	88.91(6)	Hamstring tendon	75	86.13(7.5)	2.78(0.63,4.	Favors patellar

Table 80. Results: Bone Patellar Tendon Versus Quadrupled Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
al. 2002 (5 year)		score							92)	tendon
Pinczewski et al. 2002 (5 year)	Moderate	Kneeling pain	Patellar tendon	80	35(44%)	Hamstring tendon	75	20(27%)		Favors hamstring tendon
Pinczewski et al. 2002 (5 year)	Moderate	Complications	Patellar tendon	80	two debridement of cyclops lesion, two ipsilateral patellar tendinitis	Hamstring tendon	75	Hematoma, debridement of cyclops lesion, and arthroscopic arthrolysis		NS
Webster et al. 2001	Moderate	IKDC score A	Patellar tendon	23	6/23(26%)	Hamstring tendon	31	8/31(26%)	1.011(0.407, 2.513)	NS
Webster et al. 2001	Moderate	IKDC score B	Patellar tendon	23	8/23(35%)	Hamstring tendon	31	11/31(35%)	0.98(0.471,2.042)	NS
Webster et al. 2001	Moderate	IKDC score C	Patellar tendon	23	7/23(30%)	Hamstring tendon	31	10/31(32%)	0.943(0.423, 2.102)	NS
Webster et al. 2001	Moderate	IKDC score D	Patellar tendon	23	2/23(9%)	Hamstring tendon	31	2/31(6%)	1.348(0.205, 8.871)	NS
Webster et al. 2001	Moderate	Cincinnati knee score ≤50	Patellar tendon	23	0/23(0%)	Hamstring tendon	31	1/31(3%)	0.444(0.019, 10.440)	NS
Webster et al. 2001	Moderate	Cincinnati knee score >50-80	Patellar tendon	23	5/23(22%)	Hamstring tendon	31	2/31(6%)	3.37(0.716,15.853)	NS
Webster et al. 2001	Moderate	Cincinnati knee score >80-100	Patellar tendon	23	10/23(43%)	Hamstring tendon	31	15/31(48%)	0.899(0.498, 1.623)	NS
Webster et al. 2001	Moderate	Cincinnati knee score 100	Patellar tendon	23	8/23(35%)	Hamstring tendon	31	13/31(42%)	0.829(0.413, 1.664)	NS
Webster et al. 2001	Moderate	KT-1000 Arthrometer anterior side-to-side	Patellar tendon	23	6/23(26%)	Hamstring tendon	31	5/31(16%)	1.617(0.562, 4.655)	NS

Table 80. Results: Bone Patellar Tendon Versus Quadrupled Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		difference 15lb 0								
Webster et al. 2001	Moderate	KT-1000 Arthrometer anterior side-to-side difference 15lb>0-2	Patellar tendon	23	15/23(65%)	Hamstring tendon	31	14/31(45%)	1.444(0.885, 2.356)	NS
Webster et al. 2001	Moderate	KT-1000 Arthrometer anterior side-to-side difference 15lb >2-3	Patellar tendon	23	2/23(9%)	Hamstring tendon	31	11/31(35%)	0.245(0.060, 1.001)	NS
Webster et al. 2001	Moderate	KT-1000 Arthrometer anterior side-to-side difference 15lb >3-5	Patellar tendon	23	0/23(0%)	Hamstring tendon	31	1/31(3%)	0.444(0.019, 10.440)	NS
Webster et al. 2001	Moderate	KT-1000 Arthrometer anterior side-to-side difference 15lb Average(range)	Patellar tendon	23	0.7(-1-2.5)	Hamstring tendon	31	1.4(0-3.5)	NA	NS
Webster et al. 2001	Moderate	KT-1000 Arthrometer anterior side-to-side difference 30lb 0	Patellar tendon	23	7/23(30%)	Hamstring tendon	31	4/31(13%)	2.359(0.782, 7.112)	NS
Webster et al. 2001	Moderate	KT-1000 Arthrometer	Patellar tendon	23	6/23(26%)	Hamstring tendon	31	17/31(55%)	0.476(0.223, 1.016)	NS

Table 80. Results: Bone Patellar Tendon Versus Quadrupled Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		anterior side-to-side difference 30lb>0-2								
Webster et al. 2001	Moderate	KT-1000 Arthrometer anterior side-to-side difference 30lb >2-3	Patellar tendon	23	8/23(35%)	Hamstring tendon	31	7/31(22%)	1.54(0.652,3.637)	NS
Webster et al. 2001	Moderate	KT-1000 Arthrometer anterior side-to-side difference 30lb >3-5	Patellar tendon	23	2/23(9%)	Hamstring tendon	31	3/31(9%)	0.899(0.163, 4.948)	NS
Webster et al. 2001	Moderate	KT-1000 Arthrometer anterior side-to-side difference 30lb Average(range)	Patellar tendon	23	1.1(-1-3.5)	Hamstring tendon	31	1.7(0-4)	NA	NS
Webster et al. 2001	Moderate	Extension deficit (degrees) 0	Patellar tendon	23	2/23(9%)	Hamstring tendon	31	9/31(29%)	0.3(0.071,1.257)	NS
Webster et al. 2001	Moderate	Extension deficit (degrees) >0-3	Patellar tendon	23	11/23(48%)	Hamstring tendon	31	17/31(55%)	0.872(0.512, 1.486)	NS
Webster et al. 2001	Moderate	Extension deficit (degrees)>3-5	Patellar tendon	23	6/23(26%)	Hamstring tendon	31	4/31(13%)	2.022(0.644, 6.349)	NS
Webster et al. 2001	Moderate	Extension deficit	Patellar tendon	23	4/23(17%)	Hamstring tendon	31	1/31(3%)	5.391(0.645, 45.091)	NS

Table 80. Results: Bone Patellar Tendon Versus Quadrupled Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		(degrees) >5-10								
Webster et al. 2001	Moderate	Extension deficit (degrees) average (overall)	Patellar tendon	23	-3.1(-9-0)	Hamstring tendon	31	-1.7(-8-0)	NA	NS
Wipfler et al. 2011 (9 years)	Moderate	Failure	Patellar tendon	31	3/31(10%)	Quadrupled hamstring tendon	31	3/31(10%)	1(0.21,4.57)	NS
Wipfler et al. 2011 (9 years)	Moderate	Lysholm score	Patellar tendon	29	87.28(9.48)	Quadrupled hamstring tendon	25	91.82(8.56)	-4.54(-9.5,0.42)	NS
Wipfler et al. 2011 (9 years)	Moderate	Tegner score	Patellar tendon	29	6.20(1.86)	Quadrupled hamstring tendon	25	6.14(1.84)	0.06(-0.95,1.07)	NS
Wipfler et al. 2011 (9 years)	Moderate	IKDC score (1-4)	Patellar tendon	29	2.08(0.53)	Quadrupled hamstring tendon	25	1.55(0.63)	0.53(0.21,0.84)	Favors quad tendon
Wipfler et al. 2011 (9 years)	Moderate	Patient satisfaction (VAS)	Patellar tendon	29	8.46(1.24)	Quadrupled hamstring tendon	25	9.10(0.88)	-0.64(-1.23,-0.04)	Favors patellar tendon
Wipfler et al. 2011 (9 years)	Moderate	Function (subjective side to side)	Patellar tendon	29	86%	Quadrupled hamstring tendon	25	93%	NA	Favors quadrupled hamstring tendon
Wipfler et al. 2011 (9 years)	Moderate	Range of motion (Extension side to side degrees)	Patellar tendon	29	1.61(2.3)	Quadrupled hamstring tendon	25	2.81(2.76)	-1.2(-2.58,0.180)	NS
Wipfler et al. 2011 (9 years)	Moderate	Range of motion (Flexion side to side degrees)	Patellar tendon	29	1.80(4.07)	Quadrupled hamstring tendon	25	1.14(2.28)	0.66(-1.18,2.500)	NS
Wipfler et al. 2011 (9 years)	Moderate	Stability (Lachman test 0-3)	Patellar tendon	29	0.56(0.10)	Quadrupled hamstring tendon	25	0.45(0.54)	0.11(-0.09,0.314)	NS
Wipfler et al. 2011 (9 years)	Moderate	Stability (Anterior	Patellar tendon	29	0.24(0.47)	Quadrupled hamstring tendon	25	0.05(0.22)	0.19(-0.01,0.395)	NS

Table 80. Results: Bone Patellar Tendon Versus Quadrupled Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		drawer test 0-3)								
Wipfler et al. 2011 (9 years)	Moderate	Stability (Pivot shift)	Patellar tendon	29	0.28(0.49)	Quadrupled hamstring tendon	25	0.18(0.42)	0.1(-0.15,0.351)	NS
Wipfler et al. 2011 (9 years)	Moderate	Stability (KT-1000 side to side mm)	Patellar tendon	29	0.90(1.46)	Quadrupled hamstring tendon	25	0.64(1.78)	0.26(-0.62,1.143)	NS
Wipfler et al. 2011 (9 years)	Moderate	Patellofemoral crepitus (0-3)	Patellar tendon	29	0.73(0.56)	Quadrupled hamstring tendon	25	0.29(0.47)	0.44(0.155,0.724)	Favors bone patellar tendon
Wipfler et al. 2011 (9 years)	Moderate	Function (Knee line test 1-4)	Patellar tendon	29	1.48(0.55)	Quadrupled hamstring tendon	25	1.09(0.31)	0.39(0.140,0.639)	Favors bone patellar tendon
Wipfler et al. 2011 (9 years)	Moderate	Function (knee walking test 1-4)	Patellar tendon	29	1.72(0.85)	Quadrupled hamstring tendon	25	1.14(0.37)	0.58(0.212,0.947)	Favors bone patellar tendon
Wipfler et al. 2011 (9 years)	Moderate	Function (Single leg hop test side to side)	Patellar tendon	29	93%	Quadrupled hamstring tendon	25	99%	NA	NS
Wipfler et al. 2011 (9 years)	Moderate	Strength (Isokinetic flexion side to side)	Patellar tendon	29	100%	Quadrupled hamstring tendon	25	95%	NA	NS
Wipfler et al. 2011 (9 years)	Moderate	Strength (Isokinetic extension side to side)	Patellar tendon	29	96%	Quadrupled hamstring tendon	25	96%	NA	NS
Zaffagnini et al. 2006 (5 years)	Moderate	IKDC A and B (%)	Bone-patellar Tendon-Bone	25	19/25(76%)	Four strand hamstring	25	18/25 (72%)	1.05(0.76,1.46)	NS
Zaffagnini et al. 2006 (5 years)	Moderate	Tegner activity	Bone-patellar Tendon-Bone	25	7.8(1.7)	Four strand hamstring	25	7.1(1.3)	0.7(-0.16,1.56)	NS
Zaffagnini et al. 2006 (5	Moderate	Anterior knee pain	Bone-patellar Tendon-Bone	25	9/25(36%)	Four strand hamstring	25	3/25(12%)	3(0.92,9.79)	NS

Table 80. Results: Bone Patellar Tendon Versus Quadrupled Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
years)										
Zaffagnini et al. 2006 (5 years)	Moderate	Kneeling pain	Bone-patellar Tendon-Bone	25	18/25(72%)	Four strand hamstring	25	11/25(44%)	1.64(0.99,2.71)	NS
Zaffagnini et al. 2006 (5 years)	Moderate	Pivot shift 0	Bone-patellar Tendon-Bone	25	22/25(88%)	Four strand hamstring	25	16/25(64%)	1.38(0.99,1.91)	NS
Zaffagnini et al. 2006 (5 years)	Moderate	Pivot shift 1	Bone-patellar Tendon-Bone	25	3/25(12%)	Four strand hamstring	25	5/25(20%)	0.6(0.16,2.25)	NS
Zaffagnini et al. 2006 (5 years)	Moderate	Pivot shift 2	Bone-patellar Tendon-Bone	25	0/25(0%)	Four strand hamstring	25	4/25(16%)	NA	NS
Zaffagnini et al. 2006 (5 years)	Moderate	Lachman 0	Bone-patellar Tendon-Bone	25	23/25(92%)	Four strand hamstring	25	19/25(72%)	1.21(0.94,1.55)	NS
Roe et al. 2005 (7 year follow-up of Pinczewski et al. 2002)	Moderate	Subjective knee function and symptoms of pain, swelling , and giving way at varying levels of activity	Ipsilateral middle-third patellar tendon	60	NR	Four-strand gracilis and semitendinosus tendons	60	NR	NA	NS
Roe et al. 2005 (7 year follow-up of Pinczewski et al. 2002)	Moderate	Range of motion	Ipsilateral middle-third patellar tendon	60	NR	Four-strand gracilis and semitendinosus tendons	60	NR	NA	NS
Roe et al. 2005 (7 year follow-up of Pinczewski et al. 2002)	Moderate	Ligament evaluation Lachman and Pivot-shift	Ipsilateral middle-third patellar tendon	60	NR	Four-strand gracilis and semitendinosus tendons	60	NR	NA	NS
Roe et al.	Moderate	Instrumental	Ipsilateral	60	NR	Four-strand	60	NR	NA	NS

Table 80. Results: Bone Patellar Tendon Versus Quadrupled Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
2005 (7 year follow-up of Pinczewski et al. 2002)		testing	middle-third patellar tendon			gracilis and semitendinosus tendons				
Roe et al. 2005 (7 year follow-up of Pinczewski et al. 2002)	Moderate	IKDC radiographic assessment grade A	Ipsilateral middle-third patellar tendon	53	29/53(55%)	Four-strand gracilis and semitendinosus tendons	51	44/51(86%)	0.63(0.48,0.83)	Favors four-strand gracilis and semitendinosus tendons
Roe et al. 2005 (7 year follow-up of Pinczewski et al. 2002)	Moderate	IKDC radiographic assessment grade B	Ipsilateral middle-third patellar tendon	53	22/53(41%)	Four-strand gracilis and semitendinosus tendons	51	6/51(12%)		
Roe et al. 2005 (7 year follow-up of Pinczewski et al. 2002)	Moderate	IKDC radiographic assessment grade C	Ipsilateral middle-third patellar tendon	53	2/53(4%)	Four-strand gracilis and semitendinosus tendons	51	1/51(2%)		
Roe et al. 2005 (7 year follow-up of Pinczewski et al. 2002)	Moderate	Strenuous or moderate activities	Ipsilateral middle-third patellar tendon	63	33/63(52%)	Four-strand gracilis and semitendinosus tendons	64	35/64(55%)	0.96(0.69,1.32)	NS
Roe et al. 2005 (7 year follow-up of Pinczewski et al. 2002)	Moderate	IKDC overall	Ipsilateral middle-third patellar tendon	63	NR	Four-strand gracilis and semitendinosus tendons	64	NR	NA	NS
Roe et al. 2005 (7 year follow-up of Pinczewski et al. 2002)	Moderate	Lysholm knee score	Ipsilateral middle-third patellar tendon	63	93(9)	Four-strand gracilis and semitendinosus tendons	64	93(8.6)	NA	NS
Roe et al. 2005 (7 year	Moderate	Kneeling pain	Ipsilateral middle-third	63	34/63(54%)	Four-strand gracilis and	64	13/64(20%)	2.66(1.55,4.54)	Favors quad tendon

Table 80. Results: Bone Patellar Tendon Versus Quadrupled Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
follow-up of Pinczewski et al. 2002)			patellar tendon			semitendinosus tendons				
Roe et al. 2005 (7 year follow-up of Pinczewski et al. 2002)	Moderate	Donor site symptoms at rest	Ipsilateral middle-third patellar tendon	63	24/63(38%)	Four-strand gracilis and semitendinosus tendons	64	9/64(14%)	2.71(1.37,5. 36)	Favors hamstring tendon
Roe et al. 2005 (7 year follow-up of Pinczewski et al. 2002)	Moderate	Failure	Ipsilateral middle-third patellar tendon	90	20/90(32%)	Four-strand gracilis and semitendinosus tendons	90	18/90(20%)	1.11(0.63,1. 96)	NS
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	Failure	Ipsilateral middle-third patellar tendon	90	7/90(8%)	Four-strand gracilis and semitendinosus tendons	90	12/90(13%)	0.58(0.24,1. 41)	NS
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	Kaplan-Meier survivorship analysis	Ipsilateral middle-third patellar tendon	90	92%(86%-98%)	Four-strand gracilis and semitendinosus tendons	90	86%(79%-94%)	NA	Favors four-strand gracilis and semitendinosus tendons
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	Complications	Ipsilateral middle-third patellar tendon	90	15.00	Four-strand gracilis and semitendinosus tendons	90	13.00	NA	NS
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et	Moderate	IKDC subjective functional assessment	Ipsilateral middle-third patellar tendon	75	NR	Four-strand gracilis and semitendinosus tendons	74	NR	NA	NS

Table 80. Results: Bone Patellar Tendon Versus Quadrupled Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
al. 2002)										
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	IKDC subjective symptoms strenuous activities without pain	Ipsilateral middle-third patellar tendon	75	57/75(77%)	Four-strand gracilis and semitendinosus tendons	74	45/74(60%)	1.25(1.00,1.56)	Favors patellar tendon
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	IKDC subjective symptoms strenuous activities without swelling	Ipsilateral middle-third patellar tendon	75	64/75(85%)	Four-strand gracilis and semitendinosus tendons	74	63/74(85%)	1.00(0.88,1.15)	NS
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	IKDC subjective symptoms strenuous activities without giving away	Ipsilateral middle-third patellar tendon	75	65/75(87%)	Four-strand gracilis and semitendinosus tendons	74	67/74(91%)	0.96(0.85,1.07)	NS
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	IKDC subjective symptoms strenuous activities no symptoms	Ipsilateral middle-third patellar tendon	75	43/75(57%)	Four-strand gracilis and semitendinosus tendons	74	53/74(71%)	0.80(0.63,1.02)	NS
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	Lysholm knee score	Ipsilateral middle-third patellar tendon	75	NR	Four-strand gracilis and semitendinosus tendons	74	NR	NA	NS
Pinczewski et al. 2007 (10 year follow-	Moderate	Activity level participating in level 1 or 2	Ipsilateral middle-third patellar tendon	75	34/75(45%)	Four-strand gracilis and semitendinosus	74	42/74(56%)	0.80(0.58,1.10)	NS

Table 80. Results: Bone Patellar Tendon Versus Quadrupled Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
up of Pinczewski et al. 2002)		sports				tendons				
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	Harvest site symptoms A (none)	Ipsilateral middle-third patellar tendon	75	49/75 (65%)	Four-strand gracilis and semitendinosus tendons	74	70/74 (94%)	0.69(0.58,0.82)	Favors Four-strand gracilis and semitendinosus tendons
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	Harvest site symptoms B mild)	Ipsilateral middle-third patellar tendon	75	22/75 (29%)	Four-strand gracilis and semitendinosus tendons	74	4/74 (5%)		
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	Harvest site symptoms C (moderate)	Ipsilateral middle-third patellar tendon	75	3/75 (4%)	Four-strand gracilis and semitendinosus tendons	74	0/74 (0%)		NS
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	Harvest site symptoms D (severe)	Ipsilateral middle-third patellar tendon	75	0/75 0(%)	Four-strand gracilis and semitendinosus tendons	74	0/74 (0%)		NS
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	Kneeling pain	Ipsilateral middle-third patellar tendon	75	44/75 (59%)	Four-strand gracilis and semitendinosus tendons	74	20/74 (27%)	2.17(1.43,3.30)	Favors Four-strand gracilis and semitendinosus tendons
Pinczewski et al. 2007 (10 year follow-	Moderate	Lachman test	Ipsilateral middle-third patellar tendon	53	NR	Four-strand gracilis and semitendinosus	58	NR	NA	NS

Table 80. Results: Bone Patellar Tendon Versus Quadrupled Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
up of Pinczewski et al. 2002)						tendons				
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	Pivot shift grade 0	Ipsilateral middle-third patellar tendon	53	48/53 (90%)	Four-strand gracilis and semitendinosus tendons	58	50/58 (86%)	1.05(0.92,1.20)	NS
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	Pivot shift grade 1	Ipsilateral middle-third patellar tendon	53	5/53 (9%)	Four-strand gracilis and semitendinosus tendons	58	8/58 (14%)	0.68(0.24,1.96)	NS
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	Instrumental testing	Ipsilateral middle-third patellar tendon	53	NR	Four-strand gracilis and semitendinosus tendons	58	NR	NA	NS
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	IKDC overall	Ipsilateral middle-third patellar tendon	53	NR	Four-strand gracilis and semitendinosus tendons	58	NR	NA	NS
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	Single-legged hop test	Ipsilateral middle-third patellar tendon	53	NR	Four-strand gracilis and semitendinosus tendons	58	NR	NA	NS
Pinczewski et al. 2007 (10 year follow-	Moderate	Range of motion	Ipsilateral middle-third patellar tendon	53	NR	Four-strand gracilis and semitendinosus	58	NR	NA	NS

Table 80. Results: Bone Patellar Tendon Versus Quadrupled Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
up of Pinczewski et al. 2002)						tendons				
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	Radiographic osteoarthritis	Ipsilateral middle-third patellar tendon	53	NR	Four-strand gracilis and semitendinosus tendons	58	NR	NA	Favors Four-strand gracilis and semitendinosus tendons
Roe et al. 2005 (7 year follow-up of Pinczewski et al. 2002)	Moderate	Subjective knee function and symptoms of pain, swelling , and giving way at varying levels of activity	Ipsilateral middle-third patellar tendon	60	NR	Four-strand gracilis and semitendinosus tendons	60	NR	NA	NS
Roe et al. 2005 (7 year follow-up of Pinczewski et al. 2002)	Moderate	Range of motion	Ipsilateral middle-third patellar tendon	60	NR	Four-strand gracilis and semitendinosus tendons	60	NR	NA	NS
Roe et al. 2005 (7 year follow-up of Pinczewski et al. 2002)	Moderate	Ligament evaluation Lachman and Pivot-shift	Ipsilateral middle-third patellar tendon	60	NR	Four-strand gracilis and semitendinosus tendons	60	NR	NA	NS
Roe et al. 2005 (7 year follow-up of Pinczewski et al. 2002)	Moderate	Instrumental testing	Ipsilateral middle-third patellar tendon	60	NR	Four-strand gracilis and semitendinosus tendons	60	NR	NA	NS
Roe et al. 2005 (7 year follow-up of	Moderate	IKDC radiographic assessment	Ipsilateral middle-third patellar tendon	53	29/53(55%)	Four-strand gracilis and semitendinosus	51	44/51(86%)	0.63(0.48,0.83)	Favors four-strand gracilis and semitendinosus

Table 80. Results: Bone Patellar Tendon Versus Quadrupled Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Pinczewski et al. 2002)		grade A				tendons				tendons
Roe et al. 2005 (7 year follow-up of Pinczewski et al. 2002)	Moderate	IKDC radiographic assessment grade B	Ipsilateral middle-third patellar tendon	53	22/53(41%)	Four-strand gracilis and semitendinosus tendons	51	6/51(12%)		NA
Roe et al. 2005 (7 year follow-up of Pinczewski et al. 2002)	Moderate	IKDC radiographic assessment grade C	Ipsilateral middle-third patellar tendon	53	2/53(4%)	Four-strand gracilis and semitendinosus tendons	51	1/51(2%)		NA
Roe et al. 2005 (7 year follow-up of Pinczewski et al. 2002)	Moderate	Strenuous or moderate activities	Ipsilateral middle-third patellar tendon	63	33/63(52%)	Four-strand gracilis and semitendinosus tendons	64	35/64(55%)	0.96(0.69,1. 32)	NS
Roe et al. 2005 (7 year follow-up of Pinczewski et al. 2002)	Moderate	IKDC overall	Ipsilateral middle-third patellar tendon	63	NR	Four-strand gracilis and semitendinosus tendons	64	NR	NA	NS
Roe et al. 2005 (7 year follow-up of Pinczewski et al. 2002)	Moderate	Lysholm knee score	Ipsilateral middle-third patellar tendon	63	93(9)	Four-strand gracilis and semitendinosus tendons	64	93(8.6)	0(-3.09,3.09)	NS
Roe et al. 2005 (7 year follow-up of Pinczewski et al. 2002)	Moderate	Kneeling pain	Ipsilateral middle-third patellar tendon	63	34/63(54%)	Four-strand gracilis and semitendinosus tendons	64	13/64(20%)	**2.66(1.55,4. 54)**	Favors hamstring tendon
Roe et al. 2005 (7 year follow-up of Pinczewski et	Moderate	Donor site symptoms at rest	Ipsilateral middle-third patellar tendon	63	24/63(38%)	Four-strand gracilis and semitendinosus tendons	64	9/64(14%)	**2.71(1.37,5. 36)**	Favors hamstring tendon

Table 80. Results: Bone Patellar Tendon Versus Quadrupled Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
al. 2002)										
Roe et al. 2005 (7 year follow-up of Pinczewski et al. 2002)	Moderate	Failure	Ipsilateral middle-third patellar tendon	90	20/90(32%)	Four-strand gracilis and semitendinosus tendons	90	18/90(20%)	1.11(0.63,1.96)	NS
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	Failure	Ipsilateral middle-third patellar tendon	90	7/90(8%)	Four-strand gracilis and semitendinosus tendons	90	12/90(13%)	0.58(0.24,1.41)	NS
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	Kaplan-Meier survivorship analysis	Ipsilateral middle-third patellar tendon	90	92%(86%-98%)	Four-strand gracilis and semitendinosus tendons	90	86%(79%-94%)		Favors four-strand gracilis and semitendinosus tendons
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	Complications	Ipsilateral middle-third patellar tendon	90	15.00	Four-strand gracilis and semitendinosus tendons	90	13.00		NS
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	IKDC subjective functional assessment	Ipsilateral middle-third patellar tendon	75	NR	Four-strand gracilis and semitendinosus tendons	74	NR	NA	NS
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	IKDC subjective symptoms strenuous activities without pain	Ipsilateral middle-third patellar tendon	75	57/75(77%)	Four-strand gracilis and semitendinosus tendons	74	45/74(60%)	1.25(1.00,1.56)	Favors four-strand gracilis and semitendinosus tendons

Table 80. Results: Bone Patellar Tendon Versus Quadrupled Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	IKDC subjective symptoms strenuous activities without swelling	Ipsilateral middle-third patellar tendon	75	64/75(85%)	Four-strand gracilis and semitendinosus tendons	74	63/74(85%)	1.00(0.88,1.15)	NS
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	IKDC subjective symptoms strenuous activities without giving away	Ipsilateral middle-third patellar tendon	75	65/75(87%)	Four-strand gracilis and semitendinosus tendons	74	67/74(91%)	0.96(0.85,1.07)	NS
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	IKDC subjective symptoms strenuous activities no symptoms	Ipsilateral middle-third patellar tendon	75	43/75(57%)	Four-strand gracilis and semitendinosus tendons	74	53/74(71%)	0.80(0.63,1.02)	NS
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	Lysholm knee score	Ipsilateral middle-third patellar tendon	75	NR	Four-strand gracilis and semitendinosus tendons	74	NR		NS
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	Activity level participating in level 1 or 2 sports	Ipsilateral middle-third patellar tendon	75	34/75(45%)	Four-strand gracilis and semitendinosus tendons	74	42/74(56%)	0.80(0.58,1.10)	NS
Pinczewski et al. 2007 (10 year follow-up of	Moderate	Harvest site symptoms A (none)	Ipsilateral middle-third patellar tendon	75	49/75 (65%)	Four-strand gracilis and semitendinosus tendons	74	70/74 (94%)	0.69(0.58,0.82)	Favors Four-strand gracilis and semitendinosus tendons

Table 80. Results: Bone Patellar Tendon Versus Quadrupled Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Pinczewski et al. 2002)										
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	Harvest site symptoms B mild)	Ipsilateral middle-third patellar tendon	75	22/75 (29%)	Four-strand gracilis and semitendinosus tendons	74	4/74 (5%)		
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	Harvest site symptoms C (moderate)	Ipsilateral middle-third patellar tendon	75	3/75 (4%)	Four-strand gracilis and semitendinosus tendons	74	0/74 (0%)		
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	Harvest site symptoms D (severe)	Ipsilateral middle-third patellar tendon	75	0/75 0(%)	Four-strand gracilis and semitendinosus tendons	74	0/74 (0%)		
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	Kneeling pain	Ipsilateral middle-third patellar tendon	75	44/75 (59%)	Four-strand gracilis and semitendinosus tendons	74	20/74 (27%)	**2.17(1.43,3.30)**	Favors Four-strand gracilis and semitendinosus tendons
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	Lachman test	Ipsilateral middle-third patellar tendon	53	NR	Four-strand gracilis and semitendinosus tendons	58	NR		NS
Pinczewski et al. 2007 (10 year follow-up of	Moderate	Pivot shift grade 0	Ipsilateral middle-third patellar tendon	53	48/53 (90%)	Four-strand gracilis and semitendinosus tendons	58	50/58 (86%)	1.05(0.92,1.20)	NS

Table 80. Results: Bone Patellar Tendon Versus Quadrupled Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Pinczewski et al. 2002)										
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	Pivot shift grade 1	Ipsilateral middle-third patellar tendon	53	5/53 (9%)	Four-strand gracilis and semitendinosus tendons	58	8/58 (14%)	0.68(0.25,1.96)	NS
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	Instrumental testing	Ipsilateral middle-third patellar tendon	53	NR	Four-strand gracilis and semitendinosus tendons	58	NR	NA	NS
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	IKDC overall	Ipsilateral middle-third patellar tendon	53	NR	Four-strand gracilis and semitendinosus tendons	58	NR	NA	NS
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	Single-legged hop test	Ipsilateral middle-third patellar tendon	53	NR	Four-strand gracilis and semitendinosus tendons	58	NR	NA	NS
Pinczewski et al. 2007 (10 year follow-up of Pinczewski et al. 2002)	Moderate	Range of motion	Ipsilateral middle-third patellar tendon	53	NR	Four-strand gracilis and semitendinosus tendons	58	NR	NA	NS
Pinczewski et al. 2007 (10 year follow-up of	Moderate	Radiographic osteoarthritis	Ipsilateral middle-third patellar tendon	53	NR	Four-strand gracilis and semitendinosus tendons	58	NR	NA	Favors Four-strand gracilis and semitendinosus tendons

Table 80. Results: Bone Patellar Tendon Versus Quadrupled Hamstring Tendon (2 Year Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Pinczewski et al. 2002)										

Table 81. Results: Bone Patellar Tendon Versus Hamstring Tendon (Long Term Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Ahlden et al. 2009 (7 year follow-up of Ejerhed et al. 2003)	Moderate	Stability (Lachman test 0)	Bone patellar tendon bone	22	7/22(32%)	Hamstring tendon autograft	25	6/25(24%)	1.326(0.524, 3.353)	NS
Ahlden et al. 2009 (7 year follow-up of Ejerhed et al. 2003)	Moderate	Stability (Lachman test +1)	Bone patellar tendon bone	22	14/22(64%)	Hamstring tendon autograft	25	15/25(60%)	1.06(0.67,1. 66)	NS
Ahlden et al. 2009 (7 year follow-up of Ejerhed et al. 2003)	Moderate	Stability (Lachman test +2)	Bone patellar tendon bone	22	0/22(0%)	Hamstring tendon autograft	25	2/25(8%)	0.22(0.01,4. 46)	NS
Ahlden et al. 2009 (7 year follow-up of Ejerhed et al. 2003)	Moderate	Tegner activity level	Bone patellar tendon bone	22	4.74(1.25)	Hamstring tendon autograft	25	4.74(2.25)	0(- 1.089,1.089)	NS
Ahlden et al. 2009 (7 year follow-up of Ejerhed et al. 2003)	Moderate	Lysholm knee score	Bone patellar tendon bone	22	77.60(12.7 5)	Hamstring tendon autograft	25	72.62(21.25)	4.98(- 5.48,15.44)	NS
Ahlden et al. 2009 (7 year follow-up of Ejerhed et al. 2003)	Moderate	Function (One-leg hop (median, %)	Bone patellar tendon bone	22	81%	Hamstring tendon autograft	25	94%	NA	
Ahlden et al. 2009 (7 year follow-up of Ejerhed et al. 2003)	Moderate	Range of motion (Extension deficit)	Bone patellar tendon bone	22	3/22(14%)	Hamstring tendon autograft	25	3/25(12%)	1.13(0.25,5. 06)	NS
Ahlden et al.	Moderate	Range of	Bone patellar	22	6/22(27%)	Hamstring tendon	25	12/25(48%)	0.56(0.256,1	NS

Table 81. Results: Bone Patellar Tendon Versus Hamstring Tendon (Long Term Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
2009 (7 year follow-up of Ejerhed et al. 2003)		motion (Flexion deficit)	tendon bone			autograft			.25)	
Ahlden et al. 2009 (7 year follow-up of Ejerhed et al. 2003)	Moderate	Stability (KT-1000 arthrometer measurements Side to side)	Bone patellar tendon bone	22	1.4(2.6)	Hamstring tendon autograft	25	2.6(3.3)	-1.2(-2.96,0.56)	NS
Ahlden et al. 2009 (7 year follow-up of Ejerhed et al. 2003)	Moderate	Stability (KT-1000 arthrometer measurements injured side)	Bone patellar tendon bone	22	7.1(-3.5)	Hamstring tendon autograft	25	8.7(3.4)	-1.6(-3.63,0.42)	NS
Ahlden et al. 2009 (7 year follow-up of Ejerhed et al. 2003)	Moderate	Stability (KT-1000 arthrometer measurements uninjured side)	Bone patellar tendon bone	22	5.7(2.4)	Hamstring tendon autograft	25	6.1(3.1)	-0.4(-2.044,1.24)	NS
Ahlden et al. 2009 (7 year follow-up of Ejerhed et al. 2003)	Moderate	Osteoarthritis (Ahlback and Fairbank rating)	Bone patellar tendon bone	21	NR	Hamstring tendon autograft	23	NR	NA	NS
Barenius et al. 2010 (8 year follow-up of Erickson et al. 2001)	Moderate	Range of motion (<3deg Extension deficit, N(%)	Bone patellar tendon bone	78	59/78(76%)	Quadrupled semitendinosus graft	75	63/75(84%)	0.9(0.767,1.057)	NS
Barenius et al. 2010 (8 year follow-up of Erickson et al. 2001)	Moderate	Range of motion (3-5 deg Extension deficit, N(%)	Bone patellar tendon bone	78	19/78(24%)	Quadrupled semitendinosus graft	75	10/75(13%)	1.827(0.91,3.668)	NS
Barenius et al.	Moderate	Range of	Bone patellar	78	0/78(0%)	Quadrupled	75	3/75(3%)	0.137(0.007,	NS

Table 81. Results: Bone Patellar Tendon Versus Hamstring Tendon (Long Term Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
2010 (8 year follow-up of Erickson et al. 2001)		motion (6-10 deg Extension deficit, N(%)	tendon bone			semitendinosus graft			2.616)	
Barenius et al. 2010 (8 year follow-up of Erickson et al. 2001)	Moderate	Range of motion (0-5 deg Flexion deficit, N(%)	Bone patellar tendon bone	78	72/78(97%)	Quadrupled semitendinosus graft	75	69/75(92%)	1.003(0.915, 1.101)	NS
Barenius et al. 2010 (8 year follow-up of Erickson et al. 2001)	Moderate	Range of motion (6-25 deg Flexion deficit, N(%)	Bone patellar tendon bone	78	6/78(3%)	Quadrupled semitendinosus graft	75	6/75(8%)	0.962(0.324, 2.849)	NS
Barenius et al. 2010 (8 year follow-up of Erickson et al. 2001)	Moderate	Stability (Lachman 0(0-2), N(%))	Bone patellar tendon bone	78	48/78(61%)	Quadrupled semitendinosus graft	75	50/75(67%)	0.923(0.728, 1.17)	NS
Barenius et al. 2010 (8 year follow-up of Erickson et al. 2001)	Moderate	Stability (Lachman +1(3-5), N(%))	Bone patellar tendon bone	78	28/78(36%)	Quadrupled semitendinosus graft	75	21/75(28%)	1.282(0.802, 2.049)	NS
Barenius et al. 2010 (8 year follow-up of Erickson et al. 2001)	Moderate	Stability (Lachman +2(6-10), N(%))	Bone patellar tendon bone	78	0(0%)	Quadrupled semitendinosus graft	75	3/75(4%)	0.137(0.007, 2.616)	NS
Barenius et al. 2010 (8 year follow-up of Erickson et al. 2001)	Moderate	Stability (Lachman +3(>10), N(%))	Bone patellar tendon bone	78	2/78(3%)	Quadrupled semitendinosus graft	75	1/75(1%)	1.923(0.178, 20.767)	NS
Barenius et al. 2010 (8 year	Moderate	Stability (Pivot shift, 0	Bone patellar tendon bone	75	62/75(80%)	Quadrupled semitendinosus	75	54/75(72%)	1.148(0.964, 1.368)	NS

Table 81. Results: Bone Patellar Tendon Versus Hamstring Tendon (Long Term Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
follow-up of Erickson et al. 2001)		N(%))				graft				
Barenius et al. 2010 (8 year follow-up of Erickson et al. 2001)	Moderate	Stability (Pivot shift, +1 N(%))	Bone patellar tendon bone	75	12/75(15%)	Quadrupled semitendinosus graft	75	19(25%)	0.632(0.33,1 .207)	NS
Barenius et al. 2010 (8 year follow-up of Erickson et al. 2001)	Moderate	Stability (Pivot shift, +2 N(%))	Bone patellar tendon bone	75	1/75(1%)	Quadrupled semitendinosus graft	75	1/75(1%)	1(0.064,15.6 94)	NS
Barenius et al. 2010 (8 year follow-up of Erickson et al. 2001)	Moderate	Stability (Pivot shift, +3 N(%))	Bone patellar tendon bone	78	0(0%)	Quadrupled semitendinosus graft	75	1/75(1%)	0.321(0.013, 7.75)	NS
Barenius et al. 2010 (8 year follow-up of Erickson et al. 2001)	Moderate	Not possible to perform pivot shift	Bone patellar tendon bone	78	3(4%)	Quadrupled semitendinosus graft	75	0(0%)	6.734(0.354, 128.201)	NS
Barenius et al. 2010 (8 year follow-up of Erickson et al. 2001)	Moderate	Rolimeter maximum side to side difference	Bone patellar tendon bone	78	2.3(1.9)	Quadrupled semitendinosus graft	75	2.3(1.9)	0(-0.60,0.60)	NS
Barenius et al. 2010 (8 year follow-up of Erickson et al. 2001)	Moderate	IKDC A	Bone patellar tendon bone	78	7/78(9%)	Quadrupled semitendinosus graft	75	11/75(15%)	0.612(0.251, 1.495)	NS
Barenius et al. 2010 (8 year follow-up of	Moderate	IKDC B	Bone patellar tendon bone	78	45/78(58%)	Quadrupled semitendinosus graft	75	36/75(48%)	1.202(0.888, 1.627)	NS

Table 81. Results: Bone Patellar Tendon Versus Hamstring Tendon (Long Term Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Erickson et al. 2001)										
Barenius et al. 2010 (8 year follow-up of Erickson et al. 2001)	Moderate	IKDC C	Bone patellar tendon bone	78	16/78(20%)	Quadrupled semitendinosus graft	75	21/75(28%)	0.733(0.415, 1.293)	NS
Barenius et al. 2010 (8 year follow-up of Erickson et al. 2001)	Moderate	IKDC D	Bone patellar tendon bone	78	10/78(13%)	Quadrupled semitendinosus graft	75	7/75(9%)	1.374(0.552, 3.421)	NS
Barenius et al. 2010 (8 year follow-up of Erickson et al. 2001)	Moderate	Tegner activity level	Bone patellar tendon bone	78	5(1.6)	Quadrupled semitendinosus graft	75	4.51(1.33)	0.49(0.12,0. 96)	Favors patellar tendon
Barenius et al. 2010 (8 year follow-up of Erickson et al. 2001)	Moderate	Lysholm score	Bone patellar tendon bone	78	79.64(9.5)	Quadrupled semitendinosus graft	75	79.37(10)	0.27(-2.84,3.38)	NS
Barenius et al. 2010 (8 year follow-up of Erickson et al. 2001)	Moderate	Function (VAS)	Bone patellar tendon bone	78	61.85(16.6)	Quadrupled semitendinosus graft	75	61.35(16.6)	0.5(-4.80,5.8)	NS
Barenius et al. 2010 (8 year follow-up of Erickson et al. 2001)	Moderate	Activity (VAS)	Bone patellar tendon bone	78	60.86(16.6)	Quadrupled semitendinosus graft	75	60.85(16.6)	0.01(-2.29,5.31)	NS
Barenius et al. 2010 (8 year follow-up of Erickson et al.	Moderate	KOOS subscales	Bone patellar tendon bone	78	NR	Quadrupled semitendinosus graft	75	NR	NA	NS

Table 81. Results: Bone Patellar Tendon Versus Hamstring Tendon (Long Term Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
2001)										
Barenius et al. 2010 (8 year follow-up of Erickson et al. 2001)	Moderate	SF-36 subscales	Bone patellar tendon bone	78	NR	Quadrupled semitendinosus graft	75	NR	NA	NS
Harilainen et al. 2006	Moderate	Lysholm score	Patellar tendon	40	80.65(16.5)	Hamstring tendon	39	80.64(15.5)	0.3(-5.61,6.21)	NS
Harilainen et al. 2006	Moderate	Tegner activity level	Patellar tendon	40	5.74(2.25)	Hamstring tendon	39	6(1.5)	0.01(-7.16,7.18)	NS
Harilainen et al. 2006	Moderate	Kujala PF	Patellar tendon	40	84.71(13.25)	Hamstring tendon	39	87.23(11.5)	-2.52(-8.08,3.04)	NS
Harilainen et al. 2006	Moderate	Lachman test No (-)	Patellar tendon	37	29/37(78%)	Hamstring tendon	37	31/37(84%)	0.935(0.75,1.167)	NS
Harilainen et al. 2006	Moderate	Lachman test Slight (+)	Patellar tendon	37	8/37(22%)	Hamstring tendon	37	5/37(13%)	1.6(0.577,4.438)	NS
Harilainen et al. 2006	Moderate	Lachman test Clear (++)	Patellar tendon	37	0/37(0%)	Hamstring tendon	37	1/37(2%)	0.333(0.014, 7.927)	NS
Harilainen et al. 2006	Moderate	Stability (pivot shift test No (-)	Patellar tendon	37	33/37(89%)	Hamstring tendon	37	33/37(89%)	1(0.853,1.172)	NS
Harilainen et al. 2006	Moderate	Stability (pivot shift test Slight (+)	Patellar tendon	37	4/37(11%)	Hamstring tendon	37	3/37(8%)	1.333(0.32,5.549)	NS
Harilainen et al. 2006	Moderate	Stability (pivot shift test Clear (++)	Patellar tendon	37	0/37(0%)	Hamstring tendon	37	1/37(3%)	0.333(0.014, 7.927)	NS
Harilainen et al. 2006	Moderate	Stability (side-to-side laxity difference, mm(sd)	Patellar tendon	37	1.5(3)	Hamstring tendon	37	1.2(3.9)	0.3(-1.31,1.91)	NS
Harilainen et al. 2006	Moderate	Strength (Extension torque 60	Patellar tendon	37	88.2(16%)	Hamstring tendon	37	89.2(13.3%)	NA	NS

Table 81. Results: Bone Patellar Tendon Versus Hamstring Tendon (Long Term Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		degrees/s,%)								
Harilainen et al. 2006	Moderate	Strength (Extension torque 180 degrees/s,%)	Patellar tendon	37	93.6(19.7%)	Hamstring tendon	37	91.4(11%)	NA	NS
Harilainen et al. 2006	Moderate	Strength (Flexion torque 60 degrees/s,%)	Patellar tendon	37	96.8(14.6%)	Hamstring tendon	37	97.5(12.1%)	NA	NS
Harilainen et al. 2006	Moderate	Strength (Flexion torque 180 degrees/s,%)	Patellar tendon	37	95.5(11.3%)	Hamstring tendon	37	96.5(12.7)	NA	NS
Harilainen et al. 2006	Moderate	IKDC classification A	Patellar tendon	38	13/38(34%)	Hamstring tendon	37	9/37(24%)	1.406(0.685, 2.887)	NS
Harilainen et al. 2006	Moderate	IKDC classification B	Patellar tendon	38	19/38(50%)	Hamstring tendon	37	22/37(59%)	0.841(0.556, 1.273)	NS
Harilainen et al. 2006	Moderate	IKDC classification C	Patellar tendon	38	6/38(16%)	Hamstring tendon	37	6/37(16%)	0.974(0.345, 2.747)	NS
Holm et al. 2010 (10 year follow-up Aune et al. 2001)	Moderate	Failure	Patellar tendon	28	3/28(11%)	Hamstring tendon autograft	29	3/28(11%)	1.03(0.22,4.70)	NS
Holm et al. 2010 (10 year follow-up Aune et al. 2001)	Moderate	Additional meniscal resection	Patellar tendon	28	16/28(57%)	Hamstring tendon autograft	29	12/29(41%)	1.38(0.81,2.36)	NS
Holm et al. 2010 (10 year follow-up Aune et al.	Moderate	Return to pre-injury level of sports, including	Patellar tendon	28	15/28 (54%)	Hamstring tendon autograft	29	13/29 (46%)	1.19(0.70,2.03)	NS

Table 81. Results: Bone Patellar Tendon Versus Hamstring Tendon (Long Term Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
2001)		pivoting activities								
Holm et al. 2010 (10 year follow-up Aune et al. 2001)	Moderate	Osteoarthritis	Patellar tendon	28	NR	Hamstring tendon autograft	29	NR	NA	NS
Holm et al. 2010 (10 year follow-up Aune et al. 2001)	Moderate	Cincinnati knee score (0-100)	Patellar tendon	28	84(14.5)	Hamstring tendon autograft	29	87.8(12.3)	-3.8(-10.92,3.32)	NS
Holm et al. 2010 (10 year follow-up Aune et al. 2001)	Moderate	Lysholm knee score	Patellar tendon	28	84.2(15.4)	Hamstring tendon autograft	29	86.1(15.1)	-1.9(-9.98,6.18)	NS
Holm et al. 2010 (10 year follow-up Aune et al. 2001)	Moderate	Subjective function (VAS)	Patellar tendon	28	7.6(2.7)	Hamstring tendon autograft	29	7.7(3)	-0.1(-1.61,1.41)	NS
Holm et al. 2010 (10 year follow-up Aune et al. 2001)	Moderate	KT-1000 arthrometer (manual max, mm; difference uninvolved/involved side)	Patellar tendon	28	3.0(3.2)	Hamstring tendon autograft	29	2.0(3.5)	1(-0.78,1.41)	NS
Holm et al. 2010 (10 year follow-up Aune et al. 2001)	Moderate	Hamstring strength 60 deg/s (involved side in % of uninvolved side)	Patellar tendon	28	92(12%)	Hamstring tendon autograft	29	98(28.5%)	NA	NS

Table 81. Results: Bone Patellar Tendon Versus Hamstring Tendon (Long Term Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Holm et al. 2010 (10 year follow-up Aune et al. 2001)	Moderate	Hamstring strength 240 deg/s (involved side in % of uninvolved side)	Patellar tendon	28	95.1(12.6%)	Hamstring tendon autograft	29	92.6(25.7%)	NA	NS
Holm et al. 2010 (10 year follow-up Aune et al. 2001)	Moderate	Quadriceps strength 60 deg/s (involved side in % of uninvolved side)	Patellar tendon	28	89.6(10.3%)	Hamstring tendon autograft	29	100.1(30.2%)	NA	NS
Holm et al. 2010 (10 year follow-up Aune et al. 2001)	Moderate	Quadriceps strength 240 deg/s (involved side in % of uninvolved side)	Patellar tendon	28	96.1(9.2%)	Hamstring tendon autograft	29	96(10.5%)	NA	NS
Holm et al. 2010 (10 year follow-up Aune et al. 2001)	Moderate	Triple-jump test (involved side in % of uninvolved side)	Patellar tendon	28	100.2(7.9%)	Hamstring tendon autograft	29	100.2(7.9%)	NA	NS
Holm et al. 2010 (10 year follow-up Aune et al. 2001)	Moderate	Stair-hop test (involved side in % of uninvolved side)	Patellar tendon	28	100.8(10.2%)	Hamstring tendon autograft	29	100.8(10.2%)	NA	NS
Holm et al. 2010 (10 year follow-up Aune et al. 2001)	Moderate	Pain at rest (VAS)	Patellar tendon	28	7(15)	Hamstring tendon autograft	29	8(17)	-1(-9.51,7.51)	NS

Table 81. Results: Bone Patellar Tendon Versus Hamstring Tendon (Long Term Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Holm et al. 2010 (10 year follow-up Aune et al. 2001)	Moderate	Pain in activity (VAS)	Patellar tendon	28	16(17)	Hamstring tendon autograft	29	17(22)	-1(-11.45,9.45)	NS
Holm et al. 2010 (10 year follow-up Aune et al. 2001)	Moderate	Kneeling pain (VAS)	Patellar tendon	28	39(37)	Hamstring tendon autograft	29	29(37)	10(-9.63,29.63)	NS
Liden et al. 2007	High	Lysholm score	Patellar tendon	32	71.46(18.75)	Hamstring tendon	29	82.24(12.50)	-10.78(-19.03,-2.53)	Favors hamstring tendon
Liden et al. 2007	High	Tegner activity level	Patellar tendon	32	4.23(1.75)	Hamstring tendon	29	5.74(1.75)	-1.51(-2.41,-0.61)	Favors hamstring tendon
Liden et al. 2007	High	1-Legged hop test	Patellar tendon	32	31/32 (96%)	Hamstring tendon	29	27/29 (92%)	1.041(0.926, 1.17)	NS
Liden et al. 2007	High	Meniscus problem (cause of additional surgery)	Patellar tendon	32	2/32(6%)	Hamstring tendon	29	1/29(3%)	1.813(0.173, 18.953)	NS
Liden et al. 2007	High	Screw problems (cause of additional surgery)	Patellar tendon	32	2/32(6%)	Hamstring tendon	29	1/29(3%)	1.813(0.173, 18.953)	NS
Liden et al. 2007	High	Screw and meniscus problems (cause of additional surgery)	Patellar tendon	32	1/32(6%)	Hamstring tendon	29	0/29(0%)	2.727(0.115, 64.424)	NS
Liden et al. 2007	High	ACL reinjury (cause of additional surgery)	Patellar tendon	32	1/32(6%)	Hamstring tendon	29	2/29(7%)	0.453(0.043, 4.738)	NS

Table 81. Results: Bone Patellar Tendon Versus Hamstring Tendon (Long Term Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Liden et al. 2007	High	Reinjury other than ACL (cause of additional surgery)	Patellar tendon	32	1/32(6%)	Hamstring tendon	29	0/29(0%)	2.727(0.115, 64.424)	NS
Liden et al. 2007	High	Other additional injury (cause of additional surgery)	Patellar tendon	32	1/32(6%)	Hamstring tendon	29	3/29(10%)	0.313(0.034, 2.842)	NS
Liden et al. 2007	High	IKDC normal or nearly normal	Patellar tendon	32	15/32 (48%)	Hamstring tendon	29	14/29 (50%)	0.78(0.57,1. 64)	NS
Liden et al. 2007	High	IKDC abnormal or severely abnormal	Patellar tendon	32	17/32 (52%)	Hamstring tendon	29	14/29 (50%)	1.1(0.669,1. 81)	NS
Liden et al. 2007	High	Manual Lachman test (0)	Patellar tendon	32	8/32 (25%)	Hamstring tendon	29	7/29 (24%)	1.036(0.429, 2.5)	NS
Liden et al. 2007	High	Manual Lachman test (+)	Patellar tendon	32	21/32 (72%)	Hamstring tendon	29	23/29 (79%)	0.827(0.606, 1.131)	NS
Liden et al. 2007	High	Manual Lachman test (++)	Patellar tendon	32	1/32 (3%)	Hamstring tendon	29	1/29 (3%)	0.906(0.059, 13.838)	NS
Liden et al. 2007	High	Manual Lachman test (+++)	Patellar tendon	32	0/32	Hamstring tendon	29	1/29 (3%)	0.303(0.013, 7.158)	NS
Liden et al. 2007	High	KT-1000 Arthrometer anterior side-to-side difference 89N	Patellar tendon	32	1.7(-5-6)	Hamstring tendon	29	2.7 mm (-4.5-9.5)	NA	NS
Liden et al.	High	Knee-	Patellar tendon	32	12/32	Hamstring tendon	29	13/29 (44%)	0.837(0.458,	NS

Table 81. Results: Bone Patellar Tendon Versus Hamstring Tendon (Long Term Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
2007		Walking test Normal			(39%)				1.528)	
Liden et al. 2007	High	Knee-Walking test Unpleasant	Patellar tendon	32	8/32 (26%)	Hamstring tendon	29	12/29 (41%)	0.604(0.288, 1.266)	NS
Liden et al. 2007	High	Knee-Walking test Difficult	Patellar tendon	32	5/32 (16%)	Hamstring tendon	29	3/29 (9%)	1.51(0.395,5 .77)	NS
Liden et al. 2007	High	Knee-Walking test Impossible	Patellar tendon	32	6/32 (19%)	Hamstring tendon	29	2/29 (6%)	2.719(0.595, 12.423)	NS
Liden et al. 2007	High	Disturbance in knee sensitivity (cm2)	Patellar tendon	32	4(0-299)	Hamstring tendon	29	35(0-282)	NA	NS
Liden et al. 2007	High	Kneeling Normal	Patellar tendon	32	17/32 (52%)	Hamstring tendon	29	17/29 (59%)	0.906(0.58,1 .416)	NS
Liden et al. 2007	High	Kneeling Unpleasant	Patellar tendon	32	8/32 (26%)	Hamstring tendon	29	10/29 (35%)	0.725(0.332, 1.585)	NS
Liden et al. 2007	High	Kneeling Difficult	Patellar tendon	32	5/32 (16%)	Hamstring tendon	29	0/29(0%)	10.000(0.57 7,173.315)	NS
Liden et al. 2007	High	Kneeling Impossible	Patellar tendon	32	2/32 (6%)	Hamstring tendon	29	2/29 (6%)	0.906(0.136, 6.026)	NS
Liden et al. 2007	High	Range of motion extension in degrees	Patellar tendon	32	5(-10-5)	Hamstring tendon	29	-5(-10-5)	NA	NS
Liden et al. 2007	High	Range of motion flexion degrees	Patellar tendon	32	140(110-155)	Hamstring tendon	29	140(130-155)	NA	NS
Sajovic et al. 2006 (5 years)	High	Lysholm score Excellent (95-100)	Patellar tendon	25	18/25(67%)	Hamstring tendon	27	14/27(56%)	1.085(0.675, 1.744)	NS
Sajovic et al.	High	Lysholm	Patellar tendon	25	9/25(33%)	Hamstring tendon	27	11/27(44%)	1.105(0.568,	NS

Table 81. Results: Bone Patellar Tendon Versus Hamstring Tendon (Long Term Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
2006 (5 years)		score Good (84-94)							2.147)	
Sajovic et al. 2006 (5 years)	High	Lysholm score Fair (84-94)	Patellar tendon	25	0(0%)	Hamstring tendon	27	0(0%)	NA	NS
Sajovic et al. 2006 (5 years)	High	Lysholm score Poor (84-94)	Patellar tendon	25	0(0%)	Hamstring tendon	27	0(0%)	NA	NS
Sajovic et al. 2006 (5 years)	High	Manual Lachman test A (negative)	Patellar tendon	25	16/25(64%)	Hamstring tendon	27	23/27(85%)	0.482(0.320, 0.724)	Favors Hamstring tendon
Sajovic et al. 2006 (5 years)	High	Manual Lachman test C (soft end point: 2+)	Patellar tendon	25	8/25(32%)	Hamstring tendon	27	4/27(15%)	4.500(1.674, 12.099)	
Sajovic et al. 2006 (5 years)	High	Manual Lachman test B (positive with firm end point: 1+)	Patellar tendon	25	1/25(4%)	Hamstring tendon	27	0/27(0%)	3.23(0.14,75 .8)	NS
Sajovic et al. 2006 (5 years)	High	Manual pivot shift A(negative)	Patellar tendon	25	17/25(68%)	Hamstring tendon	27	25/27(93%)	0.437(0.298, 0.64)	NS
Sajovic et al. 2006 (5 years)	High	Manual pivot shift B(glide: 1+)	Patellar tendon	25	7/25(28%)	Hamstring tendon	27	2/27(7%))	10.50(2.645, 41.676)	NS
Sajovic et al. 2006 (5 years)	High	Manual pivot shift C(clunk: 2+)	Patellar tendon	25	1/25(4%)	Hamstring tendon	27	0(0%)	3.23(0.14,75 .8)	NS
Sajovic et al. 2006 (5 years)	High	Manual pivot shift A(negative)	Patellar tendon	25	17/25(68%)	Hamstring tendon	27	25/27(93%)	0.437(0.298, 0.64)	NS
Sajovic et al. 2006 (5 years)	High	Manual pivot shift B(glide: 1+)	Patellar tendon	25	7/25(28%)	Hamstring tendon	27	2/27(7%))	10.50(2.645, 41.676)	
Sajovic et al.	High	Manual pivot	Patellar tendon	25	1/25(4%)	Hamstring tendon	27	0/27(0%)	42.00(2.403,	

Table 81. Results: Bone Patellar Tendon Versus Hamstring Tendon (Long Term Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
2006 (5 years)		shift C(clunk: 2+)							734.201)	
Sajovic et al. 2006 (5 years)	High	IKDC instrumental anteroposterior translation A (<3mm)	Patellar tendon	25	18/25(72%)	Hamstring tendon	27	6/27(24%)	3.375(1.606, 7.092)	Favors patellar tendon
Sajovic et al. 2006 (5 years)	High	IKDC instrumental anteroposterior translation B (<3-5 mm)	Patellar tendon	25	3/25(11%)	Hamstring tendon	27	6/27(24%)	1.500(0.469, 4.797)	NS
Sajovic et al. 2006 (5 years)	High	IKDC instrumental anteroposterior translation C (6-10mm)	Patellar tendon	25	0(0%)	Hamstring tendon	27	1/27(4%)	4.667(0.267, 81.578)	NS
Sajovic et al. 2006 (5 years)	High	IKDC grading of degenerative joint disease: A	Patellar tendon	25	4/25(16%)	Hamstring tendon	27	10/27(37%)	0.771(0.294, 2.021)	NS
Sajovic et al. 2006 (5 years)	High	IKDC grading of degenerative joint disease: B	Patellar tendon	25	10/25(40%)	Hamstring tendon	27	14/27(52%)	0.804(0.442, 1.46)	NS
Sajovic et al. 2006 (5 years)	High	IKDC grading of degenerative joint disease: C	Patellar tendon	25	11/25(44%)	Hamstring tendon	27	2/27(7%)	11.42(2.951, 44.222)	Favors patellar tendon
Sajovic et al. 2006 (5 years)	High	IKDC grading of degenerative joint disease:	Patellar tendon	25	0/25(0%)	Hamstring tendon	27	1/27(4%)	4.667(0.267, 81.578)	NS

Table 81. Results: Bone Patellar Tendon Versus Hamstring Tendon (Long Term Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		D								
Sajovic et al. 2011 (11 years)	Moderate	Lysholm score Excellent (95-100)	Patellar tendon	25	14/25(56%)	Hamstring tendon	27	18/27(67%)	0.84(0.542,1 .302)	NS
Sajovic et al. 2011 (11 years)	Moderate	Lysholm score Good (84-94)	Patellar tendon	25	11/25(44%)	Hamstring tendon	27	9/27(33%)	1.320(0.66,2 .639)	NS
Sajovic et al. 2011 (11 years)	Moderate	IKDC degenerative joint disease A	Patellar tendon	25	4/25(16%)	Hamstring tendon	27	10/27(37%)	0.432(0.155, 1.203)	Favors hamstring tendon
Sajovic et al. 2011 (11 years)	Moderate	IKDC degenerative joint disease B	Patellar tendon	25	10/25(40%)	Hamstring tendon	27	14/27(52%)	0.771(0.422, 1.409)	NS
Sajovic et al. 2011 (11 years)	Moderate	IKDC degenerative joint disease C	Patellar tendon	25	11/25(44%)	Hamstring tendon	27	2/27(7%)	5.940(1.457, 24.209)	NS
Sajovic et al. 2011 (11 years)	Moderate	IKDC degenerative joint disease D	Patellar tendon	25	0/25(0%)	Hamstring tendon	27	1/27(4%)	0.359(0.015, 8.426)	NS
Sajovic et al. 2011 (11 years)	Moderate	IKDC overall A	Patellar tendon	25	8/25(32%)	Hamstring tendon	27	16/27(59%)	0.540(0.282, 1.036)	NS
Sajovic et al. 2011 (11 years)	Moderate	IKDC overall B	Patellar tendon	25	16/25(64%)	Hamstring tendon	27	11/27(41%)	1.473(0.844, 2.569)	NS
Sajovic et al. 2011 (11 years)	Moderate	IKDC overall C	Patellar tendon	25	1/25(4%)	Hamstring tendon	27	0%	3.231(0.138, 75.83)	NS
Sajovic et al. 2011 (11 years)	Moderate	Lachman test A (negative)	Patellar tendon	25	16/25(64%)	Hamstring tendon	27	23/27(85%)	0.751(0.538, 1.049)	NS

Table 81. Results: Bone Patellar Tendon Versus Hamstring Tendon (Long Term Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Volpi al. 2009(5 years)	Moderate	IKDC A Normal	Bone patellar tendon bone with interference screw	30	15/30(50%)	Semitendinosus and gracilis with interference screw	30	16/30(53%)	0.94(0.57,1.53)	NS
Volpi al. 2009(5 years)	Moderate	IKDC B Nearly normal	Bone patellar tendon bone with interference screw	30	11/30(37%)	Semitendinosus and gracilis with interference screw	30	13/30(43%)		
Volpi al. 2009(5 years)	Moderate	IKDC C Abnormal	Bone patellar tendon bone with interference screw	30	4/30(13%)	Semitendinosus and gracilis with interference screw	30	1/30(3%)		
Volpi al. 2009(5 years)	Moderate	IKDC D Severely abnormal	Bone patellar tendon bone with interference screw	30	0/30(0%)	Semitendinosus and gracilis with interference screw	30	0/30(0%)		
Volpi al. 2009(5 years)	Moderate	Stability KT-1000 IKDC A Normal	Bone patellar tendon bone with interference screw	30	19/30(63%)	Semitendinosus and gracilis with interference screw	30	24/30(80%)	0.79(0.57,1.10)	NS
Volpi al. 2009(5 years)	Moderate	Stability KT-1000 IKDC B Nearly normal	Bone patellar tendon bone with interference screw	30	10/30(33%)	Semitendinosus and gracilis with interference screw	30	6/30(20%)		
Volpi al. 2009(5 years)	Moderate	Stability KT-1000 IKDC C Abnormal	Bone patellar tendon bone with interference screw	30	1/30(3%)	Semitendinosus and gracilis with interference screw	30	0/30(0%)		
Volpi al. 2009(5 years)	Moderate	Stability KT-1000 IKDC D Severely abnormal	Bone patellar tendon bone with interference screw	30	0/30(0%)	Semitendinosus and gracilis with interference screw	30	0/30(0%)		
Volpi al. 2009(5 years)	Moderate	Lysholm score (mean and range)	Bone patellar tendon bone with interference screw	30	94.43(79-100)	Semitendinosus and gracilis with interference screw	30	94.83(85-100)	NA	NS

Table 81. Results: Bone Patellar Tendon Versus Hamstring Tendon (Long Term Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Volpi al. 2009(5 years)	Moderate	Lysholm-Tegner activity score (mean and range)	Bone patellar tendon bone with interference screw	30	7.4(2-13)	Semitendinosus and gracilis with interference screw	30	7.1(2-10)	NA	NS
Zaffagnini et al. 2006 (5 years)	Moderate	IKDC A and B (%)	Bone-patellar Tendon-Bone	25	19/25(25%)	ST-G intra and extra-articular	25	21/25(84%)	0.9(0.68,1.19)	NS
Zaffagnini et al. 2006 (5 years)	Moderate	Tegner activity	Bone-patellar Tendon-Bone	25	7.8(1.7)	ST-G intra and extra-articular	25	8.5(1.9)	-0.7(-1.72,0.32)	NS
Zaffagnini et al. 2006 (5 years)	Moderate	Anterior knee pain	Bone-patellar Tendon-Bone	25	9/25(36%)	ST-G intra and extra-articular	25	2/25(8%)	4.5(1.08,18.77)	Favors ST-G
Zaffagnini et al. 2006 (5 years)	Moderate	Kneeling pain	Bone-patellar Tendon-Bone	25	18/25(72%)	ST-G intra and extra-articular	25	3/25(12%)	6(2.02,17.83)	Favors ST-G intra and extra-articular
Zaffagnini et al. 2006 (5 years)	Moderate	Pivot shift 0	Bone-patellar Tendon-Bone	25	22/25(88%)	ST-G intra and extra-articular	25	23/25(92%)	0.96(0.79,1.15)	NS
Zaffagnini et al. 2006 (5 years)	Moderate	Pivot shift 1	Bone-patellar Tendon-Bone	25	3/25(12%)	ST-G intra and extra-articular	25	2/25(8%)		
Zaffagnini et al. 2006 (5 years)	Moderate	Pivot shift 2	Bone-patellar Tendon-Bone	25	0/25(0%)	ST-G intra and extra-articular	25	0/25(0%)		
Zaffagnini et al. 2006 (5 years)	Moderate	Lachman 0	Bone-patellar Tendon-Bone	25	23/25(92%)	ST-G intra and extra-articular	25	23/25(92%)	1(0.85,1.18)	NS
Zaffagnini et al. 2006 (5 years)	Moderate	Lachman 1	Bone-patellar Tendon-Bone	25	2/25(8%)	ST-G intra and extra-articular	25	2/25(8%)		
Zaffagnini et al. 2006 (5 years)	Moderate	Lachman 2	Bone-patellar Tendon-Bone	25	0/25(0%)	ST-G intra and extra-articular	25	0/25(0%)		

Table 82. Results: Bone Patellar Tendon Versus Hamstring Tendon (Intermediate Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Beynnon et al. 2002	Moderate	Stability (Lachman test = 0)	Bone patellar tendon bone	22	10/22(45.5)	Semitendinosus gracilis graft	22	3/22(14%)	3.333(1.059, 10.495)	Favors bone patellar tendon bone
Beynnon et al. 2002	Moderate	Stability (Lachman test = 1+)	Bone patellar tendon bone	22	10/22(45.5)	Semitendinosus gracilis graft	22	6/22(27%)	1.667(0.733, 3.791)	NS
Beynnon et al. 2002	Moderate	Stability (Lachman test = 2+)	Bone patellar tendon bone	22	2(9%)	Semitendinosus gracilis graft	22	8/22(36%)	0.25(0.06,1.047)	NS
Beynnon et al. 2002	Moderate	Stability (Lachman test = 3+)	Bone patellar tendon bone	22	0/22(0%)	Semitendinosus gracilis graft	22	5/22(23%)	0.091(0.005, 1.551)	NS
Beynnon et al. 2002	Moderate	Stability (Pivot shift = 0)	Bone patellar tendon bone	22	19/22(86%)	Semitendinosus gracilis graft	22	13/22(59%)	1.462(0.994, 2.149)	Favors bone patellar tendon bone
Beynnon et al. 2002	Moderate	Stability (Pivot shift = 1+)	Bone patellar tendon bone	22	3/22(14%	Semitendinosus gracilis graft	22	3/22(14%)	1(0.226,4.425)	NS
Beynnon et al. 2002	Moderate	Stability (Pivot shift = 2+)	Bone patellar tendon bone	22	0/22(0%)	Semitendinosus gracilis graft	22	6/22(27%)	0.077(0.005, 1.288)	NS
Beynnon et al. 2002	Moderate	Stability (Pivot shift = 3+)	Bone patellar tendon bone	22	0/22(0%)	Semitendinosus gracilis graft	22	0/22(0%)	NA	NS
Beynnon et al. 2002	Moderate	Tegner activity level 0-3 (%)	Bone patellar tendon bone	22	0/22(0%)	Semitendinosus gracilis graft	22	1/22(5%)	0.333(0.014, 7.763)	NS
Beynnon et al. 2002	Moderate	Tegner activity level 4-6 (%)	Bone patellar tendon bone	22	14/22(64%)	Semitendinosus gracilis graft	22	16/22(73%)	0.875(0.583, 1.314)	NS
Beynnon et al. 2002	Moderate	Tegner activity level 7-10 (%)	Bone patellar tendon bone	22	8/22(36%)	Semitendinosus gracilis graft	22	5/22(23%)	1.6(0.62,4.13)	NS
Beynnon et al. 2002	Moderate	IKDC activity grade I	Bone patellar tendon bone	22	13/22(59%)	Semitendinosus gracilis graft	22	1/22(5%)	13(1.857,91.027)	NS
Beynnon et	Moderate	IKDC activity	Bone patellar	22	5/22(23%)	Semitendinosus	22	16/22(73%)	0.313(0.139,	NS

Table 82. Results: Bone Patellar Tendon Versus Hamstring Tendon (Intermediate Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
al. 2002		grade II	tendon bone			gracilis graft			0.704)	
Beynnon et al. 2002	Moderate	IKDC activity grade III	Bone patellar tendon bone	22	13/22(59%)	Semitendinosus gracilis graft	22	5/22(23%)	2.6(1.116,6.055)	Favors semitendinosus tendon
Beynnon et al. 2002	Moderate	Strength (Peek extension torque 60 degrees/sec (percentages of torque of the normal knee))	Bone patellar tendon bone	22	94.7	Semitendinosus gracilis graft	22	88.1	NA	NS
Beynnon et al. 2002	Moderate	Strength (Peek extension torque 180 degrees/sec (percentages of torque of the normal knee))	Bone patellar tendon bone	22	95.9	Semitendinosus gracilis graft	22	92.1	NA	NS
Beynnon et al. 2002	Moderate	Strength (Peek extension torque 240 degrees/sec (percentages of torque of the normal knee))	Bone patellar tendon bone	22	96.9	Semitendinosus gracilis graft	22	93.5	NA	NS
Beynnon et al. 2002	Moderate	Strength (Peek flexion torque 60 degrees/sec (percentages	Bone patellar tendon bone	22	95.5	Semitendinosus gracilis graft	22	95.5	NA	NS

Table 82. Results: Bone Patellar Tendon Versus Hamstring Tendon (Intermediate Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		of torque of the normal knee))								
Beynnon et al. 2002	Moderate	Strength (Peek flexion torque 180 degrees/sec (percentages of torque of the normal knee))	Bone patellar tendon bone	22	90.9	Semitendinosus gracilis graft	22	90.9	NA	NS
Beynnon et al. 2002	Moderate	Strength (Peek flexion torque 240 degrees/sec (percentages of torque of the normal knee))	Bone patellar tendon bone	22	89.3	Semitendinosus gracilis graft	22	89.3	NA	NS
Beynnon et al. 2002	Moderate	Patient satisfaction (1-10)	Bone patellar tendon bone	22	7.6(1.8)	Semitendinosus gracilis graft	22	7.9(2.1)	-0.3(-1.48,0.88)	NS
Feller et al. 2003	High	Anterior knee pain (VAS)	Patellar tendon	29	3.2(1.5)	Hamstring tendon	23	3.2(1.9)	0(-0.945,0.945)	NS
Feller et al. 2003	High	Pain on kneeling (VAS)	Patellar tendon	31	3.5(2.6)	Hamstring tendon	26	1.6(1.2)	1.9(0.722,3.078)	Favors hamstring tendon
Feller et al. 2003	High	Cincinnati knee score	Patellar tendon	31	92.7(8.2)	Hamstring tendon	26	93.7(9.0)	-1(-5.79,3.79)	NS
Feller et al. 2003	High	Sports activity level I (%)	Patellar tendon	26	7/26 (27%)	Hamstring tendon	31	11/37 (36%)	0.759(0.344,727)	NS
Feller et al. 2003	High	Sports activity level II (%)	Patellar tendon	26	16/26 (61%)	Hamstring tendon	31	10/31 (32%)	1.908(1.053,727)	Favors patellar tendon
Feller et al.	High	Sports	Patellar tendon	26	1/26 (4%)	Hamstring tendon	31	6/31 (19%)	0.199(0.026,	NS

Table 82. Results: Bone Patellar Tendon Versus Hamstring Tendon (Intermediate Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
2003		activity level III (%)							727)	
Feller et al. 2003	High	Sports activity level IV (%)	Patellar tendon	26	2/26 (8%)	Hamstring tendon	31	4/31 (13%)	0.596(0.119, 727)	NS
Feller et al. 2003	High	IKDC score (Median)	Patellar tendon	26	85	Hamstring tendon	31	80	NA	NS
Feller et al. 2003	High	Overall IKDC rating A (Normal) (%)	Patellar tendon	26	9/26 (33%)	Hamstring tendon	31	11/31(37%)	0.976(0.48,1 .985)	NS
Feller et al. 2003	High	Overall IKDC rating B (Nearly normal) (%)	Patellar tendon	26	9/26(38%	Hamstring tendon	31	18/31(56%)	0.596(0.325, 1.094)	NS
Feller et al. 2003	High	Overall IKDC rating C (Abnormal) (%)	Patellar tendon	26	6/26 (24%)	Hamstring tendon	31	2/31(7%)	3.577(0.788, 16.241)	NS
Feller et al. 2003	High	Overall IKDC rating D (Severely abnormal) (%)	Patellar tendon	26	1/26 (5%)	Hamstring tendon	31	0/31(0%)	3.556(0.151, 83.753)	NS
Feller et al. 2003	High	IKDC Subjective assessment A (Normal) (%)	Patellar tendon	29	14/29 (50%)	Hamstring tendon	23	17/23 (74%)	0.653(0.417, 1.022)	NS
Feller et al. 2003	High	IKDC Subjective assessment B (Nearly normal) (%)	Patellar tendon	29	12/29 (42%)	Hamstring tendon	23	6/23 (26%)	1.586(0.704, 3.576)	NS
Feller et al. 2003	High	IKDC Subjective assessment C (Abnormal)	Patellar tendon	29	2/29 (8%)	Hamstring tendon	23	0/23(0%)	4(0.201,79.4 27)	NS

Table 82. Results: Bone Patellar Tendon Versus Hamstring Tendon (Intermediate Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		(%)								
Feller et al. 2003	High	IKDC Subjective assessment D (Severely abnormal) (%)	Patellar tendon	29	0/29(0%)	Hamstring tendon	23	0/23(0%)	NA	NS
Feller et al. 2003	High	IKDC symptoms A (Normal) (%)	Patellar tendon	26	15/26 (58%)	Hamstring tendon	31	23/31 (73%)	0.778(0.527, 1.148)	NS
Feller et al. 2003	High	IKDC symptoms B (Nearly normal) (%)	Patellar tendon	26	7/26 (26%)	Hamstring tendon	31	4/31 (11%)	2.087(0.686, 6.347)	NS
Feller et al. 2003	High	IKDC symptoms C (Abnormal) (%)	Patellar tendon	26	1/26 (6%)	Hamstring tendon	31	1/31 (4%)	1.192(0.078, 18.142)	NS
Feller et al. 2003	High	IKDC symptoms D (Severely abnormal) (%)	Patellar tendon	26	3/26 (10%)	Hamstring tendon	31	4/31 (11%)	0.894(0.22,3 .638)	NS
Feller et al. 2003	High	IKDC range of motion A (Normal) (%)	Patellar tendon	26	18/26 (70%)	Hamstring tendon	31	18/31 (57%)	1.192(0.804, 1.768)	NS
Feller et al. 2003	High	IKDC range of motion B (Nearly normal) (%)	Patellar tendon	26	8/26 (30%)	Hamstring tendon	31	9/31 (29%)	1.06(0.478,2 .352)	NS
Feller et al. 2003	High	IKDC range of motion C (Abnormal) (%)	Patellar tendon	26	0/26(0%)	Hamstring tendon	31	4/31 (14%)	0.132(0.007, 2.338)	NS
Feller et al. 2003	High	IKDC range of motion D	Patellar tendon	26	0/26(0%)	Hamstring tendon	31	0/31(0%)	NA	NS

Table 82. Results: Bone Patellar Tendon Versus Hamstring Tendon (Intermediate Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		(Severely abnormal) (%)								
Feller et al. 2003	High	IKDC range of motion A (Normal) (%)	Patellar tendon	26	18/26 (70%)	Hamstring tendon	31	18/31 (57%)	1.192(0.804, 1.768)	NS
Feller et al. 2003	High	IKDC range of motion B (Nearly normal) (%)	Patellar tendon	26	8/26 (30%)	Hamstring tendon	31	9/31 (29%)	1.06(0.478,2 .352)	NS
Feller et al. 2003	High	IKDC range of motion C (Abnormal) (%)	Patellar tendon	26	0/26(0%)	Hamstring tendon	31	4/31 (14%)	0.132(0.007, 2.338)	NS
Feller et al. 2003	High	IKDC range of motion D (Severely abnormal) (%)	Patellar tendon	26	0/26(0%)	Hamstring tendon	31	0/31(0%)	NA	NS
Feller et al. 2003	High	IKDC ligament examination A (Normal) (%)	Patellar tendon	26	18/26 (70%)	Hamstring tendon	31	18/31 (57%)	1.192(0.804, 1.768)	NS
Feller et al. 2003	High	IKDC ligament examination B (Nearly normal) (%)	Patellar tendon	26	8/26 (30%)	Hamstring tendon	31	9/31 (29%)	1.06(0.478,2 .352)	NS
Feller et al. 2003	High	IKDC ligament examination C (Abnormal) (%)	Patellar tendon	26	0/26(0%)	Hamstring tendon	31	4/31 (14%)	0.132(0.007, 2.338)	NS
Feller et al. 2003	High	IKDC ligament	Patellar tendon	26	0/26(0%)	Hamstring tendon	31	0/31(0%)	NA	NS

Table 82. Results: Bone Patellar Tendon Versus Hamstring Tendon (Intermediate Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		examination D (Severely abnormal) (%)								
Feller et al. 2003	High	68 NKT-1000 side to side differences in anterior knee laxity	Patellar tendon	21	0.5(1.0)	Hamstring tendon	27	1.1(1.2)	-0.6(-1.25,0.05)	NS
Feller et al. 2003	High	134N KT-1000 side to side differences in anterior knee laxity	Patellar tendon	21	0.5(1.5)	Hamstring tendon	27	1.6(1.3)	-1.1(-1.91,-0.28)	Favors patellar tendon
Feller et al. 2003	High	Range of motion extension deficit	Patellar tendon	21	2.7(2.3)	Hamstring tendon	27	2.7(2.3)	0(-1.34,1.34)	NS
Feller et al. 2003	High	Range of motion active flexion	Patellar tendon	21	2.6(3.0)	Hamstring tendon	27	3.3(3.9)	-0.7(-2.77,1.37)	NS
Feller et al. 2003	High	Range of motion passive flexion	Patellar tendon	21	4.0(5.4)	Hamstring tendon	27	2.2(3.5)	1.8(-0.79,4.39)	NS
Feller et al. 2003	High	Radiographic osteoarthritis	Patellar tendon	31	0/31 (0%)	Hamstring tendon	34	0/34 (0%)	NA	NS
Feller et al. 2003	High	Complications	Patellar tendon	31	7/31 (23%)	Hamstring tendon	34	0/34 (0%)	16.4(0.97,275.89)	NS
Ibrahim et al. 2005	Moderate	IKDC A	Patellar tendon	40	25/40(62.5%)	Gracilis and semitendinosus	45	28/45(62%)	1.004(0.722, 1.398)	NS
Ibrahim et al. 2005	Moderate	IKDC B	Patellar tendon	40	10/40(25%)	Gracilis and semitendinosus	45	10/45(22%)	1.125(0.523, 2.42)	NS
Ibrahim et al. 2005	Moderate	IKDC C	Patellar tendon	40	5/40(12.5%)	Gracilis and semitendinosus	45	7/45(15%)	0.804(0.277, 2.333)	NS

Table 82. Results: Bone Patellar Tendon Versus Hamstring Tendon (Intermediate Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Ibrahim et al. 2005	Moderate	IKDC D	Patellar tendon	40	0/40(0%)	Gracilis and semitendinosus	45	0/40(0%)	NA	NS
Ibrahim et al. 2005	Moderate	Radiographic disease of the patellofemoral cartilage	Patellar tendon	40	8/40(20%)	Gracilis and semitendinosus	45	3/45(6%)	3(0.854,10.541)	NS
Ibrahim et al. 2005	Moderate	Lysholm knee score Excellent (95-100)	Patellar tendon	40	20/40(50%)	Gracilis and semitendinosus	45	24/45(53%)	0.938(0.62,1.417)	NS
Ibrahim et al. 2005	Moderate	Lysholm knee score Good (84-94)	Patellar tendon	40	16/40(40%)	Gracilis and semitendinosus	45	18/45(40%)	1(0.594,1.685)	NS
Ibrahim et al. 2005	Moderate	Lysholm knee score Fair 65-83)	Patellar tendon	40	4/40(10%)	Gracilis and semitendinosus	45	3/45(7%)	1.5(0.357,6.3)	NS
Ibrahim et al. 2005	Moderate	Tegner activity level 7-9	Patellar tendon	40	23/40(57%)	Gracilis and semitendinosus	45	26/45(57%)	0.995(0.691, 1.434)	NS
Ibrahim et al. 2005	Moderate	Tegner activity level 6-8	Patellar tendon	40	15/40(37.5%)	Gracilis and semitendinosus	45	16/45(35%)	1.055(0.602, 1.848)	NS
Ibrahim et al. 2005	Moderate	Tegner activity level 5-6	Patellar tendon	40	2/40(5%)	Gracilis and semitendinosus	45	3/45(7%)	0.75(0.132,4.263)	NS
Ibrahim et al. 2005	Moderate	Lachman test (negative) (n%)	Patellar tendon	40	35/40(87%)	Gracilis and semitendinosus	45	39/45(86%)	1.01(0.857,1.189)	NS
Ibrahim et al. 2005	Moderate	Lachman test (grade 1) (n%)	Patellar tendon	40	5/40(10%)	Gracilis and semitendinosus	45	7/45(17%)	0.804(0.277, 2.333)	NS
Ibrahim et al. 2005	Moderate	Anterior drawer test (negative) (n%)	Patellar tendon	40	35/40(87.5%)	Gracilis and semitendinosus	45	38/45(84%)	1.036(0.873, 1.23)	NS
Ibrahim et al.	Moderate	Anterior	Patellar tendon	40	5/40(10%)	Gracilis and	45	7/45(17%)	0.804(0.277,	NS

Table 82. Results: Bone Patellar Tendon Versus Hamstring Tendon (Intermediate Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
2005		drawer test (grade 1) (n%)				semitendinosus			2.333)	
Ibrahim et al. 2005	Moderate	Pivot shift test (negative) (n%)	Patellar tendon	40	35/40(87.5 %)	Gracilis and semitendinosus	45	37/45(84%)	1.064(0.889, 1.273)	NS
Ibrahim et al. 2005	Moderate	Pivot shift test (grade 1) (n%)	Patellar tendon	40	5/40(10%)	Gracilis and semitendinosus	45	8/45(17%)	0.703(0.25,1 .975)	NS
Ibrahim et al. 2005	Moderate	KT-1000 maximum manual (1N) 0-2mm n(%)	Patellar tendon	40	35/40(87%)	Gracilis and semitendinosus	45	38/45(84%)	1.036(0.873, 1.23)	NS
Ibrahim et al. 2005	Moderate	KT-1000 maximum manual (1N) 3-5mm n(%)	Patellar tendon	40	3/40(7%)	Gracilis and semitendinosus	45	3/45(6%)	1.125(0.241, 5.261)	NS
Ibrahim et al. 2005	Moderate	KT-1000 maximum manual (1N) >5 mm n(%)	Patellar tendon	40	2/40(5%)	Gracilis and semitendinosus	45	4/45(8%)	0.563(0.109, 2.909)	NS
Ibrahim et al. 2005	Moderate	Overall good result (satisfaction with surgery)	Patellar tendon	40	35/40(78%)	Gracilis and semitendinosus	45	41/45(91%)	0.96(0.828,1 .114)	NS
Ibrahim et al. 2005	Moderate	Stability (no episode of giving away)	Patellar tendon	40	37/40(92%)	Gracilis and semitendinosus	45	41/45(91%)	1.015(0.894, 1.153)	NS
Ibrahim et al. 2005	Moderate	Anterior knee pain	Patellar tendon	40	10/40(25%)	Gracilis and semitendinosus	45	3/45(6%)	**3.75(1.109,1 2.675)**	Favors Gracilis and semitendinosus
Ibrahim et al. 2005	Moderate	Activity	Patellar tendon	40	NR	Gracilis and semitendinosus	45	NR	NA	NS
Matsumoto et al. 2006	High	Return to pre-injury activity level	Bone patellar tendon bone	37	28/37 (76%)	Bone hamstring bone	35	24/35 (68%)	1.104(0.826, 1.474)	NS
Matsumoto et	High	Decrease their	Bone patellar	37	9/37(24%)	Bone hamstring	35	11/35(31%)	0.774(0.366,	NS

Table 82. Results: Bone Patellar Tendon Versus Hamstring Tendon (Intermediate Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
al. 2006		activity level	tendon bone			bone			1.638)	
Matsumoto et al. 2006	High	IKDC subjective	Bone patellar tendon bone	37	84.3(11.0)	Bone hamstring bone	35	86.8(8.3)	-2.5(-7.09,2.0)	NS
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation (Normal)	Bone patellar tendon bone	37	25/37 (68%)	Bone hamstring bone	35	26/35 (74%)	0.910(0.676, 1.223)	NS
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation (nearly normal)	Bone patellar tendon bone	37	10/37 (27%)	Bone hamstring bone	35	8/35 (23%)	1.182(0.528, 2.649)	NS
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation (abnormal)	Bone patellar tendon bone	37	2/37 (5%)	Bone hamstring bone	35	1/35 (3%)	1.892(0.179, 19.948)	NS
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation (Severely abnormal)	Bone patellar tendon bone	37	0/37 (0%)	Bone hamstring bone	35	0/35 (0%)	NA	NS
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation subjective assessment A (Normal)	Bone patellar tendon bone	37	25/37 (68%)	Bone hamstring bone	35	26/35 (74%)	0.910(0.676, 1.223)	NS
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation	Bone patellar tendon bone	37	10/37 (27%)	Bone hamstring bone	35	8/35 (23%)	1.182(0.528, 2.649)	NS

Table 82. Results: Bone Patellar Tendon Versus Hamstring Tendon (Intermediate Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		subjective assessment B (nearly normal)								
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation subjective assessment C (abnormal)	Bone patellar tendon bone	37	2/37 95%)	Bone hamstring bone	35	1/35 (3%)	1.892(0.179, 19.948)	NS
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation subjective assessment D (Severely abnormal)	Bone patellar tendon bone	37	0/37 (0%)	Bone hamstring bone	35	0/35 (0%)	NA	NS
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation symptoms A (Normal)	Bone patellar tendon bone	37	24/37 (65%)	Bone hamstring bone	35	24/35 (69%)	0.946(0.683, 1.311)	NS
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation symptoms B (nearly normal)	Bone patellar tendon bone	37	10/37 (27%)	Bone hamstring bone	35	10/35 (28%)	0.946(0.449, 1.992)	NS
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation	Bone patellar tendon bone	37	3/37 (8%)	Bone hamstring bone	35	1/35 93%)	2.838(0.31,2 6.011)	NS

Table 82. Results: Bone Patellar Tendon Versus Hamstring Tendon (Intermediate Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Matsumoto et al. 2006	High	symptoms C (abnormal) IKDC knee ligament standard evaluation symptoms D (Severely abnormal)	Bone patellar tendon bone	37	0/37 (0%)	Bone hamstring bone	35	0/35 0%)	NA	NS
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation range of motion A (Normal)	Bone patellar tendon bone	37	30/37 (81%)	Bone hamstring bone	35	24/35 (68%)	1.182(0.9,1.554)	NS
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation range of motion B (nearly normal)	Bone patellar tendon bone	37	7/37 (19%)	Bone hamstring bone	35	10/35 (28%)	0.662(0.284, 1.546)	NS
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation range of motion C (abnormal)	Bone patellar tendon bone	37	0/37 (0%)	Bone hamstring bone	35	1/35 (3%)	0.316(0.013, 7.503)	NS
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation range of	Bone patellar tendon bone	37	0/37 (0%)	Bone hamstring bone	35	0/35 (0%)	NA	NS

Table 82. Results: Bone Patellar Tendon Versus Hamstring Tendon (Intermediate Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		motion D (Severely abnormal)								
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation ligament examination A (Normal)	Bone patellar tendon bone	37	28/37 (76%)	Bone hamstring bone	35	28/35 (80%)	0.946(0.739, 1.21)	NS
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation ligament examination B (nearly normal)	Bone patellar tendon bone	37	7/37 (19%)	Bone hamstring bone	35	7/35 (20%)	0.946(0.369, 2.422)	NS
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation ligament examination C (abnormal)	Bone patellar tendon bone	37	2/37 (5%)	Bone hamstring bone	35	2/35 (6%)	0.946(0.141, 6.354)	NS
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation ligament examination D (Severely abnormal)	Bone patellar tendon bone	37	0/37 (0%)	Bone hamstring bone	35	0/35 (0%)	NA	NS
Matsumoto et al. 2006	High	IKDC knee ligament standard	Bone patellar tendon bone	37	29/37 (78%)	Bone hamstring bone	35	28/35 (80%)	0.980(0.773, 1.242)	NS

Table 82. Results: Bone Patellar Tendon Versus Hamstring Tendon (Intermediate Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		evaluation compartment findings A (Normal)								
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation compartment findings B (nearly normal)	Bone patellar tendon bone	37	7/37 (19%)	Bone hamstring bone	35	8/35 (23%)	0.828(0.336, 2.042)	NS
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation compartment findings C (abnormal)	Bone patellar tendon bone	37	1/37 (3%)	Bone hamstring bone	35	1/35 (3%)	0.946(0.062, 14.548)	NS
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation compartment findings D (Severely abnormal)	Bone patellar tendon bone	37	0/37 (0%)	Bone hamstring bone	35	0/35 (0%)	NA	NS
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation harvest site morbidity A (Normal)	Bone patellar tendon bone	37	23/37 (62%)	Bone hamstring bone	35	26/35 (74%)	0.83(0.61,1. 15)	NS
Matsumoto et al. 2006	High	IKDC knee ligament	Bone patellar tendon bone	37	8/37 (22%)	Bone hamstring bone	35	8/35 (23%)	0.837(0.609, 1.15)	NS

Table 82. Results: Bone Patellar Tendon Versus Hamstring Tendon (Intermediate Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		standard evaluation harvest site morbidity B (nearly normal)								
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation harvest site morbidity C (abnormal)	Bone patellar tendon bone	37	3/37 (8%)	Bone hamstring bone	35	1/35 (3%)	0.946(0.399, 2.245)	NS
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation harvest site morbidity D (Severely abnormal)	Bone patellar tendon bone	37	3/37 (8%)	Bone hamstring bone	35	0/35 (0%)	2.838(0.31,2 6.011)	NS
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation radiograph findings A (Normal)	Bone patellar tendon bone	37	22/37 (59%)	Bone hamstring bone	35	22/35 (63%)	6.632(0.355, 123.935)	NS
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation radiograph findings B (nearly normal)	Bone patellar tendon bone	37	12/37 (32%)	Bone hamstring bone	35	8/35 (23%)	0.946(0.655, 1.367)	NS

Table 82. Results: Bone Patellar Tendon Versus Hamstring Tendon (Intermediate Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation radiograph findings C (abnormal)	Bone patellar tendon bone	37	3/37 (8%)	Bone hamstring bone	35	10/35 (29%)	1.419(0.66,3 .052)	NS
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation radiograph findings D (Severely abnormal)	Bone patellar tendon bone	37	0/37 (0%)	Bone hamstring bone	35	3/35 (9%)	0.284(0.085, 0.947)	NS
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation functional test results A (Normal)	Bone patellar tendon bone	37	24/37 (65%)	Bone hamstring bone	35	25/35 (71%)	0.135(0.007, 2.529)	NS
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation functional test results B (nearly normal)	Bone patellar tendon bone	37	10/37 (27%)	Bone hamstring bone	35	9/35 (26%)	0.908(0.662, 1.246)	NS
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation functional test results C	Bone patellar tendon bone	37	3/37 (8%)	Bone hamstring bone	35	1/35 (3%)	1.051(0.485, 2.277)	NS

Table 82. Results: Bone Patellar Tendon Versus Hamstring Tendon (Intermediate Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Matsumoto et al. 2006	High	(abnormal) IKDC knee ligament standard evaluation functional test results D (Severely abnormal)	Bone patellar tendon bone	37	0/37 (0%)	Bone hamstring bone	35	0/35 (0%)	2.838(0.31,2 6.011)	NS
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation final evaluation results A (Normal)	Bone patellar tendon bone	37	11/37 (30%)	Bone hamstring bone	35	9/35 (26%)	1.156(0.546, 2.448)	NS
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation final evaluation B (nearly normal)	Bone patellar tendon bone	37	16/37 (43%)	Bone hamstring bone	35	21/35 (60%)	0.721(0.456, 1.139)	NS
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation final evaluation C (abnormal)	Bone patellar tendon bone	37	7/37 (19%)	Bone hamstring bone	35	5/35 (14%)	1.324(0.463, 3.786)	NS
Matsumoto et al. 2006	High	IKDC knee ligament standard evaluation	Bone patellar tendon bone	37	3/37 (8%)	Bone hamstring bone	35	0/35 (0%)	6.632(0.355, 123.935)	NS

Table 82. Results: Bone Patellar Tendon Versus Hamstring Tendon (Intermediate Follow-up)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		final evaluation D (Severely abnormal)								
Matsumoto et al. 2006	High	Complications (Infection)	Bone patellar tendon bone	37	0/37(0%	Bone hamstring bone	35	0/35(0%)	NA	NS
Matsumoto et al. 2006	High	Failure	Bone patellar tendon bone	37	0/37(0%	Bone hamstring bone	35	0/35(0%)	NA	NS
Matsumoto et al. 2006	High	Additional surgery (Partial meniscectomies)	Bone patellar tendon bone	37	8/37(22%)	Bone hamstring bone	35	7/35(20%)	1.081(0.438, 2.667)	NS
Matsumoto et al. 2006	High	Additional surgery (notchplasty)	Bone patellar tendon bone	37	4/37(11%)	Bone hamstring bone	35	0/35(20%)	8.526(0.476, 152.798)	NS
Matsumoto et al. 2006	High	Isokinetic quadriceps muscle strength 60 deg/s	Bone patellar tendon bone	37	86.4(18.2)	Bone hamstring bone	35	92.3(14.2)	-5.9(-13.60,1.80)	NS
Matsumoto et al. 2006	High	Isokinetic quadriceps muscle strength 180 deg/s	Bone patellar tendon bone	37	94.5(22)	Bone hamstring bone	35	93.0(10.9)	1.5(-6.73,9.73)	NS
Matsumoto et al. 2006	High	Isokinetic hamstring muscle strength 60 deg/s	Bone patellar tendon bone	37	100(16.6)	Bone hamstring bone	35	85.6(13.1)	14.4(7.35,21.45)	Favors bone patellar tendon bone
Matsumoto et al. 2006	High	Isokinetic hamstring muscle strength 180 deg/s	Bone patellar tendon bone	37	97.0(10.5)	Bone hamstring bone	35	91.4(13.5)	5.6(-0.06,11.26)	NS

Table 83. Results: Bone Patellar Tendon Versus Hamstring Tendon

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Gifstad et al. 2012	Moderate	Function	Bone patellar tendon	41	NR	Double looped semitendinosus and gracilis graft	36	NR	NA	NS
Gifstad et al. 2012	Moderate	Tegner activity level	Bone patellar tendon	41	NR	Double looped semitendinosus and gracilis graft	36	NR	NA	NS
Gifstad et al. 2012	Moderate	Function	Bone patellar tendon	41	NR	Double looped semitendinosus and gracilis graft	36	NR	NA	NS
Gifstad et al. 2012	Moderate	Tegner activity level	Bone patellar tendon	41	NR	Double looped semitendinosus and gracilis graft	36	NR	NA	NS
Gifstad et al. 2012	Moderate	Lysholm score	Bone patellar tendon	41	NR	Double looped semitendinosus and gracilis graft	36	NR	NA	NS
Gifstad et al. 2012	Moderate	KOOS (Pain, Symptoms, ADL, Sport, QoL)	Bone patellar tendon	41	NR	Double looped semitendinosus and gracilis graft	36	NR	NA	NS

Figure 7. Meta-Analysis: Forest Plot of Patellar Tendon Versus Hamstring: IKDC Normal (2 and 3 Years)

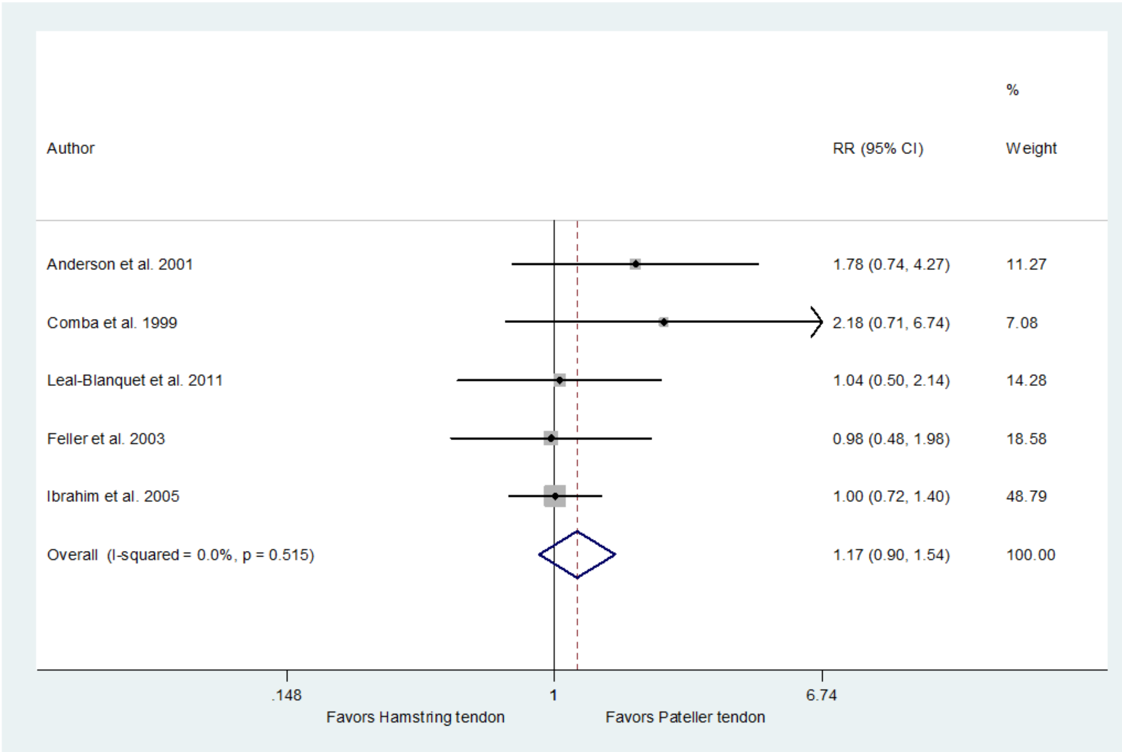
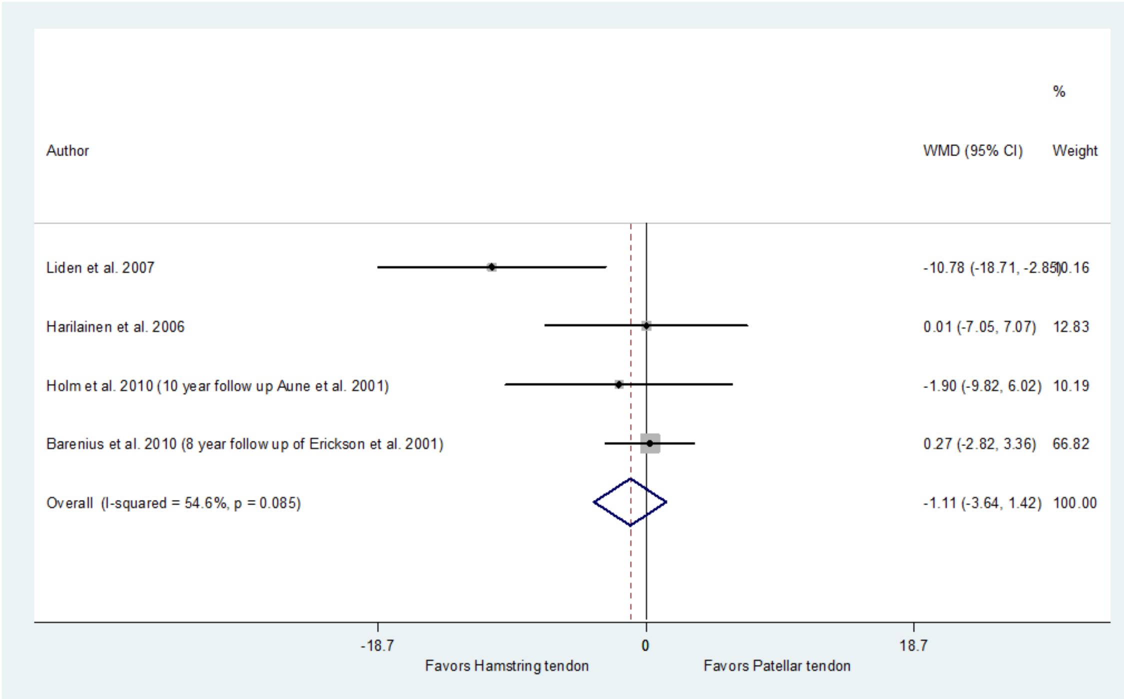


Figure 8. Meta-Analysis: Forest Plot of Patellar Tendon Versus Hamstring: Lysholm Score (5-11 Years)



ACL AUTOGRAFT VS ALLOGRAFT

Strong evidence supports that in patients undergoing ACL reconstructions, the practitioner should use either autograft or appropriately processed allograft tissue, because the measured outcomes are similar, although these results may not be generalizable to all allografts or all patients, such as young patients or highly active patients.

Strength of Recommendation: Strong ★★★★

RATIONALE

This recommendation was built upon two high strength studies and seven moderate strength studies. [26, 39, 62, 63, 85, 111, 112, 113, 117] The preparation of allografts varies with respect to procurement, processing, storage, and implantation. Each of these steps can affect the mechanical properties and incorporation of the graft. Understanding these limitations, there were two high strength and six moderate strength studies available that compared ACL reconstruction with autograft and allograft tissues.

Combining the autograft and nonirradiated allograft data from two studies, there was a 6% failure rate with autograft and a 9% failure rate with nonirradiated allograft, which was not a statistically significant difference.[111, 112] In contrast, there was a 34% failure rate with irradiated allograft (2.5 Mrad). The difference between failures in the autograft group and the irradiated allograft group was statistically significant.

Five moderate strength prospective comparative studies, similarly demonstrated that the clinical outcomes of ACL reconstruction with allograft were not significantly different from those with autograft.[26, 62, 63, 84, 117]

The allografts used in the study by Gorschewsky et al. were sterilized with osmotic treatment, oxidation, and solvent drying with acetone.[39] In contrast, the other studies involved the use of fresh-frozen allografts or cryopreservation. The patient-oriented outcomes, physical examination findings, instrumented laxity measurements, and complications in the allograft group in the study by Gorschewsky et al. were much worse than those in the other treatment arms of the other five prospective comparative studies. [26, 39, 62, 63, 84, 117]

While outcomes following ACL reconstruction using autograft tissue and using non-irradiated allograft tissue are similar overall, these results may not be generalizable to specific subsets of patients with ACL rupture, such as athletes and young patients. In fact, a longitudinal cohort study indicated a higher failure rate of allograft tissue in younger patients (Figure 3, Kaeding -- Sports Health 2011).

POTENTIAL HARMS OF IMPLEMENTATION

As with all surgery procedures, there are surgical risks and complications including but not limited to graft failure, arthrofibrosis, infection, neurovascular injury, and anesthetic complications. With ACL reconstruction using autograft tissue, there are specific additional risks of donor site morbidity, including risk of patellar fracture and long-term kneeling pain (with autograft bone-patellar tendon-bone) as well as risk of saphenous nerve trauma and long-term knee flexor strength deficit (with autograft hamstring tendon). With ACL reconstruction using allograft tissue, there are specific additional risks of potential for disease transmission and limited availability.

FUTURE RESEARCH

While outcomes following ACL reconstruction using autograft tissue and using non-irradiated allograft tissue are similar overall, these results may not be generalizable to specific subsets of patients with ACL rupture, such as elite athletes and very young patients. Specifically, further research is needed to assess the outcomes following ACL reconstruction using autograft tissue and using non-irradiated allograft tissue in patients with specific activity levels (including elite athletes), ages (including the young and very young), and associated injuries.

Further research is needed to assess the outcomes following ACL reconstruction using autograft tissue and using non-irradiated allograft tissue in patients with specific activity levels (including elite athletes), ages (including the young and very young), and associated injuries.

SUMMARY OF FINDINGS

Table 84. Summary of Findings: Autograft Versus Allograft (Patellar Tendon 2 Year)

🟢:Favors Autograft 🔴:Favors Allograft ○:Not significant	**Scales/Measures**	*Gorschewsky et al. 2005 *(M)*	Leal-Blanquet et al. 2011 *(M)*	Shelton et al. 1997 *(M)*	Victor et al. 1997 *(M)*	**Meta-Analysis**
Patient satisfaction			○			NA
Function		🟢				NA
Pain			○	○	○	NA
	IKDC subjective	🟢				NA
	IKDC Normal	🟢	○			NA
	Lysholm Score	🟢			○	NA
Failure		🟢			○	NA
Return to play		○			○	NA
	Tegner Activity				○	NA
Stability			○	○	○	NA
Osteoarthritis		○				NA
Complications	***Donor site morbidity***	🔴				NA
Strength			○		○	NA
Range of motion		○		○		NA

Overall strength of study; High: *(H)*, Moderate: *(M)*, Low: *(L)*, Very low: *(V)*

Table 85. Summary of Findings: Autograft Versus Allograft (Patellar Tendon Long Term)

🟢:Favors Autograft 🔴:Favors Allograft ○:Not significant	Scales/Measures	*Gorschewsky et al. 2005 *(M)*	Peterson et al. 2001 *(M)*	Sun et al. 2009 *(M)*	Meta-Analysis
Patient satisfaction					NA
Function		🟢		○	NA
Pain		🟢	○		NA
	IKDC subjective			○	NA
	IKDC Normal	🟢			NA
	Lysholm Score	🟢		○	NA
	Cincinnati knee Score			○	NA
Failure		🟢	○		NA
	Tegner Activity		○	○	NA
Stability		🟢	○	○	NA
Osteoarthritis		○		○	NA
Complications	***Donor site morbidity***	🔴			NA
Range of motion		○	○	○	NA

Overall strength of study; High: *(H)*, Moderate: *(M)*, Low: *(L)*, Very low: *(V)*

Table 86. Summary of Findings: Autograft Versus Allograft (Hamstring)

●:Favors Autograft ●:Favors Allograft ○:Not significant	Scales/Measures	Edger et al. 2008 *(M)*	Lawhorn et al. 2012 *(M)*	Sun et al. 2011(b) *(M)*	Sun et al. 2011(a) *(M)*	Meta-Analysis
Patient satisfaction						NA
Function		○	○	○	○	NA
Pain						NA
	IKDC subjective	○	○	○	○	NA
	IKDC Normal			○		NA
	Lysholm Score	○		○	○	NA
	Cincinnati knee Score			○	○	NA
Failure		○	○			NA
	Tegner Activity	○		○		NA
Stability			○	●	○	NA
Osteoarthritis			○			NA
Range of motion			○	○	○	NA

Overall strength of study; High: *(H)*, Moderate: *(M)*, Low: *(L)*, Very low: *(V)*

QUALITY AND APPLICABILITY SUMMARY

Table 87. Quality and Applicability Summary: Autograft Versus Allograft

Study	Outcome	Graft	Surgical Technique	Duration	Age	Quality	Applicability	Overall Strength of Evidence
Sun et al. 2009	Cincinnati knee score	Bone patellar tendon autograft/Allograft	8-10cm incision over the medial aspect of the patellar tendon	5 years	Autograft:31.7(6.3), Allograft: 32.8(7.1)	Moderate	Moderate	Moderate
Sun et al. 2009	Cincinnati knee score	Bone patellar tendon autograft/Allograft	8-10cm incision over the medial aspect of the patellar tendon	5 years	Autograft:31.7(6.3), Allograft: 32.8(7.1)	Moderate	Moderate	Moderate
Sun et al. 2011	Cincinnati knee score	Hamstring tendon autograft/Allograft	Anteromedial portal	8 years	Autograft= 29.6(19-56), Allograft=31.2(18-59)	Moderate	Moderate	Moderate
Sun et al. 2011 (b)	Cincinnati knee score	Hamstring tendon autograft/Allograft	Anteromedial portal	2.5 years	30.9(18-54), Irradiated allograft: 30.3(20-51)	Moderate	Moderate	Moderate
Peterson et al. 2001	Complications	Bone patellar tendon autograft/Allograft	NR	5 years	Autograft:25(15-43)	Moderate	Moderate	Moderate
Sun et al. 2011 (b)	Complications	Hamstring tendon autograft/Allograft	Anteromedial portal	2.5 years	30.9(18-54), Irradiated allograft: 30.3(20-51)	Moderate	Moderate	Moderate
Edger et al. 2008	Failure	Hamstring autograft/Allograft	Longitudinal incision	3 years	Autograft=27(7), Allograft=31(10)	Moderate	Moderate	Moderate

Table 87. Quality and Applicability Summary: Autograft Versus Allograft

Study	Outcome	Graft	Surgical Technique	Duration	Age	Quality	Applicability	Overall Strength of Evidence
			centered over the pes anserinus					
Gorschewsky et al. 2005	Failure	IKDC	Bone patellar tendon-bone autograft/ BPTB allograft	2 and 6 year	NR	Moderate	Moderate	Moderate
Lawhorn et al. 2012	Failure	Hamstring autograft/ Tibialis allograft	2-3cm anteromedial incision	2 years	Hamstring autograft:32, Allograft anterior tibialis:34	Moderate	Moderate	Moderate
Sun et al. 2009	Function	Bone patellar tendon autograft/Allograft	8-10cm incision over the medial aspect of the patellar tendon	5 years	Autograft:31.7(6.3), Allograft: 32.8(7.1)	Moderate	Moderate	Moderate
Edger et al. 2008	IKDC	Hamstring autograft/Allograft	Longitudinal incision centered over the pes anserinus	3 years	Autograft=27(7), Allograft=31(10)	Moderate	Moderate	Moderate
Gorschewsky et al. 2005	IKDC	Bone patellar tendon-bone autograft/ BPTB allograft	Transtibial single incision	2 and 6 years	NR	Moderate	Moderate	Moderate
Lawhorn et	IKDC	Hamstring	2-3cm	2 years	Hamstring	Moderate	Moderate	Moderate

Table 87. Quality and Applicability Summary: Autograft Versus Allograft

Study	Outcome	Graft	Surgical Technique	Duration	Age	Quality	Applicability	Overall Strength of Evidence
al. 2012		autograft/ Tibialis allograft	anteromedial incision		autograft:32, Allograft anterior tibialis:34			
Sun et al. 2009	IKDC	Bone patellar tendon autograft/Allograft	8-10cm incision over the medial aspect of the patellar tendon	5 years	Autograft:31.7(6.3), Allograft: 32.8(7.1)	Moderate	Moderate	Moderate
Sun et al. 2009	IKDC	Bone patellar tendon autograft/Allograft	8-10cm incision over the medial aspect of the patellar tendon	5 years	Autograft:31.7(6.3), Allograft: 32.8(7.1)	Moderate	Moderate	Moderate
Sun et al. 2011	IKDC	Hamstring tendon autograft/Allograft	Anteromedial portal	8 years	Autograft= 29.6(19-56), Allograft=31.2(18-59)	Moderate	Moderate	Moderate
Sun et al. 2011 (b)	IKDC	Hamstring tendon autograft/Allograft	Anteromedial portal	2.5 years	Autograft: 30.9(18-54), Irradiated allograft: 30.3(20-51)	Moderate	Moderate	Moderate
Victor et al. 1997	Kujala patellar scores	Patellar tendon autograft/Allograft	Standard arthroscopic technique without a lateral	2 years	28(18-43)	Moderate	Moderate	Moderate

Table 87. Quality and Applicability Summary: Autograft Versus Allograft

Study	Outcome	Graft	Surgical Technique	Duration	Age	Quality	Applicability	Overall Strength of Evidence
			incision					
Sun et al. 2011 (b)	Lysholm knee score	Hamstring tendon autograft/Allograft	Anteromedial portal	2.5 years	30.9(18-54), Irradiated allograft: 30.3(20-51)	Moderate	Moderate	Moderate
Edger et al. 2008	Lysholm score	Hamstring autograft/Allograft	Longitudinal incision centered over the pes anserinus	3 years	Autograft=27(7), Allograft=31(10)	Moderate	Moderate	Moderate
Gorschewsky et al. 2005	Lysholm score	IKDC	Bone patellar tendon-bone autograft/ BPTB allograft	2 and 6 year	NR	Moderate	Moderate	Moderate
Sun et al. 2009	Lysholm score	Bone patellar tendon autograft/Allograft	8-10cm incision over the medial aspect of the patellar tendon	5 years	Autograft:31.7(6.3), Allograft: 32.8(7.1)	Moderate	Moderate	Moderate
Sun et al. 2009	Lysholm score	Bone patellar tendon autograft/Allograft	8-10cm incision over the medial aspect of the patellar tendon	5 years	Autograft:31.7(6.3), Allograft: 32.8(7.1)	Moderate	Moderate	Moderate
Sun et al. 2011	Lysholm score	Hamstring tendon autograft/Allograft	Anteromedial portal	8 years	Autograft= 29.6(19-56),	Moderate	Moderate	Moderate

Table 87. Quality and Applicability Summary: Autograft Versus Allograft

Study	Outcome	Graft	Surgical Technique	Duration	Age	Quality	Applicability	Overall Strength of Evidence
					Allograft=31.2(18-59)			
Victor et al. 1997	Lysholm score	Patellar tendon autograft/Allograft	Standard arthroscopic technique without a lateral incision	2 years	28(18-43)	Moderate	Moderate	Moderate
Gorschewsky et al. 2005	Noyes	IKDC	Bone patellar tendon-bone autograft/ BPTB allograft	2 and 6 year	NR	Moderate	Moderate	Moderate
Sun et al. 2011	Objective (Stability, ROM etc...)	Hamstring tendon autograft/Allograft	Anteromedial portal	8 years	Autograft= 29.6(19-56), Allograft=31.2(18-59)	Moderate	Moderate	Moderate
Sun et al. 2011 (b)	Objective clinical results	Hamstring tendon autograft/Allograft	Anteromedial portal	2.5 years	30.9(18-54), Irradiated allograft: 30.3(20-51)	Moderate	Moderate	Moderate
Sun et al. 2009	Objective functional scores	Bone patellar tendon autograft/Allograft	8-10cm incision over the medial aspect of the patellar tendon	5 years	Autograft:31.7(6.3), Allograft: 32.8(7.1)	Moderate	Moderate	Moderate
Lawhorn et al. 2012	Osteoarthritis	Hamstring autograft/ Tibialis	2-3cm anteromedial	2 years	Hamstring autograft:32,	Moderate	Moderate	Moderate

Table 87. Quality and Applicability Summary: Autograft Versus Allograft

Study	Outcome	Graft	Surgical Technique	Duration	Age	Quality	Applicability	Overall Strength of Evidence
		allograft	incision		Allograft anterior tibialis:34			
Sun et al. 2009	Osteoarthritis	Bone patellar tendon autograft/Allograft	8-10cm incision over the medial aspect of the patellar tendon	5 years	Autograft:31.7(6.3), Allograft: 32.8(7.1)	Moderate	Moderate	Moderate
Sun et al. 2009	Osteoarthritis (Kellgren classification)	Bone patellar tendon autograft/Allograft	8-10cm incision over the medial aspect of the patellar tendon	5 years	Autograft:31.7(6.3), Allograft: 32.8(7.1)	Moderate	Moderate	Moderate
Peterson et al. 2001	Pain	Bone patellar tendon autograft/Allograft	NR	5 years	Autograft:25(15-43)	Moderate	Moderate	Moderate
Peterson et al. 2001	Range of motion	Bone patellar tendon autograft/Allograft	NR	5 years	Autograft:25(15-43)	Moderate	Moderate	Moderate
Edger et al. 2008	Stability	Hamstring autograft/Allograft	Longitudinal incision centered over the pes anserinus	3 years	Autograft=27(7), Allograft=31(10)	Moderate	Moderate	Moderate
Lawhorn et al. 2012	Stability	Hamstring autograft/ Tibialis allograft	2-3cm anteromedial incision	2 years	Hamstring autograft:32, Allograft anterior	Moderate	Moderate	Moderate

Table 87. Quality and Applicability Summary: Autograft Versus Allograft

Study	Outcome	Graft	Surgical Technique	Duration	Age	Quality	Applicability	Overall Strength of Evidence
					tibialis:34			
Peterson et al. 2001	Stability	Bone patellar tendon autograft/Allograft	NR	5 years	Autograft:25(15-43)	Moderate	Moderate	Moderate
Shelton et al. 1997	Stability	Patellar tendon autograft/Allograft	Lateral incision	2 years	Autograft=25(15-43), Allograft= 27(15-55)	Moderate	Moderate	Moderate
Sun et al. 2009	Stability	Bone patellar tendon autograft/Allograft	8-10cm incision over the medial aspect of the patellar tendon	5 years	Autograft:31.7(6.3), Allograft: 32.8(7.1)	Moderate	Moderate	Moderate
Victor et al. 1997	Stability (KT-1000)	Patellar tendon autograft/Allograft	Standard arthroscopic technique without a lateral incision	2 years	28(18-43)	Moderate	Moderate	Moderate
Victor et al. 1997	Strength	Patellar tendon autograft/Allograft	Standard arthroscopic technique without a lateral incision	2 years	28(18-43)	Moderate	Moderate	Moderate
Sun et al. 2011	Tegner activity	Hamstring tendon autograft/Allograft	Anteromedial portal	8 years	Autograft= 29.6(19-56), Allograft=31.2(18-	Moderate	Moderate	Moderate

Table 87. Quality and Applicability Summary: Autograft Versus Allograft

Study	Outcome	Graft	Surgical Technique	Duration	Age	Quality	Applicability	Overall Strength of Evidence
					59)			
Sun et al. 2011 (b)	Tegner activity level	Hamstring tendon autograft/Allograft	Anteromedial portal	2.5 years	30.9(18-54), Irradiated allograft: 30.3(20-51)	Moderate	Moderate	Moderate
Victor et al. 1997	Tegner activity level	Patellar tendon autograft/Allograft	Standard arthroscopic technique without a lateral incision	2 years	28(18-43)	Moderate	Moderate	Moderate
Edger et al. 2008	Tegner activity score	Hamstring autograft/Allograft	Longitudinal incision centered over the pes anserinus	3 years	Autograft=27(7), Allograft=31(10)	Moderate	Moderate	Moderate
Sun et al. 2009	Tegner activity score	Bone patellar tendon autograft/Allograft	8-10cm incision over the medial aspect of the patellar tendon	5 years	Autograft:31.7(6.3), Allograft: 32.8(7.1)	Moderate	Moderate	Moderate
Sun et al. 2009	Tegner score	Bone patellar tendon autograft/Allograft	8-10cm incision over the medial aspect of the patellar tendon	5 years	Autograft:31.7(6.3), Allograft: 32.8(7.1)	Moderate	Moderate	Moderate
Leal-	IKDC	Bone patellar	Transtibial	2 years	Autograft: 27,	Moderate	Moderate	Moderate

Table 87. Quality and Applicability Summary: Autograft Versus Allograft

Study	Outcome	Graft	Surgical Technique	Duration	Age	Quality	Applicability	Overall Strength of Evidence
Blanquet et al. 2011		tendon bone autograft/ Hamstring semitendinosus gracilis tendon autograft/			Allograft: 25.4(7.3)			
Leal-Blanquet et al. 2011	Strength	Bone patellar tendon bone autograft/ Hamstring semitendinosus gracilis tendon autograft/	Transtibial	2 years	Autograft: 27, Allograft: 25.4(7.3)	Moderate	Moderate	Moderate
Leal-Blanquet et al. 2011	Symptoms	Bone patellar tendon bone autograft/ Hamstring semitendinosus gracilis tendon autograft/	Transtibial	2 years	Autograft: 27, Allograft: 25.4(7.3)	Moderate	Moderate	Moderate
Leal-Blanquet et al. 2011	Clinical evaluation	Bone patellar tendon bone autograft/ Hamstring semitendinosus gracilis tendon autograft/	Transtibial	2 years	Autograft: 27, Allograft: 25.4(7.3)	Moderate	Moderate	Moderate
Leal-	Satisfaction	Bone patellar	Transtibial	2 years	Autograft: 27,	Moderate	Moderate	Moderate

Table 87. Quality and Applicability Summary: Autograft Versus Allograft

Study	Outcome	Graft	Surgical Technique	Duration	Age	Quality	Applicability	Overall Strength of Evidence
Blanquet et al. 2011	(VAS)	tendon bone autograft/ Hamstring semitendinosus gracilis tendon autograft/			Allograft: 25.4(7.3)			
Shelton et al. 1997	Stability	Central one third of patellar tendon	2-inch lateral incision	2 years	Autograft: 25(15-43), Allograft: 27.4(15-55)	Moderate	Moderate	Moderate
Shelton et al. 1997	Range of motion	Central one third of patellar tendon	2-inch lateral incision	2 years	Autograft: 25(15-43), Allograft: 27.4(15-55)	Moderate	Moderate	Moderate
Shelton et al. 1997	Pain	Central one third of patellar tendon	2-inch lateral incision	2 years	Autograft: 25(15-43), Allograft: 27.4(15-55)	Moderate	Moderate	Moderate

RESULTS

QUALITY AND APPLICABILITY

Table 88. Quality and Applicability: Autograft Versus Allograft

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Sun et al. 2009	Cincinnati knee score	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Sun et al. 2009	Cincinnati knee score	●	○	●	○	●	●	●	**Moderate**	○	○	●	○	**Moderate**
Sun et al. 2011	Cincinnati knee score	●	○	●	●	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Sun et al. 2011 (b)	Cincinnati knee score	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Leal-Blanquet et al. 2011	Clinical evaluation	●	○	●	○	○	●	●	**Moderate**	●	○	●	●	**Moderate**
Peterson et al. 2001	Complications	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Sun et al. 2011 (b)	Complications	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Edger et al. 2008	Failure	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**

Table 88. Quality and Applicability: Autograft Versus Allograft

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Gorschewsky et al. 2005	Failure	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Lawhorn et al. 2012	Failure	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Sun et al. 2009	Function	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Edger et al. 2008	IKDC	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Gorschewsky et al. 2005	IKDC	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Lawhorn et al. 2012	IKDC	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Sun et al. 2009	IKDC	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Sun et al. 2009	IKDC	●	○	●	○	●	●	●	**Moderate**	○	○	●	○	**Moderate**
Sun et al. 2011	IKDC	●	○	●	●	●	●	○	**Moderate**	●	○	●	●	**Moderate**

Table 88. Quality and Applicability: Autograft Versus Allograft

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Sun et al. 2011 (b)	IKDC	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Leal-Blanquet et al. 2011	IKDC	●	○	●	○	○	●	●	**Moderate**	●	○	●	●	**Moderate**
Victor et al. 1997	Kujala patellar scores	●	○	●	○	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Sun et al. 2011 (b)	Lysholm knee score	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Edger et al. 2008	Lysholm score	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Gorschewsky et al. 2005	Lysholm score	●	○	●	○	●	●	●	**Moderate**	●	●	●	○	**Moderate**
Sun et al. 2009	Lysholm score	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Sun et al. 2009	Lysholm score	●	○	●	○	●	●	●	**Moderate**	○	○	●	○	**Moderate**
Sun et al. 2011	Lysholm score	●	○	●	●	●	●	○	**Moderate**	●	○	●	●	**Moderate**

Table 88. Quality and Applicability: Autograft Versus Allograft

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Victor et al. 1997	Lysholm score	●	○	●	○	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Gorschewsky et al. 2005	Noyes	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Sun et al. 2011	Objective (Stability, ROM etc...)	●	○	●	●	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Sun et al. 2011 (b)	Objective clinical results	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Sun et al. 2009	Objective functional scores	●	○	●	○	●	●	●	**Moderate**	○	○	●	●	**Moderate**
Lawhorn et al. 2012	Osteoarthritis	●	○	●	○	●	○	●	**Moderate**	●	○	●	○	**Moderate**
Sun et al. 2009	Osteoarthritis	●	○	●	○	●	○	●	**Moderate**	●	○	●	○	**Moderate**
Sun et al. 2009	Osteoarthritis (Kellgren classification)	●	○	●	○	●	●	●	**Moderate**	○	○	●	○	**Moderate**
Peterson et al. 2001	Pain	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**

Table 88. Quality and Applicability: Autograft Versus Allograft

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Shelton et al. 1997	Pain	●	○	●	●	●	○	○	**Moderate**	●	○	●	●	**Moderate**
Peterson et al. 2001	Range of motion	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Shelton et al. 1997	Range of motion	●	○	●	●	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Leal-Blanquet et al. 2011	Satisfaction (VAS)	●	○	●	○	○	●	●	**Moderate**	●	○	●	●	**Moderate**
Edger et al. 2008	Stability	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Lawhorn et al. 2012	Stability	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Peterson et al. 2001	Stability	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Sun et al. 2009	Stability	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Shelton et al. 1997	Stability	●	○	●	●	●	●	○	**Moderate**	●	○	●	●	**Moderate**

Table 88. Quality and Applicability: Autograft Versus Allograft

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Victor et al. 1997	Stability (KT-1000)	●	○	●	○	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Victor et al. 1997	Strength	●	○	●	○	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Leal-Blanquet et al. 2011	Strength	●	○	●	○	○	●	●	**Moderate**	●	○	●	●	**Moderate**
Leal-Blanquet et al. 2011	Symptoms	●	○	●	○	○	●	●	**Moderate**	●	○	●	●	**Moderate**
Sun et al. 2011	Tegner activity	●	○	●	●	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Sun et al. 2011 (b)	Tegner activity level	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Victor et al. 1997	Tegner activity level	●	○	●	○	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Edger et al. 2008	Tegner activity score	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Sun et al. 2009	Tegner activity score	●	○	●	○	●	●	●	**Moderate**	○	○	●	○	**Moderate**

Table 88. Quality and Applicability: Autograft Versus Allograft

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Sun et al. 2009	Tegner score	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**

FINDINGS

Table 89. Results: Autograft Versus Allograft (Patellar Tendon)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Gorschewsky et al. 2005	Moderate	Lysholm score	Bone patellar tendon bone autograft	104	92.8(6.8)	BPTB allograft	97	86.2(10.2)	6.6(4.2,8.99)	Favors Autograft
Gorschewsky et al. 2005	Moderate	Failure	Bone patellar tendon bone autograft	104	5/104(5%)	BPTB allograft	97	20/97(21%)	0.233(0.09,0 .60)	Favors Autograft
Gorschewsky et al. 2005	Moderate	Crepitation in patellofemora l joint (light to moderate)	Bone patellar tendon bone autograft	104	5/104(4.8%)	BPTB allograft	97	6/97(6.2%)	0.777(0.25,2 .47)	NS
Gorschewsky et al. 2005	Moderate	Crepitation in patellofemora l joint (none)	Bone patellar tendon bone autograft	104	97/104(93. 3%)	BPTB allograft	97	87/97(89.7%)	1.04(0.96,1. 13)	Favors Autograft
Gorschewsky et al. 2005	Moderate	Donor site morbidity	Bone patellar tendon bone autograft	104	NR	BPTB allograft	97	NR	NA	Favors Allograft
Gorschewsky et al. 2005	Moderate	Radiographic findings	Bone patellar tendon bone autograft	104	NR	BPTB allograft	97	NR	NA	NS
Gorschewsky et al. 2005	Moderate	Function (1-legged hop)	Bone patellar tendon bone autograft	104	86/104(82. 7%)	BPTB allograft	97	48/97(49.5%)	1.671(1.34,2 .08)	Favors Autograft
Gorschewsky et al. 2005	Moderate	Return to sport (Noyes)	Bone patellar tendon bone autograft	104	68/104(65. 4%)	BPTB allograft	97	56/97(57.7%)	1.133(0.91,1 .41)	NS
Gorschewsky et al. 2005	Moderate	Function (IKDC normal)	Bone patellar tendon bone autograft	104	74/104(71. 2%)	BPTB allograft	97	59/97(60.8%)	1.17(0.96,1. 43)	NS
Gorschewsky et al. 2005	Moderate	Influence on level of activity (IKDC did not have influence on	Bone patellar tendon bone autograft	104	74/104(71. 2%)	BPTB allograft	97	59/97(60.8%)	1.17(0.96,1. 43)	Favors Autograft

Table 89. Results: Autograft Versus Allograft (Patellar Tendon)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		operated knee)								
Gorschewsky et al. 2005	Moderate	Overall (IKDC A normal or nearly normal)	Bone patellar tendon bone autograft	104	72/101(69.2%)	BPTB allograft	97	53/85(54.6%)	1.14(0.93,1.40)	NS
Gorschewsky et al. 2005	Moderate	Symptoms (IKDC B pain swelling, and giving away)	Bone patellar tendon bone autograft	104	80/104(76.9%)	BPTB allograft	97	60/97(61.9%)	1.244(1.03,1.50)	Favors Autograft
Gorschewsky et al. 2005	Moderate	Range of motion (IKDC normal or nearly normal)	Bone patellar tendon bone autograft	104	86/104(82.7%)	BPTB allograft	97	94/97(96.9%)	0.853(0.78,0.94)	NS
Gorschewsky et al. 2005	Moderate	Ligament evaluation (IKDC normal or nearly normal)	Bone patellar tendon bone autograft	104	86/104(82.7%)	BPTB allograft	97	59/97(60.8%)	1.36(1.13,1.63)	Favors Autograft
Leal-Blanquet et al. 2011	Moderate	VAS satisfaction	Bone patellar tendon bone autograft	15	8.5(1.3)	Bone patellar tendon bone allograft	16	9(1.1)	0.5(-0.38,1.38)	NS
Leal-Blanquet et al. 2011	Moderate	Anterior knee pain (VAS)	Bone patellar tendon bone autograft	15	0(0%)	Bone patellar tendon bone allograft	16	0(0%)	NA	NS
Leal-Blanquet et al. 2011	Moderate	Crepitation (VAS)	Bone patellar tendon bone autograft	15	3/15(20%)	Bone patellar tendon bone allograft	16	5/16(31.3%)	0.64(0.184,2.225)	NS
Leal-Blanquet et al. 2011	Moderate	Swelling (VAS)	Bone patellar tendon bone autograft	15	0/15(0%)	Bone patellar tendon bone allograft	16	0/16(0%)	0.64(0.184,2.225)	NS
Leal-Blanquet	Moderate	Instability	Bone patellar	15	3/15(20%)	Bone patellar	16	5/16(31.3%)	0.64(0.184,2	NS

Table 89. Results: Autograft Versus Allograft (Patellar Tendon)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
et al. 2011		(VAS)	tendon bone autograft			tendon bone allograft			.225)	
Leal-Blanquet et al. 2011	Moderate	Strength hamstring 60 deg/s (Isokinetic knee strength)	Bone patellar tendon bone autograft	15	6(23.8)	Bone patellar tendon bone allograft	16	2.2(33.7)	3.8(-17.7,25.3)	NS
Leal-Blanquet et al. 2011	Moderate	Strength hamstring 180 deg/s (Isokinetic knee strength)	Bone patellar tendon bone autograft	15	4.6(24.4)	Bone patellar tendon bone allograft	16	-3.7(32.3)	8.3(-12.78,29.38)	NS
Leal-Blanquet et al. 2011	Moderate	Strength quadriceps 60 deg/s (Isokinetic knee strength)	Bone patellar tendon bone autograft	15	-7(22.8)	Bone patellar tendon bone allograft	16	6(29)	-13(-32.20,6.20)	NS
Leal-Blanquet et al. 2011	Moderate	Strength quadriceps 180 deg/s (Isokinetic knee strength)	Bone patellar tendon bone autograft	15	-3(20.4)	Bone patellar tendon bone allograft	16	-12.6(42.1)	9.6(-14.9,34.1)	NS
Leal-Blanquet et al. 2011	Moderate	KT-1000 neutral position (0-30min value)	Bone patellar tendon bone autograft	15	-0.43(1.05)	Bone patellar tendon bone allograft	16	-0.28(2.18)	-0.15(-1.37,1.07)	NS
Leal-Blanquet et al. 2011	Moderate	KT-1000 external rotation (0-30min value)	Bone patellar tendon bone autograft	15	-0.9(1.33)	Bone patellar tendon bone allograft	16	0.22(1.83)	-1.12(-2.30,0.06)	NS
Leal-Blanquet et al. 2011	Moderate	Lachman test (positive) (n%)	Bone patellar tendon bone autograft	15	3/15(20%)	Bone patellar tendon bone allograft	16	3/16(18.8%)	1.067(0.253, 4.488)	NS
Leal-Blanquet et al. 2011	Moderate	Lachman test (negative) (n%)	Bone patellar tendon bone autograft	15	12/15(80%)	Bone patellar tendon bone allograft	16	13/16(81.3%)	0.985(0.697, 1.391)	NS

Table 89. Results: Autograft Versus Allograft (Patellar Tendon)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Leal-Blanquet et al. 2011	Moderate	Pivot shift sign (positive (n%)	Bone patellar tendon bone autograft	15	3/15(20%)	Bone patellar tendon bone allograft	16	3/16(18.8%)	1.067(0.253, 4.488)	NS
Leal-Blanquet et al. 2011	Moderate	Pivot shift sign (negative) (n%)	Bone patellar tendon bone autograft	15	12/15(80%)	Bone patellar tendon bone allograft	16	13/16(81.3%)	0.985(0.697, 1.391)	NS
Leal-Blanquet et al. 2011	Moderate	IKDC A, (n%)	Bone patellar tendon bone autograft	15	7/15(46.7%)	Bone patellar tendon bone allograft	16	8/16(50%)	0.933(0.45,1 .937)	NS
Leal-Blanquet et al. 2011	Moderate	IKDC B, (n%)	Bone patellar tendon bone autograft	15	8/15(53.3%)	Bone patellar tendon bone allograft	16	8/16(50%)	1.067(0.54,2 .108)	NS
Leal-Blanquet et al. 2011	Moderate	Swelling (VAS)	Bone patellar tendon bone autograft	20	0/20(0%)	Bone patellar tendon bone allograft	16	0/16(0%)	0.64(0.184,2 .225)	NS
Victor et al. 1997	Moderate	Lysholm score	Patellar tendon autograft	48	92.6	Patellar tendon allograft	25	85.4	NA	NS
Victor et al. 1997	Moderate	Tegner score	Patellar tendon autograft	48	4.75	Patellar tendon allograft	25	4.41	NA	NS
Victor et al. 1997	Moderate	Failure	Patellar tendon autograft	48	0/48 (0%)	Patellar tendon allograft	25	3/25(12%)	0.076(0.004, 1.412)	NS
Victor et al. 1997	Moderate	Strength	Patellar tendon autograft	48	NR	Patellar tendon allograft	25	NR	NA	NS
Victor et al. 1997	Moderate	Stability (KT-1000)	Patellar tendon autograft	48	NR	Patellar tendon allograft	25	NR	NA	NS
Victor et al. 1997	Moderate	Kujala patellofemora l score	Patellar tendon autograft	48	91.6	Patellar tendon allograft	25	87.8	NA	NS
Victor et al. 1997	Moderate	Pain (anterior knee pain)	Patellar tendon autograft	48	20/48(42%)	Patellar tendon allograft	25	10/25(40%)	1.041(0.58,1 .87)	NS
Victor et al. 1997	Moderate	Return to sport (no more sport)	Patellar tendon autograft	48	2/48(4%)	Patellar tendon allograft	25	3/25(12%)	0.347(0.06,1 .944)	NS
Victor et al. 1997	Moderate	Return to sport (at	Patellar tendon autograft	48	6/48(13%)	Patellar tendon allograft	25	1/25(4%)	3.125(0.397, 24.546)	NS

Table 89. Results: Autograft Versus Allograft (Patellar Tendon)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		lower level)								
Victor et al. 1997	Moderate	Return to sport (same level)	Patellar tendon autograft	48	40/48(83%)	Patellar tendon allograft	25	21/25(84%)	0.992(0.802, 1.227)	NS

Table 90. Results: Autograft Versus Allograft (Hamstring)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Edger et al. 2008	Moderate	Lysholm score	Hamstring autograft	37	91(7.7)	Hamstring allograft	47	92.7(10)	1.7 (-2.26,5.66)	NS
Edger et al. 2008	Moderate	Subjective IKDC score	Hamstring autograft	37	87.6(10.2)	Hamstring allograft	47	87(11.7)	0.6 (-4.24,5.44)	NS
Edger et al. 2008	Moderate	Failure	Hamstring autograft	37	3/37(8%)	Hamstring allograft	47	5/47(11%)	1.03(0.89,1.18)	NS
Edger et al. 2008	Moderate	Functional outcome (IKDC A normal)	Hamstring autograft	37	12/37(32%)	Hamstring allograft	47	19/47(40%)	0.8(0.45,1.43)	NS
Edger et al. 2008	Moderate	Functional outcome (IKDC B nearly normal)	Hamstring autograft	37	19/37(51%)	Hamstring allograft	47	19/47(40%)	1.27(0.78,2.03)	NS
Edger et al. 2008	Moderate	Functional outcome (IKDC C abnormal)	Hamstring autograft	37	4/37(11%)	Hamstring allograft	47	6/47(13%)	0.85(0.26,2.78)	NS
Edger et al. 2008	Moderate	Functional outcome (IKDC D	Hamstring autograft	37	2/37(5%)	Hamstring allograft	47	2/47(4%)	1.27(0.19,8.60)	NS

Table 90. Results: Autograft Versus Allograft (Hamstring)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		severely abnormal)								
Edger et al. 2008	Moderate	Activities (Tegner)	Hamstring autograft	37	6.8(1.2)	Hamstring allograft	47	6.9(1.3)	0.1(-0.45,0.65)	NS
Lawhorn et al. 2012	Moderate	IKDC subjective	Hamstring autograft	54	91(NR)	Anterior tibialis allograft	48	90.9(NR)	0.258(0.078,0.856)	NS
Lawhorn et al. 2012	Moderate	Functional (IKDC overall normal)	Hamstring autograft	54	46/54(85%)	Anterior tibialis allograft	48	43/48(90%)	0.951(0.8211.102)	NS
Lawhorn et al. 2012	Moderate	Functional (IKDC overall nearly normal)	Hamstring autograft	54	7/54(13%)	Anterior tibialis allograft	48	5/48(10%)	1.244(0.4233.664)	NS
Lawhorn et al. 2012	Moderate	Functional (IKDC overall abnormal)	Hamstring autograft	54	0/54(0%)	Anterior tibialis allograft	48	0/48(0%)	NA	NS
Lawhorn et al. 2012	Moderate	Functional (IKDC overall severely normal)	Hamstring autograft	54	1/54(2%)	Anterior tibialis allograft	48	0/48(0%)	2.673(0.11164.101)	NS
Lawhorn et al. 2012	Moderate	Stability (KT measurements normal 1-2mm)	Hamstring autograft	54	46/54(85%)	Anterior tibialis allograft	48	43/48(90%)	0.951(0.8211.102)	NS
Lawhorn et al. 2012	Moderate	Stability (KT measurements nearly normal 3-5mm)	Hamstring autograft	54	7/54(13%)	Anterior tibialis allograft	48	5/48(10%)	1.244(0.4233.664)	NS
Lawhorn et al. 2012	Moderate	Stability (Pivot shift normal)	Hamstring autograft	54	48/54(89%)	Anterior tibialis allograft	48	44/48(92%)	0.97(0.8541.101)	NS
Lawhorn et al. 2012	Moderate	Stability (Pivot shift nearly	Hamstring autograft	54	9/54(9%)	Anterior tibialis allograft	48	4/48(8%)	2(0.6586.079)	NS

Table 90. Results: Autograft Versus Allograft (Hamstring)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		normal)								
Lawhorn et al. 2012	Moderate	Stability (Pivot shift severely abnormal)	Hamstring autograft	54	1/54(2%)	Anterior tibialis allograft	48	0/48(0%)	2.673(0.11164.101)	NS
Lawhorn et al. 2012	Moderate	Effusion (mild)	Hamstring autograft	54	1/54(1%)	Anterior tibialis allograft	48	0/48(0%)	2.673(0.11164.101)	NS
Lawhorn et al. 2012	Moderate	Range of motion (normal extension compared to contralateral side)	Hamstring autograft	54	51/54(94%)	Anterior tibialis allograft	48	46/48(96%)	0.986(0.9031.076)	NS
Lawhorn et al. 2012	Moderate	Range of motion (nearly normal extension to contralateral side)	Hamstring autograft	54	1/54(2%)	Anterior tibialis allograft	48	2/48(4%)	0.444(0.0424.749)	NS
Lawhorn et al. 2012	Moderate	Range of motion (abnormal extension to contralateral side)	Hamstring autograft	54	2/54(4%)	Anterior tibialis allograft	48	0/48(0%)	4.455(0.21990.539)	NS
Lawhorn et al. 2012	Moderate	Functional (single leg hop test)	Hamstring autograft	54	NR	Anterior tibialis allograft	48	NR	NA	NS
Lawhorn et al. 2012	Moderate	Medial compartment arthrosis: None (Radiographic)	Hamstring autograft	54	50/54(93%)	Anterior tibialis allograft	48	42/48(88%)	1.058(0.9281.206)	NS
Lawhorn et	Moderate	Medial	Hamstring	54	2/54(4%)	Anterior tibialis	48	5/48(10%)	0.356(0.0721.7	NS

Table 90. Results: Autograft Versus Allograft (Hamstring)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
al. 2012		compartment arthrosis: Mild (Radiographic)	autograft			allograft			49)	
Lawhorn et al. 2012	Moderate	Lateral compartment arthrosis: None (Radiographic)	Hamstring autograft	54	52/54(96%)	Anterior tibialis allograft	48	42/48(88%)	1.101(0.9771.2 4)	NS
Lawhorn et al. 2012	Moderate	Lateral compartment arthrosis: Mild (Radiographic)	Hamstring autograft	54	2/54(4%)	Anterior tibialis allograft	48	5/48(10%)	0.356(0.0721.7 49)	NS
Lawhorn et al. 2012	Moderate	Reoperations	Hamstring autograft	54	3/54(5%)	Anterior tibialis allograft	48	5/48(10%)	0.533(0.1352.1 15)	NS
Sun et al. 2011(b)	Moderate	IKDC subjective	Hamstring tendon autograft	36	87(10)	Irradiated hamstring tendon allograft	31	83(10)	4(-0.89,8.89)	NS
Sun et al. 2011(b)	Moderate	Cincinnati knee score	Hamstring tendon autograft	36	88(11)	Irradiated hamstring tendon allograft	31	85(13)	3(-2.85,8.85)	NS
Sun et al. 2011(b)	Moderate	Lysholm score	Hamstring tendon autograft	36	89(8)	Irradiated hamstring tendon allograft	31	87(11)	2(-2.65,6.65)	NS
Sun et al. 2011(b)	Moderate	Activities (Tegner score)	Hamstring tendon autograft	36	7.6(1.3)	Irradiated hamstring tendon allograft	31	7(1.4)	0.6(-0.06,1.26)	NS
Sun et al. 2011(b)	Moderate	Functional (IKDC overall normal)	Hamstring tendon autograft	36	11/36(31%)	Irradiated hamstring tendon allograft	31	9/31(29%)	1.052(0.503,2.203)	NS
Sun et al. 2011(b)	Moderate	Functional (IKDC	Hamstring tendon autograft	36	22/36(61%)	Irradiated hamstring tendon	31	18/31(58%)	1.052(0.708,1.565)	NS

Table 90. Results: Autograft Versus Allograft (Hamstring)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		overall nearly normal)				allograft				
Sun et al. 2011(b)	Moderate	Functional (IKDC overall abnormal)	Hamstring tendon autograft	36	2/36(6%)	Irradiated hamstring tendon allograft	31	3/31(10%)	0.574(0.102,3. 217)	NS
Sun et al. 2011(b)	Moderate	Functional (IKDC overall severely normal)	Hamstring tendon autograft	36	1/36(3%)	Irradiated hamstring tendon allograft	31	1/31(3%)	0.861(0.056,13 .202)	NS
Sun et al. 2011(b)	Moderate	Functional (Range of motion overall normal)	Hamstring tendon autograft	36	16/36(44%)	Irradiated hamstring tendon allograft	31	16/31(52%)	0.861(0.523,1. 419)	NS
Sun et al. 2011(b)	Moderate	Functional (Range of motion nearly normal)	Hamstring tendon autograft	36	17/36(47%)	Irradiated hamstring tendon allograft	31	13/31(42%)	1.126(0.657,1.931)	NS
Sun et al. 2011(b)	Moderate	Functional (Range of motion abnormal)	Hamstring tendon autograft	36	2/36(6%)	Irradiated hamstring tendon allograft	31	1/31(3%)	1.722(0.164,18.093)	NS
Sun et al. 2011(b)	Moderate	Functional Range of motion severely normal)	Hamstring tendon autograft	36	1/36(3%)	Irradiated hamstring tendon allograft	31	1/31(3%)	0.861(0.056,13.202)	NS
Sun et al. 2011(b)	Moderate	Functional (Harner's vertical jump overall normal)	Hamstring tendon autograft	36	13/36(36%)	Irradiated hamstring tendon allograft	31	9/31(29%)	1.244(0.617,2.508)	NS
Sun et al. 2011(b)	Moderate	Functional (Harner's vertical jump	Hamstring tendon autograft	36	21/36(58%)	Irradiated hamstring tendon allograft	31	18/31(58%)	1.005(0.669,1.509)	NS

Table 90. Results: Autograft Versus Allograft (Hamstring)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		nearly normal)								
Sun et al. 2011(b)	Moderate	Functional (Harner's vertical jump abnormal)	Hamstring tendon autograft	36	2/36(6%)	Irradiated hamstring tendon allograft	31	4/31(13%)	0.431(0.085,2.193)	NS
Sun et al. 2011(b)	Moderate	Functional (Harner's vertical jump severely normal)	Hamstring tendon autograft	36	0/36(0%)	Irradiated hamstring tendon allograft	31	0/31(0%)	NA	NS
Sun et al. 2011(b)	Moderate	Functional (Daniel's 1-leg hop test overall normal)	Hamstring tendon autograft	36	13/36(36%)	Irradiated hamstring tendon allograft	31	10/31(32%)	1.119(0.573,2.188)	NS
Sun et al. 2011(b)	Moderate	Functional (Daniel's 1-leg hop test nearly normal)	Hamstring tendon autograft	36	22(61%)	Irradiated hamstring tendon allograft	31	18/31(58%)	1.052(0.708,1.565)	NS
Sun et al. 2011(b)	Moderate	Functional (Daniel's 1-leg hop test abnormal)	Hamstring tendon autograft	36	1/36(3%)	Irradiated hamstring tendon allograft	31	3/31(10%)	0.287(0.031,2.621)	NS
Sun et al. 2011(b)	Moderate	Functional (Harner's vertical jump severely normal)	Hamstring tendon autograft	36	0/36(0%)	Irradiated hamstring tendon allograft	31	0/31(0%)	NA	NS
Sun et al. 2011(b)	Moderate	Stability (Pivot shift 0)	Hamstring tendon autograft	36	33/36(92%)	Irradiated hamstring tendon allograft	31	19/31(61%)	1.496(1.112,2.012)	Favors Autograft
Sun et al. 2011(b)	Moderate	Stability (Pivot shift I	Hamstring tendon autograft	36	3/36(8%)	Irradiated hamstring tendon allograft	31	8/31(26%)	0.323(0.094,1.112)	NS
Sun et al.	Moderate	Stability	Hamstring tendon	36	0/36(0%)	Irradiated	31	4/31(13%)	0.096(0.005,1.	NS

Table 90. Results: Autograft Versus Allograft (Hamstring)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
2011(b)		(Pivot shift II)	autograft			hamstring tendon allograft			717)	
Sun et al. 2011(b)	Moderate	Stability (Pivot shift III)	Hamstring tendon autograft	36	0/36(0%)	Irradiated hamstring tendon allograft	31	0/31(0%)	NA	NS
Sun et al. 2011(b)	Moderate	Stability (Anterior drawer test 0)	Hamstring tendon autograft	36	30/36(83%)	Irradiated hamstring tendon allograft	31	11/31(35%)	**2.348(1.429,3.859)**	Favors Autograft
Sun et al. 2011(b)	Moderate	Stability (Anterior drawer test I	Hamstring tendon autograft	36	4/36(11%)	Irradiated hamstring tendon allograft	31	1/31(3%)	3.444(0.406,29.218)	NS
Sun et al. 2011(b)	Moderate	Stability (Anterior drawer test II)	Hamstring tendon autograft	36	2/36(6%)	Irradiated hamstring tendon allograft	31	9/31(29%)	0.191(0.045,0.82)	
Sun et al. 2011(b)	Moderate	Stability (Anterior drawer test III)	Hamstring tendon autograft	36	0/36(0%)	Irradiated hamstring tendon allograft	31	0/31(0%)	NA	NS
Sun et al. 2011(b)	Moderate	Stability (Lachman test 0)	Hamstring tendon autograft	36	29/36(81%)	Irradiated hamstring tendon allograft	31	10/31(32%)	**2.497(1.463,4.263)**	Favors Autograft
Sun et al. 2011(b)	Moderate	Stability (Lachman test I	Hamstring tendon autograft	36	4/36(11%)	Irradiated hamstring tendon allograft	31	11/31(35%)	0.313(0.111,0.885)	Favors allograft
Sun et al. 2011(b)	Moderate	Stability (Lachman test II)	Hamstring tendon autograft	36	3/36(8%)	Irradiated hamstring tendon allograft	31	10/31(32%)	0.258(0.078,0.856)	
Sun et al. 2011(b)	Moderate	Stability (Lachman test III)	Hamstring tendon autograft	36	0/36(0%)	Irradiated hamstring tendon allograft	31	0/31(0%)	NA	NS
Sun et al. 2011(b)	Moderate	Stability (KT-2000: Anterior tibial displacement)	Hamstring tendon autograft	36	5.2(2.8)	Irradiated hamstring tendon allograft	31	9.6(3.1)	-4.4(-5.84,-2.96)	Favors autograft
Sun et al. 2011(b)	Moderate	Stability (KT-2000: side to side	Hamstring tendon autograft	36	2.5(0.7)	Irradiated hamstring tendon allograft	31	5.6(3.1)	-3.1(-4.16,-2.04)	Favors autograft

Table 90. Results: Autograft Versus Allograft (Hamstring)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		difference)								
Sun et al. 2011(b)	Moderate	Stability (KT-2000: Side to side difference <3mm no of knees (%)))	Hamstring tendon autograft	36	31/36(86%)	Irradiated hamstring tendon allograft	31	10/31(32%)	**2.669(1.576,4.52)**	Favors autograft
Sun et al. 2011(b)	Moderate	Stability (KT-2000: Side to side difference >5mm no of knees (%))	Hamstring tendon autograft	36	3/36(8%)	Irradiated hamstring tendon allograft	31	10/31(32%)	0.258(0.078,0.856)	Favors autograft

Table 91. Results: Autograft Versus Allograft Long Term Follow-up

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Gorschewsky et al. 2005	Moderate	Lysholm score	Bone patellar tendon bone autograft	101	93.6(5.6)	BPTB allograft	85	78.3(14.4)	15.3(12.23,18.37)	Favors Autograft
Gorschewsky et al. 2005	Moderate	Failure	Bone patellar tendon bone autograft	101	6/101(6%)	BPTB allograft	85	38/85(45%)	0.133(0.06,0.30)	Favors Autograft
Gorschewsky et al. 2005	Moderate	Crepitation in patellofemoral joint (light to moderate)	Bone patellar tendon bone autograft	101	30/101(29.7%)	BPTB allograft	85	36/85(42.4%)	0.701(0.48,1.04)	NS
Gorschewsky et al. 2005	Moderate	Crepitation in patellofemoral joint (none)	Bone patellar tendon bone autograft	101	70/101(69.3%)	BPTB allograft	85	27/85(31.7%)	2.18(1.55.3.06)	Favors Autograft
Gorschewsky et al. 2005	Moderate	Donor site morbidity	Bone patellar tendon bone autograft	101	NR	BPTB allograft	85	NR	NA	Favors Allograft
Gorschewsky et al. 2005	Moderate	Radiographic findings	Bone patellar tendon bone autograft	101	NR	BPTB allograft	85	NR	NA	NS
Gorschewsky et al. 2005	Moderate	Function (1-legged hop)	Bone patellar tendon bone autograft	101	80/101(79.2%)	BPTB allograft	85	31/85(36.5%)	2.172(1.61,2.93)	Favors Autograft
Gorschewsky et al. 2005	Moderate	Return to sport (Noyes)	Bone patellar tendon bone autograft	101	81/101(80.2%)	BPTB allograft	85	64/85(75.3%)	1.065(0.91,1.24)	NS
Gorschewsky et al. 2005	Moderate	Function (IKDC normal)	Bone patellar tendon bone autograft	101	63/101(62.3%)	BPTB allograft	85	20/85(23.5%)	2.651(1.76,4.00)	Favors Autograft
Gorschewsky et al. 2005	Moderate	Influence on level of activity (IKDC did not have influence on operated knee)	Bone patellar tendon bone autograft	101	63/101(62.3%)	BPTB allograft	85	20/85(23.5%)	2.651(1.76,4.00)	Favors Autograft

Table 91. Results: Autograft Versus Allograft Long Term Follow-up

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Gorschewsky et al. 2005	Moderate	Overall (IKDC A normal or nearly normal)	Bone patellar tendon bone autograft	101	56/104(55.4%)	BPTB allograft	85	15/97(17.6%)	3.48(2.11,5.73)	Favors Autograft
Gorschewsky et al. 2005	Moderate	Symptoms (IKDC B pain swelling, and giving away)	Bone patellar tendon bone autograft	101	55/101(54.5%)	BPTB allograft	85	14/85(16.5%)	3.306(1.98,5.51)	Favors Autograft
Gorschewsky et al. 2005	Moderate	Range of motion (IKDC normal or nearly normal)	Bone patellar tendon bone autograft	101	97/101(96%)	BPTB allograft	85	82/85(96.5%)	0.996(0.94,1.05)	NS
Gorschewsky et al. 2005	Moderate	Ligament evaluation (IKDC normal or nearly normal)	Bone patellar tendon bone autograft	101	67/101(66.3%)	BPTB allograft	85	23/85(27.1%)	**2.45(1.68,3.57)**	Favors Autograft
Peterson et al. 2001	Moderate	Pain (Lysholm score average (range))	Bone patellar tendon bone autograft	30	88.6(61-100)	Bone patellar tendon bone allograft	30	90(62-100)	NA	NS
Peterson et al. 2001	Moderate	Pain (Lysholm score 90-100)	Bone patellar tendon bone autograft	30	23/30(76%)	Bone patellar tendon bone allograft	30	22/30(73%)	1.045(0.78,1.401)	NS
Peterson et al. 2001	Moderate	Pain (Lysholm score 80-89)	Bone patellar tendon bone autograft	30	2/30(7%)	Bone patellar tendon bone allograft	30	2/30(7%)	1(0.151,6.643)	NS
Peterson et al. 2001	Moderate	Pain (Lysholm score 70-79)	Bone patellar tendon bone autograft	30	2/30(7%)	Bone patellar tendon bone allograft	30	3/30(10%)	0.667(0.12,3.709)	NS
Peterson et al. 2001	Moderate	Pain (Lysholm	Bone patellar tendon bone	30	3/30(10%)	Bone patellar tendon bone	30	3/30(10%)	1(0.219,4.564)	NS

Table 91. Results: Autograft Versus Allograft Long Term Follow-up

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		score 60-69)	autograft			allograft				
Peterson et al. 2001	Moderate	Activities (Tegner mean range))	Bone patellar tendon bone autograft	30	6.1(3-7)	Bone patellar tendon bone allograft	30	5.4(2-8)	NA	NS
Peterson et al. 2001	Moderate	Effusion (0=none)	Bone patellar tendon bone autograft	30	24/30(80%)	Bone patellar tendon bone allograft	30	27/30(90%)	0.889(0.717, 1.102)	NS
Peterson et al. 2001	Moderate	Effusion (1=barely detectable)	Bone patellar tendon bone autograft	30	5/30(17%)	Bone patellar tendon bone allograft	30	3/30(10%)	1.667(0.437, 6.358)	NS
Peterson et al. 2001	Moderate	Effusion (2=easily detectable)	Bone patellar tendon bone autograft	30	1/30(3%)	Bone patellar tendon bone allograft	30	0/30(0%)	3(0.127,70.8 29)	NS
Peterson et al. 2001	Moderate	Effusion (3=tightly swollen)	Bone patellar tendon bone autograft	30	0/30(0%)	Bone patellar tendon bone allograft	30	0/30(0%)	NA	NS
Peterson et al. 2001	Moderate	Range of motion (Flexion loss deg)	Bone patellar tendon bone autograft	30	0.5(0-10)	Bone patellar tendon bone allograft	30	0.83(0-10)	NA	NS
Peterson et al. 2001	Moderate	Range of motion (Extension loss deg)	Bone patellar tendon bone autograft	30	2.47(2-5)	Bone patellar tendon bone allograft	30	1.07(0-10)	NA	NS
Peterson et al. 2001	Moderate	Patellofemora l crepitus	Bone patellar tendon bone autograft	30	8/30(26%)	Bone patellar tendon bone allograft	30	10/30(33%)	0.8(0.367,1. 745)	NS
Peterson et al. 2001	Moderate	Stability (KT-1000 <3mm)	Bone patellar tendon bone autograft	30	20/30(67%)	Bone patellar tendon bone allograft	30	22/30(73%)	0.909(0.652, 1.268)	NS
Peterson et al. 2001	Moderate	Stability (KT-1000 3-5mm)	Bone patellar tendon bone autograft	30	8/30(26%)	Bone patellar tendon bone allograft	30	8/30(27%)	1(0.432,2.31 5)	NS
Peterson et al. 2001	Moderate	Stability (KT-1000 >5mm)	Bone patellar tendon bone autograft	30	2/30(7%)	Bone patellar tendon bone allograft	30	0/30(0%)	5(0.25,99.95 4)	NS

Table 91. Results: Autograft Versus Allograft Long Term Follow-up

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Peterson et al. 2001	Moderate	Failure	Bone patellar tendon bone autograft	30	1/30(3%)	Bone patellar tendon bone allograft	30	1/30(3%)	1(0.066,15.26)	NS
Sun et al. 2009	Moderate	IKDC (Subjective)	Bone patellar tendon bone autograft	76	90(10)	Bone patellar tendon bone allograft	80	88(9)	2(-1.,5)	NS
Sun et al. 2009	Moderate	Lysholm score	Bone patellar tendon bone autograft	76	90(8)	Bone patellar tendon bone allograft	80	91(6)	-1(-3.23,1.23)	NS
Sun et al. 2009	Moderate	Activities (Tegner)	Bone patellar tendon bone autograft	76	7.8(1.6)	Bone patellar tendon bone allograft	80	7.6(1.9)	0.2(0.36,0.75)	NS
Sun et al. 2009	Moderate	Cincinnati knee score	Bone patellar tendon bone autograft	76	91(12)	Bone patellar tendon bone allograft	80	92(11)	-1(-4.64,2.64)	NS
Sun et al. 2009	Moderate	Osteoarthritis (Kellgren classification)	Bone patellar tendon bone autograft	76	NR	Bone patellar tendon bone allograft	80	NR	NA	NS
Sun et al. 2009	Moderate	Functional (IKDC overall normal)	Bone patellar tendon bone autograft	76	27/76(35%)	Bone patellar tendon bone allograft	80	30/80(37%)	0.947(0.626, 1.434)	NS
Sun et al. 2009	Moderate	Functional (IKDC overall nearly normal)	Bone patellar tendon bone autograft	76	45/76(59%)	Bone patellar tendon bone allograft	80	45/80(56%)	1.053(0.805, 1.377)	NS
Sun et al. 2009	Moderate	Functional (IKDC overall abnormal)	Bone patellar tendon bone autograft	76	3/76(4%)	Bone patellar tendon bone allograft	80	4/80(5%)	0.789(0.183, 3.412)	NS
Sun et al. 2009	Moderate	Functional (IKDC overall severely normal)	Bone patellar tendon bone autograft	76	1/76(1%)	Bone patellar tendon bone allograft	80	1/80(1%)	1.053(0.067, 16.531)	NS
Sun et al.	Moderate	Functional	Bone patellar	76	39/76(51%)	Bone patellar	80	45/80(56%)	0.912	NS

Table 91. Results: Autograft Versus Allograft Long Term Follow-up

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
2009		(Range of motion overall normal)	tendon bone autograft			tendon bone allograft			(0.681,1.222)	
Sun et al. 2009	Moderate	Functional (Range of motion nearly normal)	Bone patellar tendon bone autograft	76	33/76(43%)	Bone patellar tendon bone allograft	80	29/80(36%)	1.198(0.813, 1.765)	NS
Sun et al. 2009	Moderate	Functional (Range of motion abnormal)	Bone patellar tendon bone autograft	76	2/76(3%)	Bone patellar tendon bone allograft	80	6/80(6%)	0.351 (0.073,1.685)	NS
Sun et al. 2009	Moderate	Functional Range of motion severely normal)	Bone patellar tendon bone autograft	76	2/76(3%)	Bone patellar tendon bone allograft	80	0/80(0%)	5.260 (0.257,107.8 11)	NS
Sun et al. 2009	Moderate	Functional (Harner's vertical jump overall normal)	Bone patellar tendon bone autograft	76	27/76(35%)	Bone patellar tendon bone allograft	80	25/80(31%)	1.137 (0.729,1.773)	NS
Sun et al. 2009	Moderate	Functional (Harner's vertical jump nearly normal)	Bone patellar tendon bone autograft	76	45/76(60%)	Bone patellar tendon bone allograft	80	50/80(62%)	0.947(0.736, 1.219)	NS
Sun et al. 2009	Moderate	Functional (Harner's vertical jump abnormal)	Bone patellar tendon bone autograft	76	4/76(5%)	Bone patellar tendon bone allograft	80	5/80(6%)	0.842(0.235, 3.019)	NS
Sun et al. 2009	Moderate	Functional (Harner's vertical jump severely normal)	Bone patellar tendon bone autograft	76	0/76(0%)	Bone patellar tendon bone allograft	80	0/80(0%)	NA	NS

Table 91. Results: Autograft Versus Allograft Long Term Follow-up

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Sun et al. 2009	Moderate	Functional (Daniel's 1-leg hop test overall normal)	Bone patellar tendon bone autograft	76	26/76(34%)	Bone patellar tendon bone allograft	80	26/80(32%)	1.053(0.675, 1.641)	NS
Sun et al. 2009	Moderate	Functional (Daniel's 1-leg hop test nearly normal)	Bone patellar tendon bone autograft	76	46/76(60%)	Bone patellar tendon bone allograft	80	49/80(61%)	0.988(0.768, 1.271)	NS
Sun et al. 2009	Moderate	Functional (Daniel's 1-leg hop test abnormal)	Bone patellar tendon bone autograft	76	4/76(5%)	Bone patellar tendon bone allograft	80	5/80(6%)	0.842(0.235, 3.019)	NS
Sun et al. 2009	Moderate	Functional (Harner's vertical jump severely normal)	Bone patellar tendon bone autograft	76	0/76(0%)	Bone patellar tendon bone allograft	80	0/80(0%)	NA	NS
Sun et al. 2009	Moderate	Stability (Pivot shift 0)	Bone patellar tendon bone autograft	76	71/76(93%)	Bone patellar tendon bone allograft	80	74/80(92%)	1.01(0.926,1 .101)	NS
Sun et al. 2009	Moderate	Stability (Pivot shift I	Bone patellar tendon bone autograft	76	5/76(7%)	Bone patellar tendon bone allograft	80	6/80(7%)	0.877(0.279, 2.755)	NS
Sun et al. 2009	Moderate	Stability (Pivot shift II)	Bone patellar tendon bone autograft	76	0/76(0%)	Bone patellar tendon bone allograft	80	0/80(0%)	NA	NS
Sun et al. 2009	Moderate	Stability (Pivot shift III)	Bone patellar tendon bone autograft	76	0/76(0%)	Bone patellar tendon bone allograft	80	0/80(0%)	NA	NS
Sun et al. 2009	Moderate	Stability (Lachman test 0)	Bone patellar tendon bone autograft	76	62/76(82%)	Bone patellar tendon bone allograft	80	65/80(92%)	1.004(0.864, 1.167)	NS
Sun et al. 2009	Moderate	Stability (Lachman test	Bone patellar tendon bone	76	9/76(12%)	Bone patellar tendon bone	80	9/80(11%)	1.053(0.441, 2.51)	NS

Table 91. Results: Autograft Versus Allograft Long Term Follow-up

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		I	autograft			allograft				
Sun et al. 2009	Moderate	Stability (Lachman test II)	Bone patellar tendon bone autograft	76	5/76(7%)	Bone patellar tendon bone allograft	80	6/80(7%)	0.877(0.279, 2.755)	NS
Sun et al. 2009	Moderate	Stability (Lachman test III)	Bone patellar tendon bone autograft	76	0/76(0%)	Bone patellar tendon bone allograft	80	0/80(0%)	NA	NS
Sun et al. 2009	Moderate	Stability (Anterior drawer test 0)	Bone patellar tendon bone autograft	76	64/76(84%)	Bone patellar tendon bone allograft	80	67/80(84%)	1.005(0.877, 1.153)	NS
Sun et al. 2009	Moderate	Stability (Anterior drawer test I	Bone patellar tendon bone autograft	76	8/76(10%)	Bone patellar tendon bone allograft	80	8/80(10%)	1.053(0.416, 2.663)	NS
Sun et al. 2009	Moderate	Stability (Anterior drawer test II)	Bone patellar tendon bone autograft	76	4/76(5%)	Bone patellar tendon bone allograft	80	5/80(6%)	0.842(0.235, 3.019)	NS
Sun et al. 2009	Moderate	Stability (Anterior drawer test III)	Bone patellar tendon bone autograft	76	0/76(0%)	Bone patellar tendon bone allograft	80	0/80(0%)	NA	NS
Sun et al. 2011 (a)	Moderate	IKDC	Hamstring autograft	91	89(12)	Hamstring allograft	95	90(14)	-1(-4.78,2.78)	NS
Sun et al. 2011 (a)	Moderate	Lysholm score	Hamstring autograft	91	89(9)	Hamstring allograft	95	90(8)	-1(-3.46,1.46)	NS
Sun et al. 2011 (a)	Moderate	Activities (Tegner)	Hamstring autograft	91	7.7(1.8)	Hamstring allograft	95	7.6(1.5)	0.1(-0.37,0.58)	NS
Sun et al. 2011 (a)	Moderate	Cincinnati knee score	Hamstring autograft	91	90(10)	Hamstring allograft	95	91(11)	-1(-4.04,2.04)	NS
Sun et al. 2011 (a)	Moderate	Functional (normal overall IKDC)	Hamstring autograft	91	30/91(33%)	Hamstring allograft	95	33/95(35%)	0.949(0.635, 1.419)	NS
Sun et al. 2011 (a)	Moderate	Functional (nearly normal overall	Hamstring autograft	91	55/91(60%)	Hamstring allograft	95	53/95(56%)	1.083(0.849, 1.383)	NS

Table 91. Results: Autograft Versus Allograft Long Term Follow-up

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		IKDC)								
Sun et al. 2011 (a)	Moderate	Functional (abnormal overall IKDC)	Hamstring autograft	91	5/91(5.5%)	Hamstring allograft	95	8/95(42.1%)	0.652(0.222, 1.921)	NS
Sun et al. 2011 (a)	Moderate	Functional (severely abnormal overall IKDC)	Hamstring autograft	91	1/91(1.1%)	Hamstring allograft	95	1/95(1%)	1.044(0.066, 16.443)	NS
Sun et al. 2011 (a)	Moderate	Range of motion (Normal overall IKDC)	Hamstring autograft	91	44/91(48%)	Hamstring allograft	95	48/95(50%)	0.957(0.715, 1.28)	NS
Sun et al. 2011 (a)	Moderate	Range of motion (nearly normal overall IKDC)	Hamstring autograft	91	40/91(44%)	Hamstring allograft	95	40/95(42%)	1.044(0.75,1 .453)	NS
Sun et al. 2011 (a)	Moderate	Range of motion (abnormal overall IKDC)	Hamstring autograft	91	5/91(5.5%)	Hamstring allograft	95	6/95(6%)	0.87(0.275,2 .752)	NS
Sun et al. 2011 (a)	Moderate	Range of motion (severely abnormal overall IKDC)	Hamstring autograft	91	2/91(2%)	Hamstring allograft	95	1/95(1%)	2.088(0.193, 22.631)	NS
Sun et al. 2011 (a)	Moderate	Functional (normal Harner vertical jump	Hamstring autograft	91	31/91(34%)	Hamstring allograft	95	32/95(34%)	1.011(0.677, 1.511)	NS

Table 91. Results: Autograft Versus Allograft Long Term Follow-up

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		test)								
Sun et al. 2011 (a)	Moderate	Functional (nearly normal Harner vertical jump test)	Hamstring autograft	91	52/91(57%)	Hamstring allograft	95	54/95(57%)	1.005(0.783, 1.29)	NS
Sun et al. 2011 (a)	Moderate	Functional (abnormal Harner vertical jump test)	Hamstring autograft	91	7/91(8%)	Hamstring allograft	95	9/95(6%)	0.812(0.316, 2.089)	NS
Sun et al. 2011 (a)	Moderate	Functional (severely abnormal Harner vertical jump test)	Hamstring autograft	91	1/91(1%)	Hamstring allograft	95	0/95(0%)	3.13(0.129,7 5.867)	NS
Sun et al. 2011 (a)	Moderate	Functional (normal Daniel 1-legged hop test)	Hamstring autograft	91	32/91(35%)	Hamstring allograft	95	30/95(32%)	1.114(0.741, 1.672)	NS
Sun et al. 2011 (a)	Moderate	Functional (nearly normal Daniel 1-legged hop test)	Hamstring autograft	91	52/91(57%)	Hamstring allograft	95	57/95(60%)	0.952(0.748, 1.213)	NS
Sun et al. 2011 (a)	Moderate	Functional (abnormal Daniel 1-legged hop test)	Hamstring autograft	91	7/91(8%)	Hamstring allograft	95	8/95(8%)	0.913(0.345, 2.416)	NS
Sun et al. 2011 (a)	Moderate	Functional (severely abnormal	Hamstring autograft	91	0/91(0%)	Hamstring allograft	95	0/95(0%)	NA	NS

Table 91. Results: Autograft Versus Allograft Long Term Follow-up

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		Daniel 1-legged hop test)								
Sun et al. 2011 (a)	Moderate	Stability (KT-2000 arthrometer mm anterior tibial displacement)	Hamstring autograft	91	5.3(3.1)	Hamstring allograft	95	5.6(2.5)	-0.3(-1.11,0.51)	NS
Sun et al. 2011 (a)	Moderate	Stability (KT-2000 arthrometer mm side to side difference)	Hamstring autograft	91	2.5(0.7)	Hamstring allograft	95	2.7(0.9)	1.8(1.56,2.03)	NS
Sun et al. 2011 (a)	Moderate	Stability (KT-2000 arthrometer mm side to side difference <3mm (range))	Hamstring autograft	91	76/91(83.5%)	Hamstring allograft	95	78/90(82%)	1.017(0.892, 1.159)	NS
Sun et al. 2011 (a)	Moderate	Stability (KT-2000 arthrometer mm side to side difference >5mm (range))	Hamstring autograft	91	7/91(8%)	Hamstring allograft	95	8/95(8%)	0.913(0.345, 2.416)	NS
Sun et al. 2011 (a)	Moderate	Stability (Pivot shift test 0)	Hamstring autograft	91	84/91(92%)	Hamstring allograft	95	87/95(92%)	1.008(0.926, 1.097)	NS
Sun et al.	Moderate	Stability	Hamstring	91	7/91(8%)	Hamstring	95	8/95(8%)	0.913(0.345,	NS

Table 91. Results: Autograft Versus Allograft Long Term Follow-up

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
2011 (a)		(Pivot shift test I)	autograft			allograft			2.416)	
Sun et al. 2011 (a)	Moderate	Stability (Pivot shift test II)	Hamstring autograft	91	0/91(0%)	Hamstring allograft	95	0/95(0%)	NA	NS
Sun et al. 2011 (a)	Moderate	Stability (Pivot shift test III)	Hamstring autograft	91	0/91(0%)	Hamstring allograft	95	0/95%)	NA	NS
Sun et al. 2011 (a)	Moderate	Stability (Anterior drawer test 0)	Hamstring autograft	91	77/91(85%)	Hamstring allograft	95	79/95(83%)	1.018(0.897, 1.154)	NS
Sun et al. 2011 (a)	Moderate	Stability (Anterior drawer test I)	Hamstring autograft	91	8/91(9%)	Hamstring allograft	95	9/95(9%)	0.928(0.374, 2.301)	NS
Sun et al. 2011 (a)	Moderate	Stability (Anterior drawer test II)	Hamstring autograft	91	6/91(7%)	Hamstring allograft	95	7/95(7%)	0.895(0.313, 2.562)	NS
Sun et al. 2011 (a)	Moderate	Stability (Anterior drawer test III)	Hamstring autograft	91	0/91(0%)	Hamstring allograft	95	0/95(0%)	NA	NS
Sun et al. 2011 (a)	Moderate	Stability (Lachman test 0)	Hamstring autograft	91	76/91(83%)	Hamstring allograft	95	78(82%)	1.017(0.892, 1.159)	NS
Sun et al. 2011 (a)	Moderate	Stability (Lachman test I)	Hamstring autograft	91	8/91(9%)	Hamstring allograft	95	9/95(9.5%)	0.928(0.374, 2.301)	NS
Sun et al. 2011 (a)	Moderate	Stability (Lachman test II)	Hamstring autograft	91	7/91(8%)	Hamstring allograft	95	8/95(8%)	0.913(0.345, 2.416)	NS
Sun et al. 2011 (a)	Moderate	Stability (Lachman test III)	Hamstring autograft	91	0/91(0%)	Hamstring allograft	95	0/95(0%)	NA	NS

ACL FEMORAL TUNNEL TECHNIQUE

Moderate evidence supports that in patients undergoing intra-articular ACL reconstruction the practitioner could use either a tibial independent approach or transtibial approach for the femoral tunnel, because the measured outcomes are similar.

Strength of Recommendation: Moderate ★★★☆

RATIONALE

There were seven moderate, one low, and one very low strength studies that compared intra-articular ACL reconstruction with use of a tibial independent to a transtibial approach to create the femoral drill hole.[9, 18, 44, 73, 74, 78, 81, 82, 98]

Research on this recommendation did not evaluate the techniques used for ACL reconstructions in skeletally immature patients. The tibial independent approach included both outside-in and medial portal drilling techniques. The studies demonstrate no consistent differences between the two techniques in objective metrics or patient reported outcomes. Meta-analysis of the study demonstrated no difference in IKDC knee exam or Lysholm scores.

POTENTIAL HARMS OF IMPLEMENTATION

As with all surgical techniques, there are potential complications such as malposition of the femoral tunnel or femoral tunnel blowout.

FUTURE RESEARCH

Prospective randomized trials comparing the results of ACL reconstruction with femoral tunnels created using tibial independent and trans-tibial approaches should be performed to evaluate difference in objective metrics including limits of knee motion, and patient reported outcomes.

SUMMARY OF FINDINGS

Table 92. Summary of Findings: Tibial Independent Approach Versus Transtibial

● (green): Favors tibial independent approach

● (red): Favors Transtibial approach for the femoral tunnel

○: Not significant

	Scales/Measures	Alentorn- Geli et al. 2010 *(L)*	Anderson et al. 2001 *(H)*	Brandsson et al. 1999 *(M)*	Harner et al. 1994 *(M)*	Nakame et al. 2011 *(V)*	Noh et al. 2013 *(M)*	O'Neill et al. 1996 *(M)*	Otsuka et al. 2003 *(M)*	Panni et al. 2001 *(M)*	Santori et al. 1996 *(M)*	**Meta-Analysis**
Patient satisfaction		○										NA
Function		○	○		○			○				NA
Pain				○	○							NA
	IKDC subjective											NA
	IKDC Normal	● (green)	○	○	○		○	○		○	○	○
	Lysholm Score	○		○		○	● (green)	○	○		○	○
Failure					○							NA
Activities of daily living			○									NA
Return to play								○		○		NA
	Tegner Activity	○		○			○		○			NA
Stability		● (green)	○	○	○	○	○	○	○	○		NA
Osteoarthritis												NA
Complications				○								NA
Strength			○					○				NA
Range of motion		○			○			○		○		NA

Overall strength of study; High: *(H)*, Moderate: *(M)*, Low: *(L)*, Very low: *(V)*

QUALITY AND APPLICABILITY SUMMARY

Table 93. Quality and Applicability Summary: Tibial Independent Approach Versus Transtibial

Study	Outcome	Graft	Surgical Technique	Duration	Quality	Applicability	Overall Strength of Evidence
Panni et al. 2001	Activity	Patellar tendon	Outside-in vs inside out	6.7 years	Moderate	Moderate	Moderate
Harner et al. 1994	Complications	Bone patellar tendon bone autograft or allograft	Two incision vs. endoscopic	2 years (24-40)	Moderate	Moderate	Moderate
Brandsson et al. 1999	Complications	Bone patellar tendon-bone graft	Outside-in vs inside out	2 years	Moderate	Moderate	Moderate
Harner et al. 1994	Function	Bone patellar tendon bone autograft or allograft	Two incision vs. endoscopic	2 years (24-40)	Low	Moderate	Low
Brandsson et al. 1999	Function (one leg hop)	Bone patellar tendon-bone graft	Outside-in vs inside out	2 years	Moderate	Moderate	Moderate
Alentorn-Geli et al. 2010	IKDC	Bone patellar tendon bone graft	AMP vs. TT	2-5 years	Low	Moderate	Low
Brandsson et al. 1999	IKDC	Bone patellar tendon-bone graft	Outside-in vs inside out	2 years	Moderate	Moderate	Moderate
Harner et al. 1994	IKDC	Bone patellar tendon bone autograft or allograft	Two incision vs. endoscopic	2 years (24-40)	Moderate	Moderate	Moderate
Noh et al. 2011	IKDC	Free Achilles Tendon Allograft	Transtibial vs. Anteromedial portal technique	30.2 (2.8)	High	Moderate	High
Noh et al. 2013	IKDC	Free Achilles Tendon Allograft	Transtibial vs. Anteromedial portal technique	30.2 (2.8)	Moderate	Moderate	Moderate
Panni et al. 2001	IKDC	Patellar tendon	Outside-in vs inside out	6.7 years	Moderate	Moderate	Moderate

Table 93. Quality and Applicability Summary: Tibial Independent Approach Versus Transtibial

Study	Outcome	Graft	Surgical Technique	Duration	Quality	Applicability	Overall Strength of Evidence
Santori et al. 1996	IKDC	Bone patellar tendon bone graft	One or two incision	2 years	Moderate	Moderate	Moderate
Santori et al. 1996	Lysholm II rating scale	Bone patellar tendon bone graft	One or two incision	2 years	Moderate	Moderate	Moderate
Alentorn-Geli et al. 2010	Lysholm score	Bone patellar tendon bone graft	AMP vs. TT	2-5 years	Low	Moderate	Low
Brandsson et al. 1999	Lysholm score	Bone patellar tendon-bone graft	Outside-in vs inside out	2 years	Moderate	Moderate	Moderate
Nakamae et al. 2012	Lysholm score	NR	AMP (Single bundle) vs. TT (Double bundle)	2 years	Very Low	Moderate	Very Low
Noh et al. 2011	Lysholm score	Free Achilles Tendon Allograft	Transtibial vs. Anteromedial portal technique	30.2 (2.8)	High	Moderate	High
Noh et al. 2013	Lysholm score	Free Achilles Tendon Allograft	Transtibial vs. Anteromedial portal technique	30.2 (2.8)	Moderate	Moderate	Moderate
Alentorn-Geli et al. 2010	One leg hop test	Bone patellar tendon bone graft	AMP vs. TT	2-5 years	Low	Moderate	Low
Alentorn-Geli et al. 2010	Range of motion	Bone patellar tendon bone graft	AMP vs. TT	2-5 years	Low	Moderate	Low
Noh et al. 2011	Range of motion	Free Achilles Tendon Allograft	Transtibial vs. Anteromedial portal technique	30.2 (2.8)	Moderate	Moderate	Moderate
Alentorn-Geli et al. 2010	Return to play	Bone patellar tendon bone graft	AMP vs. TT	2-5 years	Very Low	Moderate	Very Low

Table 93. Quality and Applicability Summary: Tibial Independent Approach Versus Transtibial

Study	Outcome	Graft	Surgical Technique	Duration	Quality	Applicability	Overall Strength of Evidence
Harner et al. 1994	Range of motion	Bone patellar tendon bone autograft or allograft	Two incision vs. endoscopic	2 years (24-40)	Moderate	Moderate	Moderate
Alentorn-Geli et al. 2010	Satisfaction (VAS)	Bone patellar tendon bone graft	AMP vs. TT	2-5 years	Low	Moderate	Low
Alentorn-Geli et al. 2010	SF-12	Bone patellar tendon bone graft	AMP vs. TT	2-5 years	Low	Moderate	Low
Alentorn-Geli et al. 2010	Stability	Bone patellar tendon bone graft	AMP vs. TT	2-5 years	Low	Moderate	Low
Brandsson et al. 1999	Stability	Bone patellar tendon-bone graft	Outside-in vs inside out	2 years	Moderate	Moderate	Moderate
Harner et al. 1994	Stability	Bone patellar tendon bone autograft or allograft	Two incision vs. endoscopic	2 years (24-40)	Moderate	Moderate	Moderate
Nakamae et al. 2012	Stability	NR	AMP (Single bundle) vs. TT (Double bundle)	2 years	Very Low	Moderate	Very Low
Noh et al. 2011	Stability	Free Achilles Tendon Allograft	Transtibial vs. Anteromedial portal technique	30.2 (2.8)	High	Moderate	High
Panni et al. 2001	Stability (KT-1000)	Patellar tendon	Outside-in vs inside out	6.7 years	Moderate	Moderate	Moderate
Noh et al. 2013	Stability (Lachman and Pivot shift)	Free Achilles Tendon Allograft	Transtibial vs. Anteromedial portal technique	30.2 (2.8)	Moderate	Moderate	Moderate
Harner et al. 1994	Symptoms	Bone patellar tendon bone autograft or	Two incision vs. endoscopic	2 years (24-40)	Low	Moderate	Low

Table 93. Quality and Applicability Summary: Tibial Independent Approach Versus Transtibial

Study	Outcome	Graft	Surgical Technique	Duration	Quality	Applicability	Overall Strength of Evidence
		allograft					
Noh et al. 2011	Tegner	Free Achilles Tendon Allograft	Transtibial vs. Anteromedial portal technique	30.2 (2.8)	High	Moderate	High
Alentorn-Geli et al. 2010	Tegner activity	Bone patellar tendon bone graft	AMP vs. TT	2-5 years	Low	Moderate	Low
Brandsson et al. 1999	Tegner activity level	Bone patellar tendon-bone graft	Outside-in vs inside out	2 years	Moderate	Moderate	Moderate
Noh et al. 2013	Tegner activity scale	Free Achilles Tendon Allograft	Transtibial vs. Anteromedial portal technique	30.2 (2.8)	Moderate	Moderate	Moderate
O'Neill et al. 1996	IKDC	Patellar ligament/ Semitendinosus-gracilis graft	Endoscopic/ Two-incision	2 years	Moderate	Moderate	Moderate
O'Neill et al. 1996	Range of motion	Patellar ligament/ Semitendinosus-gracilis graft	Endoscopic/ Two-incision	2 years	Moderate	Moderate	Moderate
O'Neill et al. 1996	Strength	Patellar ligament/ Semitendinosus-gracilis graft	Endoscopic/ Two-incision	2 years	Moderate	Moderate	Moderate
O'Neill et al. 1996	Failure	Patellar ligament/ Semitendinosus-gracilis graft	Endoscopic/ Two-incision	2 years	Moderate	Moderate	Moderate
O'Neill et al. 1996	Function (Lysholm)	Patellar ligament/ Semitendinosus-gracilis graft	Endoscopic/ Two-incision	2 years	Moderate	Moderate	Moderate
O'Neill et al. 1996	Stability (KT-2000)	Patellar ligament/ Semitendinosus-	Endoscopic/ Two-incision	2 years	Moderate	Moderate	Moderate

Table 93. Quality and Applicability Summary: Tibial Independent Approach Versus Transtibial

Study	Outcome	Graft	Surgical Technique	Duration	Quality	Applicability	Overall Strength of Evidence
O'Neill et al. 1996	Return to pre-injury level of activity	gracilis graft Patellar ligament/ Semitendinosus-gracilis graft	Endoscopic/ Two-incision	2 years	Moderate	Moderate	Moderate
Otsuka et al. 2003	Stability	Bone-patellar tendon bone graft	Nonanatomic single incision/ Anatomic fixation group with all inside reconstruction	2 years	Moderate	Moderate	Moderate
Otsuka et al. 2003	Lysholm Score	Bone-patellar tendon bone graft	Nonanatomic single incision/ Anatomic fixation group with all inside reconstruction	2 years	Moderate	Moderate	Moderate
Otsuka et al. 2003	Tegner activity score	Bone-patellar tendon bone graft	Nonanatomic single incision/ Anatomic fixation group with all inside reconstruction	2 years	Moderate	Moderate	Moderate
Anderson et al. 2001	IKDC	Patellar tendon graft/ semitendinosus and gracilis	Single incision/Extra-articular procedure lateral incision 3cm and 5cm	2 years	Moderate	Moderate	Moderate
Anderson et al. 2001	Complications	Patellar tendon graft/ semitendinosus and gracilis	Single incision/Extra-articular procedure lateral incision 3cm and 5cm	2 years	Moderate	Moderate	Moderate
Anderson et al. 2001	Activity level	Patellar tendon graft/ semitendinosus and gracilis	Single incision/Extra-articular procedure lateral incision 3cm and 5cm	2 years	Moderate	Moderate	Moderate
Anderson et al. 2001	Hospital for special surgery knee scores	Patellar tendon graft/ semitendinosus and gracilis	Single incision/Extra-articular procedure lateral incision 3cm and 5cm	2 years	Moderate	Moderate	Moderate

Table 94. Quality and Applicability: Surgical Technique

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Panni et al. 2001	Activity	●	○	●	○	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Harner et al. 1994	Complications	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Harner et al. 1994	Function	●	○	●	○	●	○	○	**Low**	●	○	●	○	**Moderate**
Brandsson et al. 1999	Function (one leg hop)	●	○	●	●	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Alentorn-Geli et al. 2010	IKDC	●	○	○	○	○	●	○	**Low**	○	○	●	○	**Moderate**
Brandsson et al. 1999	IKDC	●	○	●	●	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Harner et al. 1994	IKDC	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Noh et al. 2011	IKDC	●	○	●	●	●	●	●	**High**	○	○	●	○	**Moderate**

Table 94. Quality and Applicability: Surgical Technique

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Noh et al. 2013	IKDC	●	○	●	○	●	●	●	**Moderate**	●	○	●	●	**Moderate**
Panni et al. 2001	IKDC	●	○	●	○	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Santori et al. 1996	IKDC	●	○	●	○	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Santori et al. 1996	Lysholm II rating scale	●	○	●	○	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Alentorn-Geli et al. 2010	Lysholm score	●	○	○	○	○	●	○	**Low**	○	○	●	○	**Moderate**
Brandsson et al. 1999	Lysholm score	●	○	●	●	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Nakamae et al. 2012	Lysholm score	○	○	○	○	○	●	○	**Very Low**	○	○	●	○	**Moderate**
Noh et al. 2011	Lysholm score	●	○	●	●	●	●	●	**High**	○	○	●	○	**Moderate**
Noh et al. 2013	Lysholm score	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**

Table 94. Quality and Applicability: Surgical Technique

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Alentorn-Geli et al. 2010	One leg hop test	●	○	○	○	○	●	○	**Low**	○	○	●	○	**Moderate**
Alentorn-Geli et al. 2010	Range of motion	●	○	○	○	○	●	○	**Low**	○	○	●	○	**Moderate**
Harner et al. 1994	Range of motion	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Noh et al. 2011	Range of motion	●	○	●	●	●	○	●	**Moderate**	○	○	●	○	**Moderate**
Alentorn-Geli et al. 2010	Return to play	●	○	○	○	○	○	○	**Very Low**	○	○	●	○	**Moderate**
Alentorn-Geli et al. 2010	Satisfaction (VAS)	●	○	○	○	○	●	○	**Low**	○	○	●	○	**Moderate**
Alentorn-Geli et al. 2010	SF-12	●	○	○	○	○	●	○	**Low**	○	○	●	○	**Moderate**
Alentorn-Geli et al. 2010	Stability	●	○	○	○	○	●	○	**Low**	○	○	●	○	**Moderate**
Brandsson et al. 1999	Stability	●	○	●	●	●	●	○	**Moderate**	●	○	●	●	**Moderate**

Table 94. Quality and Applicability: Surgical Technique

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Harner et al. 1994	Stability	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Nakamae et al. 2012	Stability	○	○	○	○	○	●	○	**Very Low**	○	○	●	○	**Moderate**
Noh et al. 2011	Stability	●	○	●	●	●	●	●	**High**	○	○	●	○	**Moderate**
Panni et al. 2001	Stability (KT-1000)	●	○	●	○	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Noh et al. 2013	Stability (Lachman and Pivot shift)	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Harner et al. 1994	Symptoms	●	○	●	○	●	○	○	**Low**	●	○	●	○	**Moderate**
Noh et al. 2011	Tegner	●	○	●	●	●	●	●	**High**	○	○	●	○	**Moderate**
Alentorn-Geli et al. 2010	Tegner activity	●	○	○	○	○	●	○	**Low**	○	○	●	○	**Moderate**
Brandsson et al. 1999	Tegner activity level	●	○	●	●	●	●	○	**Moderate**	●	○	●	●	**Moderate**

Table 94. Quality and Applicability: Surgical Technique

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Noh et al. 2013	Tegner activity scale	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
O'Neill et al. 1996	IKDC	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
O'Neill et al. 1996	Range of motion	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
O'Neill et al. 1996	Strength	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
O'Neill et al. 1996	Failure	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Otsuka et al. 2003	Stability	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Otsuka et al. 2003	Lysholm Score	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Otsuka et al. 2003	Tegner activity score	●	○	●	○	●	●	●	**Moderate**	●	○	●	○	**Moderate**
Anderson et al. 2001	IKDC	●	○	●	●	●	●	○	**Moderate**	●	○	●	○	**Moderate**

Table 94. Quality and Applicability: Surgical Technique

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Anderson et al. 2001	Complications	●	○	●	●	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Anderson et al. 2001	Activity level	●	○	●	●	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Anderson et al. 2001	Hospital for special surgery knee scores	●	○	●	●	●	○	○	**Moderate**	●	○	●	○	**Moderate**

FINDINGS

Table 95. Results: Anterior Medial Portal Versus Transtibial

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Alentorn-Geli et al. 2010	Low	Vigorous physical activity	AMP	26	10/26(21%)	Transtibial	21	5/21(11%)	1.615(0.653, 3.999)	NS
Alentorn-Geli et al. 2010	Low	Moderate physical activity	AMP	26	9/26(19%)	Transtibial	21	4/21(9%)	1.817(0.65,5 .08)	NS
Alentorn-Geli et al. 2010	Low	Light physical activity	AMP	26	7/26(15%)	Transtibial	21	7/21(15%)	0.808(0.336, 1.939)	NS
Alentorn-Geli et al. 2010	Low	Sedentary physical activity	AMP	26	0/26(0%)	Transtibial	21	5/26(11%)	0.074(0.004, 1.268)	NS
Alentorn-Geli et al. 2010	Low	Competitive playing soccer	AMP	26	14/26(30%)	Transtibial	21	5/21(11%)	2.262(0.973, 5.259)	NS
Alentorn-Geli et al. 2010	Low	Recreationall y playing soccer	AMP	26	2/26(4%)	Transtibial	21	10/21(21%)	0.162(0.04,0 .658)	Favors AMP
Alentorn-Geli et al. 2010	Low	Not playing soccer	AMP	26	10/26(21%)	Transtibial	21	6/21(13%)	1.346(0.585, 3.096)	NS
Alentorn-Geli et al. 2010	Low	Patient satisfaction (VAS)	AMP	26	9.1(1.3)	Transtibial	21	8.6(1.6)	0.5(-0.35,1.35)	NS
Alentorn-Geli et al. 2010	Low	Short Form-12	AMP	26	91.8(8.2)	Transtibial	21	90.1(9.9)	1.7(-3.6,7)	NS
Alentorn-Geli et al. 2010	Low	Lysholm score	AMP	26	99.3(2.3)	Transtibial	21	97.1(7.2)	2.2(-0.8,5.20)	NS
Alentorn-Geli et al. 2010	Low	Tegner activity level	AMP	26	7.8(1.6)	Transtibial	21	7.1(1.3)	0.7(-0.17,1.57)	NS
Alentorn-Geli et al. 2010	Low	Stability (KT-1000 at 134 N (mm))	AMP	26	-0.6(1.3)	Transtibial	21	-0.3(1.2)	-0.3(-1,00.44)	NS
Alentorn-Geli et al. 2010	Low	Stability (KT-1000 manual maximum	AMP	26	0.2(1.6)	Transtibial	21	1.9(1.8)	-1.7(-2.7,-0.7)	Favors TT

Table 95. Results: Anterior Medial Portal Versus Transtibial

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		(mm)								
Alentorn-Geli et al. 2010	Low	One leg hop test (cm)	AMP	26	1.9(6.5)	Transtibial	21	6.6(15.6)	-4.7(-11.47,2.07)	NS
Alentorn-Geli et al. 2010	Low	Range of motion (Flexion)	AMP	26	-0.3(3.9)	Transtibial	21	-0.2(3.2)	-0.1(-2.23,2.03)	NS
Alentorn-Geli et al. 2010	Low	Range of motion (Extension)	AMP	26	0.1(0.3)	Transtibial	21	0.2(1.1)	-0.1(-0.55,0.35)	NS
Alentorn-Geli et al. 2010	Low	IKDC A (Normal)	AMP	26	19/26(40%)	Transtibial	21	7/21(15%)	2.19(1.14,4.19)	Favors AMP
Alentorn-Geli et al. 2010	Low	IKDC B (Nearly normal)	AMP	26	7/26(15%)	Transtibial	21	12/21(25%)	0.47(0.22,0.98)	
Alentorn-Geli et al. 2010	Low	IKDC C (Abnormal)	AMP	26	0/26(0%)	Transtibial	21	2/21(4%)	0.17(0,3.52)	NS
Alentorn-Geli et al. 2010	Low	IKDC D (Severely abnormal)	AMP	26	0/26(0%)	Transtibial	21	0/21(0%)	NA	NS
Alentorn-Geli et al. 2010	Low	Stability (Lachman test (0)	AMP	26	21/26(81%)	Transtibial	21	11/21(52%)	1.54(0.98,2.41)	Favors AMP
Alentorn-Geli et al. 2010	Low	Stability (Lachman test (1+)	AMP	26	5/26(19%)	Transtibial	21	10/21(48%)	0.4(0.16,0.99)	Favors AMP
Alentorn-Geli et al. 2010	Low	Stability (Lachman test (2+)	AMP	26	0/26(0%)	Transtibial	21	0/21(0%)	NA	NS
Alentorn-Geli et al. 2010	Low	Stability (Lachman test (3+)	AMP	26	0/26(0%)	Transtibial	21	0/21(0%)	NA	NS
Alentorn-Geli et al. 2010	Low	Stability (Pivot shift test (0)	AMP	24	19/24(79%)	Transtibial	17	7/17(41%)	1.922(1.05,3.52)	Favors AMP
Alentorn-Geli et al. 2010	Low	Stability (Pivot shift	AMP	24	5/24(21%)	Transtibial	17	8/21(38%)	0.44(0.17,1.12)	

Table 95. Results: Anterior Medial Portal Versus Transtibial

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		test (1+)								
Alentorn-Geli et al. 2010	Low	Stability (Pivot shift test (2+)	AMP	24	0/24(0%)	Transtibial	17	2/21(10%)	0.17(0,3.47)	
Alentorn-Geli et al. 2010	Low	Stability (Pivot shift test (3+)	AMP	24	0/24(0%)	Transtibial	17	0/21(0%)	NA	
Nakamae et al. 2011	Very Low	Lysholm score	AMP	28	97.1(3.5)	Transtibial	22	97.1(3.5)	0(-2,2)	NS
Nakamae et al. 2011	Very Low	Stability (Mean KT-2000 side to side difference (mm))	AMP	28	0.7(1.7)	Transtibial	22	0.9(2)	-0.2(-1.25,0.85)	NS
Nakamae et al. 2011	Very Low	Stability (Pivot shift test (0)	AMP	28	22/28(79%)	Transtibial	22	18/22(81%)	0.96(0.73,1.26)	NS
Nakamae et al. 2011	Very Low	Stability (Pivot shift test (1+)	AMP	28	6/28(21%)	Transtibial	22	3/22(14%)	1.57(0.44,5.59)	NS
Nakamae et al. 2011	Very Low	Stability (Pivot shift test (2+)	AMP	28	0/28(0%)	Transtibial	22	1/22(4%)	0.27(0.01,6.47)	NS
Nakamae et al. 2011	Very Low	Stability (Pivot shift test (3+)	AMP	28	0/28(0%)	Transtibial	22	0/22(0%)	NA	NS

Table 96. Results: Two Incision Versus Transtibial (Endoscopic)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Harner et al. 1994	Moderate	Change in frequency of sports activity (High)	Two incision	24	1/24(4%)	Endoscopic (Transtibial)	25	0/25(0%)	3.12(0.13,73 .0)	NS
Harner et al. 1994	Moderate	Change in frequency of sports activity (Same)	Two incision	24	14/24(58%)	Endoscopic (Transtibial)	25	18/25(69%)	0.81(0.53,1. 23)	NS
Harner et al. 1994	Moderate	Change in frequency of sports activity (Lower)	Two incision	24	9/24(38%)	Endoscopic (Transtibial)	25	7/25(27%)	1.34(0.59.3. 02)	NS
Harner et al. 1994	Moderate	Change in type of sports activity (More stressful)	Two incision	24	1/24(4%)	Endoscopic (Transtibial)	25	2/25(8%)	0.52(0.05,5. 37)	NS
Harner et al. 1994	Moderate	Change in type of sports activity (Same stress)	Two incision	24	15/24(62%)	Endoscopic (Transtibial)	25	13/25(52%)	1.2(0.74,1.9 6)	NS

Table 96. Results: Two Incision Versus Transtibial (Endoscopic)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Harner et al. 1994	Moderate	Change in type of sports activity (Less stressful)	Two incision	24	8/24(33%)	Endoscopic (Transtibial)	25	10/25(40%)	0.83(0.39,1. 75)	NS
Harner et al. 1994	Moderate	Subjective rating (0-100 possibly IKDC)	Two incision	24	88(12)	Endoscopic (Transtibial)	25	90(8)	-2(- 7.83,3.83)	NS
Harner et al. 1994	Low	Functional level (Inability to perform Squatting)	Two incision	24	0/24(0%)	Endoscopic (Transtibial)	26	0/26(0%)	NA	NS
Harner et al. 1994	Low	Functional level (Definite limitations when Squatting)	Two incision	24	0/24(0%)	Endoscopic (Transtibial)	26	4/26(15%)	0.12(0,2.11)	NS
Harner et al. 1994	Low	Functional level (Some limitations when Squatting)	Two incision	24	6/24(25%)	Endoscopic (Transtibial)	26	8/26(31%)	0.81(0.333,2)	NS

Table 96. Results: Two Incision Versus Transtibial (Endoscopic)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Harner et al. 1994	Low	Functional level (No limitation when Squatting)	Two incision	24	18/24(75%)	Endoscopic (Transtibial)	26	14/26(54%)	1.39(0.9,2.13)	NS
Harner et al. 1994	Low	Functional level (Inability to perform Running)	Two incision	24	1/24(4%)	Endoscopic (Transtibial)	26	0/26(0%)	3.24(0.14,75.92)	NS
Harner et al. 1994	Low	Functional level (Definite limitations when Running)	Two incision	24	0/24(0%)	Endoscopic (Transtibial)	26	2/26(23%)	0.21(0.01,4.28)	NS
Harner et al. 1994	Low	Functional level (Some limitations when Running)	Two incision	24	4/24(17%)	Endoscopic (Transtibial)	26	6/26(23%)	0.72(0.23,2.25)	NS
Harner et al. 1994	Low	Functional level (No limitation when Running)	Two incision	24	19/24(79%)	Endoscopic (Transtibial)	26	18/26(69%)	1.14(0.82,1.59)	NS

Table 96. Results: Two Incision Versus Transtibial (Endoscopic)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Harner et al. 1994	Low	Functional level (Inability to perform Jumping)	Two incision	24	1/24(4%)	Endoscopic (Transtibial)	26	0/26(0%)	3.24(0.14,75 .91)	NS
Harner et al. 1994	Low	Functional level (Definite limitations when Jumping)	Two incision	24	0/24(0%)	Endoscopic (Transtibial)	26	3/26(12%)	0.15(0,2.84)	NS
Harner et al. 1994	Low	Functional level (Some limitations when Jumping)	Two incision	24	10/24(42%)	Endoscopic (Transtibial)	26	10/26(38%)	1.08(0.55,2. 13)	NS
Harner et al. 1994	Low	Functional level (No limitation when Jumping)	Two incision	24	13/24(54%)	Endoscopic (Transtibial)	26	13/26(50%)	1.08(0.63,1. 84)	NS
Harner et al. 1994	Low	Functional level (Inability to perform Cutting/Pivoti ng)	Two incision	24	1/24(4%)	Endoscopic (Transtibial)	26	0/26(0%)	3.24(0.14,75 .92)	NS

Table 96. Results: Two Incision Versus Transtibial (Endoscopic)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Harner et al. 1994	Low	Functional level (Definite limitations when Cutting/Pivoting)	Two incision	24	1/24(4%)	Endoscopic (Transtibial)	26	3/26(12%)	0.36(0.04,3.24)	NS
Harner et al. 1994	Low	Functional level (Some limitations when Cutting/Pivoting)	Two incision	24	12/24(50%)	Endoscopic (Transtibial)	26	11/26(42%)	1.18(0.65,2.15)	NS
Harner et al. 1994	Low	Functional level (No limitation when Cutting/Pivoting)	Two incision	24	10/42(42%)	Endoscopic (Transtibial)	26	12/26(46%)	0.9(0.48,1.69)	NS
Harner et al. 1994	Moderate	Range of motion (Positive extension in degrees ≤2)	Two incision	24	16/24(67%)	Endoscopic (Transtibial)	26	20/26(77%)	0.86(0.6,1.23)	NS
Harner et al. 1994	Moderate	Range of motion (Positive extension in degrees 3-5)	Two incision	24	7/24(29%)	Endoscopic (Transtibial)	26	6/26(23%)	1.26(0.49,3.23)	NS

Table 96. Results: Two Incision Versus Transtibial (Endoscopic)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Harner et al. 1994	Moderate	Range of motion (Positive extension in degrees 6-10)	Two incision	24	1/24(4%)	Endoscopic (Transtibial)	26	0/26(0%)	3.24(0.14,75 .92)	NS
Harner et al. 1994	Moderate	Range of motion (Positive extension in degrees >10)	Two incision	24	0/24(0%)	Endoscopic (Transtibial)	26	0/26(0%)	NA	NS
Harner et al. 1994	Moderate	Range of motion (Positive flexion in degrees ≤5)	Two incision	21	20/21(95%)	Endoscopic (Transtibial)	26	18/26(69%)	1.37(1.04,1. 8)	NS
Harner et al. 1994	Moderate	Range of motion (Positive flexion in degrees 6-15)	Two incision	21	1/21(1%)	Endoscopic (Transtibial)	26	7/26(27%)	0.18(0.02,1. 33)	NS
Harner et al. 1994	Moderate	Range of motion (Positive extension in degrees 16-25)	Two incision	21	0/21(0%)	Endoscopic (Transtibial)	26	1/26(4%)	0.4(0.01.9.5 5)	NS

Table 96. Results: Two Incision Versus Transtibial (Endoscopic)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Harner et al. 1994	Moderate	Range of motion (Positive extension in degrees >25	Two incision	21	0/21(0%)	Endoscopic (Transtibial)	26	0/26(0%)	NA	NS
Harner et al. 1994	Moderate	Pain (Light activity)	Two incision	24	0/24(0%)	Endoscopic (Transtibial)	26	0/26(0%)	NA	NS
Harner et al. 1994	Moderate	Pain (Moderate activity)	Two incision	24	3/24(11%)	Endoscopic (Transtibial)	26	4/26(15%)	0.81(0.2,3.2 6)	NS
Harner et al. 1994	Moderate	Pain (Strenuous activity)	Two incision	24	8/24(35%)	Endoscopic (Transtibial)	26	7/26(27%)	1.24(0.53,2. 89)	NS
Harner et al. 1994	Moderate	Pain (No symptoms)	Two incision	24	13/24(54%)	Endoscopic (Transtibial)	26	15/26(58%)	0.94(0.57,1. 54)	NS
Harner et al. 1994	Moderate	Swelling (Light activity)	Two incision	24	0/24(0%)	Endoscopic (Transtibial)	26	0/26(0%)	NA	NS
Harner et al. 1994	Moderate	Swelling (Moderate activity)	Two incision	24	1/24(4%)	Endoscopic (Transtibial)	26	1/26(4%)	1.08(0.07,16 .38)	NS
Harner et al. 1994	Moderate	Swelling (Strenuous activity)	Two incision	24	4/24(20%)	Endoscopic (Transtibial)	26	4/26(15%)	1.08(0.3,3.8 6)	NS

Table 96. Results: Two Incision Versus Transtibial (Endoscopic)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Harner et al. 1994	Moderate	Swelling (No symptoms)	Two incision	24	19/24(79%)	Endoscopic (Transtibial)	26	21/26(81%)	0.98(0.74,1.29)	NS
Harner et al. 1994	Moderate	Partial giving way (Light activity)	Two incision	24	1/24(4%)	Endoscopic (Transtibial)	26	0/26(0%)	3.24(0.14,75.91)	NS
Harner et al. 1994	Moderate	Partial giving way (Moderate activity)	Two incision	24	0/24(0%)	Endoscopic (Transtibial)	26	1/26(4%)	0.36(0.02,8.43)	NS
Harner et al. 1994	Moderate	Partial giving way (Strenuous activity)	Two incision	24	4/24(20%)	Endoscopic (Transtibial)	26	5/26(19%)	0.87(0.26,2.85)	NS
Harner et al. 1994	Moderate	Partial giving way (No symptoms)	Two incision	24	19/24(79%)	Endoscopic (Transtibial)	26	20/26(77%)	1.03(0.77,1.38)	NS
Harner et al. 1994	Moderate	Stability (KT-1000 Mean I-N(mm) KT 30)	Two incision	24	1.8(2.8)	Endoscopic (Transtibial)	26	1.4(2.2)	0.4(-1.02,1.82)	NS

Table 96. Results: Two Incision Versus Transtibial (Endoscopic)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Harner et al. 1994	Moderate	Stability (KT-1000 Mean I-N(mm) KT Max)	Two incision	24	1.8(2.8)	Endoscopic (Transtibial)	26	1.6(2)	0.2(-1.17,1.57)	NS
Harner et al. 1994	Moderate	Stability (KT-1000 Mean I-N(mm) KT Active)	Two incision	24	1.8(3.4)	Endoscopic (Transtibial)	26	1.5(2)	0.3(-1.27,1.87)	NS
Harner et al. 1994	Moderate	Stability (KT-1000 Frequency KT 30 <3)	Two incision	24	13/24(54%)	Endoscopic (Transtibial)	26	18/26(69%)	0.78(0.5,1.23)	NS
Harner et al. 1994	Moderate	Stability (KT-1000 Frequency KT 3-5)	Two incision	24	9/24(37%)	Endoscopic (Transtibial)	26	7/26(27%)	1.39(0.62,3.15)	NS
Harner et al. 1994	Moderate	Stability (KT-1000 Frequency KT >5)	Two incision	24	2/24(8%)	Endoscopic (Transtibial)	26	1/26(4%)	2.17(0.21,22.39)	NS
Harner et al. 1994	Moderate	Stability (KT-1000 Frequency KT max <3)	Two incision	24	15/24(63%)	Endoscopic (Transtibial)	26	16/26(62%)	1.02(0.66,1.57)	NS

Table 96. Results: Two Incision Versus Transtibial (Endoscopic)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Harner et al. 1994	Moderate	Stability (KT-1000 Frequency max 3-5)	Two incision	24	8/24(33%)	Endoscopic (Transtibial)	26	9/26(35%)	0.96(0.44,2.09)	NS
Harner et al. 1994	Moderate	Stability (KT-1000 Frequency KT max >5)	Two incision	24	1/24(4%)	Endoscopic (Transtibial)	26	1/26(3%)	1.08(0.07,16.38)	NS
Harner et al. 1994	Moderate	Stability (Lachman Normal)	Two incision	24	18/24(75%)	Endoscopic (Transtibial)	26	18/26(69%)	1.08(0.77,1.53)	NS
Harner et al. 1994	Moderate	Stability (Lachman Nearly normal)	Two incision	24	5/24(21%)	Endoscopic (Transtibial)	26	7/26(26%)	0.77(0.28,2.11)	NS
Harner et al. 1994	Moderate	Stability (Lachman Abnormal)	Two incision	24	1/24(4%)	Endoscopic (Transtibial)	26	1/26(4%)	1.08(0.07,16.38)	NS
Harner et al. 1994	Moderate	Stability (Anterior drawer Normal)	Two incision	24	17/24(71%)	Endoscopic (Transtibial)	26	21/26(81%)	0.88(0.64,1.21)	NS
Harner et al. 1994	Moderate	Stability (Anterior drawer Nearly normal)	Two incision	24	6/24(25%)	Endoscopic (Transtibial)	26	5/26(19%)	1.3(0.46,3.71)	NS

Table 96. Results: Two Incision Versus Transtibial (Endoscopic)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Harner et al. 1994	Moderate	Stability (Anterior drawer Abnormal)	Two incision	24	1/24(4%)	Endoscopic (Transtibial)	26	0/26(0%)	3.24(0.14,75 .91)	NS
Harner et al. 1994	Moderate	Stability (Pivot shift Glide 2+)	Two incision	24	5/24(21%)	Endoscopic (Transtibial)	26	5/26(19%)	1.08(0.36,3. 28)	NS
Harner et al. 1994	Moderate	Stability (Pivot shift Negative)	Two incision	24	19/24(79%)	Endoscopic (Transtibial)	26	21/26(81%)	0.98(0.74,1. 29)	NS
Harner et al. 1994	Moderate	Functional (Vertical jump normal ≥90)	Two incision	24	18/24(75%)	Endoscopic (Transtibial)	26	18/26(69%)	1.08(0.77,1. 53)	NS
Harner et al. 1994	Moderate	Functional (Vertical jump abnormal <90)	Two incision	24	6/24(25%)	Endoscopic (Transtibial)	26	8/26(31%)	0.81(0.33,2)	NS
Harner et al. 1994	Moderate	Functional (Hop test normal ≥90)	Two incision	24	18/24(75%)	Endoscopic (Transtibial)	26	24/26(92%)	0.81(0.63,1. 05)	NS
Harner et al. 1994	Moderate	Functional (Hop test abnormal <90)	Two incision	24	6/24(25%)	Endoscopic (Transtibial)	26	2/26(8%)	3.25(0.72,14 .58)	NS

Table 96. Results: Two Incision Versus Transtibial (Endoscopic)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Harner et al. 1994	Moderate	IKDC Overall final score (A Normal)	Two incision	24	4/24(17%)	Endoscopic (Transtibial)	26	3/26(12%)	1.44(0.36,5.8)	NS
Harner et al. 1994	Moderate	IKDC Overall final score (B Nearly normal)	Two incision	24	10/24(42%)	Endoscopic (Transtibial)	26	18/26(69%)	0.6(0.35,1.03)	NS
Harner et al. 1994	Moderate	IKDC Overall final score (C Abnormal)	Two incision	24	9/24(37%)	Endoscopic (Transtibial)	26	5/26(19%)	1.95(0.76,5)	NS
Harner et al. 1994	Moderate	IKDC Overall final score (D Severely abnormal)	Two incision	24	1/24(4%)	Endoscopic (Transtibial)	26	0/26(0%)	3.24(0.14,75.91)	NS
Harner et al. 1994	Moderate	Complications (loss of motion)	Two incision	24	2/24(8%)	Endoscopic (Transtibial)	26	3/26(0%)	0.72(0.13,3.96)	NS
Harner et al. 1994	Moderate	Failure	Two incision	24	1/24(4%)	Endoscopic (Transtibial)	26	0/26(0%)	3.24(0.14,75.91)	NS

Table 97. Results: Two Incision Versus Transtibial (Single Incision)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
O'Neill et al. 1996	Moderate	Return to pre-injury level of activity	Patellar ligament (single-incision)	45	NR	Patellar ligament (two-incision)	40	NR	NA	NS
O'Neill et al. 1996	Moderate	KT-2000 arthrometer stability with side to side difference on instrumented testing of laxity (0mm)	Patellar ligament (single-incision)	45	25/45 (55%)	Patellar ligament (two-incision)	40	22/40 (55%)	1.01(0.69,1.48)	NS
O'Neill et al. 1996	Moderate	KT-2000 arthrometer stability with side to side difference on instrumented testing of laxity (>0≤2 mm)	Patellar ligament (single-incision)	45	10/45 (22%)	Patellar ligament (two-incision)	40	9/40 (22%)	0.99(0.45,2.18)	NS
O'Neill et al. 1996	Moderate	KT-2000 arthrometer stability with side to side difference on instrumented	Patellar ligament (single-incision)	45	4/45 (9%)	Patellar ligament (two-incision)	40	6/40 (15%)	0.59(0.18,1.95)	NS

Table 97. Results: Two Incision Versus Transtibial (Single Incision)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		testing of laxity (>2≤3 mm)								
O'Neill et al. 1996	Moderate	KT-2000 arthrometer stability with side to side difference on instrumented testing of laxity (>3≤5 mm)	Patellar ligament (single-incision)	45	5/45 (11%)	Patellar ligament (two-incision)	40	1/40 (2%)	4.44(0.54,36 .45)	NS
O'Neill et al. 1996	Moderate	KT-2000 arthrometer stability with side to side difference on instrumented testing of laxity (>5 mm)	Patellar ligament (single-incision)	45	1/45 (22%)	Patellar ligament (two-incision)	40	2/40 (5%)	0.44(0.04,4. 72)	NS
O'Neill et al. 1996	Moderate	KT-2000 arthrometer stability with side to side difference on instrumented testing of laxity (0mm)	Patellar ligament (single-incision)	45	25/45 (55%)	Patellar ligament (two-incision)	40	22/40 (55%)	1.01(0.69,1. 48)	NS

Table 97. Results: Two Incision Versus Transtibial (Single Incision)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
O'Neill et al. 1996	Moderate	KT-2000 arthrometer stability with side to side difference on instrumented testing of laxity (>0≤2 mm)	Patellar ligament (single-incision)	45	10/45 (22%)	Patellar ligament (two-incision)	40	9/40 (22%)	0.99(0.45,2. 18)	NS
O'Neill et al. 1996	Moderate	KT-2000 arthrometer stability with side to side difference on instrumented testing of laxity (>2≤3 mm)	Patellar ligament (single-incision)	45	4/45 (95)	Patellar ligament (two-incision)	40	6/40 (15%)	0.59(0.18,1. 95)	NS
O'Neill et al. 1996	Moderate	KT-2000 arthrometer stability with side to side difference on instrumented testing of laxity (>3≤5 mm)	Patellar ligament (single-incision)	45	5/45 (11%)	Patellar ligament (two-incision)	40	1/40 (2%)	4.44(0.54,36 .45)	NS

Table 97. Results: Two Incision Versus Transtibial (Single Incision)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
O'Neill et al. 1996	Moderate	KT-2000 arthrometer stability with side to side difference on instrumented testing of laxity (>5 mm)	Patellar ligament (single-incision)	45	1/45 (2%)	Patellar ligament (two-incision)	40	2/40 (5%)	0.44(0.04,4.72)	NS
O'Neill et al. 1996	Moderate	Range of motion terminal flexion loss of 11 degrees	Patellar ligament (single-incision)	45	2/45 (4%)	Patellar ligament (two-incision)	40	2/40 (5%)	0.89(0.13,6.02)	NS
O'Neill et al. 1996	Moderate	Strength (Quadriceps) deficits on isokinetic testing ≥10	Patellar ligament (single-incision)	45	18/45 (40%)	Patellar ligament (two-incision)	40	11/40 (27%)	1.45(0.78,2.7)	NS
O'Neill et al. 1996	Moderate	Strength (Quadriceps) deficits on isokinetic testing ≥20	Patellar ligament (single-incision)	45	5/45 (11%)	Patellar ligament (two-incision)	40	0/40 (0%)	9.8(0.56,171.94)	NS
O'Neill et al. 1996	Moderate	Strength (Hamstring) deficits on isokinetic testing ≥10	Patellar ligament (single-incision)	45	0/45 (0%)	Patellar ligament (two-incision)	40	5/40 (12%)	0.08(0,1.42)	NS

Table 97. Results: Two Incision Versus Transtibial (Single Incision)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
O'Neill et al. 1996	Moderate	Strength (Hamstring) deficits on isokinetic testing ≥20	Patellar ligament (single-incision)	45	0/45 (0%)	Patellar ligament (two-incision)	40	0/40 (0%)	0(0,0)	NS
Santori et al. 1996	Moderate	Lysholm II score	One incision	37	94.65	Two incision	24	96.81	NA	NS
Santori et al. 1996	Moderate	IKDC Overall A (Normal)	One incision	37	0/37(0%)	Two incision	24	2/24(7%)	0.13(0.01,2.63)	NS
Santori et al. 1996	Moderate	IKDC Overall B (Nearly normal)	One incision	37	22/37(0%)	Two incision	24	14/24(59%)	1.02(0.66,1.57)	NS
Santori et al. 1996	Moderate	IKDC Overall C (Abnormal)	One incision	37	10/37(27%)	Two incision	24	7/24(27%)	0.93(0.41,2.1)	NS
Santori et al. 1996	Moderate	IKDC Overall D (Severely abnormal)	One incision	37	5/37(13%)	Two incision	24	2/24(7%)	1.62(0.34,7.7)	NS

Table 98. Results: Outside In Versus Transtibial (All-Inside)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Brandsson et al. 1999	Moderate	Lysholm score	Outside in	30	91(9)	All inside	29	90(15)	1(-5.42,7.42)	NS
Brandsson et al. 1999	Moderate	Tegner activity level	Outside in	30	5.7(2)	All inside	29	4.9(2.3)	0.8(-0.32,1.92)	NS
Brandsson et al. 1999	Moderate	One leg hop quotient between the operated and non-operated leg (%)	Outside in	30	95(5)	All inside	29	95(9)	0(-3.77,3.77)	NS
Brandsson et al. 1999	Moderate	Stability (KT 1000 value at 89 N)	Outside in	30	0.5(1.3)	All inside	29	0.8(2.1)	-0.3(-1.2,0.6)	NS
Brandsson et al. 1999	Moderate	Patellofemoral pain score	Outside in	30	18(5)	All inside	29	18(4)	0(-2.36,2.36)	NS
Brandsson et al. 1999	Moderate	IKDC A	Outside in	30	12/30(40%)	All inside	29	10/29(34%)	1.16(0.59,2.26)	NS
Brandsson et al. 1999	Moderate	IKDC B	Outside in	30	16/30(53%)	All inside	29	15/29(52%)	1.03(0.63,1.67)	NS
Brandsson et al. 1999	Moderate	IKDC C	Outside in	30	2/30(7%)	All inside	29	4/29(14%)	0.48(0.09,2.44)	NS
Brandsson et al. 1999	Moderate	IKDC D	Outside in	30	0/30(0%)	All inside	29	0/29(0%)	NA	NS

Table 98. Results: Outside In Versus Transtibial (All-Inside)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Brandsson et al. 1999	Moderate	Complications (postoperative peroneal nerve palsy)	Outside in	30	1/30(3%)	All inside	29	0/29(0%)	2.9(0.12,68.5)	NS
Brandsson et al. 1999	Moderate	Complications (superficial infection)	Outside in	30	1/30(3%)	All inside	29	1/29(3%)	0.96(0.06,14.74)	NS
Brandsson et al. 1999	Moderate	Complications (postoperative hemarthrosis)	Outside in	30	3/30(10%)	All inside	29	1/29(3%)	2.9(0.32,26.3)	NS
Brandsson et al. 1999	Moderate	Complications (minor loss of extension 5-10)	Outside in	30	1/30(3%)	All inside	29	4/29(14%)	0.24(0.03,2.03)	NS
Brandsson et al. 1999	Moderate	Complications (significant loss of flexion 15)	Outside in	30	0/30(0%)	All inside	29	1/29(3%)	0.3(0.01,7.87)	NS
Brandsson et al. 1999	Moderate	Reoperation for cartilage or meniscal injuries	Outside in	30	2/30(7%)	All inside	29	4/29(14%)	0.48(0.09,2.44)	NS
Otsuka et al. 2003	Moderate	Lysholm scores	Single incision	20	97(2.6)	All inside	20	97.3(2.6)	-0.3(-1.87,1.27)	NS
Otsuka et al. 2003	Moderate	Tegner activity score	Single incision	20	5(2.3)	All inside	20	4.8(1.9)	0.2(-1.15,1.55)	NS

Table 98. Results: Outside In Versus Transtibial (All-Inside)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Otsuka et al. 2003	Moderate	Stability (Anterior knee laxity)	Single incision	20	1.9(1)	All inside	20	1.8(1.5)	0.1(-0.71,0.91)	NS

Table 99. Results: Outside In Versus Transtibial (Inside Out)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Panni et al. 2001	Moderate	Subjective IKDC (Normal)	Outside in	63	21/63(33%)	Inside out	78	28/78(36%)	0.93(0.59,1.47)	NS
Panni et al. 2001	Moderate	Subjective IKDC (Nearly normal)	Outside in	63	27/63(43%)	Inside out	78	34/78(43%)	0.98(0.67,1.44)	NS
Panni et al. 2001	Moderate	Subjective IKDC (Abnormal)	Outside in	63	12/63(33%)	Inside out	78	16/78(20%)	0.93(0.47,1.82)	NS
Panni et al. 2001	Moderate	Subjective IKDC (Severely abnormal)	Outside in	63	3/63(5%)	Inside out	78	0/78(0%)	8.64(0.45,164.23)	NS
Panni et al. 2001	Moderate	Symptoms IKDC (Normal)	Outside in	63	24/63(38%)	Inside out	78	30/78(38%)	0.99(0.65,1.51)	NS

Table 99. Results: Outside In Versus Transtibial (Inside Out)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Panni et al. 2001	Moderate	Symptoms IKDC (Nearly normal)	Outside in	63	30/63(48%)	Inside out	78	34/78(44%)	1.09(0.76,1.57)	NS
Panni et al. 2001	Moderate	Symptoms IKDC (Abnormal)	Outside in	63	9/63(14%)	Inside out	78	14/78(18%)	0.8(0.37,1.72)	NS
Panni et al. 2001	Moderate	Symptoms IKDC (Severely abnormal)	Outside in	63	0/63(5%)	Inside out	78	0/78(0%)	NA	NS
Panni et al. 2001	Moderate	Range of motion IKDC (Normal)	Outside in	63	54/63(86%)	Inside out	78	70/78(90%)	0.96(0.84,1.08)	NS
Panni et al. 2001	Moderate	Range of motion IKDC (Nearly normal)	Outside in	63	3/63(5%)	Inside out	78	4/78(5%)	0.93(0.22,4)	NS
Panni et al. 2001	Moderate	Range of motion IKDC (Abnormal)	Outside in	63	6/63(10%)	Inside out	78	4/78(5%)	1.86(0.55,6.3)	NS
Panni et al. 2001	Moderate	Range of motion IKDC (Severely abnormal)	Outside in	63	0/63(5%)	Inside out	78	0/78(0%)	NA	NS

Table 99. Results: Outside In Versus Transtibial (Inside Out)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Panni et al. 2001	Moderate	Ligaments IKDC (Normal)	Outside in	63	21/63(33%)	Inside out	78	30/78(38%)	0.87(0.55,1.36)	NS
Panni et al. 2001	Moderate	Ligaments IKDC (Nearly normal)	Outside in	63	30/63(48%)	Inside out	78	37/78(47%)	1(0.71,1.42)	NS
Panni et al. 2001	Moderate	Ligaments IKDC (Abnormal)	Outside in	63	12/63(19%)	Inside out	78	11/78(14%)	1.35(0.64,2.85)	NS
Panni et al. 2001	Moderate	Ligaments IKDC (Severely abnormal)	Outside in	63	0/63(0%)	Inside out	78	0/78(0%)	NA	NS
Panni et al. 2001	Moderate	Overall IKDC (Normal)	Outside in	63	12/63(19%)	Inside out	78	18/78(23%)	0.83(0.43,1.58)	NS
Panni et al. 2001	Moderate	Overall IKDC (Nearly normal)	Outside in	63	36/63(57%)	Inside out	78	43/78(55%)	1.04(0.77,1.39)	NS
Panni et al. 2001	Moderate	Overall IKDC (Abnormal)	Outside in	63	12/63(19%)	Inside out	78	17/78(22%)	0.87(0.45,1.69)	NS
Panni et al. 2001	Moderate	Overall IKDC (Severely abnormal)	Outside in	63	3/63(5%)	Inside out	78	0/78(0%)	8.64(0.45,164.23)	NS

Table 99. Results: Outside In Versus Transtibial (Inside Out)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Panni et al. 2001	Moderate	Activity level I (Jumping, pivoting, hard cutting, football soccer)	Outside in	63	26/63(41%)	Inside out	78	24/78(31%)	1.34(0.86,2.09)	NS
Panni et al. 2001	Moderate	Activity level II (Heavy manual work, skiing, tennis)	Outside in	63	16/63(25%)	Inside out	78	26/78(33%)	0.76(0.45,1.29)	NS
Panni et al. 2001	Moderate	Activity level III (light manual work, jogging running)	Outside in	63	15/63(24%)	Inside out	78	24/78(31%)	0.77(0.45,1.35)	NS
Panni et al. 2001	Moderate	Activity level IV (Sedentary work, activities of daily living)	Outside in	63	6/63(9%)	Inside out	78	4/78(5%)	1.86(0.55,6.3)	NS
Panni et al. 2001	Moderate	Stability (KT 1000 mean side to side differences MM 15lb)	Outside in	63	2.5(1.2)	Inside out	78	2.6(1.8)	-0.1(0.61,0.41)	NS

Table 99. Results: Outside In Versus Transtibial (Inside Out)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Panni et al. 2001	Moderate	Stability (KT 1000 mean side to side differences MM 20lb)	Outside in	63	2.7(1.5)	Inside out	78	2.7(1.9)	0(-0.57,0.57)	NS
Panni et al. 2001	Moderate	Stability (KT 1000 mean side to side differences MM maximum manual traction)	Outside in	63	3.1(2.0)	Inside out	78	2.9(1.8)	0.2(-0.41,0.81)	NS

Table 100. Results: Anteromedial Portal Versus Transtibial (Achilles Tendon Allograft)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Noh et al. 2013	Moderate	Lachman test: Negative	Transtibial technique	30	17/30 (57%)	Anteromedial portal technique	31	25/31 (81%)	0.70(0.49,1.00)	Favors Anteromedial Portal Technique
Noh et al. 2013	Moderate	Lachman test: 1+	Transtibial technique	30	9/30 (30%)	Anteromedial portal technique	31	5/31 (16%)	1.86(0.70,4.91)	NS
Noh et al. 2013	Moderate	Lachman test: 2+	Transtibial technique	30	4/30(13%)	Anteromedial portal technique	31	1/31 (3%)	4.13(0.49,34.8 9)	NS
Noh et al. 2013	Moderate	Lachman test: 3+	Transtibial technique	30	0/30 (0%)	Anteromedial portal technique	31	0/31 (0%)	1.0(0.94,1.06)	NS
Noh et al. 2013	Moderate	Pivot-shift test: Negative	Transtibial technique	30	20/30 (67%)	Anteromedial portal technique	31	27/31 (87%)	0.77(0.57,1.02)	NS
Noh et al. 2013	Moderate	Pivot-shift test: 1+	Transtibial technique	30	8/30 (27%)	Anteromedial portal technique	31	4/31 (13%)	2.07(0.69,6.15)	NS
Noh et al. 2013	Moderate	Pivot-shift test: 2+	Transtibial technique	30	2/30 (7%)	Anteromedial portal technique	31	0/31 (0%)	0.93(0.83,1.05)	NS
Noh et al. 2013	Moderate	Pivot-shift test: 3+	Transtibial technique	30	0/30 (0%)	Anteromedial portal technique	31	0/31 (0%)	1.0(0.94,1.06)	NS

Table 100. Results: Anteromedial Portal Versus Transtibial (Achilles Tendon Allograft)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Noh et al. 2013	Moderate	IKDC Score: A	Transtibial technique	30	16/30 (53%)	Anteromedial portal technique	31	21/31 (68%)	0.79(0.52,1.19)	NS
Noh et al. 2013	Moderate	IKDC Score: B	Transtibial technique	30	10/30 (33%)	Anteromedial portal technique	31	9/31 (29%)	1.15(0.54,2.43)	NS
Noh et al. 2013	Moderate	IKDC Score: C	Transtibial technique	30	4/30 (13%)	Anteromedial portal technique	31	1/31 (3%)	4.13(0.49,34.8 9)	NS
Noh et al. 2013	Moderate	IKDC Score: D	Transtibial technique	30	0/30 (0%)	Anteromedial portal technique	31	0/31 (0%)	1.0(0.94,1.06)	NS
Noh et al. 2013	Moderate	Lysholm score, median (range)	Transtibial technique	30	92 (80-100)	Anteromedial portal technique	31	95 (88-100)	-3(-5.10,-0.90)	Favors Anteromedial Portal Technique
Noh et al. 2013	Moderate	Tegner Activity Level: Comparison between level at last follow-up and level before injury, to same or higher level	Transtibial technique	30	11/30 (37%)	Anteromedial portal technique	31	16/31 (52%)	0.71(0.40,1.27)	NS

Table 100. Results: Anteromedial Portal Versus Transtibial (Achilles Tendon Allograft)

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Noh et al. 2013	Moderate	Tegner Activity Level: Comparison between level at last follow-up and level before injury, to one level lower	Transtibial technique	30	13/30 (43%)	Anteromedial portal technique	31	11/31 (36%)	1.22(0.65,2.29)	NS
Noh et al. 2013	Moderate	Tegner Activity Level: Comparison between level at last follow-up and level before injury, to 2 or more levels lower	Transtibial technique	30	6/30 (20%)	Anteromedial portal technique	31	4/31 (13%)	1.55(0.49,4.95)	NS
Noh et al. 2013	Moderate	Side-to-side difference: < 3 mm	Transtibial technique	30	20/30 (67%)	Anteromedial portal technique	31	25/31 (81%)	0.83(0.61,1.12)	NS
Noh et al. 2013	Moderate	Side-to-side difference: 3-5 mm	Transtibial technique	30	6/30 (20%)	Anteromedial portal technique	31	5/31 (16%)	1.24(0.42,3.63)	NS
Noh et al. 2013	Moderate	Side-to-side difference: > 5 mm	Transtibial technique	30	4/30 (13%)	Anteromedial portal technique	31	1/31 (3%)	4.13(0.49,34.89)	NS

Table 101. Results: Single Incision Versus Extra-Articular Lateral Incision 3cm and 5cm

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Anderson et al. 2001	High	Patellofemoral crepitation 0	Semitendinosus and gracilis tendon graft extra-articular procedure	34	23/34 (68%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	30/33 (91%)	0.74(0.57,0.96)	NS
Anderson et al. 2001	High	Patellofemoral crepitation 1+	Semitendinosus and gracilis tendon graft extra-articular procedure	34	9/34 (26%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	3/30 (10%)	2.65(0.79,8.88)	NS
Anderson et al. 2001	High	Patellofemoral crepitation 2+	Semitendinosus and gracilis tendon graft extra-articular procedure	34	2/34 (6%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	0/30 (0%)	4.43(0.22,88.74)	NS
Anderson et al. 2001	High	Patellofemoral crepitation 3+	Semitendinosus and gracilis tendon graft extra-articular procedure	34	0/34 (0%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	0/30 (0%)	NA	NS
Anderson et al. 2001	High	Strength (Quadriceps muscle strength 60deg/sec (mean and range: % of normal side))	Semitendinosus and gracilis tendon graft extra-articular procedure	34	83(70-103)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	96(76-116)	NA	NS

Table 101. Results: Single Incision Versus Extra-Articular Lateral Incision 3cm and 5cm

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Anderson et al. 2001	High	Strength (Quadriceps muscle strength 180 deg/sec (mean and range: % of normal side))	Semitendinosus and gracilis tendon graft extra-articular procedure	34	87(60-118)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	99(69-123)	NA	NS
Anderson et al. 2001	High	Strength (Hamstring muscle strength 60deg/sec (mean and range: % of normal side))	Semitendinosus and gracilis tendon graft extra-articular procedure	34	94(60-125)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	96(69-123)	NA	NS
Anderson et al. 2001	High	Strength (Hamstring muscle strength 180 deg/sec (mean and range: % of normal side))	Semitendinosus and gracilis tendon graft extra-articular procedure	34	94(70-131)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	94(63-133)	NA	NS
Anderson et al. 2001	High	Stability Objective (mm)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	2.6(2.2)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	3.1(2.3)	-0.5(-1.59,0.59)	NS
Anderson et al. 2001	High	Stability No. of patients with <3mm side to side difference	Semitendinosus and gracilis tendon graft extra-articular procedure	34	21/34 (62%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	17/34 (50%)	1.2(0.78,1.83)	NS

Table 101. Results: Single Incision Versus Extra-Articular Lateral Incision 3cm and 5cm

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Anderson et al. 2001	High	Stability pivot shift 0	Semitendinosus and gracilis tendon graft extra-articular procedure	34	23/34 (67%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	20/34 (59%)	1.12(0.78,1.6)	NS
Anderson et al. 2001	High	Stability pivot shift 1+	Semitendinosus and gracilis tendon graft extra-articular procedure	34	4/34 (12%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	5/34 (15%)	0.78(0.23,2.64)	NS
Anderson et al. 2001	High	Stability pivot shift 2+	Semitendinosus and gracilis tendon graft extra-articular procedure	34	5/34 (15%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	4/34 (12%)	1.21(0.36,4.13)	NS
Anderson et al. 2001	High	Stability pivot shift 3+	Semitendinosus and gracilis tendon graft extra-articular procedure	34	2/34 (6%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	4/34 (12%)	0.49(0.1,2.47)	NS
Anderson et al. 2001	High	Hospital for special knee scores subjective scores	Semitendinosus and gracilis tendon graft extra-articular procedure	34	15.1(4.8)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	14.0(3.9)	1.1(-1.04,3.24)	NS

Table 101. Results: Single Incision Versus Extra-Articular Lateral Incision 3cm and 5cm

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Anderson et al. 2001	High	Function (Hospital for special knee scores)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	17.5(3.8)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	18.8(1.8)	-1.3(-2.76,0.16)	NS
Anderson et al. 2001	High	Hospital for special knee scores objective scores	Semitendinosus and gracilis tendon graft extra-articular procedure	34	44.3(7)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	48.4(12.2)	-4.1(-8.93,0.73)	NS
Anderson et al. 2001	High	Hospital for special knee scores objective scores	Semitendinosus and gracilis tendon graft extra-articular procedure	34	75.8(13.2)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	80(6.9)	-4.2(-9.36,0.96)	NS
Anderson et al. 2001	High	Activity level I (IKDC)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	25/34 (73%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	29/33 (88%)	0.84(0.66,1.06)	NS
Anderson et al. 2001	High	Activity level II (IKDC)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	7/34 (20%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	2/33 (6%)	3.4(0.76,15.17)	NS

Table 101. Results: Single Incision Versus Extra-Articular Lateral Incision 3cm and 5cm

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Anderson et al. 2001	High	Activity level III (IKDC)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	2/34 (6%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	2/33 (6%)	0.97(0.15,6.49)	NS
Anderson et al. 2001	High	Subjective assessment normal (IKDC)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	15/34 (43%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	17/34 (50%)	0.86(0.52,1.42)	NS
Anderson et al. 2001	High	Subjective assessment nearly normal (IKDC)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	13/34 (38%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	13/33 (39%)	0.97(0.53,1.77)	NS
Anderson et al. 2001	High	Subjective assessment abnormal (IKDC)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	2/34 (6%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	3/33 (9%)	0.65(0.12,3.63)	NS
Anderson et al. 2001	High	Symptoms normal (IKDC)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	23/34 (67%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	23/33 (70%)	0.97(0.7,1.34)	NS

Table 101. Results: Single Incision Versus Extra-Articular Lateral Incision 3cm and 5cm

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Anderson et al. 2001	High	Symptoms nearly normal (IKDC)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	8/34 (23%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	9/33 (27%)	0.86(0.38,1.97)	NS
Anderson et al. 2001	High	Symptoms abnormal (IKDC)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	1/34 (3%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	1/33 (3%)	0.97(0.06,14.88)	NS
Anderson et al. 2001	High	Symptoms severely abnormal (IKDC)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	2/34 (6%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	0/33 (0%)	4.86(0.24,97.51)	NS
Anderson et al. 2001	High	Range of motion normal (IKDC)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	23/34 (66%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	29/33 (88%)	0.77(0.59,1)	NS
Anderson et al. 2001	High	Range of motion nearly normal (IKDC)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	11/34 (32%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	4/33 (12%)	2.67(0.94,7.55)	NS

Table 101. Results: Single Incision Versus Extra-Articular Lateral Incision 3cm and 5cm

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Anderson et al. 2001	High	Ligament examination normal (IKDC)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	17/35 (49%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	16/33 (48%)	1.03(0.63,1.68)	NS
Anderson et al. 2001	High	Ligament examination nearly normal (IKDC)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	11/34 (32%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	10/33 (30%)	1.07(0.52,2.17)	NS
Anderson et al. 2001	High	Ligament examination abnormal (IKDC)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	6/34 (15%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	7/33 (21%)	0.83(0.31,2.22)	NS
Anderson et al. 2001	High	Osteoarthritis (compartment findings normal (IKDC))	Semitendinosus and gracilis tendon graft extra-articular procedure	34	26/34 (76%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	31/33 (94%)	0.81(0.66,1)	NS
Anderson et al. 2001	High	Osteoarthritis (compartment findings nearly normal (IKDC))	Semitendinosus and gracilis tendon graft extra-articular procedure	34	8/34 (23%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	2/33 (6%)	3.88(0.89,16.95)	NS

Table 101. Results: Single Incision Versus Extra-Articular Lateral Incision 3cm and 5cm

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Anderson et al. 2001	High	Final rating normal (IKDC)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	6/34 (18%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	8/33 (24%)	0.34(0.15,0.76)	Favors HT extra-articular 3cm long
Anderson et al. 2001	High	Final rating nearly normal (IKDC)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	17/34 (50%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	18/33 (54%)	0.92(0.58,1.45)	NS
Anderson et al. 2001	High	Final rating abnormal (IKDC)	Semitendinosus and gracilis tendon graft extra-articular procedure	34	9/34 (26%)	Semitendinosus and gracilis tendon graft extra-articular procedure 3cm long	33	7/33 (21%)	1.25(0.53,2.96)	NS

Figure 9. Meta-Analysis: Forest Plot of Tibial Independent Versus Transtibial IKDC A

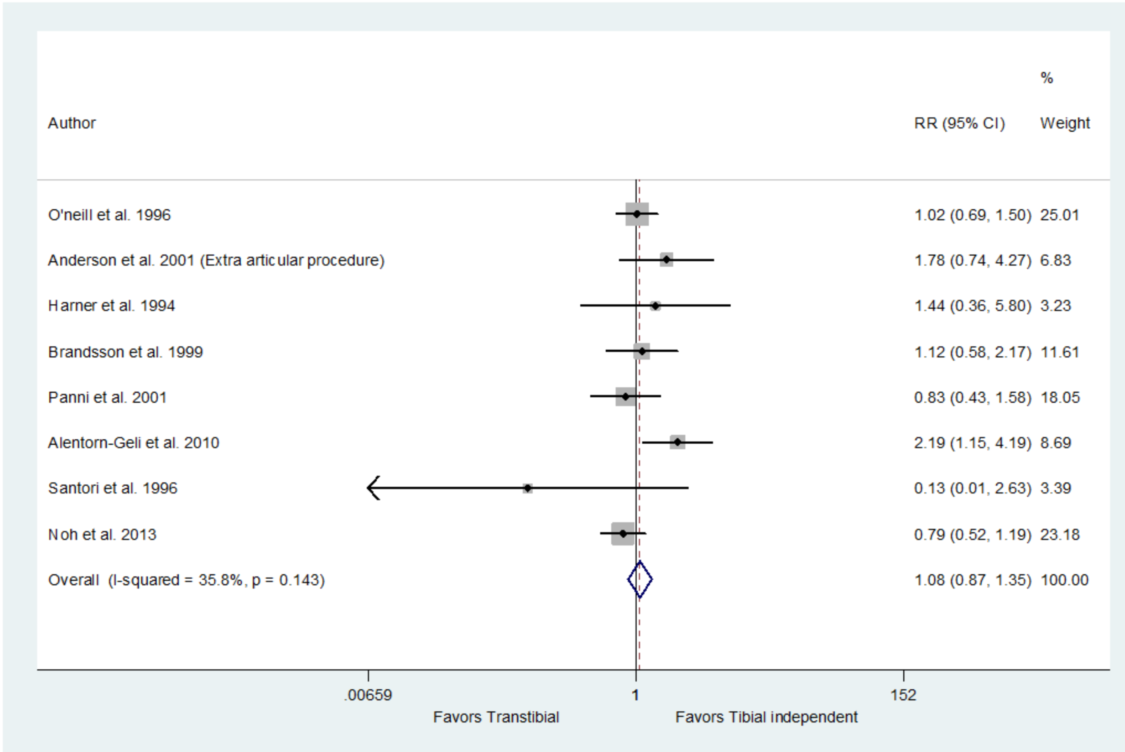
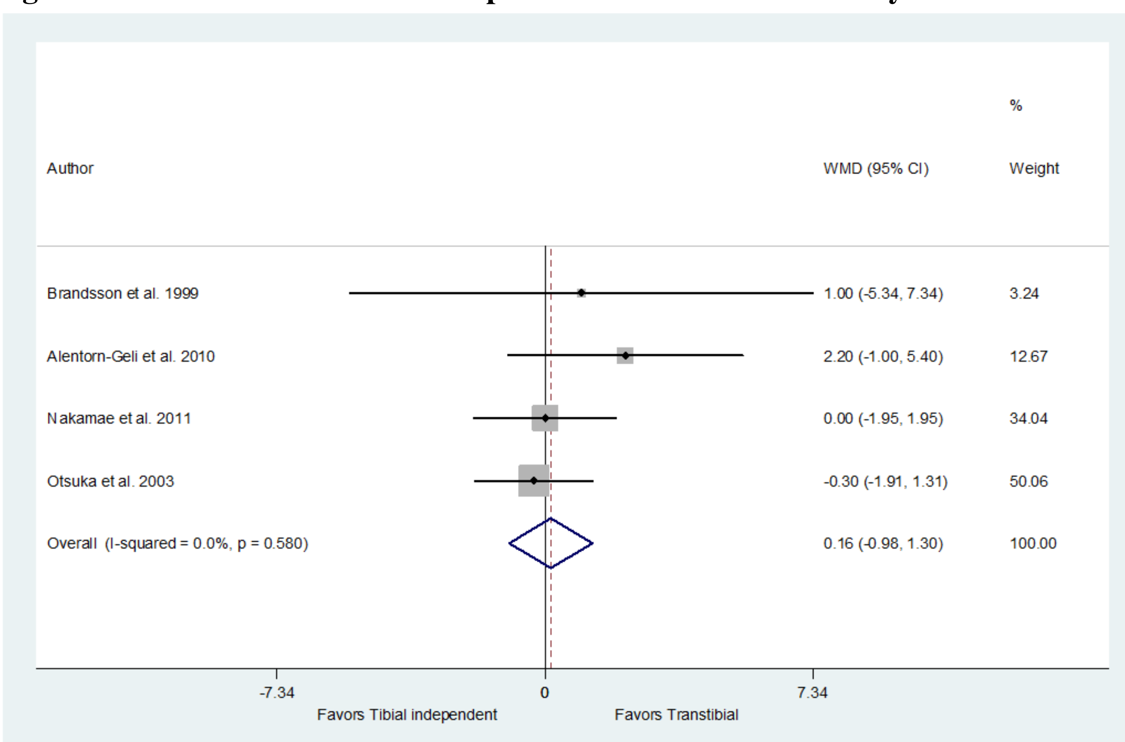


Figure 10. Forest Plot of Tibial Independent Versus Transtibial Lysholm Score



ACL POST-OP FUNCTIONAL BRACING

Moderate evidence does not support the routine use of functional knee bracing after isolated ACL reconstruction, because there is no demonstrated efficacy.

Strength of Recommendation: Moderate

RATIONALE

Three moderate strength studies compared the use of functional bracing following ACL reconstruction to either the use of no brace or a neoprene knee sleeve. [16, 69, 94] None of the studies showed statistically significant benefit of the functional brace in any of the functional or laxity measurements, including Tegner activity scale, Lysholm score, ACL Quality of Life, IKDC score, instrumented laxity testing, and limb hop distance symmetry. These results held up for one and two years in all of the studies. Based on this moderate evidence for lack of efficacy in the use of functional knee bracing following ACL reconstruction, its routine use cannot be supported.

POTENTIAL BENEFITS OF IMPLEMENTATION

The benefit of implementing this recommendation may be a decrease in the overall cost of ACL reconstruction and rehabilitation.

POTENTIAL HARMS OF IMPLEMENTATION

There are no known harms associated with implementing this recommendation.

FUTURE RESEARCH

No future research needed.

SUMMARY OF FINDINGS

Table 102. Summary of Findings: Functional Knee Brace After ACLR

●:Favors No Brace ●:Favors Brace ○:Not significant	**Scales/Measures**	Moller et al. 2001 *(M)*	McDevitt et al. 2004 *(M)*	Hasan et al. 2004 *(L)*	Risberg et al. 1999 *(M)*	Harilainen et al. 2006 *(M)*	**Meta-Analysis**
Patient satisfaction							NA
Function		○	○		○		NA
Pain		○		○	○		NA
	IKDC subjective		○				NA
	IKDC Normal		○				NA
	Lysholm Score	○	○	○		○	NA
	Cincinnati knee Score				○		NA
Return to play			○				NA
	Tegner Activity	○		○		○	NA
Stability		○	○		○	○	NA
Complications		○					NA
Strength		○	○		○	○	NA
Range of motion		○	○		○		NA

Overall strength of study; High: *(H)*, Moderate: *(M)*, Low: *(L)*, Very low: *(V)*

QUALITY AND APPLICABILITY SUMMARY

Table 103. Quality and Applicability Summary: Functional Knee Brace After ACLR

Study	Outcome	Graft	Surgical Technique	Duration	Quality	Applicability	Overall Strength of Evidence
Risberg et al. 1999	Cincinnati score	NR	NR	2 years	Moderate	Moderate	Moderate
Moller et al. 2001	Complications	Patellar tendon autograft fixation with interference screws	Endoscopic technique	2 years	Moderate	Moderate	Moderate
Moller et al. 2001	Discomfort (VAS)	Patellar tendon autograft fixation with interference screws	Endoscopic technique	2 years	Moderate	Moderate	Moderate
Birmingham et al. 2008	Failure	Bone patellar tendon bone with titanium interference screws	NR	2 years	Moderate	Moderate	Moderate
McDevitt et al. 2004	Function (Single legged hop test)	Central bone-patellar tendon bone with femoral interference metallic screw	NR	2 years (24-42 months)	Moderate	Moderate	Moderate

Table 103. Quality and Applicability Summary: Functional Knee Brace After ACLR

Study	Outcome	Graft	Surgical Technique	Duration	Quality	Applicability	Overall Strength of Evidence
Birmingham et al. 2008	Functional (Hop limb index)	Bone patellar tendon bone with titanium interference screws	NR	2 years	Moderate	Moderate	Moderate
Risberg et al. 1999	Functional knee test (Hop test)	NR	NR	2 years	Moderate	Moderate	Moderate
Risberg et al. 1999	Functional knee test (Hop tests)	NR	NR	2 years	Moderate	Moderate	Moderate
McDevitt et al. 2004	IKDC	Central bone-patellar tendon bone with femoral interference metallic screw	NR	2 years (24-42 months)	Moderate	Moderate	Moderate
Moller et al. 2001	Instability (VAS)	Patellar tendon autograft fixation with interference screws	Endoscopic technique	2 years	Moderate	Moderate	Moderate
Moller et al. 2001	Knee circumference (cm)	Patellar tendon autograft fixation with interference	Endoscopic technique	2 years	Moderate	Moderate	Moderate

Table 103. Quality and Applicability Summary: Functional Knee Brace After ACLR

Study	Outcome	Graft	Surgical Technique	Duration	Quality	Applicability	Overall Strength of Evidence
		screws					
Moller et al. 2001	Lysholm knee score	Patellar tendon autograft fixation with interference screws	Endoscopic technique	2 years	Moderate	Moderate	Moderate
Harilainen et al. 2006	Lysholm score	Bone tendon bone	Arthroscopically assisted "outside in" (n=46) or endoscopic "inside out" (n=13)	5 years	Moderate	Moderate	Moderate
McDevitt et al. 2004	Lysholm score	Central bone-patellar tendon bone with femoral interference metallic screw	NR	2 years (24-42 months)	Moderate	Moderate	Moderate
Hasan et al. 2004	Lysholm scores	Bone patellar tendon bone with two interference screw	One incision	2 years	Low	Moderate	Low
Risberg et al. 1999	Muscle atrophy	NR	NR	2 years	Moderate	Moderate	Moderate
Risberg et al. 1999	Muscle atrophy	NR	NR	2 years	Moderate	Moderate	Moderate

Table 103. Quality and Applicability Summary: Functional Knee Brace After ACLR

Study	Outcome	Graft	Surgical Technique	Duration	Quality	Applicability	Overall Strength of Evidence
McDevitt et al. 2004	Osteoarthritis	Central bone-patellar tendon bone with femoral interference metallic screw	NR	2 years (24-42 months)	Moderate	Moderate	Moderate
Hasan et al. 2004	Pain	Bone patellar tendon bone with two interference screw	One incision	4 years	Very Low	Moderate	Very Low
Moller et al. 2001	Pain (VAS)	Patellar tendon autograft fixation with interference screws	Endoscopic technique	2 years	Moderate	Moderate	Moderate
Risberg et al. 1999	Pain (VAS)	NR	NR	2 years	Moderate	Moderate	Moderate
Risberg et al. 1999	Pain (VAS)	NR	NR	2 years	Moderate	Moderate	Moderate
Risberg et al. 1999	Patient satisfaction	NR	NR	2 years	Moderate	Moderate	Moderate
Risberg et al. 1999	Patient satisfaction (VAS)	NR	NR	2 years	Moderate	Moderate	Moderate

Table 103. Quality and Applicability Summary: Functional Knee Brace After ACLR

Study	Outcome	Graft	Surgical Technique	Duration	Quality	Applicability	Overall Strength of Evidence
McDevitt et al. 2004	Prone heel height difference	Central bone-patellar tendon bone with femoral interference metallic screw	NR	2 years (24-42 months)	Low	Moderate	Low
Birmingham et al. 2008	Quality of life (ACL)	Bone patellar tendon bone with titanium interference screws	NR	2 years	Moderate	Moderate	Moderate
Birmingham et al. 2008	Range of motion	Bone patellar tendon bone with titanium interference screws	NR	2 years	Moderate	Moderate	Moderate
McDevitt et al. 2004	Range of motion	Central bone-patellar tendon bone with femoral interference metallic screw	NR	2 years (24-42 months)	Moderate	Moderate	Moderate
Moller et al. 2001	Range of motion	Patellar tendon autograft fixation with interference screws	Endoscopic technique	2 years	Moderate	Moderate	Moderate

Table 103. Quality and Applicability Summary: Functional Knee Brace After ACLR

Study	Outcome	Graft	Surgical Technique	Duration	Quality	Applicability	Overall Strength of Evidence
Risberg et al. 1999	Range of motion	NR	NR	2 years	Moderate	Moderate	Moderate
McDevitt et al. 2004	Return to sport	Central bone-patellar tendon bone with femoral interference metallic screw	NR	2 years (24-42 months)	Moderate	Moderate	Moderate
Harilainen et al. 2006	Stability	Bone tendon bone	Arthroscopically assisted "outside in" (n=46) or endoscopic "inside out" (n=13)	5 years	Moderate	Moderate	Moderate
Moller et al. 2001	Stability	Patellar tendon autograft fixation with interference screws	Endoscopic technique	2 years	Moderate	Moderate	Moderate
Risberg et al. 1999	Stability (KT-1000)	NR	NR	2 years	Moderate	Moderate	Moderate
Risberg et al. 1999	Stability (KT-1000)	NR	NR	2 years	Moderate	Moderate	Moderate
Birmingham et al. 2008	Stability (KT-1000, Lachman, Pivot shift)	Bone patellar tendon bone with titanium interference screws	NR	2 years	Moderate	Moderate	Moderate
McDevitt et al.	Stability (KT-	Central bone-	NR	2 years (24-	Moderate	Moderate	Moderate

Table 103. Quality and Applicability Summary: Functional Knee Brace After ACLR

Study	Outcome	Graft	Surgical Technique	Duration	Quality	Applicability	Overall Strength of Evidence
2004	1000, Lachman, Pivot shift)	patellar tendon bone with femoral interference metallic screw		42 months)			
Harilainen et al. 2006	Strength	Bone tendon bone	Arthroscopically assisted "outside in" (n=46) or endoscopic "inside out" (n=13)	5 years	Moderate	Moderate	Moderate
McDevitt et al. 2004	Strength	Central bone-patellar tendon bone with femoral interference metallic screw	NR	2 years (24-42 months)	Moderate	Moderate	Moderate
Moller et al. 2001	Strength	Patellar tendon autograft fixation with interference screws	Endoscopic technique	2 years	Moderate	Moderate	Moderate
Risberg et al. 1999	Strength	NR	NR	2 years	Moderate	Moderate	Moderate
Risberg et al. 1999	Strength	NR	NR	2 years	Moderate	Moderate	Moderate
McDevitt et al. 2004	Subsequent injuries	Central bone-patellar tendon bone with femoral	NR	2 years (24-42 months)	Moderate	Moderate	Moderate

Table 103. Quality and Applicability Summary: Functional Knee Brace After ACLR

Study	Outcome	Graft	Surgical Technique	Duration	Quality	Applicability	Overall Strength of Evidence
		interference metallic screw					
Harilainen et al. 2006	Tegner activity level	Bone tendon bone	Arthroscopically assisted "outside in" (n=46) or endoscopic "inside out" (n=13)	5 years	Moderate	Moderate	Moderate
Birmingham et al. 2008	Tegner activity scale	Bone patellar tendon bone with titanium interference screws	NR	2 years	Moderate	Moderate	Moderate
Moller et al. 2001	Tegner activity score	Patellar tendon autograft fixation with interference screws	Endoscopic technique	2 years	Moderate	Moderate	Moderate
Hasan et al. 2004	Tegner score	Bone patellar tendon bone with two interference screw	One incision	3 years	Low	Moderate	Low

(Back to top)

RESULTS

QUALITY AND APPLICABILITY

Table 104. Quality and Applicability: Functional Knee Brace After ACLR

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Risberg et al. 1999	Cincinnati score	●	○	●	○	●	●	●	**Moderate**	●	○	○	○	**Moderate**
Moller et al. 2001	Complications	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Moller et al. 2001	Discomfort (VAS)	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Birmingham et al. 2008	Failure	●	○	●	●	●	●	○	**Moderate**	●	○	●	○	**Moderate**
McDevitt et al. 2004	Function (Single legged hop test)	●	○	●	○	○	●	●	**Moderate**	●	○	○	○	**Moderate**
Birmingham et al. 2008	Functional (Hop limb index)	●	○	●	●	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Risberg et al. 1999	Functional knee test (Hop test)	●	○	●	○	●	●	●	**Moderate**	○	○	○	○	**Low**
Risberg et al. 1999	Functional knee test (Hop tests)	●	○	●	○	●	●	●	**Moderate**	●	○	○	○	**Moderate**

Table 104. Quality and Applicability: Functional Knee Brace After ACLR

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
McDevitt et al. 2004	IKDC	●	○	●	○	○	●	●	**Moderate**	●	○	○	○	**Moderate**
Moller et al. 2001	Instability (VAS)	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Moller et al. 2001	Lysholm knee score	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Harilainen et al. 1997	Lysholm score	●	○	●	●	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Harilainen et al. 2006	Lysholm score	●	○	●	●	●	●	○	**Moderate**	●	○	●	○	**Moderate**
McDevitt et al. 2004	Lysholm score	●	○	●	○	○	●	●	**Moderate**	●	○	○	○	**Moderate**
Hasan et al. 2004	Lysholm scores	○	○	○	○	●	●	○	**Low**	●	○	●	●	**Moderate**
Risberg et al. 1999	Muscle atrophy	●	○	●	○	●	●	●	**Moderate**	●	○	○	○	**Moderate**
Risberg et al. 1999	Muscle atrophy	●	○	●	○	●	○	●	**Moderate**	○	○	○	○	**Low**

Table 104. Quality and Applicability: Functional Knee Brace After ACLR

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
McDevitt et al. 2004	Osteoarthritis	●	○	●	○	○	●	●	**Moderate**	●	○	○	○	**Moderate**
Hasan et al. 2004	Pain	○	○	○	○	●	○	○	**Very Low**	●	○	●	●	**Moderate**
Moller et al. 2001	Pain (VAS)	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Risberg et al. 1999	Pain (VAS)	●	○	●	○	●	●	●	**Moderate**	○	○	○	○	**Moderate**
Risberg et al. 1999	Pain (VAS)	●	○	●	○	●	●	●	**Moderate**	●	○	○	○	**Moderate**
Risberg et al. 1999	Patient satisfaction	●	○	●	○	●	●	●	**Moderate**	○	○	○	○	**Moderate**
Risberg et al. 1999	Patient satisfaction (VAS)	●	○	●	○	●	●	●	**Moderate**	●	○	○	○	**Moderate**
McDevitt et al. 2004	Prone heel height difference	●	○	●	○	○	○	●	**Low**	●	○	○	○	**Moderate**
Birmingham et al. 2008	Quality of life (ACL)	●	○	●	●	●	●	○	**Moderate**	●	○	●	○	**Moderate**

Table 104. Quality and Applicability: Functional Knee Brace After ACLR

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Birmingham et al. 2008	Range of motion	●	○	●	●	●	●	○	**Moderate**	●	○	●	○	**Moderate**
McDevitt et al. 2004	Range of motion	●	○	●	○	○	●	●	**Moderate**	●	○	○	○	**Moderate**
Moller et al. 2001	Range of motion	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Risberg et al. 1999	Range of motion	●	○	●	○	●	●	●	**Moderate**	●	○	○	○	**Moderate**
McDevitt et al. 2004	Return to sport	●	○	●	○	○	●	●	**Moderate**	●	○	○	○	**Moderate**
Harilainen et al. 1997	Stability	●	○	●	●	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Harilainen et al. 2006	Stability	●	○	●	●	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Moller et al. 2001	Stability	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Risberg et al. 1999	Stability (KT-1000)	●	○	●	○	●	●	●	**Moderate**	○	○	○	○	**Moderate**

Table 104. Quality and Applicability: Functional Knee Brace After ACLR

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Risberg et al. 1999	Stability (KT-1000)	●	○	●	○	●	●	●	**Moderate**	●	○	○	○	**Moderate**
Birmingham et al. 2008	Stability (KT-1000, Lachman, Pivot shift)	●	○	●	●	●	●	○	**Moderate**	●	○	●	○	**Moderate**
McDevitt et al. 2004	Stability (KT-1000, Lachman, Pivot shift)	●	○	●	○	○	●	●	**Moderate**	●	○	○	○	**Moderate**
Harilainen et al. 1997	Strength	●	○	●	●	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Harilainen et al. 2006	Strength	●	○	●	●	●	●	○	**Moderate**	●	○	●	○	**Moderate**
McDevitt et al. 2004	Strength	●	○	●	○	○	●	●	**Moderate**	●	○	○	○	**Moderate**
Moller et al. 2001	Strength	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Risberg et al. 1999	Strength	●	○	●	○	●	●	●	**Moderate**	●	○	○	○	**Low**

Table 104. Quality and Applicability: Functional Knee Brace After ACLR

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
McDevitt et al. 2004	Subsequent injuries	●	○	●	○	○	●	●	**Moderate**	●	○	○	○	**Moderate**
Harilainen et al. 2006	Tegner activity level	●	○	●	●	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Birmingham et al. 2008	Tegner activity scale	●	○	●	●	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Harilainen et al. 1997	Tegner activity score	●	○	●	●	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Moller et al. 2001	Tegner activity score	●	○	●	○	●	●	○	**Moderate**	●	○	●	○	**Moderate**
Hasan et al. 2004	Tegner score	○	○	○	○	●	●	○	**Low**	●	○	●	●	**Moderate**

FINDINGS

Table 105. Results: Functional Knee Brace After ACLR: No Brace Versus Brace

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Moller et al. 2001	Moderate	Stability (Anterior-posterior laxity: side to side difference between involved and non-involved leg)	No brace	27	2.9(2.4)	Brace	29	1.6(1.92)	NA	NS
Moller et al. 2001	Moderate	Range of motion (Extension)	No brace	27	-3 plus minus 3 hyperextension	Brace	29	-2 plus minus 3 hyperextension	NA	NS
Moller et al. 2001	Moderate	Range of motion (Flexion)	No brace	27	146(5)	Brace	29	145(5)	NA	NS
Moller et al. 2001	Moderate	Knee circumference (cm)	No brace	27	0.1(0.3)	Brace	29	0.2(0.3)	NA	NS
Moller et al. 2001	Moderate	Strength (Isokinetic peak ext torque, quadriceps 90 degrees)	No brace	27	97(11)	Brace	29	93(11)	NA	NS
Moller et al. 2001	Moderate	Strength (Isokinetic peak ext torque, quadriceps 180 degrees)	No brace	27	97(11)	Brace	29	94(12)	NA	NS
Moller et al. 2001	Moderate	Strength (Isokinetic	No brace	27	101(11)	Brace	29	103(13)	NA	NS

Table 105. Results: Functional Knee Brace After ACLR: No Brace Versus Brace

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		peak ext torque, hamstring 90 degrees)								
Moller et al. 2001	Moderate	Strength (Isokinetic peak ext torque, hamstring 180 degrees)	No brace	27	102(12)	Brace	29	104(10)	NA	NS
Moller et al. 2001	Moderate	Function (one leg hop test)	No brace	27	93(8)	Brace	29	94(11)	NA	NS
Moller et al. 2001	Moderate	Lysholm knee score	No brace	27	99(64-100)	Brace	29	95(63-100)	NA	NS
Moller et al. 2001	Moderate	Tegner activity level	No brace	27	6(1-10)	Brace	29	5(1-9)	NA	NS
Moller et al. 2001	Moderate	Pain (VAS)	No brace	27	0(0-2.9)	Brace	29	0.2(0-3)	NA	NS
Moller et al. 2001	Moderate	Discomfort (VAS)	No brace	27	0.5(1.2-1.9)	Brace	29	0.8(1.5-1.6)	NA	NS
Moller et al. 2001	Moderate	Instability (VAS)	No brace	27	0.1(0-6)	Brace	29	0.2(0-3.3)	NA	NS
Moller et al. 2001	Moderate	Complications	No brace	30	7/30(23%)	Brace	32	7/32(22%)	1.06(0.42,2.68)	NS
McDevitt et al. 2004	Moderate	Return to sport	No brace	48	47/48(98%)	Brace	47	47/47(100%)	0.98(0.94,1.02)	NS
McDevitt et al. 2004	Moderate	Subsequent injuries	No brace	48	45/48(94%)	Brace	47	45/47(96%)	0.98(0.89,1.07)	NS
McDevitt et al. 2004	Moderate	Range of motion (Loss of knee extension)	No brace	48	1/48(2%)	Brace	47	2/47(4%)	0.49(0.045,5.22)	NS
McDevitt et al. 2004	Moderate	Prone heel height difference	No brace	48	2.9cm(0 to 5)	Brace	47	2.3cm(-1.5 to 4)	NA	NS

Table 105. Results: Functional Knee Brace After ACLR: No Brace Versus Brace

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		(mean and range)								
McDevitt et al. 2004	Moderate	Strength (Isokinetic testing knee concentric peak torque >90% of the opposite knee)	No brace	48	NR	Brace	47	NR	NA	NS
McDevitt et al. 2004	Moderate	Function (Single-legged hop for distance mean and range)	No brace	48	95%(92%-104%)	Brace	47	96%(94%-105%)	NA	NS
McDevitt et al. 2004	Moderate	Lysholm knee score (mean and range)	No brace	48	93(79-100)	Brace	47	94(86-100)	NA	NS
McDevitt et al. 2004	Moderate	Stability (KT-1000 manual maximum side to side difference)	No brace	48	0-5mm	Brace	47	-4 to 5mm	NA	NS
McDevitt et al. 2004	Moderate	IKDC	No brace	48	NR	Brace	47	NR	NA	NS
McDevitt et al. 2004	Moderate	IKDC (Normal or nearly normal)	No brace	48	98%	Brace	47	98%	NA	NS
McDevitt et al. 2004	Moderate	Lachman test (2+)	No brace	48	1/48(2%)	Brace	47	1/47(2%)	0.97(0.06,15.2)	NS
McDevitt et al. 2004	Moderate	Pivot shift test (2+)	No brace	48	1/48(2%)	Brace	47	2/47(4%)	0.49(0.04,5.22)	NS
Hasan et al. 2004	Low	Lysholm knee score	No brace	53	65	Brace	32	61	NA	NS

Table 105. Results: Functional Knee Brace After ACLR: No Brace Versus Brace

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Hasan et al. 2004	Low	Tegner activity level	No brace	53	6.7	Brace	32	6.3	NA	NS
Hasan et al. 2004	Very Low	Knee pain	No brace	53	7/53(13%)	Brace	32	4/32(12%)	1.05(0.33,3.33)	NS
Harilainen et al. 2006 (5 year follow-up of Harilainen et al. 1996	Moderate	Lysholm knee score	No brace	25	91(9.6)	Brace	23	89(13)	2(-4.59,8.59)	NS
Harilainen et al. 2006 (5 year follow-up of Harilainen et al. 1996	Moderate	Tegner activity level (Median)	No brace	25	5.75(2.25)	Brace	23	6.25(1.75)	-0.5(-1.67,0.67)	NS
Harilainen et al. 2006 (5 year follow-up of Harilainen et al. 1996	Moderate	Stability(AP Laxity 178N (mm))	No brace	25	15(4.5)	Brace	23	15(3.8)	2(-4.6,8.6)	NS
Harilainen et al. 2006 (5 year follow-up of Harilainen et al. 1996	Moderate	Stability(AP Laxity side to side difference 178N mm)	No brace	25	1.7(3.5)	Brace	23	1.2(2.5)	-0.5(-1.68,0.68)	NS
Harilainen et al. 2006 (5 year follow-up of Harilainen et al. 1996	Moderate	Strength (% isokinetic extension torque 60)	No brace	25	91%(10.5%)	Brace	23	93%(11.8%)	0(-2.43,2.43)	NS
Harilainen et al. 2006 (5	Moderate	Strength (% isokinetic	No brace	25	93%(8.8%)	Brace	23	94%(8.4%)	0.5(-1.28,2.28)	NS

Table 105. Results: Functional Knee Brace After ACLR: No Brace Versus Brace

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
year follow-up of Harilainen et al. 1996		extension torque 180)								
Harilainen et al. 2006 (5 year follow-up of Harilainen et al. 1996	Moderate	Strength (% isokinetic extension torque 60)	No brace	25	98%(13.4%)	Brace	23	101%(14.5%)	NA	NS
Harilainen et al. 2006 (5 year follow-up of Harilainen et al. 1996	Moderate	Strength (% isokinetic extension torque 180)	No brace	25	98%(12.6%)	Brace	23	97%(10.9%)	NA	NS
Risberg et al. 1999	Moderate	Stability (KT-1000 mm difference)	No brace	NR	2.5(4)	Brace	NR	2.1(3.7)	NA	NS
Risberg et al. 1999	Moderate	Cincinnati knee score	No brace	NR	87.4(12.8)	Brace	NR	85.7(12.3)	NA	NS
Risberg et al. 1999	Moderate	Range of motion (Extension deficit degrees)	No brace	NR	0.1(0.5)	Brace	NR	0.2(1.6)	NA	NS
Risberg et al. 1999	Moderate	Range of motion (Flexion deficit degrees)	No brace	NR	136.3(4.1)	Brace	NR	136.3(4.1)	NA	NS
Risberg et al. 1999	Moderate	Strength (Extension total work (60 deg/s)	No brace	NR	92.7(11.1)	Brace	NR	89.4(9.5)	NA	NS
Risberg et al.	Moderate	Strength	No brace	NR	87(11)	Brace	NR	88.9(13.8)	NA	NS

Table 105. Results: Functional Knee Brace After ACLR: No Brace Versus Brace

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
1999		(Extension total work (240 deg/s)								
Risberg et al. 1999	Moderate	Strength (Flexion total work (60 deg/s)	No brace	NR	99.9(16.3)	Brace	NR	96.8(12)	NA	NS
Risberg et al. 1999	Moderate	Strength (Flexion total work (240 deg/s)	No brace	NR	95.2(13.2)	Brace	NR	97.4(11.2)	NA	NS
Risberg et al. 1999	Moderate	Function (Stairs hopple test)	No brace	NR	92.3(11.3)	Brace	NR	94.1(12.7)	NA	NS
Risberg et al. 1999	Moderate	Function (Triple jump)	No brace	NR	97.1(5.1)	Brace	NR	97.5(4.4)	NA	NS
Risberg et al. 1999	Moderate	Function (Single-legged hop)	No brace	NR	94.6(7.2)	Brace	NR	94.8(9.4)	NA	NS
Risberg et al. 1999	Moderate	Pain at rest (VAS)	No brace	NR	3.8(7.8)	Brace	NR	4.5(12.7)	NA	NS
Risberg et al. 1999	Moderate	Pain during activities (VAS)	No brace	NR	22(27.7)	Brace	NR	18(22.8)	NA	NS
Risberg et al. 1999	Moderate	Patient satisfaction (VAS)	No brace	NR	78.8(24.6)	Brace	NR	79.4(28.1)	NA	NS

Table 106. Results: Functional Knee Brace After ACLR

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Birmingham et al. 2008	Moderate	Symptoms and physical complaints (ACL-QOL)	Brace	62	83.7(17.6)	Sleeve	65	84.1(17.4)	-0.4(-6.55,5.75)	NS
Birmingham et al. 2008	Moderate	Work/school related concerns (ACL-QOL)	Brace	62	80.8(19.7)	Sleeve	65	82.9(20.9)	-2.1(-9.24,5.04)	NS
Birmingham et al. 2008	Moderate	Recreational activities and sport (ACL-QOL)	Brace	62	63.8(27.3)	Sleeve	65	69(25.8)	-5.2(-14.52,4.12)	NS
Birmingham et al. 2008	Moderate	Lifestyle (ACL-QOL)	Brace	62	80.3(22.1)	Sleeve	65	80.2(19.6)	0.1(-7.23,7.43)	NS
Birmingham et al. 2008	Moderate	Social and emotional (ACL-QOL)	Brace	62	70.9(24.3)	Sleeve	65	73.6(23.2)	-2.7(-11.04,5.64)	NS
Birmingham et al. 2008	Moderate	ACL-QOL total	Brace	62	76.1(19.1)	Sleeve	65	77.6(19.3)	-1.5(-8.25,5.25)	NS
Birmingham et al. 2008	Moderate	Stability (KT-1000 side to side difference mm)	Brace	62	2.3(2.3)	Sleeve	65	2.3(2.5)	0(-0.84,0.84)	NS
Birmingham et al. 2008	Moderate	Limb symmetry index (%)	Brace	62	95.2%(22%)	Sleeve	65	96%(16.2%)	NA	NS
Birmingham et al. 2008	Moderate	Stability (Lachman Normal)	Brace	62	24/62(44%)	Sleeve	65	25/65(43%)	1.01(0.65,1.56)	NS
Birmingham et al. 2008	Moderate	Stability (Lachman Nearly normal +)	Brace	62	28/62(51%)	Sleeve	65	31/65(53%)	0.95(0.65,1.38)	NS
Birmingham et al. 2008	Moderate	Stability (Lachman	Brace	62	3/62(6%)	Sleeve	65	2/65(3%)	1.57(0.27,9.1)	NS

Table 106. Results: Functional Knee Brace After ACLR

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		Abnormal ++)								
Birmingham et al. 2008	Moderate	Stability (Lachman Severely abnormal +++)	Brace	62	0/62(0%)	Sleeve	65	0/65(0%)	NA	NS
Birmingham et al. 2008	Moderate	Stability (Pivot shift Normal)	Brace	62	32/62(59%)	Sleeve	65	38/65(67%)	0.88(0.64,1.21)	NS
Birmingham et al. 2008	Moderate	Stability (Pivot shift Nearly normal glide)	Brace	62	20/62(37%)	Sleeve	65	16/65(28%)	1.31(0.75,2.29)	NS
Birmingham et al. 2008	Moderate	Stability (Pivot shift Abnormal clunk)	Brace	62	2/62(4%)	Sleeve	65	3/65(5%)	0.7(0.12,4.04)	NS
Birmingham et al. 2008	Moderate	Stability (Pivot shift Severely abnormal gross)	Brace	62	0/62(0%)	Sleeve	65	0/62(0%)	NA	NS
Birmingham et al. 2008	Moderate	Range of motion (Extension loss in degrees compared to contralateral knee)	Brace	62	2.2(2.8)	Sleeve	65	3.6(5.6)	-1.4(-2.97,0.17)	NS
Birmingham et al. 2008	Moderate	Range of motion (Flexion loss in degrees compared to contralateral	Brace	62	3.2(10.7)	Sleeve	65	3.2(10.7)	0(-3.76,3.76)	NS

Table 106. Results: Functional Knee Brace After ACLR

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Birmingham et al. 2008	Moderate	knee) Tegner activity score	Brace	62	6.3(1.8)	Sleeve	65	6.4(1.9)	-0.1(-0.75,0.55)	NS
Birmingham et al. 2008	Moderate	Failure	Brace	62	3/62(5%)	Sleeve	65	3/65(5%)	1.05(0.22,4.99)	NS

ACL PROPHYLACTIC BRACES

Limited evidence supports that the practitioner might not prescribe prophylactic knee braces to prevent ACL injury, because they do not reduce the risk for ACL injury.

Strength of Recommendation: Limited ★★☆☆

RATIONALE

One moderate strength and one low strength study demonstrated no reduction in ACL injury rates with ACL prophylactic bracing in high school and collegiate American football players.[25, 108]

FUTURE RESEARCH

Additional research could investigate the effect of prophylactic bracing in other populations (i.e. adolescent female soccer players) in which ACL injury rates are high.

SUMMARY OF FINDINGS

QUALITY AND APPLICABILITY SUMMARY

Table 107. Quality and Applicability Summary: ACL Injury Prevention (Prophylactic Brace)

Study	Outcome	Sports	Subjects	Duration	Quality	Applicability	Overall Strength of Evidence
Sitler et al. 1990	Prevention (ACL injury)	Intramural tackle football	Cadets at West Point	2 seasons	Moderate	Moderate	Moderate
Deppen et al. 1994	Prevention (ACL injury)	High school football	High school football players 16-18 years of age	4 years	Low	Moderate	Low

Table 108. Quality and Applicability: ACL Injury Prevention (Prophylactic Brace)

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Sitler et al. 1990	Prevention (ACL injury)	●	○	●	○	●	●	●	Moderate	●	○	○	●	Moderate
Deppen et al. 1994	Prevention (ACL injury)	●	○	●	●	○	○	○	Low	●	○	○	●	Moderate

FINDINGS

Table 109. Results: ACL Injury Prevention (Prophylactic Brace)

Author	Outcome	Follow up	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean (sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Sitler et al. 1990	ACL injury	One season (1986)	Prophylactic knee brace	691	2/691(0.3%)	No brace	705	5/705(0.7%)	0.4(0.08,2.09)	NS
Sitler et al. 1990	ACL injury	One season (1987)	Prophylactic knee brace	691	2/691(0.3%)	No brace	705	7/705(0.9%)	0.3(0.06,1.39)	NS
Sitler et al. 1990	ACL injury	2 years combined	Prophylactic knee brace	691	4/691(0.6%)	No brace	705	12/705(1.7%)	0.34(0.11,1.0 5)	NS
Sitler et al. 1990	Medial collateral ligament injury	One season (1986)	Prophylactic knee brace	691	6/691(0.9%)	No brace	705	5/705(0.7%)	11/705(1.6%)	NS
Sitler et al. 1990	Medial collateral ligament injury	One season (1987)	Prophylactic knee brace	691	6/691(0.9%)	No brace	705	7/705(0.9%)	14/705(2.03%)	NS
Sitler et al. 1990	Medial collateral ligament injury	2 years combined	Prophylactic knee brace	691	12/691(1.77 %)	No brace	705	12/705(1.7%)	25/705(3.68%)	NS
Sitler et al. 1990	Lateral collateral ligament injury	One season (1986)	Prophylactic knee brace	691	0/691(0%)	No brace	705	2/705(0.3%)	0.2(0.00,4.24)	NS
Sitler et al. 1990	Lateral collateral ligament injury	One season (1987)	Prophylactic knee brace	691	1/691(0.14%)	No brace	705	3/705(0.4%)	0.34(0.11,1.0 5)	NS
Sitler et al. 1990	Lateral collateral ligament injury	2 years combined	Prophylactic knee brace	691	1/691(0.14%)	No brace	705	5/705(0.7%)	0.2(0.09,0.49)	NS
Sitler et al. 1990	Posterior collateral ligament injury	One season (1986)	Prophylactic knee brace	691	0/691(0%)	No brace	705	2/705(0.3%)	0.2(0.009,4.2 4)	NS
Sitler et al. 1990	Posterior collateral ligament injury	One season (1987)	Prophylactic knee brace	691	0/691(0%)	No brace	705	1/705(0.14%)	0.34(0.01,8.3 3)	NS
Sitler et al. 1990	Posterior collateral ligament injury	2 years combined	Prophylactic knee brace	691	0/691(0%)	No brace	705	3/705(0.4%)	0.14(0.007,2. 81)	NS
Sitler et al.	Medial	One season	Prophylactic	691	0/691(0%)	No brace	705	1/705(0.14%	0.34(0.014)	NS

Table 109. Results: ACL Injury Prevention (Prophylactic Brace)

Author	Outcome	Follow up	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean (sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
1990	meniscus injury	(1986)	knee brace					)		
Sitler et al. 1990	Medial meniscus injury	One season (1987)	Prophylactic knee brace	691	1/691(0.14%)	No brace	705	1/705(0.14%)	1.02(0.14,7.2 4)	NS
Sitler et al. 1990	Medial meniscus injury	2 years combined	Prophylactic knee brace	691	1/691(0.14%)	No brace	705	2/705(0.3%)	0.51(0.13,2.0 4)	NS
Sitler et al. 1990	Lateral meniscus injury	One season (1986)	Prophylactic knee brace	691	1/691(0.14%)	No brace	705	2/705(0.3%)	0.51(0.13,2.0 4)	NS
Sitler et al. 1990	Lateral meniscus injury	One season (1987)	Prophylactic knee brace	691	1/691(0.14%)	No brace	705	2/705(0.3%)	0.51(0.13,2.0 4)	NS
Sitler et al. 1990	Lateral meniscus injury	2 years combined	Prophylactic knee brace	691	2/691(0.3%)	No brace	705	4/705(0.57%)	0.51(0.19,1.3 6)	NS
Sitler et al. 1990	Any ligament injury	One season (1986)	Prophylactic knee brace	691	9/691(1.3%)	No brace	705	23/705(0.3%)	0.4(0.27,0.6)	NS
Sitler et al. 1990	Any ligament injury	One season (1987)	Prophylactic knee brace	691	11/691(1.6%)	No brace	705	28/705(0.4%)	0.4(0.28,0.58)	NS
Sitler et al. 1990	Any ligament injury	2 years combined	Prophylactic knee brace	691	20/691(2.9%)	No brace	705	51/705(7.2%)	0.4(0.31,0.52)	NS
Deppen et al. 1994	ACL tear	4 years	Prophylactic knee brace	21640 exposure s	2	No brace	19484 exposur es	6	NA	NS
Deppen et al. 1994	Meniscus tears	4 years	Prophylactic knee brace	21640 exposure s	1	No brace	19484 exposur es	2	NA	NS
Deppen et al. 1994	Medial collateral ligament sprain (Grade 2)	4 years	Prophylactic knee brace	21640 exposure s	5	No brace	19484 exposur es	0	NA	NS
Deppen et al. 1994	Medial collateral ligament sprain	4 years	Prophylactic knee brace	21640 exposure s	11	No brace	19484 exposur es	10	NA	NS

Table 109. Results: ACL Injury Prevention (Prophylactic Brace)

Author	Outcome	Follow up	Treatment Group 1	n1	Mean (sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean (sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
	(Grade 1)									
Deppen et al. 1994	Contusions	4 years	Prophylactic knee brace	21640 exposures	2	No brace	19484 exposures	4	NA	NS
Deppen et al. 1994	Other	4 years	Prophylactic knee brace	21640 exposures	2	No brace	19484 exposures	4	NA	NS
Deppen et al. 1994	Total	4 years	Prophylactic knee brace	21640 exposures	23	No brace	19484 exposures	26	NA	NS

(Back to top)

ACL NEUROMUSCULAR TRAINING PROGRAMS

Moderate strength evidence from pooled analyses with a small effect size (Number Needed to Treat=109) supports that neuromuscular training programs could reduce ACL injuries.

Strength of Recommendation: Moderate

RATIONALE

One moderate strength study of female adolescent handball players and two low strength studies of adult male and adolescent female soccer players demonstrated significant reduction in ACL injuries after neuromuscular training.[80, 19, 66] Five moderate strength studies showed a non-significant reduction and one moderate strength study showed a non-significant increase in ACL injuries (note: we were unable to confirm statistically significant reductions in injury reported by some of the aforementioned studies when reanalyzing the raw data).[36, 46, 48, 61, 85, 109] No high strength double-blind randomized control trials implementing neuromuscular training interventions were identified, likely due to the difficulty in blinding of athletes and the need to cluster randomize athletes by team. A two-step process of pooled analyses was employed. The initial pooled analysis contained all best available quality studies meeting the a priori inclusion criteria for this recommendation (Figure 11. Meta-Analysis of All Investigations Meeting Inclusion Criteria for), showed no quantitative heterogeneity (0%), and indicated a relative risk reduction of 53 (20 to 72%). However, content and delivery methods among programs in these studies demonstrated *qualitative* heterogeneity; therefore a subset of the most homogeneous programs was identified. Programs were considered homogeneous if they contained similar exercise modalities and training implementation strategies (e.g., plyometrics, strengthening, instructor feedback to athletes). The second pooled analysis of the homogeneous programs (Figure 12. Meta-Analysis of Investigations that Employed the Most Homogeneous Intervention) confirmed significant relative risk reduction of 62 (41 to 79%) favoring neuromuscular training programs for prevention of non-contact ACL injuries. The majority of the reported programs were coach-led and compliance was fair to poor, when reported. The current analyses indicate that the number needed to treat to prevent one ACL injury is approximately109 athletes (Figure 13. Number Needed to Treat (NNT) Analysis for Most Homogeneous Investigations (NNT =108.75)). An assessment of the studies included in this analysis demonstrated no publication bias (Figure 1D)

POTENTIAL BENEFITS OF IMPLEMENTATION

The benefits of a neuromuscular training program implementation as part of a sports competition regime include a reduced risk of sustaining a sports related ACL injury.

POTENTIAL HARMS OF IMPLEMENTATION

No studies reported a significant increase in injury in those who participate in a neuromuscular training program for ACL injury prevention.

FUTURE RESEARCH

Future research from multi-site studies utilizing a standardized neuromuscular training program with large populations of high-risk athletes is recommended to further establish efficacy. In addition, there is a need to investigate methods to optimize protocols (i.e., exercise modality), improve delivery and instruction (i.e., training feedback) and improve coach and athlete compliance. Lastly, a majority of the studies included adolescent and adult female soccer, basketball, volleyball and handball players. Future research that includes other high risk sports as well as male athletes is warranted to expand the generalizability of these results.

SUMMARY OF FINDINGS

Table 110. Summary of Findings: ACL Injury Prevention (Neuromuscular Training Program)

●:Favors preventive training program ●:Favors usual training ○:Not significant	Gilchrist et al. 2008 *(M)*	Petersen et al. 2005 *(M)*	LaBella et al. 2011 *(M)*	Soderman et al. 2000 *(M)*	Heidt et al. 2000 *(M)*	Olsen et al. 2005 *(M)*	Hewette et al. 1999 *(H)*	Caraffa et al. 1996 *(M)*	Mandelbaum et al. 2005 *(L)*	**Meta-Analysis**
ACL injury prevention	○	○	○	○	○	●	○	●	●	NA

Overall strength of study; High: *(H)*, Moderate: *(M)*, Low: *(L)*, Very low: *(V)*

QUALITY AND APPLICABILITY SUMMARY

Table 111. Quality and Applicability Summary: ACL Injury Prevention (Neuromuscular Training Program)

Study	Outcome	Sport	Subjects	Training program	Quality	Applicability	Overall Strength of Evidence
Gilchrist et al. 2008	Prevention (ACL injury)	Soccer	Female college	Prevent injury and enhance performance program	Moderate	Moderate	Moderate
Heidt et al. 2000	Prevention (ACL injury)	Soccer	Female (14-18 years)	Frappier acceleration training program	Moderate	Moderate	Moderate
Hewett et al. 1999	Prevention (ACL injury)	Soccer, Volleyball, Basketball	Female	Preseason neuromuscular training program Hewett et al. 1996	Moderate	High	High
LaBella et al. 2011	Prevention (ACL injury)	Soccer and Basketball	Female high school	Neuromuscular warm up	Low	Moderate	Low
Olsen et al. 2005	Prevention (ACL injury)	Handball	15-17 years old (Male:150 Female: 808)	Warm up program	Moderate	Moderate	Moderate
Soderman et al. 2000	Prevention (ACL injury)	Soccer	Female 20 years	Balance board training	Moderate	Moderate	Moderate
Mandelbaum et al. 2005	Prevention (ACL injury)	Soccer	Female	Neuromuscular and Proprioceptive training	Low	Moderate	Low
Caraffa et al. 1996	Prevention (ACL injury)	Soccer	NR	Proprioceptive training program	Moderate	Moderate	Moderate

Table 111. Quality and Applicability Summary: ACL Injury Prevention (Neuromuscular Training Program)

Study	Outcome	Sport	Subjects	Training program	Quality	Applicability	Overall Strength of Evidence

(Back to top)

RESULTS

QUALITY AND APPLICABILITY

Table 112. Quality and Applicability: ACL Injury Prevention (Neuromuscular Training Program)

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Gilchrist et al. 2008	Prevention (ACL injury)	●	○	●	●	○	●	●	**Moderate**	●	○	○	●	**Moderate**
Heidt et al. 2000	Prevention (ACL injury)	●	○	●	○	○	●	●	**Moderate**	●	○	●	●	**Moderate**
Heidt et al. 2000	Prevention (ACL injury)	●	○	●	○	○	●	●	**Moderate**	●	○	●	●	**Moderate**
Hewett et al. 1999	Prevention (ACL injury)	●	○	●	○	○	●	●	**Moderate**	●	●	●	●	**High**
LaBella et al. 2011	Prevention (ACL injury)	●	○	●	○	○	●	○	**Low**	●	○	○	○	**Moderate**
Olsen et al. 2005	Prevention (ACL injury)	●	●	●	●	○	●	○	**Moderate**	●	○	●	●	**Moderate**
Petersen et al. 2005	Prevention (ACL injury)	●	○	●	○	○	●	●	**Moderate**	●	○	●	○	**Moderate**
Soderman et al. 2000	Prevention (ACL injury)	●	○	●	○	○	●	●	**Moderate**	●	○	●	○	**Moderate**

Table 112. Quality and Applicability: ACL Injury Prevention (Neuromuscular Training Program)

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Caraffa et al. 1996	Prevention (ACL injury)	●	○	●	○	○	●	●	**Moderate**	●	○	●	●	**Moderate**
Mandelbaum et al. 2005	Prevention (ACL injury)	●	○	●	○	○	●	○	**Low**	●	○	○	●	**Moderate**

FINDINGS

Table 113. Results: ACL Injury Prevention (Pre-Season Neuromuscular Training Program)

Author	Outcome	Sports	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Heidt et al. 2000	ACL tear	Soccer	Frappier acceleration training program	42	1/42(2.4%)	Untrained	258	8/258(3.1%)	0.77(0.09,5.98)	NS
Heidt et al. 2000	MCL sprain or tear	Soccer	Frappier acceleration training program	42	1/42(2.4%)	Untrained	258	6/258(2.3%)	1(0.13,8.29)	NS
Heidt et al. 2000	Chondromalacia patellae	Soccer	Frappier acceleration training program	42	0/42(0%)	Untrained	258	6/258(2.3%)	0.46(0.26,8.08)	NS
Heidt et al. 2000	Meniscal tear	Soccer	Frappier acceleration training program	42	0/42(0%)	Untrained	258	3/258(1.2%)	0.86(0.04,16.37)	NS
Heidt et al. 2000	Contusion	Soccer	Frappier acceleration training program	42	0/42(0%)	Untrained	258	3/258(1.2%)	0.86(0.04,16.37)	NS
Heidt et al. 2000	Bursitis	Soccer	Frappier acceleration training program	42	1/42(2.4%)	Untrained	258	0/258(0%)	18.07(0.75,436.41)	NS
Heidt et al. 2000	Strain	Soccer	Frappier acceleration training program	42	0/42(0%)	Untrained	258	1/258(0.4%)	2(0.083,48.49)	NS
Heidt et al. 2000	Patellar subluxation	Soccer	Frappier acceleration training program	42	0/42(0%)	Untrained	258	1/258(0.4%)	2(0.083,48.49)	NS

Table 113. Results: ACL Injury Prevention (Pre-Season Neuromuscular Training Program)

Author	Outcome	Sports	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Heidt et al. 2000	Patellar dislocation	Soccer	Frappier acceleration training program	42	0/42(0%)	Untrained	258	1/258(0.4%)	2(0.083,48.49)	NS
Hewette et al. 1999	ACL injury only	Soccer, Volleyball, Basketball	Preseason neuromuscular training program	366	1/366(0.2%)	Untrained	463	5/463(1%)	2(0.08,48.49)	NS
Hewette et al. 1999	ACL and MCL injury	Soccer, Volleyball, Basketball	Preseason neuromuscular training program	366	1/366(0.2%)	Untrained	463	0/463(0%)	3.79(0.15,92. 84)	NS
Hewette et al. 1999	ACL injury	Volleyball	Preseason neuromuscular training program	185	0/185(0%)	Untrained	81	0/81(0%)	NA	NS
Hewette et al. 1999	ACL injury	Soccer	Preseason neuromuscular training program	97	0/185(0%)	Untrained	193	2/81(2.5%)	0.08(0.004,1. 81)	NS
Hewette et al. 1999	MCL injury	Soccer	Preseason neuromuscular training program	97	0/97(0%)	Untrained	193	3/193(1.5%)	0.28(0.015,5. 50)	NS
Hewette et al. 1999	ACL injury	Basketball	Preseason neuromuscular training program	84	1/84(1.2%)	Untrained	189	3/189(1.6%)	0.75(0.08,7.1)	NS
Hewette et al. 1999	ACL/MCL injury	Basketball	Preseason neuromuscular training program	84	1/84(1.2%)	Untrained	189	0/189(0%)	6.7(0.27,162. 94)	NS

Table 113. Results: ACL Injury Prevention (Pre-Season Neuromuscular Training Program)

Author	Outcome	Sports	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Hewette et al. 1999	MCL injury	Basketball	Preseason neuromuscular training program	84	0/84(0%)	Untrained	189	2/189(1%)	0.45(0.02,9.3)	NS
Hewette et al. 1999	ACL injury	Soccer	Untrained	436	1/436(0.2%)					
Hewette et al. 1999	MCL injury	Basketball	Untrained	436	1/436(0.2%)					

Table 114. Results: ACL Injury Prevention (In-Season Neuromuscular Training Program)

Author	Outcome	Sports	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Olsen et al. 2005	ACL injury	Handball	Structured warm up program	958	3/958(0.3%)	Training as usual	879	10/879(1.13 %)	0.27(0.07,0.9 9)	Favors warm up program
Soderman et al. 2000	ACL injury	Soccer	Balance board training	62	3/62(4.8%)	Training as usual	78	1/78(1.3%)	3.7(0.4,35.4)	NS
Soderman et al. 2000	ACL and MCL injury	Soccer	Balance board training	62	1/62(1.6%)	Training as usual	78	0/78(0%)	3.76(0.15,90. 7)	NS
Soderman et al. 2000	MCL injury	Soccer	Balance board training	62	1/62(1.6%)	Training as usual	78	1/78(1.3%)	1.26(0.08,19. 7)	NS
Soderman et al. 2000	LCL injury	Soccer	Balance board training	62	2/62(3.2%)	Training as usual	78	0/78(0%)	6.27(0.3,128. 26)	NS
Soderman et al. 2000	Contusion	Soccer	Balance board training	62	1/62(1.6%)	Training as usual	78	4/78(5.1%)	0.31(0.03,2.7 4)	NS
Petersen et al. 2005	All knee injuries	Handball	Prevention training program	134	5/134(3%)	Training as usual	142	9/142(6%)	0.59(0.2,1.71)	NS
Petersen et al. 2005	All knee injuries from 1000 h exposure	Handball	Prevention training program	134	0.18	Training as usual	142	0.56	NA	
Petersen et al. 2005	ACL injury	Handball	Prevention training program	134	1/134(0.7%)	Training as usual	142	5/142(3%)	0.21(0.03,1.7 9)	NS
Petersen et al. 2005	ACL injury from 1000h of exposures	Handball	Prevention training program	134	0.04	Training as usual	142	0.21	NA	
Petersen et al. 2005	PCL injury	Handball	Prevention training program	134	0/134(0%)	Training as usual	142	0/142(0%)	NA	NS

Table 114. Results: ACL Injury Prevention (In-Season Neuromuscular Training Program)

Author	Outcome	Sports	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Petersen et al. 2005	PCL injury from 1000h of exposures	Handball	Prevention training program	134	NA	Training as usual	142	NA		
Petersen et al. 2005	MCL/LCL injury	Handball	Prevention training program	134	1/134(0.7%)	Training as usual	142	1/142(0.07%)	1.06(0.07,16.77)	NS
Petersen et al. 2005	PCL injury from 1000h of exposures	Handball	Prevention training program	134	0.04	Training as usual	142	0.04	NA	NS
Petersen et al. 2005	Meniscus injury	Handball	Prevention training program	134	1/134(0.7%)	Training as usual	142	2/142(1.5%)	0.53(0.05,5.78)	NS
Petersen et al. 2005	Meniscus injury from 1000h of exposures	Handball	Prevention training program	134	0.04	Training as usual	142	0.08	NA	NS
Petersen et al. 2005	Other injury	Handball	Prevention training program	134	1/134(0.7%)	Training as usual	142	2/142(1.5%)	0.53(0.05,5.78)	NS
Petersen et al. 2005	Other injury from 1000h exposure	Handball	Prevention training program	134	0.04	Training as usual	142	0.08	NA	NA
Gilchrist et al. 2008	All knee injuries	Soccer	PEP training program	583	40/583(7%)	Training as usual	852	58/852(7%)	1.01(0.68,1.49)	NS
Gilchrist et al. 2008	ACL injury	Soccer	PEP training program	583	7/583(1.2%)	Training as usual	852	18/852(2%)	0.57(0.24,1.35)	NS
Gilchrist et al. 2008	Noncontact ACL injury	Soccer	PEP training program	583	2/583(0.3%)	Training as usual	852	10/852(1.2%)	0.29(0.06,1.33)	NS
Gilchrist et al. 2008	All knee injuries in practice	Soccer	PEP training program	583	8/583(1.37%)	Training as usual	852	19/852(2.2%)	0.62(0.27,1.4)	NS

Table 114. Results: ACL Injury Prevention (In-Season Neuromuscular Training Program)

Author	Outcome	Sports	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Gilchrist et al. 2008	ACL injury in practice	Soccer	PEP training program	583	0/583(0%)	Training as usual	852	6/852(0.7%)	0.11(0.006,1.99)	NS
Gilchrist et al. 2008	Noncontact ACL injury in practice	Soccer	PEP training program	583	0/583(0%)	Training as usual	852	3/852(0.3%)	0.2(0.01,4.03)	NS
Gilchrist et al. 2008	All knee injuries in game	Soccer	PEP training program	583	29/583(5%)	Training as usual	852	37/852(4.34%)	1.15(0.71,1.84)	NS
Gilchrist et al. 2008	ACL injury in game	Soccer	PEP training program	583	7/583(1.2%)	Training as usual	852	12/852(1.4%)	0.85(0.34,2.15)	NS
Gilchrist et al. 2008	Noncontact ACL injury in game	Soccer	PEP training program	583	2/583(0.3%)	Training as usual	852	7/852(0.8%)	0.42(0.09,2)	NS
Gilchrist et al. 2008	All knee injuries (History of past ACL injury)	Soccer	PEP training program	583	7/583(1.2%)	Training as usual	852	16/852(1.9%)	0.64(0.26,1.54)	NS
Gilchrist et al. 2008	ACL injury (History of past ACL injury)	Soccer	PEP training program	583	1/583(0.2%)	Training as usual	852	7/852(0.8%)	0.21(0.03,1.69)	NS
Gilchrist et al. 2008	Noncontact ACL injury (History of past ACL injury)	Soccer	PEP training program	583	0/583(0%)	Training as usual	852	4/852(0.5%)	0.16(0.008,3.008)	NS

Table 114. Results: ACL Injury Prevention (In-Season Neuromuscular Training Program)

Author	Outcome	Sports	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Gilchrist et al. 2008	All knee injuries (No history of past ACL injury)	Soccer	PEP training program	583	33/583(5.6%)	Training as usual	852	41/852(4.81)	1.18(0.75,1.84)	NS
Gilchrist et al. 2008	ACL injury (No history of past ACL injury)	Soccer	PEP training program	583	6/583(1%)	Training as usual	852	10/852(1.7%)	0.88(0.32,2.4)	NS
Gilchrist et al. 2008	Noncontact ACL injury (No history of past ACL injury)	Soccer	PEP training program	583	2/583(0.3%)	Training as usual	852	6/852(0.7%)	0.49(0.1,2.41)	NS
LaBella et al. 2011	ACL sprain	Soccer and Basketball	Warm-up program	737	2/737(0.3%)	Training as usual	755	6/755(0.8%)	0.34(0.07,1.69)	NS
LaBella et al. 2011	Knee sprain	Soccer and Basketball	Warm-up program	737	6/737(0.8%)	Training as usual	755	11/755(1.4%)	0.55(0.2,1.5)	NS
Caraffa et al. 1996	ACL injury	Soccer	Proprioceptive training program	300	10/300(3%)	Training as usual	300	70/300(23%)	0.14(0.07,0.27)	Favors Training
Mandelbaum et al. 2005	ACL tears	Soccer	Neuromuscular and Proprioceptive training	1041	2/1041	Training as usual	1905	32/1905	0.11(0.03,0.48)	Favors training

Table 114. Results: ACL Injury Prevention (In-Season Neuromuscular Training Program)

Author	Outcome	Sports	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Mandelbaum et al. 2005	ACL tears	Soccer	Neuromuscular and Proprioceptive training	844	4/844	Training as usual	1913	35/1913	0.26(0.09,0.73)	Favors training
Mandelbaum et al. 2005	ACL tears	Soccer	Neuromuscular and Proprioceptive training	1885	6/1885	Training as usual	5703	67/3818	0.27(0.12,0.62)	Favors training
Mandelbaum et al. 2005	ACL tears by exposures	Soccer	Neuromuscular and Proprioceptive training	37476	2/37476	Training as usual	68580	32/68580	0.11(0.03,0.48)	Favors training
Mandelbaum et al. 2005	ACL tears by exposures	Soccer	Neuromuscular and Proprioceptive training	30384	4/30384	Training as usual	68868	35/68868	0.26(0.09,0.73)	Favors training
Mandelbaum et al. 2005	ACL tears by exposures	Soccer	Neuromuscular and Proprioceptive training	67860	6/67860	Training as usual	137448	67/137448	0.18(0.08,0.42)	Favors training

Figure 11. Meta-Analysis of All Investigations Meeting Inclusion Criteria for ACL Neuromuscular Training Programs

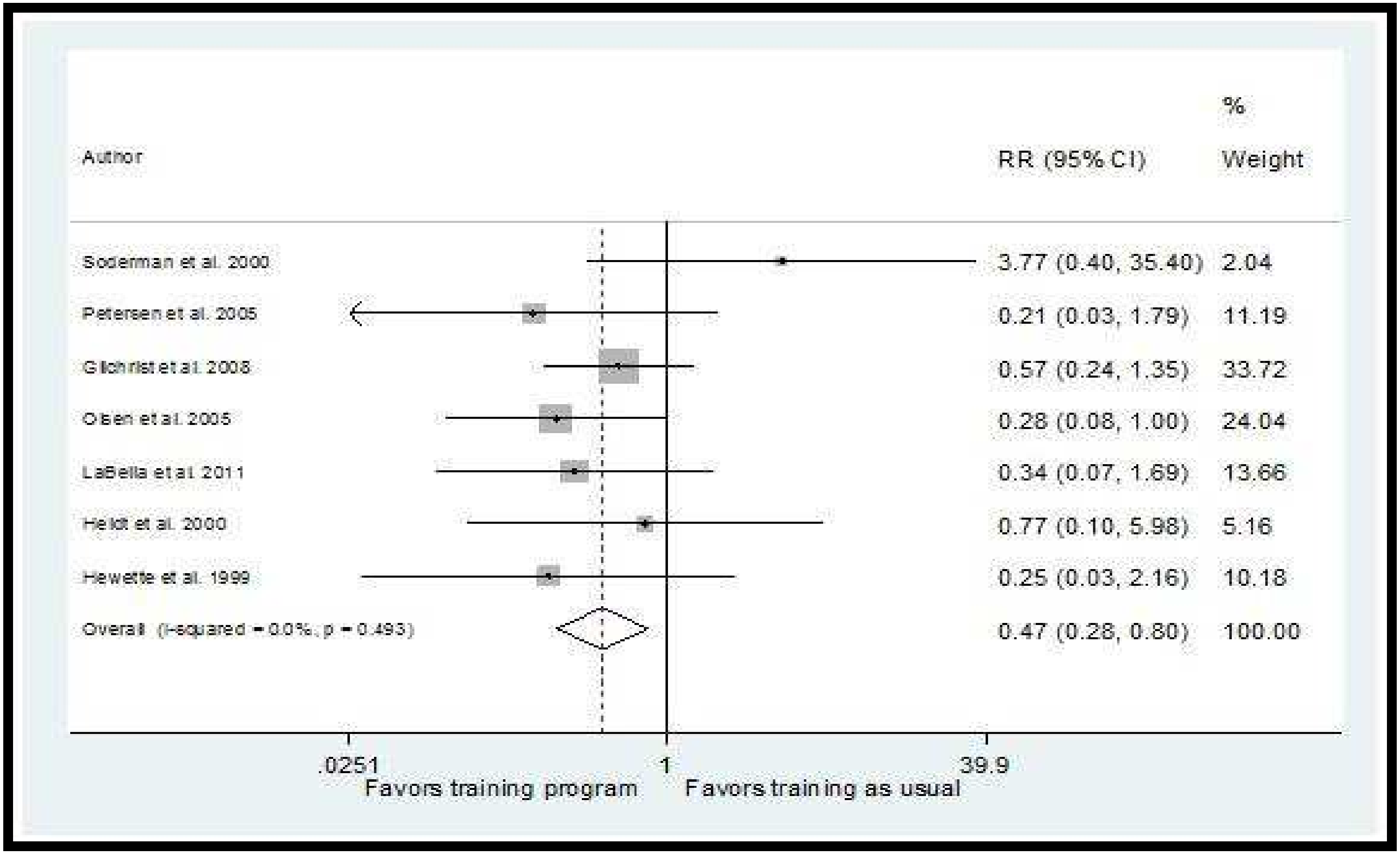


Figure 12. Meta-Analysis of Investigations that Employed the Most Homogeneous Intervention

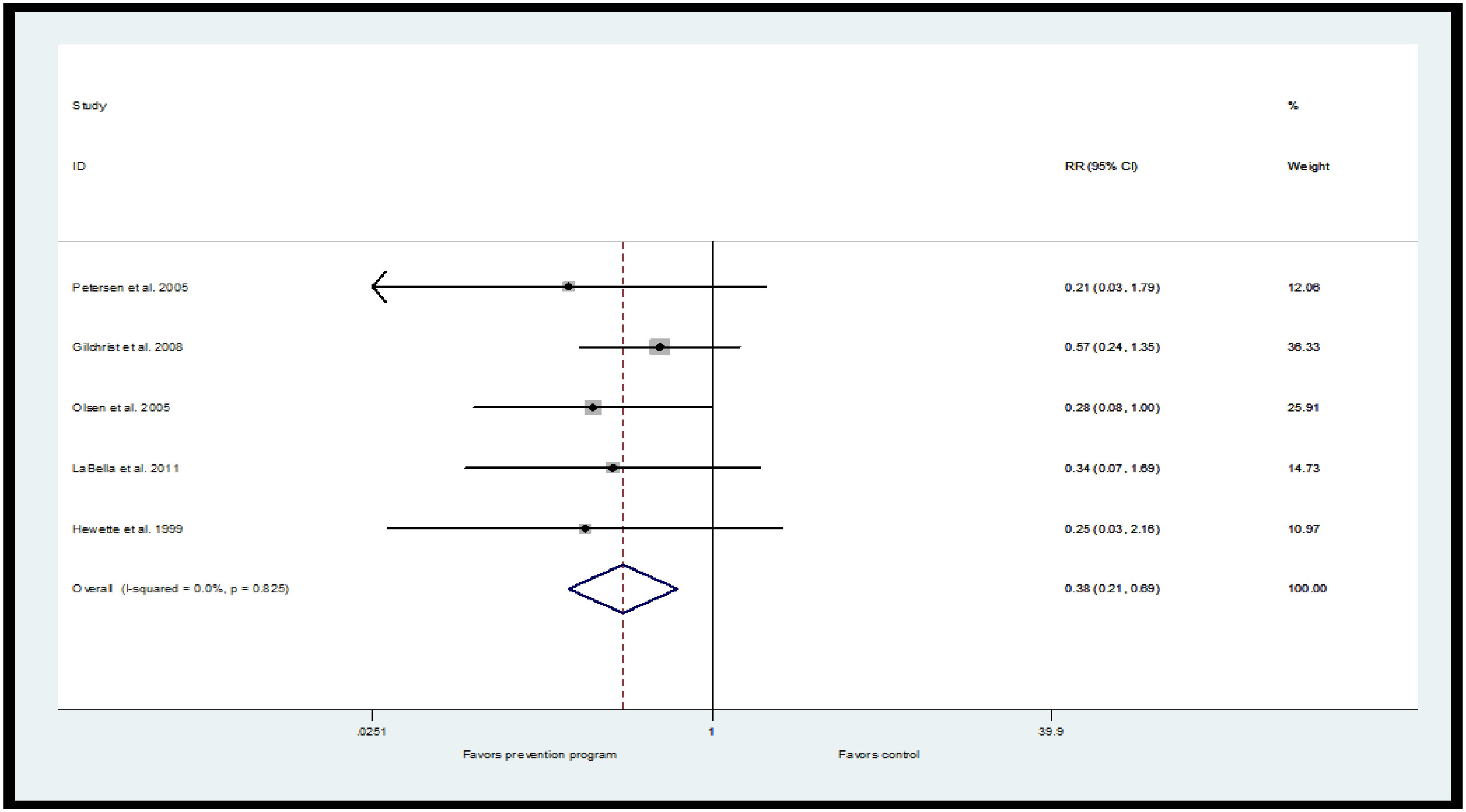


Figure 13. Number Needed to Treat (NNT) Analysis for Most Homogeneous Investigations (NNT =108.75)

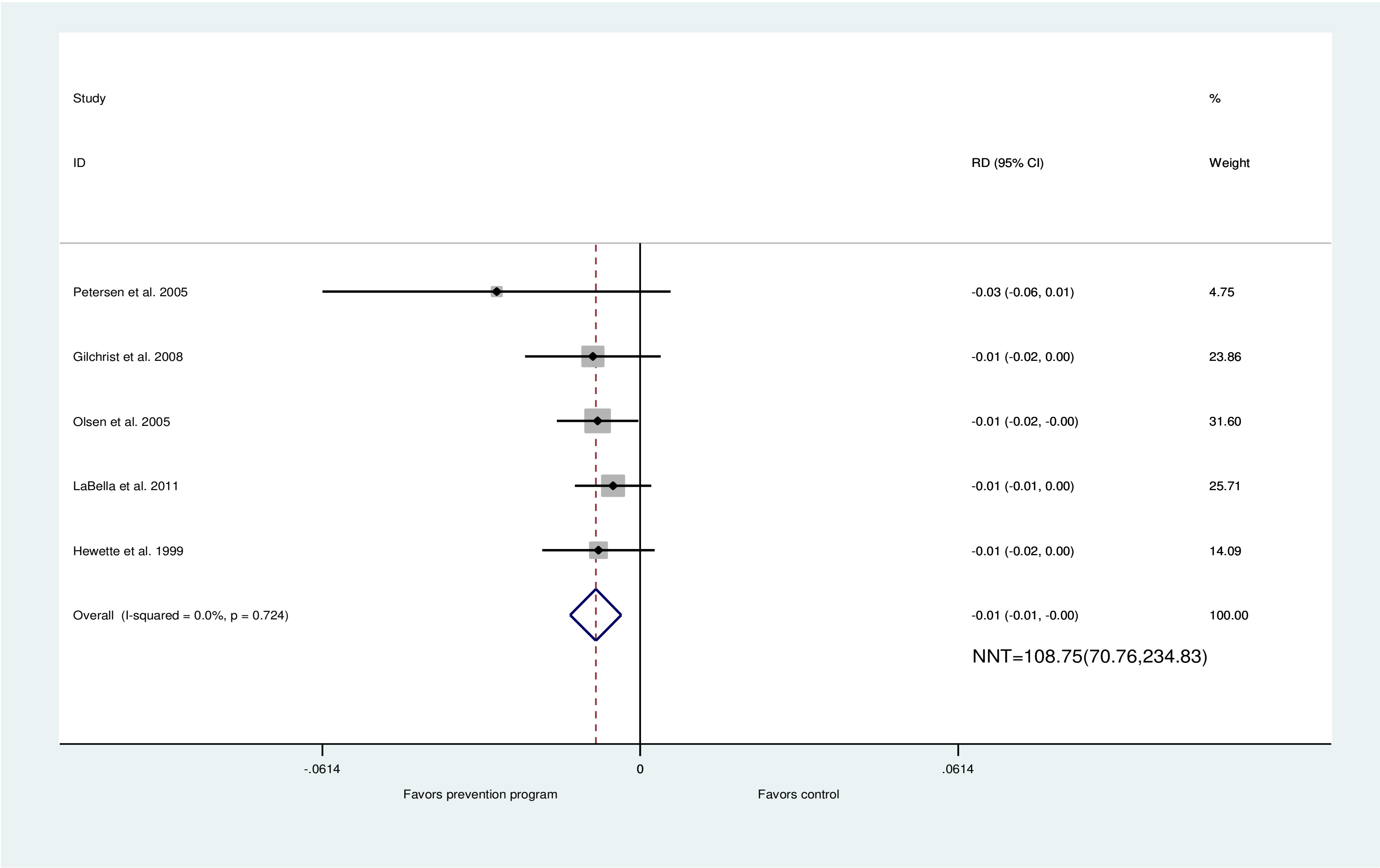
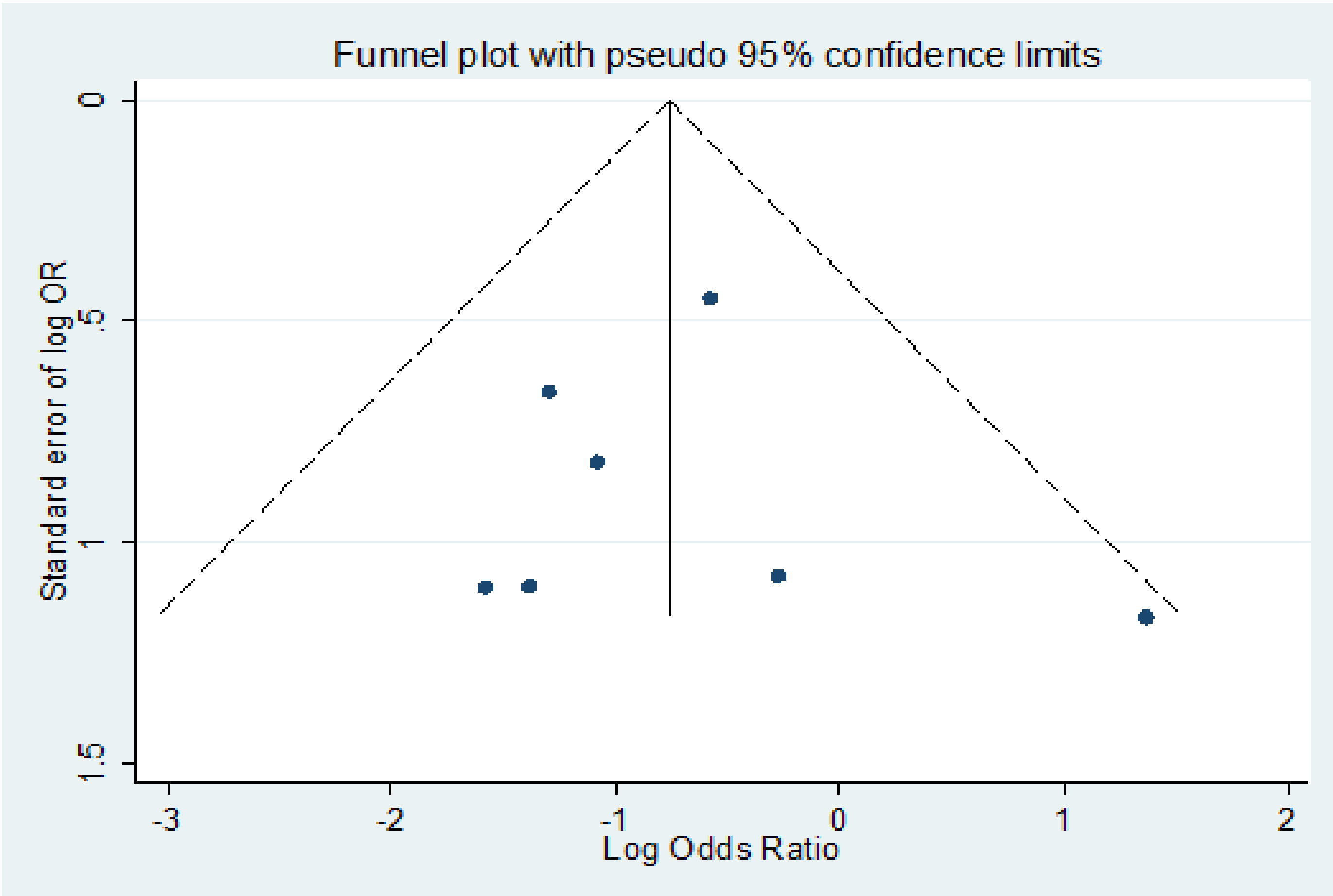


Figure 14. Publication Bias Assessment



ACL POST-OP PHYSICAL THERAPY

For those undergoing post-operative rehabilitation after ACL reconstruction, moderate evidence supports early, accelerated, and non-accelerated protocols because they have similar outcomes.

Strength of Recommendation: Moderate

RATIONALE

One high and one moderate strength study compared two year patient outcomes between a 19-week accelerated rehabilitation program versus a 32 week non-accelerated program.[14, 15] The rehabilitative programs were common relative to limits in knee ROM, the amount of weight bearing permitted, and type of rehab activity prescribed –however the accelerated programs had earlier initiation of activities known to strain the ACL, including unrestricted ROM (week 4 versus week 8), earlier weaning from brace (weeks 2-6 versus weeks 4-6), earlier OKC full knee extension (week 6 versus week 12), earlier CKC and functional tasks (week 5-6 versus week 12). At 24-months post ACL reconstruction, the two groups had similar knee laxity, clinical assessments, patient satisfaction, activity levels and functional scores; and similar detection of passive motion and knee extensor strength.[14, 15]

Other moderate strength studies examine early unrestricted motion and weight bearing (immediate versus 2-4 weeks; immediate versus 5-6 weeks) and early initiation open kinetic chain quadriceps exercise (limited range [90 – 40^{o}] starting at 4 versus 12 weeks in isolation, and all reported similar patient outcomes with early versus late initiation of these activities.[21,35, 47, 54] Early, accelerated protocols may include early weight bearing, range of motion, and strengthening including the addition of open kinetic chain exercises at six weeks.

POTENTIAL BENEFITS OF IMPLEMENTATION

The benefit of early accelerated rehabilitation is that patients may be able to return to full, unrestricted activity sooner.

POTENTIAL HARMS OF IMPLEMENTATION

The impact on long term outcomes (e.g. progression of osteoarthritis) of the timing and intensity of rehabilitation programs is currently unknown. For example, Beynnon (2005) noted that biomarkers of articular cartilage metabolism remained elevated well after the completion of both rehabilitation programs and the time interval that most individuals will return to full, unrestricted physical activity. Cleavage of Type II collagen returned to normal after 12 months, while synthesis of Type II collagen and turnover of aggrecan approached normal but remained at 24 months.

FUTURE RESEARCH

Current evidence is limited to two studies that have followed patients out 2 years post-surgery. Additional research on long term outcomes of early, accelerated, and non-accelerated rehabilitation and return to activity on long term physical activity, biomechanical deficits and incidence of complications (e.g. onset of OA) are needed.

Future Research should also address the influence of accelerated rehabilitation on graft integrity and the integrity of articular cartilage. This includes the use of imaging (MRI) to assess the effects of accelerated or delayed rehabilitation on graft healing and maturation and on the integrity of articular cartilage.

Table 115. Summary of Findings: Rehabilitation: Accelerated Versus Non Accelerated

●:Favors Accelerated ●:Favors Non accelerated ○:Not significant	Scales/Measures	Beynnon et al. 2005 (6 months) *(H)*	Beynnon et al. 2011 (6 months) *(M)*	Beynnon et al. 2005 (12 months) *(H)*	Beynnon et al. 2011 (12 months) *(M)*	Beynnon et al. 2005 (24 months) *(H)*	Beynnon et al. 2011 (24 months) *(M)*	**Meta-Analysis**
Patient satisfaction								NA
Function		● (green)	○	● (red)	○	● (green)	○	NA
Pain		○	○	○	○	○	○	NA
	IKDC Normal	○	○	○	○	○	○	NA
Quality of life		○	○	○	○	○	○	NA
Activities of daily living		○	○	○	○	○	○	NA
	Tegner Activity		○	○	○	○	○	NA
	KOOS Sports and Recreation activities	○	○	○	○	● (green)	○	NA
Stability		● (green)	○	○	○	○	○	NA
Strength			○		○		○	NA

Overall strength of study; High: *(H)*, Moderate: *(M)*, Low: *(L)*, Very low: *(V)*

QUALITY AND APPLICABILITY SUMMARY

Table 116. Quality and Applicability Summary: Rehabilitation After ACLR

Study	Outcome	Graft	Rehab	Duration	Quality	Applicability	Overall Strength of Evidence
Fukuda et al. 2013	Function (Hop test)	Semitendinosus and gracilis autografts	Early vs. Late kinetic chain exercises	6&17 months	Moderate	Moderate	Moderate
Beynnon et al. 2011	Function (One legged hop test)	Bone-patellar tendon bone graft	Accelerated/Non-Accelerated	6,12 and 24 months	Moderate	Moderate	Moderate
Isberg et al. 2006	Function (One-leg hop test)	Patellar tendon	Allowing vs. not allowing full active and passive extension	24 months	Moderate	Moderate	Moderate
Beynnon et al. 2005	Function (Single-legged hop test)	Bone-patellar tendon bone graft	Accelerated/Non-Accelerated	6,12 and 24 months	High	Moderate	High
Beynnon et al. 2005	IKDC	Bone-patellar tendon bone graft	Accelerated/Non-Accelerated	Over the top with an interference screw	High	Moderate	High
Beynnon et al. 2011	IKDC	Bone-patellar tendon bone graft	Accelerated/Non-Accelerated	6,12 and 24 months	Moderate	Moderate	Moderate
Heijne et al. 2007	IKDC	Bone patellar tendon or Hamstring tendon	4th vs. 12th week start of quadriceps exercises	7 months	Moderate	Moderate	Moderate
Isberg et al. 2006	IKDC	Patellar tendon	Allowing vs. not allowing full active and passive	24 months	Moderate	Moderate	Moderate

Table 116. Quality and Applicability Summary: Rehabilitation After ACLR

Study	Outcome	Graft	Rehab	Duration	Quality	Applicability	Overall Strength of Evidence
			extension				
Beynnon et al. 2005	KOOS (Pain, Symptoms, Activities of daily living, Sports and recreation, Quality of life)	Bone-patellar tendon bone graft	Accelerated/Non-Accelerated	6,12 and 24 months	High	Moderate	High
Beynnon et al. 2011	KOOS (Pain, Symptoms, Activities of daily living, Sports and recreation, Quality of life)	Bone-patellar tendon bone graft	Accelerated/Non-Accelerated	6,12 and 24 months	Moderate	Moderate	Moderate
Fukuda et al. 2013	Lysholm score	Semitendinosus and gracilis autografts	Early vs. Late kinetic chain exercises	6&17 months	Moderate	Moderate	Moderate
Isberg et al. 2006	Lysholm score	Patellar tendon	Allowing vs. not allowing full active and passive extension	24 months	Moderate	Moderate	Moderate
Fukuda et al. 2013	Numerical pain rating	Semitendinosus and gracilis autografts	Early vs. Late kinetic chain exercises	6&17 months	Moderate	Moderate	Moderate

Table 116. Quality and Applicability Summary: Rehabilitation After ACLR

Study	Outcome	Graft	Rehab	Duration	Quality	Applicability	Overall Strength of Evidence
Heijne et al. 2007	Pain	Bone patellar tendon or Hamstring tendon	4^{th} vs. 12^{th} week start of quadriceps exercises	7 months	Moderate	Moderate	Moderate
Heijne et al. 2007	Range of motion	Bone patellar tendon or Hamstring tendon	4^{th} vs. 12^{th} week start of quadriceps exercises	7 months	Moderate	Moderate	Moderate
Heijne et al. 2007	Stability (Anterior knee laxity Pivot shift)	Bone patellar tendon or Hamstring tendon	4^{th} vs. 12^{th} week start of quadriceps exercises	7 months	Moderate	Moderate	Moderate
Beynnon et al. 2011	Stability (KT 1000)	Bone-patellar tendon bone graft	Accelerated/Non-Accelerated	6,12 and 24 months	Moderate	Moderate	Moderate
Isberg et al. 2006	Stability (KT:1000)	Patellar tendon	Allowing vs. not allowing full active and passive extension	24 months	Moderate	Moderate	Moderate
Fukuda et al. 2013	Stability (Laxity)	Semitendinosus and gracilis autografts	Early vs. Late kinetic chain exercises	6&17 months	Moderate	Moderate	Moderate
Beynnon et al. 2005	Stability (KT-1000 laxity)	Bone-patellar tendon bone graft	Accelerated/Non-Accelerated	6,12 and 24 months	High	Moderate	High
Beynnon et al. 2011	Strength	Bone-patellar tendon bone graft	Accelerated/Non-Accelerated	6,12 and 24 months	Moderate	Moderate	Moderate

Table 116. Quality and Applicability Summary: Rehabilitation After ACLR

Study	Outcome	Graft	Rehab	Duration	Quality	Applicability	Overall Strength of Evidence
Fukuda et al. 2013	Strength	Semitendinosus and gracilis autografts	Early vs. Late kinetic chain exercises	6&17 months	Moderate	Moderate	Moderate
Heijne et al. 2007	Strength	Bone patellar tendon or Hamstring tendon	4th vs. 12th week start of quadriceps exercises	7 months	Moderate	Moderate	Moderate
Beynnon et al. 2005	Tegner activity level	Bone-patellar tendon bone graft	Accelerated/Non-Accelerated	6,12 and 24 months	High	Moderate	High
Beynnon et al. 2011	Tegner activity level	Bone-patellar tendon bone graft	Accelerated/Non-Accelerated	6,12 and 24 months	Moderate	Moderate	Moderate
Isberg et al. 2006	Tegner activity score	Patellar tendon	Allowing vs. not allowing full active and passive extension	24 months	Moderate	Moderate	Moderate

(Back to top)

RESULTS

QUALITY AND APPLICABILITY

Table 117. Quality and Applicability: Rehabilitation After ACLR

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Fukuda et al. 2013	Function (Hop test)	●	○	●	○	●	●	●	**Moderate**	●	○	●	●	**Moderate**
Beynnon et al. 2011	Function (One legged hop test)	●	○	●	●	●	●	○	**Moderate**	●	○	○	○	**Moderate**
Isberg et al. 2006	Function (One-leg hop test)	●	○	●	●	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Beynnon et al. 2005	Function (Single-legged hop test)	●	●	●	●	●	●	●	**High**	●	○	○	○	**Moderate**
Beynnon et al. 2005	IKDC	●	●	●	●	●	●	●	**High**	●	○	○	○	**Moderate**
Beynnon et al. 2011	IKDC	●	○	●	●	●	●	○	**Moderate**	●	○	○	○	**Moderate**
Isberg et al. 2006	IKDC	●	○	●	●	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Beynnon et al. 2005	KOOS (Pain, Symptoms,	●	●	●	●	●	●	●	**High**	●	○	○	○	**Moderate**

Table 117. Quality and Applicability: Rehabilitation After ACLR

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Beynnon et al. 2011	Activities of daily living, Sports and recreation, Quality of life) KOOS (Pain, Symptoms, Activities of daily living, Sports and recreation, Quality of life)	●	○	●	●	●	●	○	**Moderate**	●	○	○	○	**Moderate**
Fukuda et al. 2013	Lysholm score	●	○	●	○	●	●	●	**Moderate**	●	○	●	●	**Moderate**
Isberg et al. 2006	Lysholm score	●	○	●	●	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Fukuda et al. 2013	Numerical pain rating	●	○	●	○	●	●	●	**Moderate**	●	○	●	●	**Moderate**
Heijne et al. 2007	Pain	●	○	●	●	○	●	●	**Moderate**	●	○	●	○	**Moderate**
Heijne et al. 2007	IKDC	●	○	●	●	○	●	●	**Moderate**	●	○	●	○	**Moderate**

Table 117. Quality and Applicability: Rehabilitation After ACLR

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Heijne et al. 2007	Range of motion	●	○	●	●	○	●	●	**Moderate**	●	○	●	○	**Moderate**
Heijne et al. 2007	Stability (Anterior knee laxity Pivot shift)	●	○	●	●	○	●	●	**Moderate**	●	○	●	○	**Moderate**
Beynnon et al. 2011	Stability (KT 1000)	●	○	●	●	●	●	○	**Moderate**	●	○	○	○	**Moderate**
Isberg et al. 2006	Stability (KT:1000)	●	○	●	●	●	●	○	**Moderate**	●	○	●	●	**Moderate**
Fukuda et al. 2013	Stability (Laxity)	●	○	●	○	●	●	●	**Moderate**	●	○	●	●	**Moderate**
Beynnon et al. 2005	Stability (KT-1000 laxity)	●	●	●	●	●	●	●	**High**	●	○	○	○	**Moderate**
Beynnon et al. 2011	Strength	●	○	●	●	●	●	○	**Moderate**	●	○	○	○	**Moderate**
Fukuda et al. 2013	Strength	●	○	●	○	●	●	●	**Moderate**	●	○	●	●	**Moderate**
Heijne et al. 2007	Strength	●	○	●	●	○	●	●	**Moderate**	●	○	●	○	**Moderate**

Table 117. Quality and Applicability: Rehabilitation After ACLR

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Beynnon et al. 2005	Tegner activity level	●	●	●	●	●	●	●	**High**	●	○	○	○	**Moderate**
Beynnon et al. 2011	Tegner activity level	●	○	●	●	●	●	○	**Moderate**	●	○	○	○	**Moderate**
Isberg et al. 2006	Tegner activity score	●	○	●	●	●	●	○	**Moderate**	●	○	●	●	**Moderate**

FINDINGS

Table 118. Results: Rehabilitation After ACLR (Accelerated Versus Non Accelerated)

Author	Study Strength	Outcome	Follow up	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Beynnon et al. 2005	*High*	Stability (KT-1000 AP 90N knee laxity)	6 months	Accelerated	10	2.4(1.6)	Non accelerated	12	0.6(2.4)	1.8(-0.05,3.65)	NS
Beynnon et al. 2005	*High*	Stability (KT-1000 AP 90N knee laxity)	12 months	Accelerated	10	3.8(1.6)	Non accelerated	12	1.5(3.2)	2.3(-0.01,4.61)	NS
Beynnon et al. 2005	High	Stability (KT-1000 AP 90N knee laxity)	24 months	Accelerated	10	2.9(2)	Non accelerated	12	1.4(2.2)	1.5(-0.38,3.38)	NS
Beynnon et al. 2005	*High*	Stability (KT-1000 AP 130N knee laxity)	6 months	Accelerated	10	2.7(1.7)	Non accelerated	12	0.6(2.5)	**2.1(0.17,4.03)**	Favors non accelerated
Beynnon et al. 2005	*High*	Stability (KT-1000 AP 130N knee laxity)	12 months	Accelerated	10	3.9(1.6)	Non accelerated	12	1.5(3.4)	2.4(-0.03,4.83)	NS
Beynnon et al. 2005	High	Stability (KT-1000 AP 130N knee laxity)	24 months	Accelerated	10	3.2(2.3)	Non accelerated	12	1.8(2.5)	1.4(-0.74,3.54)	NS
Beynnon et al. 2005	*High*	IKDC A	6 months	Accelerated	10	0/10(0 %)	Non accelerated	12	0/12(0%)	1.18(0.02,54.8)	NS
Beynnon et al. 2005	*High*	IKDC B	6 months	Accelerated	10	2/10(20 %)	Non accelerated	12	1/12(8%)	2.4(0.25,22.75)	NS
Beynnon et al. 2005	*High*	IKDC C	6 months	Accelerated	10	6/10(60 %)	Non accelerated	12	8/12(67%)	0.9(0.47,1.71)	NS
Beynnon et al. 2005	*High*	IKDC D	6 months	Accelerated	10	0/10(0 %)	Non accelerated	12	0/12(0%)	1.18(0.02,54.8)	NS
Beynnon et al. 2005	*High*	IKDC A	12 months	Accelerated	10	4/10(40 %)	Non accelerated	12	2/12(17%)	2.4(0.55,10.5)	NS
Beynnon et al. 2005	*High*	IKDC B	12 months	Accelerated	10	3/10(30 %)	Non accelerated	12	3/12(25%)	1.2(0.3,4.7)	NS
Beynnon et al. 2005	*High*	IKDC C	12 months	Accelerated	10	2/10(20 %)	Non accelerated	12	4/12(33%)	0.6(0.14,2.62)	NS
Beynnon et al. 2005	*High*	IKDC D	12 months	Accelerated	10	0/10(0 %)	Non accelerated	12	0/12(0%)	1.18(0.02,54.8)	NS
Beynnon et	High	IKDC A	24	Accelerated	10	2/10(20	Non accelerated	12	1/12(8%)	2.4(0.25,22.75)	NS

Table 118. Results: Rehabilitation After ACLR (Accelerated Versus Non Accelerated)

Author	Study Strength	Outcome	Follow up	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
al. 2005			months			%)					
Beynnon et al. 2005	High	IKDC B	24 months	Accelerated	10	4/10(40 %)	Non accelerated	12	7/12(58%)	0.68(0.28,1.69)	NS
Beynnon et al. 2005	High	IKDC C	24 months	Accelerated	10	3/10(30 %)	Non accelerated	12	2/12(17%)	1.8(0.37,8.74)	NS
Beynnon et al. 2005	High	IKDC D	24 months	Accelerated	10	0/10(0 %)	Non accelerated	12	0/12(0%)	1.18(0.02,54.8)	NS
Beynnon et al. 2005	*High*	Pain (KOOS)	6 months	Accelerated	10	88.8(8. 3)	Non accelerated	12	93.1(7.9)	-4.3(-11.48,2.88)	NS
Beynnon et al. 2005	*High*	Pain (KOOS)	12 months	Accelerated	10	93.6(9. 2)	Non accelerated	12	95.6(5.1)	-2(-8.43,4.43)	NS
Beynnon et al. 2005	High	Pain (KOOS)	24 months	Accelerated	10	93.9(8. 7)	Non accelerated	12	94.1(5.7)	-0.2(-6.6,6.2)	NS
Beynnon et al. 2005	*High*	Symptoms (KOOS)	6 months	Accelerated	10	88.6(8. 7)	Non accelerated	12	85.6(9.5)	3(-5.12,11.12)	NS
Beynnon et al. 2005	*High*	Symptoms (KOOS)	12 months	Accelerated	10	91.1(5. 9)	Non accelerated	12	91.6(7.9)	-0.5(-6.78,5.78)	NS
Beynnon et al. 2005	High	Symptoms (KOOS)	24 months	Accelerated	10	94.2(5. 5)	Non accelerated	12	88.2(13.6)	6(-3.54,15.54)	NS
Beynnon et al. 2005	*High*	Activities of daily living (KOOS)	6 months	Accelerated	10	95.1(4. 2)	Non accelerated	12	97.6(2.7)	-2.5(-5.57,0.57)	NS
Beynnon et al. 2005	*High*	Activities of daily living (KOOS)	12 months	Accelerated	10	97.3(3. 6)	Non accelerated	12	99.3(1.1)	-2(-4.26,0.26)	NS
Beynnon et al. 2005	High	Activities of daily living (KOOS)	24 months	Accelerated	10	97.6(3. 1)	Non accelerated	12	98.8(2.4)	-1.2(-3.63,1.23)	NS
Beynnon et al. 2005	*High*	Sports and recreational participation (KOOS)	6 months	Accelerated	10	72.5(16 .2)	Non accelerated	12	68.2(16.8)	4.3(-10.38,18.98)	NS
Beynnon et al. 2005	*High*	Sports and recreational participation (KOOS)	12 months	Accelerated	10	85(15.1)	Non accelerated	12	82.7(14.9)	2.3(-11.01,15.61)	NS
Beynnon et	High	Sports and	24	Accelerated	10	97.6(3.	Non accelerated	12	86.3(12.8)	11.3(2.67,19.93)	Favors

Table 118. Results: Rehabilitation After ACLR (Accelerated Versus Non Accelerated)

Author	Study Strength	Outcome	Follow up	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
al. 2005		recreational participation (KOOS)	months			1)					accelerated (Possibly important)
Beynnon et al. 2005	*High*	Quality of life (KOOS)	6 months	Accelerated	10	64.1(6.8)	Non accelerated	12	58.9(17.3)	5.2(-6.89,17.29)	NS
Beynnon et al. 2005	*High*	Quality of life (KOOS)	12 months	Accelerated	10	73.8(13.2)	Non accelerated	12	76.2(19.5)	-2.4(-17.46,12.66)	NS
Beynnon et al. 2005	High	Quality of life (KOOS)	24 months	Accelerated	10	78.7(11.1)	Non accelerated	12	82.4(17.3)	-3.7(-16.87,9.47)	NS
Beynnon et al. 2005	High	Tegner activity level	24 months	Accelerated	10	5(3-8)	Non accelerated	12	5(2-6)	NA	NS
Beynnon et al. 2005	*High*	Function (Single leg hop test cm)	6 months	Accelerated	10	31(4.6)	Non accelerated	12	22.3(4.7)	8.7(4.57,12.83)	Favors accelerated
Beynnon et al. 2005	*High*	Function (Single leg hop test cm)	12 months	Accelerated	10	7.3(4.2)	Non accelerated	12	15.8(6.7)	-8.5(-13.57,-3.43)	Favors non accelerated
Beynnon et al. 2005	High	Function (Single leg hop test cm)	24 months	Accelerated	10	12.6(4.7)	Non accelerated	12	7.8(2.2)	4.8(1.65,7.95)	Favors accelerated
Beynnon et al. 2011	*Moderate*	Stability (A-P displacement mm, Roentgen streophotogrammetric laxity)	6 months	Accelerated	20	11.3(3.89)	Non accelerated	17	11.7(3.75)	-0.4(-2.96,2.16)	NS
Beynnon et al. 2011	*Moderate*	Stability (A-P displacement mm, Roentgen streophotogrammetric laxity)	12 months	Accelerated	19	11.3(2.92)	Non accelerated	17	11.9(2.93)	-0.6(-2.58,1.38)	NS
Beynnon et al. 2011	Moderate	Stability (A-P displacement mm, Roentgen streophotogrammetric laxity)	24 months	Accelerated	19	0.77(3.35)	Non accelerated	17	12.8(3.38)	-12.03(-14.31,-9.75)	Favors accelerated
Beynnon et al. 2011	*Moderate*	Stability (M-L displacement mm,	6 months	Accelerated	20	0.34(3.3)	Non accelerated	17	-0.2(3.17)	0.54(-1.63,2.71)	NS

Table 118. Results: Rehabilitation After ACLR (Accelerated Versus Non Accelerated)

Author	Study Strength	Outcome	Follow up	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		Roentgen streophotogrammetric laxity)									
Beynnon et al. 2011	*Moderate*	Stability (M-L displacement mm, Roentgen streophotogrammetric laxity)	12 months	Accelerated	19	-0.2(2.83)	Non accelerated	17	0.1(2.84)	-0.3(-2.22,1.62)	NS
Beynnon et al. 2011	Moderate	Stability (M-L displacement mm, Roentgen streophotogrammetric laxity)	24 months	Accelerated	19	0.7(2.31)	Non accelerated	17	-0.6(2.35)	1.3(-0.28,2.88)	NS
Beynnon et al. 2011	*Moderate*	Stability (P-D displacement mm, Roentgen streophotogrammetric laxity)	6 months	Accelerated	20	1.5(1.30)	Non accelerated	17	1.9(1.24)	-0.4(-1.25,0.45)	NS
Beynnon et al. 2011	*Moderate*	Stability (P-D displacement mm, Roentgen streophotogrammetric laxity)	12 months	Accelerated	19	1.4(1.48)	Non accelerated	17	1.9(1.48)	-0.5(-1.5,0.5)	NS
Beynnon et al. 2011	Moderate	Stability (P-D displacement mm, Roentgen streophotogrammetric laxity)	24 months	Accelerated	19	1.6(1.48)	Non accelerated	17	2(1.48)	-0.4(-1.4,0.6)	NS
Beynnon et al. 2011	*Moderate*	Stability (Absolute displacement mm, Roentgen streophotogrammetric laxity)	6 months	Accelerated	20	12(3.98)	Non accelerated	17	12.2(3.83)	-0.2(-2.81,2.41)	NS
Beynnon et	*Moderate*	Stability (Absolute	12	Accelerated	19	11.6(3.	Non accelerated	17	12.3(3.13)	-0.7(-2.82,1.42)	NS

Table 118. Results: Rehabilitation After ACLR (Accelerated Versus Non Accelerated)

Author	Study Strength	Outcome	Follow up	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
al. 2011		displacement mm, Roentgen streophotogrammetric laxity)	months			14)					
Beynnon et al. 2011	Moderate	Stability (Absolute displacement mm, Roentgen streophotogrammetric laxity)	24 months	Accelerated	19	11.9(3.44)	Non accelerated	17	13.2(3.46)	-1.3(-3.64,1.04)	NS
Beynnon et al. 2011	*Moderate*	Stability (External rotation, deg, Roentgen streophotogrammetric)	6 months	Accelerated	20	13.3(4.3)	Non accelerated	17	12.9(4)	0.4(-2.38,3.18)	NS
Beynnon et al. 2011	*Moderate*	Stability (External rotation, deg, Roentgen streophotogrammetric)	12 months	Accelerated	19	14.5(3.3)	Non accelerated	17	13.3(2.8)	1.2(-0.88,3.28)	NS
Beynnon et al. 2011	Moderate	Stability (External rotation, deg, Roentgen streophotogrammetric)	24 months	Accelerated	19	13.3(4.1)	Non accelerated	17	13.2(2.3)	0.1(-2.18,2.38)	NS
Beynnon et al. 2011	*Moderate*	Stability (Varus rotation, deg, Roentgen streophotogrammetric)	6 months	Accelerated	20	3.6(4.3)	Non accelerated	17	4.4(3.2)	-0.8(-3.36,1.76)	NS
Beynnon et al. 2011	*Moderate*	Stability (Varus rotation, deg, Roentgen streophotogrammetric)	12 months	Accelerated	19	4.4(3.8)	Non accelerated	17	4.8(3.2)	-0.4(-2.79,1.99)	NS

Table 118. Results: Rehabilitation After ACLR (Accelerated Versus Non Accelerated)

Author	Study Strength	Outcome	Follow up	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Beynnon et al. 2011	Moderate	Stability (Varus rotation, deg, Roentgen streophotogrammetric)	24 months	Accelerated	19	3.2(3.3)	Non accelerated	17	4.7(3.3)	-1.5(-3.73,0.73)	NS
Beynnon et al. 2011	*Moderate*	Stability (Extension rotation, deg, Roentgen streophotogrammetric)	6 months	Accelerated	20	12.9(4.7)	Non accelerated	17	13.7(4.1)	-0.8(-3.76,2.16)	NS
Beynnon et al. 2011	*Moderate*	Stability (Extension rotation, deg, Roentgen streophotogrammetric)	12 months	Accelerated	19	15.3(5.6)	Non accelerated	17	13.7(3.7)	1.6(-1.65,4.85)	NS
Beynnon et al. 2011	Moderate	Stability (Extension rotation, deg, Roentgen streophotogrammetric)	24 months	Accelerated	19	14.2(4.3)	Non accelerated	17	13.7(3.2)	0.5(-2.09,3.09)	NS
Beynnon et al. 2011	*Moderate*	IKDC A	6 months	Accelerated	19	0/19(0%)	Non accelerated	15	1/15(7%)	0.26(0.01,6.11)	NS
Beynnon et al. 2011	*Moderate*	IKDC B	6 months	Accelerated	19	10/19(53%)	Non accelerated	15	4/15(27%)	1.97(0.77,5.06)	NS
Beynnon et al. 2011	*Moderate*	IKDC C	6 months	Accelerated	19	8/19(42%)	Non accelerated	15	4/15(27%)	1.58(0.58,4.25)	NS
Beynnon et al. 2011	*Moderate*	IKDC D	6 months	Accelerated	19	1/19(5%)	Non accelerated	15	6/15(40%)	0.13(0.02,0.98)	NS
Beynnon et al. 2011	*Moderate*	IKDC A	12 months	Accelerated	18	5/18(28%)	Non accelerated	17	2/17(12%)	2.36(0.53,10.58)	NS
Beynnon et al. 2011	*Moderate*	IKDC B	12 months	Accelerated	18	9/18(50%)	Non accelerated	17	10/17(59%)	0.85(0.46,1.56)	NS
Beynnon et al. 2011	*Moderate*	IKDC C	12 months	Accelerated	18	3/18(17%)	Non accelerated	17	4/17(24%)	0.7(0.18,2.71)	NS

Table 118. Results: Rehabilitation After ACLR (Accelerated Versus Non Accelerated)

Author	Study Strength	Outcome	Follow up	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Beynnon et al. 2011	*Moderate*	IKDC D	12 months	Accelerated	18	1/18(6 %)	Non accelerated	17	1/17(6%)	0.94(0.06,13.9)	NS
Beynnon et al. 2011	Moderate	IKDC A	24 months	Accelerated	18	7/18(39 %)	Non accelerated	17	4/17(25%)	1.65(0.59,4.65)	NS
Beynnon et al. 2011	Moderate	IKDC B	24 months	Accelerated	18	7/18(39 %)	Non accelerated	17	10/17(63%)	0.66(0.33,1.33)	NS
Beynnon et al. 2011	Moderate	IKDC C	24 months	Accelerated	18	3/18(17 %)	Non accelerated	17	0/17(0%)	6.63(0.36,119.59)	NS
Beynnon et al. 2011	Moderate	IKDC D	24 months	Accelerated	18	1/18(6 %)	Non accelerated	17	2/17(13%)	0.47(0.047,4.74)	NS
Beynnon et al. 2011	*Moderate*	Pain (KOOS)	6 months	Accelerated	20	88(14)	Non accelerated	17	87(10)	1(-7.24,9.24)	NS
Beynnon et al. 2011	*Moderate*	Pain (KOOS)	12 months	Accelerated	19	92(12)	Non accelerated	17	91(10)	1(-6.52,8.52)	NS
Beynnon et al. 2011	Moderate	Pain (KOOS)	24 months	Accelerated	19	93(12)	Non accelerated	17	95(6)	-2(-8.54,4.54)	NS
Beynnon et al. 2011	*Moderate*	Symptoms (KOOS)	6 months	Accelerated	20	86(7)	Non accelerated	17	80(13)	6(-0.81,12.81)	NS
Beynnon et al. 2011	*Moderate*	Symptoms (KOOS)	12 months	Accelerated	19	92(8)	Non accelerated	17	83(16)	9(0.59,17.41)	Favors accelerated (Possibly important)
Beynnon et al. 2011	Moderate	Symptoms (KOOS)	24 months	Accelerated	19	93(6)	Non accelerated	17	90(12)	3(-3.31,9.31)	NS
Beynnon et al. 2011	*Moderate*	Activities of daily living (KOOS)	6 months	Accelerated	20	95(13)	Non accelerated	17	94(6)	1(-5.95,7.95)	NS
Beynnon et al. 2011	*Moderate*	Activities of daily living (KOOS)	12 months	Accelerated	19	96(13)	Non accelerated	17	98(4)	-2(-8.67,4.67)	NS
Beynnon et al. 2011	Moderate	Activities of daily living (KOOS)	24 months	Accelerated	19	97(10)	Non accelerated	17	98(3)	-1(-6.12,4.12)	NS
Beynnon et al. 2011	*Moderate*	Sports and recreation (KOOS)	6 months	Accelerated	20	74(21)	Non accelerated	17	70(24)	4(-10.99,18.99)	NS
Beynnon et al. 2011	*Moderate*	Sports and recreation (KOOS)	12 months	Accelerated	19	87(21)	Non accelerated	17	88(13)	-1(-12.98,10.98)	NS

Table 118. Results: Rehabilitation After ACLR (Accelerated Versus Non Accelerated)

Author	Study Strength	Outcome	Follow up	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Beynnon et al. 2011	Moderate	Sports and recreation (KOOS)	24 months	Accelerated	19	92(17)	Non accelerated	17	93(9)	-1(-10.36,8.36)	NS
Beynnon et al. 2011	*Moderate*	Quality of life (KOOS)	6 months	Accelerated	20	67(18)	Non accelerated	17	63(27)	4(-11.08,19.08)	NS
Beynnon et al. 2011	*Moderate*	Quality of life (KOOS)	12 months	Accelerated	19	81(18)	Non accelerated	17	75(17)	6(-5.87,17.87)	NS
Beynnon et al. 2011	Moderate	Quality of life (KOOS)	24 months	Accelerated	19	86(14)	Non accelerated	17	80(18)	6(-4.84,16.84)	NS
Beynnon et al. 2011	*Moderate*	Tegner activity level	6 months	Accelerated	20	5.4	Non accelerated	17	5.3	NA	NS
Beynnon et al. 2011	*Moderate*	Tegner activity level	12 months	Accelerated	19	6.5	Non accelerated	17	5.7	NA	NS
Beynnon et al. 2011	Moderate	Tegner activity level	24 months	Accelerated	19	6.5	Non accelerated	17	5.6	NA	NS
Beynnon et al. 2011	*Moderate*	Function (Single leg hop test cm)	6 months	Accelerated	20	23.6(20.3)	Non accelerated	17	38.9(39.6)	-15.3(-35.8,5.2)	NS
Beynnon et al. 2011	*Moderate*	Function (Single leg hop test cm)	12 months	Accelerated	19	11.3(14.3)	Non accelerated	17	4.8(20.3)	6.5(-5.27,18.27)	NS
Beynnon et al. 2011	Moderate	Function (Single leg hop test cm)	24 months	Accelerated	19	4(13.2)	Non accelerated	17	9.6(18.5)	-5.6(-16.38,5.18)	NS
Beynnon et al. 2011	*Moderate*	Strength	6 months	Accelerated	20	NR	Non accelerated	17	NR	NA	NS
Beynnon et al. 2011	*Moderate*	Strength	12 months	Accelerated	19	NR	Non accelerated	17	NR	NA	NS
Beynnon et al. 2011	Moderate	Strength	24 months	Accelerated	19	NR	Non accelerated	17	NR	NA	NS

Table 119. Results: Rehabilitation After ACLR (Early Versus Late Start)

Author	Study Strength	Outcome	Follow-up	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Heijne et al. 2007	Moderate	IKDC (Range of motion)	7 months	Open kinetic chain quadriceps exercises 4th week	16	NR	Open kinetic chain quadriceps exercises 12th week	14	NR	NA	NS
Heijne et al. 2007	Moderate	IKDC (Range of motion)	7 months	Open kinetic chain quadriceps exercises 4th week	16	NR	Open kinetic chain quadriceps exercises 12th week	14	NR	NA	NS
Heijne et al. 2007	Moderate	Stability (KT-1000 max)	7 months	Open kinetic chain quadriceps exercises 4th week	16	1.3(1.44)	Open kinetic chain quadriceps exercises 12th week	14	1.3(1.26)	0(-1,1)	NS
Heijne et al. 2007	Moderate	Stability (KT-1000 max)	7 months	Open kinetic chain quadriceps exercises 4th week	16	2.3(1.38)	Open kinetic chain quadriceps exercises 12th week	14	1.2(1.56)	1.1(0,2.19)	NS
Heijne et al. 2007	Moderate	Stability (Pivot shift)	7 months	Open kinetic chain quadriceps exercises 4th week	16	NR	Open kinetic chain quadriceps exercises 12th week	14	NR	NA	NS
Heijne et al. 2007	Moderate	Stability (Pivot shift)	7 months	Open kinetic chain quadriceps exercises 4th week	16	NR	Open kinetic chain quadriceps exercises 12th week	14	NR	NA	NS
Heijne et al. 2007	Moderate	Strength (Thigh and quadriceps	7 months	Open kinetic chain	16	NR	Open kinetic chain quadriceps exercises	14	NR	NA	NS

Table 119. Results: Rehabilitation After ACLR (Early Versus Late Start)

Author	Study Strength	Outcome	Follow-up	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		muscle torque)		quadriceps exercises 4th week			12th week				
Heijne et al. 2007	Moderate	Strength (Thigh and quadriceps muscle torque)	7 months	Open kinetic chain quadriceps exercises 4th week	16	NR	Open kinetic chain quadriceps exercises 12th week	14	NR	NA	NS
Heijne et al. 2007	Moderate	Anterior knee pain	7 months	Open kinetic chain quadriceps exercises 4th week	16	NR	Open kinetic chain quadriceps exercises 12th week	14	NR	NA	NS
Heijne et al. 2007	Moderate	Anterior knee pain	7 months	Open kinetic chain quadriceps exercises 4th week	16	NR	Open kinetic chain quadriceps exercises 12th week	14	NR	NA	NS

Table 120. Results: Rehabilitation After ACLR (Other)

Author	Study Strength	Outcome	Follow up	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean (sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Isberg et al. 2006	Moderate	Stability (RSA laxity side to side difference median and range)	6 months	Allowing full active and passive extension	11	3.4(-0.6 to 11.5)	Not allowing full active and passive extension	11	3.4(-3.3 to 7.8)	NA	
Isberg et al. 2006	Moderate	Stability (RSA laxity side to side difference median and range)	24 months	Allowing full active and passive extension	11	2.7(0 to 10.7)	Not allowing full active and passive extension	11	2.8(-1.8 to 9.5)	NA	
Isberg et al. 2006	Moderate	Stability (KT-1000 laxity side to side difference median and range)	6 months	Allowing full active and passive extension	11	0(-3 to 1.5)	Not allowing full active and passive extension	11	1.5(-0.5 to 4.5)	NA	
Isberg et al. 2006	Moderate	Stability (KT-1000 laxity side to side difference median and range)	24 months	Allowing full active and passive extension	11	1(-1.5 to 3.5)	Not allowing full active and passive extension	11	0.5(-1 to 4)	NA	
Isberg et al. 2006	Moderate	Tegner score	24 months	Allowing full active and passive extension	11	7(1.73)	Not allowing full active and passive extension	11	6.5(1.44	0.5(-0.91,1.91)	NS
Isberg et al. 2006	Moderate	Lysholm score	24 months	Allowing full active and passive extension	11	92.5(5.95)	Not allowing full active and passive extension	11	93.25(6.44)	-0.75(-6.23,4.73)	NS
Isberg et al. 2006	Moderate	One leg hop test	24 months	Allowing full active and passive extension	11	95(4.2)	Not allowing full active and passive extension	11	94.2(4.44)	0.8(-3.02,4.62)	NS
Isberg et al. 2006	Moderate	IKDC A	24 months	Allowing full active and passive extension	11	4/11(36%)	Not allowing full active and passive extension	11	4/11(36%)	1(0.33,3.02)	NS
Isberg et al. 2006	Moderate	IKDC B	24 months	Allowing full active and passive extension	11	6/11(54%)	Not allowing full active and passive extension	11	6/11(54%)	1(0.46,2.14)	NS

Table 120. Results: Rehabilitation After ACLR (Other)

Author	Study Strength	Outcome	Follow up	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean (sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Isberg et al. 2006	Moderate	IKDC C	24 months	Allowing full active and passive extension	11	1/11(9 %)	Not allowing full active and passive extension	11	1/11(9%)	1(0.07,14.05)	NS
Isberg et al. 2006	Moderate	IKDC D	24 months	Allowing full active and passive extension	11	0/11(0 %)	Not allowing full active and passive extension	11	0/11(0%)	NA	NS
Fukuda et al. 2013	Moderate	Quadriceps strength	25 weeks	Early Open Kinetic Chain Exercises	18	94.1 (12.0)	Late Open Kinetic Chain Exercises	17	89.5 (10.7)	4.6 (-3.22, 12.4)	NS
Fukuda et al. 2013	Moderate	Quadriceps strength	17 months	Early Open Kinetic Chain Exercises	18	99.7 (7.2)	Late Open Kinetic Chain Exercises	17	95.1 (11.8)	4.6 (-2.06, 11.3)	NS
Fukuda et al. 2013	Moderate	Hamstrings strength	25 weeks	Early Open Kinetic Chain Exercises	18	84.5 (14.4)	Late Open Kinetic Chain Exercises	17	87.4 (16)	-2.9 (-13.3, 7.53)	NS
Fukuda et al. 2013	Moderate	Hamstrings strength	17 months	Early Open Kinetic Chain Exercises	18	91.2 (14.5)	Late Open Kinetic Chain Exercises	17	98 (12.3)	-6.8 (-16.1, 2.45)	NS
Fukuda et al. 2013	Moderate	Single-legged hop test, cm	25 weeks	Early Open Kinetic Chain Exercises	18	92.3 (8.1)	Late Open Kinetic Chain Exercises	17	94.9 (6.7)	-2.6 (-7.72, 2.52)	NS
Fukuda et al. 2013	Moderate	Single-legged hop test, cm	17 months	Early Open Kinetic Chain Exercises	18	98.5 (6.5)	Late Open Kinetic Chain Exercises	17	96.9 (7.9)	1.6 (-3.35, 6.55)	NS
Fukuda et al. 2013	Moderate	Crossover hop test, cm	25 weeks	Early Open Kinetic Chain Exercises	18	94 (6.4)	Late Open Kinetic Chain Exercises	17	92.5 (7.6)	1.5 (-3.31, 6.31)	NS
Fukuda et al. 2013	Moderate	Crossover hop test, cm	17 months	Early Open Kinetic Chain Exercises	18	98.8 (6.5)	Late Open Kinetic Chain Exercises	17	96.2 (8.4)	2.6 (-2.54, 7.74)	NS
Fukuda et al. 2013	Moderate	Lysholm score (0-100)	25 weeks	Early Open Kinetic Chain Exercises	18	95.8 (4.9)	Late Open Kinetic Chain Exercises	17	94.3 (12.4)	1.5 (-4.9, 7.9)	NS
Fukuda et al.	Moderate	Lysholm score (0-	17 months	Early Open	18	96.5	Late Open Kinetic	17	99 (4.8)	-2.5 (-5.76, 0.76)	NS

Table 120. Results: Rehabilitation After ACLR (Other)

Author	Study Strength	Outcome	Follow up	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean (sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
2013		100)		Kinetic Chain Exercises		(4.7)	Chain Exercises				
Fukuda et al. 2013	Moderate	Numerical pain rating scale (0-10)	25 weeks	Early Open Kinetic Chain Exercises	18	0.4 (0.8)	Late Open Kinetic Chain Exercises	17	0.2 (0.5)	0.2 (-0.261, 0.661)	NS
Fukuda et al. 2013	Moderate	Numerical pain rating scale (0-10)	17 months	Early Open Kinetic Chain Exercises	18	0.4 (1.2)	Late Open Kinetic Chain Exercises	17	0.1 (0.3)	0.3 (-0.309, 0.908)	NS
Fukuda et al. 2013	Moderate	Anterior laxity, mm	25 weeks	Early Open Kinetic Chain Exercises	18	3 (1.5)	Late Open Kinetic Chain Exercises	17	3 (1.7)	0 (-1.1, 1.1)	NS
Fukuda et al. 2013	Moderate	Anterior laxity, mm	17 months	Early Open Kinetic Chain Exercises	18	2.7 (1.4)	Late Open Kinetic Chain Exercises	17	3.5 (1.8)	-0.8 (-1.9, 0.303)	NS
Fukuda et al. 2013	Moderate	Anterior laxity: 3-5 mm	17 months	Early Open Kinetic Chain Exercises	18	7/18 (39%)	Late Open Kinetic Chain Exercises	17	10/17 (59%)	P = 0.2415	NS
Fukuda et al. 2013	Moderate	Anterior laxity: > 5 mm	17 months	Early Open Kinetic Chain Exercises	18	2/18 (11%)	Late Open Kinetic Chain Exercises	17	2/17 (12%)	P = 0.9516	NS
Fukuda et al. 2013	Moderate	Had graft failure and underwent new surgical reconstruction	17 months	Early Open Kinetic Chain Exercises	18	2/18 (11%)	Late Open Kinetic Chain Exercises	17	2/17 (12%)	P = 0.9516	NS

ACL RETURN TO SPORTS

Limited strength evidence does not support waiting a specific time from surgery/ injury, or achieving a specific functional goal prior to return to sports participation after ACL injury or reconstruction.

Strength of Recommendation: Limited

RATIONALE

The rationale for return to play and secondary injury risk was based on one low and one very low strength study.[37, 104] Early return (mean five months) versus late return (mean nine months) to sport was not different for subsequent ipsilateral ACL injury, subjective and objective functional outcomes or knee laxity.[37] Similarly, early return to sports (<6 months versus >6months) was not associated with increased incidence of either contralateral or ipsilateral ACL injury.[104]

The rationale for return to play based on achieving functional criteria was based on one low strength study.[11] This study reported similar potential return to pre-injury sport levels in those who attempted to return before 12 months relative to those who returned after 12 months.

POTENTIAL HARMS OF IMPLEMENTATION

As individuals heal and recover at different rates and each injury has its own unique circumstances, it is difficult to assign a specific endpoint that would favor return to sport. Each patient should be treated individually and functionally advanced to the level of their ability. Premature return to full activity may cause injury to a reconstructed ligament, surrounding structures, or the contralateral knee. Early return in those individuals who elect non-operative management may lead to further injury of surrounding tissues and further decline. Current evidence is lacking as to the long-term consequences of premature return to sport on joint homeostasis, dynamic function, and risk of secondary injury.

FUTURE RESEARCH

Future research is needed to identify the functional deficits that are associated with increased second injury risk and reduced long term outcomes. Future investigations may assess more directly individual graft healing times, alternative therapeutic exercises, changes in frequency or duration to individual programs, platelet rich plasma treatments, genetic markers/gene therapy.

SUMMARY OF FINDINGS

QUALITY AND APPLICABILITY SUMMARY

Table 121. Quality and Applicability Summary: Return to Play After ACLR

Study	Outcome	Quality	Applicability	Overall Strength of Evidence
Glasgow et al. 1993	Cincinnati knee rating scores (Function and Symptoms)	Very Low	Moderate	Very Low
Shelbourne et al. 2009	Failure	Low	Moderate	Low
Glasgow et al. 1993	Range of motion	Very Low	Moderate	Very Low
Ardern et al. 2012	Return to play	Low	Moderate	Low
Glasgow et al. 1993	Return to play	Very Low	Moderate	Very Low
Glasgow et al. 1993	Stability (KT-1000, Lachman, Pivot shift)	Very Low	Moderate	Very Low
Glasgow et al. 1993	Strength	Very Low	Moderate	Very Low

Table 122. Quality and Applicability: Return to Play After ACLR

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Glasgow et al. 1993	Cincinnati knee rating scores (Function and Symptoms)	○	○	○	○	○	●	○	**Very Low**	●	○	●	●	**Moderate**
Shelbourne et al. 2009	Failure	●	○	○	○	○	●	●	**Low**	●	○	●	○	**Moderate**
Glasgow et al. 1993	Range of motion	○	○	○	○	○	●	○	**Very Low**	●	○	●	●	**Moderate**
Ardern et al. 2012	Return to play	●	○	○	○	○	●	○	**Low**	●	○	●	○	**Moderate**
Glasgow et al. 1993	Return to sport	○	○	○	○	○	●	○	**Very Low**	●	○	●	●	**Moderate**
Glasgow et al. 1993	Stability (KT-1000, Lachman, Pivot shift)	○	○	○	○	○	●	○	**Very Low**	●	○	●	●	**Moderate**

Table 122. Quality and Applicability: Return to Play After ACLR

●:Domain free of flaws

○:Domain flaws present

Study	Outcome	Hypothesis	Group Assignment	Blinding	Group Comparability	Treatment Integrity	Measurement	Investigator Bias	*Quality*	Participants	Intervention and Expertise	Compliance and Adherence	Analysis	*Applicability*
Glasgow et al. 1993	Strength	○	○	○	○	○	●	○	**Very Low**	●	○	●	●	**Moderate**

FINDINGS

Table 123. Results: Return to Play After ACLR

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Glasgow et al. 1993	Very low	Range of motion (Mean time to return to final range of motion in months)	Early Group (5 months (2-6))	31	4.3 (range= 2.25-8)	Late Group (9 months (7-14))	33	5.4 (range= 2.5-12.5)	NA	Favors Late Group
Glasgow et al. 1993	Very low	Range of motion (Mean decreases in range of motion for extension in degrees)	Early Group (5 months (2-6))	31	3	Late Group (9 months (7-14))	33	3	NA	NS
Glasgow et al. 1993	Very low	Range of motion (Mean decreases in range of motion for flexion in degrees)	Early Group (5 months (2-6))	31	4	Late Group (9 months (7-14))	33	5	NA	NS
Glasgow et al. 1993	Very low	Range of motion (# of patients that underwent a manipulation under anesthesia to improve motion postoperatively)	Early Group (5 months (2-6))	31	4/31 (13%)	Late Group (9 months (7-14))	33	7/33 (21%)	1.19(0.86,1.64)	NS
Glasgow et al. 1993	Very low	Return to play (patients returning to preoperative level)	Early Group (5 months (2-6))	31	23/31 (74%)	Late Group (9 months (7-14))	33	22/33 (67%)	1.72(0.79,3.71)	NS
Glasgow et al. 1993	Very low	Return to play (patients decreasing activity level)	Early Group (5 months (2-6))	31	8/31 (26%)	Late Group (9 months (7-14))	33	11/33 (33%)	0.15(0.0,2.82)	NS
Glasgow et al. 1993	Very low	Return to play (patients with knee-related decrease in activity	Early Group (5 months (2-6))	31	0/31 (0%)	Late Group (9 months (7-14))	33	3/33 (9%)	0.19(0.0,3.88)	NS

Table 123. Results: Return to Play After ACLR

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
		level)								
Glasgow et al. 1993	Very low	Return to play (patients with increase in activity level)	Early Group (5 months (2-6))	31	0/31 (0%)	Late Group (9 months (7-14))	33	2/33 (6%)	1.31(0.93,1.85)	NS
Glasgow et al. 1993	Very low	Stability (Lachman Test, # of negative results)	Early Group (5 months (2-6))	31	23/31 (74%)	Late Group (9 months (7-14))	33	20/33 (61%)	1.31(0.92,1.85)	NS
Glasgow et al. 1993	Very low	Stability (Pivot shift test, # of negative results)	Early Group (5 months (2-6))	31	23/31 (74%)	Late Group (9 months (7-14))	33	20/33 (61%)	1.05(0.84,1.31)	NS
Glasgow et al. 1993	Very low	Stability (KT-1000 20 lbs, ≤ 3 mm)	Early Group (5 months (2-6))	31	26/31 (84%)	Late Group (9 months (7-14))	33	27/33 (82%)	5.88(1.43,24.18)	NS
Glasgow et al. 1993	Very low	Stability (KT-1000 20 lbs, >3-5 mm)	Early Group (5 months (2-6))	31	4/31 (13%)	Late Group (9 months (7-14))	33	3/33 (9%)	5.59(0.61,50.9)	NS
Glasgow et al. 1993	Very low	Stability (KT-1000 20 lbs, >5 mm)	Early Group (5 months (2-6))	31	1/31 (3%)	Late Group (9 months (7-14))	33	3/33 (9%)	1.35(0.96,1.88)	NS
Glasgow et al. 1993	Very low	Stability (KT-1000 maximal manual, ≤ 3 mm)	Early Group (5 months (2-6))	31	24/31 (77%)	Late Group (9 months (7-14))	33	20/33 (61%)	1.99(0.75,5.3)	NS
Glasgow et al. 1993	Very low	Stability (KT-1000 maximal manual, >3-5 mm)	Early Group (5 months (2-6))	31	5/31 (16%)	Late Group (9 months (7-14))	33	9/33 (27%)	4.26(0.84,21.65)	NS
Glasgow et al. 1993	Very low	Stability (KT-1000 maximal manual, >5 mm)	Early Group (5 months (2-6))	31	2/31 (7%)	Late Group (9 months (7-14))	33	4/33 (12%)	NA	NS
Glasgow et al. 1993	Very low	Strength (Isokinetic Muscle Performance Evaluation)	Early Group (5 months (2-6))	31	NR	Late Group (9 months (7-14))	33	NR	NA	NS
Glasgow et al. 1993	Very low	Pain (Mean subjective assessment)	Early Group (5 months (2-6))	31	NR	Late Group (9 months (7-14))	33	NR	NA	NS

Table 123. Results: Return to Play After ACLR

Author	Study Strength	Outcome	Treatment Group 1	n1	Mean(sd)1 or (E1/N1 (%))	Treatment Group 2	n2	Mean(sd)2 or (E2/N2 (%))	Results (Mean difference or RR)	Favors
Glasgow et al. 1993	Very low	Swelling (Mean subjective assessment)	Early Group (5 months (2-6))	31	NR	Late Group (9 months (7-14))	33	NR	NA	NS
Glasgow et al. 1993	Very low	Function (Mean subjective assessment)	Early Group (5 months (2-6))	31	NR	Late Group (9 months (7-14))	33	NR	NA	NS
Glasgow et al. 1993	Very low	Patient Satisfaction (Mean Cincinnati Knee Rating Scores, out of 50 points)	Early Group (5 months (2-6))	31	44.3	Late Group (9 months (7-14))	33	45.2	NA	NS
Glasgow et al. 1993	Very low	Function (Mean Cincinnati Knee Rating Scores, out of 50 points)	Early Group (5 months (2-6))	31	46.9	Late Group (9 months (7-14))	33	47.6	NA	NS
Shelbourne et al. 2009	Low	Re-Rupture	Return to play <6 months	787	36/787 (4.6%)	Return to play ≥6 months	628	25/628(4%)	1.15(0.7,1.89)	NS
Shelbourne et al. 2009	Low	ACL rupture in contralateral knee	Return to play <6 months	787	41/787 (5.2%)	Return to play ≥6 months	628	34/628(5.4 %)	0.96(0.62,1.5)	NS

Table 124. Results: Return to Play After ACLR

Author	Study Strength	Outcome	N	Treatment Group 1	E1/N1 (%)
Ardern et al. 2012	Low	Return to play 12 months	2331	ACLR	204(65%)
Ardern et al. 2012	Low	Return to play at pre-injury level	314	ACLR	140/314(45%)
Ardern et al. 2012	Low	Return to play at competitive sport	196	ACLR	91/196(46%)

V. APPENDICES

APPENDIX I
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APPENDIX II
AAOS BODIES THAT APPROVED THIS CLINICAL PRACTICE GUIDELINE

This final guideline draft must be approved by the AAOS Committee on Evidence Based Quality and Value, the AAOS Council on Research and Quality, and the AAOS Board of Directors. These decision-making bodies are invited to provide comments during the review process for consideration by the work group but are not designated to modify the contents of the guideline. Their charge is to approve or reject its publication by majority vote.

Committee on Evidence Based Quality and Value

The committee on Evidence Based Quality and Value (EBQV) consists of twenty AAOS members who implement evidence-based quality initiatives such as clinical practice guidelines (CPGs) and appropriate use criteria (AUCs). They also oversee the dissemination of related educational materials and promote the utilization of orthopaedic value products by the Academy's leadership and its members.

Council on Research and Quality

The Council on Research and Quality promotes ethically and scientifically sound clinical and translational research to sustain patient care in musculoskeletal disorders. The Council also serves as the primary resource for educating its members, the public, and public policy makers regarding evidenced-based medical practice, orthopaedic devices and biologics, regulatory pathways and standards development, patient safety, occupational health, technology assessment, and other related important errors.

The Council is comprised of the chairs of the committees on Biological Implants, Biomedical Engineering, Occupational Health and Workers' Compensation, Patient Safety, Research Development, U.S. Bone and Joint Decade, and chair and Appropriate Use Criteria and Clinical Practice Guideline section leaders of the Evidence Based Quality and Value committee. Also on the Council are the second vice-president, three members at large, and representatives of the Diversity Advisory Board, Women's Health Issues Advisory Board, Board of Specialty Societies (BOS), Board of Councilors (BOC), Communications Cabinet, Orthopaedic Research Society (ORS), Orthopedic Research and Education Foundation (OREF).

Board of Directors

The 17 member Board of Directors manage the affairs of the AAOS, set policy, and oversee the Strategic Plan.

APPENDIX III

DETERMINING CRITICAL OUTCOMES

The first task of the work group is to identify the critical outcomes for the guideline. Members are asked to construct a preliminary list of important outcomes prior to attending the introductory meeting. They participate in three Delphi rounds, completing the “Critical Outcomes Form” shown below.

CRITICAL OUTCOMES FORM

DETERMINING OUTCOMES

The first task as a guideline work group member is to determine outcomes. List the variables you think are relevant and rank them in order of importance. Appropriate outcomes are patient-centered and consider the benefits and potential harm of the treatments being measured.

Criticality
Some outcomes are more important than others. The *most* important ones are considered critical. Critical outcomes are vital for determining whether or not you should offer a treatment or diagnostic test to a patient. Without knowing what the essential outcomes are and how the treatment or test influences them, efficacy cannot be determined.

Patient-Oriented Outcomes
In general, good practice and good evidence-based medicine give priority to the outcomes that patients care about. Patient-oriented outcomes:

- Help the patient live longer or better
- Are typically something the patient experiences
- Are often the patient’s diagnostic or treatment goal(s)
- Do not require extrapolation or interpolation to determine their importance to the patient

Examples of patient-oriented outcomes are:

- Survival/mortality
- Pain relief
- Fracture prevention
- Functional status
- Quality of life

Surrogate Outcomes
Patient-oriented outcomes contrast surrogate ones in that the latter:

- Substitute measures for patient-oriented outcomes
- Are typically not experienced by the patient
- Are typically not the patient's goals for treatment
- Require extrapolation or interpolation to determine their relationship to (or effect on) patient-oriented outcomes

Examples of surrogate outcomes are:

- Blood cholesterol (a surrogate for survival)
- Bone mineral density (a surrogate for fractures)
- All imaging results (often surrogates for pain or functional status but they can also be surrogates for other patient-oriented outcomes)

Benefit versus Harm
Potential benefit to patients is based on the patient-oriented outcomes that they desire and potential harm can be thought of as patient-oriented outcomes unwanted to them. For example, avoiding harm (e.g. fractures or death) is considered a benefit.

Rating Outcomes
In addition to identifying patient outcomes, work group members rated the importance of each one using a scale of 1 to 9. The rating categories are shown in the table below:

Rating	***Importance***
9	
8	**Critical**
7	
6	
5	**Important**
4	
3	
2	**Not Important**
1	

Work group members were advised to note that:

1. **Unless you are interested in measures of diagnostic test performance (i.e., sensitivity and specificity), surrogate Outcomes may not be rated as "Critical" (7-9).**
2. **If all Outcomes are rated as critically important, then it will not be possible to prioritize the ones that are more likely to generate a comprehensive list of initial recommendations.**

Final Determinations
To determine which outcomes to include and designate as critical, three rounds of the Delphi method were used.

The form below was used by the work group.

Please list up to 10 Outcomes that you think this guideline should address, and rate them in order of importance on a scale from 1-9. Do not consult with other members of the work group during this step.

Outcome Number	Outcome	Rating
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

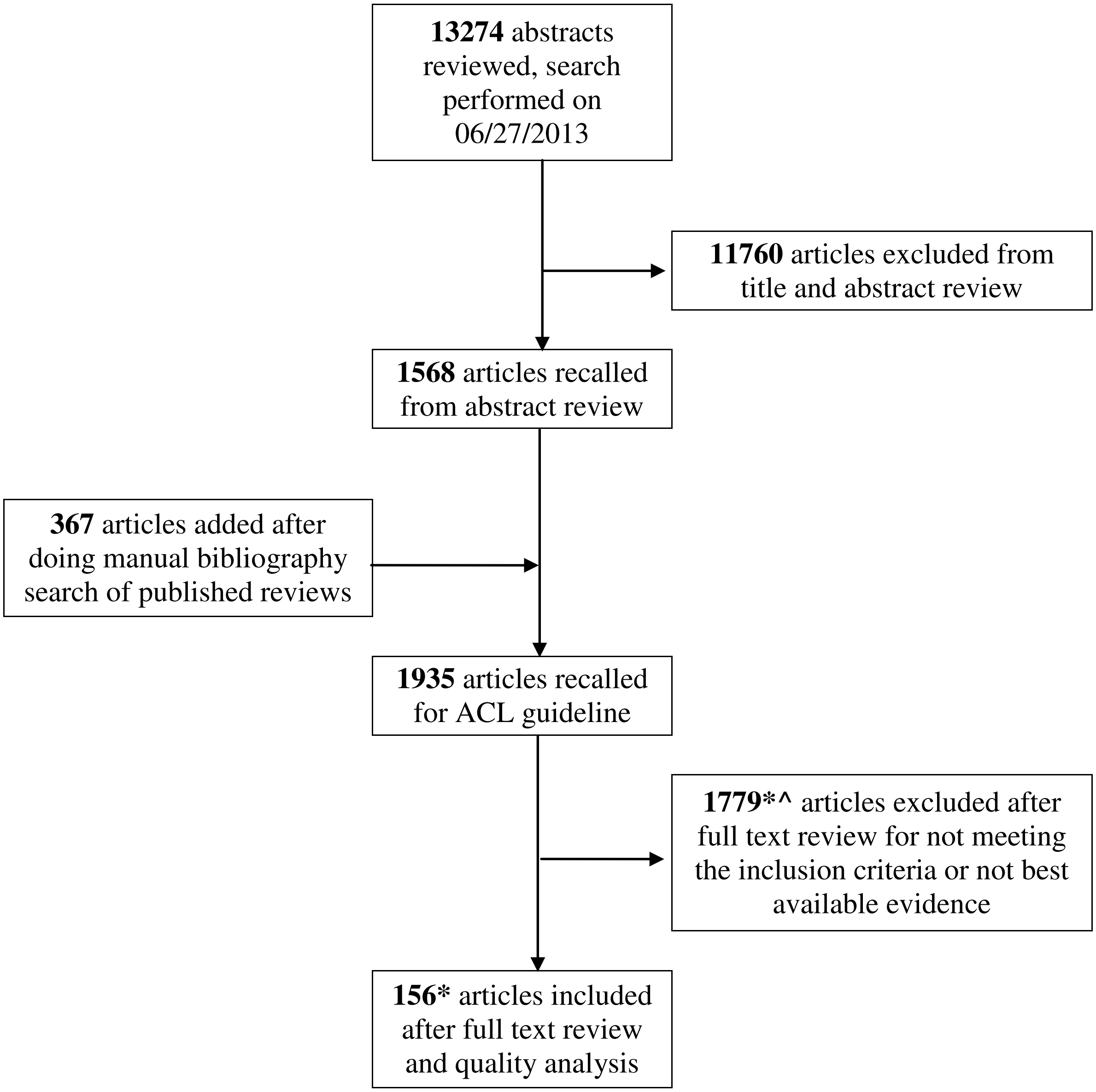
This form was circulated <u>three times.</u>

In the present guideline, the work group identified six critical outcomes: knee pain, activities of daily living, quality of life, functional status, activity tolerance, and self-reported physical function.

The work group identified the following outcomes as important: performance based physical function, serious GI bleed, ability to perform recreational activities, survival, treatment side effects, surgical complications, night time pain affecting sleep, major surgery complications, revision surgery, ability to earn income, ability to drive, social role function, joint stiffness, stability, range of motion, minor GI bleed, avoidance of need for knee replacement, strength, limpness, prevention of disease progression, deformity, joint alignment and stability, and joint swelling/effusion.

The work group identified the following outcomes as unimportant: radiographic improvement, MRI findings, and biomarker improvement.

APPENDIX IV
STUDY ATTRITION FLOWCHART



(*Provisional)
(^Includes recalled articles that the librarian was unable to retrieve and articles not in English)

APPENDIX V
LITERATURE SEARCH STRATEGIES

Total # citations added to database: 13,274
RefMan database: G:\GUIDELINES\Anterior Cruciate Ligament Injuries\8 Librarian\ACLInjuries_2012

Database: **PubMed/MEDLINE**
Date searched: June 27, 2013
No. search results: 771
De-duplicated results added to database: 757
Ref IDs: 20392-21161

Search Strategy

#1
“Anterior Cruciate Ligament”[Mesh] OR “Anterior Cruciate Ligament Reconstruction”[Mesh]

#2
“anterior cruciate ligament”[Title/Abstract] OR “ACL”[Title/Abstract] OR “ACLR”[Title/Abstract]

#3
#1 OR #2

#4
(animal[mh] NOT human[mh]) OR cadaver[mh] OR cadaver*[titl] OR ((comment[pt] OR editorial[pt] OR letter[pt] OR "historical article"[pt]) NOT "clinical trial"[pt]) OR addresses[pt] OR news[pt] OR "newspaper article"[pt] OR pmcbook OR "case report"[titl]

#5
(“2012/09/08”[Date - Entrez] : “2013/06/27”[Date - Entrez]) AND “English”[la]

#6
#3 NOT #4

#7
#6 AND #5

Sorted by study type

#8
Medline[tw] OR systematic review[tiab] OR Meta-analysis[pt]

#9
"Clinical Trial"[pt] OR (clinical[tiab] AND trial[tiab]) OR random*[tw] OR "Therapeutic use"[sh]

#10
#7 AND #8

#11
(#7 AND #9) NOT #8

#12
#7 NOT (#9 OR #8)

PubMed Sorted Search Results

Study type	Search line	Results	De-duplicated	AAOS IDs
Systematic Reviews	10	47	46	20392-20438

Clinical Trials	11	108	104	20439-20545
Other Studies	12	616	607	20546-21161

Database: **Embase**
Date searched: June 27, 2013
No. search results: 1,307
De-duplicated results added to database: 287
Ref IDs: 21166-22409

Search Strategy
#1
'anterior cruciate ligament'/exp OR 'anterior cruciate ligament injury'/exp OR 'anterior cruciate ligament rupture'/exp OR 'anterior cruciate ligament reconstruction'/exp OR 'anterior cruciate ligament':ab,ti OR 'acl':ab,ti OR 'aclr':ab,ti
#2
[english]/lim AND [humans]/lim AND [2012-2013]/py
#3
cadaver/de OR 'in vitro study'/exp OR 'abstract report'/de OR book/de OR editorial/de OR note/de OR letter/de OR 'case report':ti
#4
(#1 AND #2) NOT #3
#5
#4 AND ([Cochrane review]/lim OR [meta analysis]/lim OR [systematic review]/lim)
#6
(#4 AND ([controlled clinical trial]/lim OR [randomized controlled trial]/lim)) NOT #5
#7
#4 NOT (#5 OR #6)

Embase Sorted Search Results

Study type	Search line	Results	De-duplicated	AAOS IDs
Systematic Reviews	5	48	9	21166-21190
Clinical Trials	6	82	7	21194-21242
Other Studies	7	1,177	271	21243-22409

Database: **Cochrane Library**
Date searched: June 27, 2013
No. search results: 42
De-duplicated results added to database: 17
Ref IDs: 22411-22445
Search Strategy
("anterior cruciate ligament":ti,ab,kw OR "ACL":ti,ab,kw)
Limits: 2012-2013

Cochrane Sorted Results
5 - Cochrane Reviews (Cochrane Database of Systematic Reviews)
(1 de-duplicated, AAOS ID 22411)

14 - Other Reviews
(11 de-duplicated, AAOS IDs 22412-22425)
21 - Clinical Trials
(4 de-duplicated, AAOS IDs 22436-22443)
0 - Methods Studies

0 - Technology Assessments

2 - Economic Evaluations
(1 de-duplicated, AAOS IDs 22445)

Database: **PEDro**
Date searched: June 27, 2013
No. search results: 13
De-duplicated results added to database: 8
Ref IDs: 22446-22458

Search Strings
Abstract & Title: =“anterior cruciate ligament”
New records added since: 09/07/2012

PEDro Sorted Search Results

Study type	Results	De-duplicated	AAOS IDs
Guideline	1	1	22446
Systematic Reviews	4	2	22449-22450
Clinical Trials	8	5	22451-22458

APPENDIX VI
EVALUATION OF QUALITY

Quality questions are asked for every outcome reported in a study. They vary according to the rigor of a study's research design. Different questions are asked depending on if a study uses a controlled design with a no-treatment comparison group, is a crossover or historically controlled study, or case series. A total of 20 questions are asked for each type of research design and are described below:

Quality Questions and Domains for Four Designs of Studies of Interventions

Domain	Question:	Parallel, Contemporary Controls	Crossover Trials	Historical Controls	Case Series
Group Assignment	Stochastic	Yes	Yes	No	No
Group Assignment	Quasi-random Assignment	No	No	No	*NA
Group Assignment	Matched Groups	No	No	Yes	No
Group Assignment	Consecutive Enrollment	NA	NA	NA	Yes
Prospective	Prospective	Yes	Yes	Yes	Yes
Blinding	Blinded Patients	Yes	Yes	No	No
Blinding	Blinded Assessors	Yes	Yes	No	No
Blinding	Blinding Verified	Yes	Yes	No	No
Group Comparability	Allocation Concealment	Yes	Yes	No	No
Group Comparability	>80% Follow-up	Yes	Yes	No	Yes
Group Comparability	<20% Completion Difference	Yes	Yes	No	No
Group Comparability	Similar Baseline Outcome Values	Yes	NA	Yes	No
Group Comparability	Comparable Pt. Characteristics	Yes	NA	Yes	No
Group Comparability	Same Control Group Results	NA	Yes	NA	NA
Group Comparability	Same Experimental Group Results	NA	Yes	NA	NA
Treatment Integrity	Same Centers	Yes	Yes	Yes	No
Treatment Integrity	Same Treatment Duration in and across All Groups	Yes	Yes	Yes	No
Treatment Integrity	Same Concomitant Treatment to All Groups (controlled studies only)	Yes	Yes	Yes	NA
Treatment Integrity	No Confounding Treatment (case series only)	NA	NA	NA	Yes
Measurement	Same Instruments	Yes	Yes	Yes	Yes
Measurement	Valid Instrument	Yes	Yes	Yes	Yes
Bias	Article & Abstract Agree	Yes	Yes	Yes	Yes
Bias	All Outcomes Reported	Yes	Yes	Yes	Yes
Bias	A Priori Analysis	Yes	Yes	Yes	Yes
Statistical Power	Statistically Significant	High	High	High	High
Statistical Power	Number of patients in analysis	See below for further information			

*"NA" means "not asked."

The statistical power domain is assessed differently from the other domains. We characterize this domain as free from flaws if any one of the following is true:

- The results of a statistical test on the outcome of interest are statistically significant (statistical significance is indicative of adequate statistical power).
- The results of a statistical test of the outcome of interest are not statistically significant (or it is unclear whether the results are statistically significant), and the study is either an uncontrolled study in which data from 34 or more patients are included in the statistical analysis of the outcome of interest OR a controlled study in which data from 128 or more patients are included in the analysis of the outcome of interest.
- The study's results for the outcome of interest are used in a meta-analysis. We make this assumption because one reason for performing a meta-analysis is to compensate for the low statistical power of individual studies. Implicit in this assumption is a second assumption; that the power of the meta-analysis will be sufficient to detect an effect as statistically significant.

We term the power domain as flawed if all of the following are true:

- The results of a statistical test on the outcome of interest are either not statistically significant or it is unclear whether the results of statistical test on the outcome of interest are statistically significant.
- The study is an uncontrolled study in which data from fewer than 15 patients are included in the analysis of the outcome of interest OR the study is a controlled study in which data from fewer than 52 patients were included in the analysis of the outcome of interest.
- The results on the outcome of interest will not be used in a meta-analysis.

The numbers used to determine whether a study is of sufficient power are based on Cohen's[134] definitions of small, medium, and large effects. To compute the number of patients needed for an uncontrolled study using a pretest/posttest design, we consider a two-tailed paired samples t-test. We then determine whether or not sample size is sufficient to detect a large effect (defined as a standardized mean difference of ≥ 0.8) with alpha = 0.05 significance level and power = 80%. If a study does not have the ability to detect even a large effect as statistically significant, we characterize it as underpowered and the domain flawed.

To compute the number of patients needed for a controlled study, we consider a two-tailed independent samples t-test with equal size groups, and then determine if sample size is adequate for detecting a large effect, again with alpha = 0.05 and power = 80%. Similar to the above, we term a study as underpowered and the domain flawed if it does not enroll enough patients to detect a large effect size. It is viewed as adequately powered if it enrolls enough patients to detect a small effect.

Quality Domains for Incidence and Prevalence studies

#	Domain	Relationship between Quality and Domain Scores for Incident and Prevalence studies
1	Outcome: Whether the study is measuring the incidence/prevalence of a clinically meaningful event.	0 Flawed Domains = High Quality Study 1 Flawed Domain = Moderate Quality Study 2 Flawed Domains = Low Quality Study ≥ 3 Flawed Domains = Very Low Quality Study
2	Measurement: Whether the study measured the disease/disorder/condition in a way that would lead to accurate estimates of incidence or prevalence.	
3	Participant: Whether those who were studied were representative of the population of interest.	
4	Investigator Bias: Whether author biases could have prejudiced the results.	

Quality Domains for Screening & Diagnosis studies

#	Domain	Relationship between Quality and Domain Scores for Screening and Diagnosis studies
1	Participants: Whether the spectrum of disease among the participants enrolled in the study is the same as the spectrum of disease seen in actual clinical practice	0 Flawed Domains = High Quality Study 1 Flawed Domain = Moderate Quality Study 2 Flawed Domains = Low Quality Study ≥ 3 Flawed Domains = Very Low Quality Study
2	Reference Test: Whether the reference test , often a “gold standard” and the way it was employed in the study ensures correct and unbiased categorization of patients as having or not having disease	
3	Index Test: Whether interpretation of the results of the test under study, often called the “index test”, was unbiased	
4	Study Design: Whether the design of the study allowed for unbiased interpretation of test results	
5	Information: Whether the same clinical data were available when test results were interpreted as would be available when the test is used in practice	
6	Reporting: Whether the patients, tests, and study protocol were described well enough to permit its replication	

Quality Domains for Prognostic studies

Domain	Relationship between Quality and Domain Scores for Prognosis Studies

1	Prospective: With prospective studies, a variable is specified as a potential prognostic variable a priori. This is not possible with retrospective studies.	0 Flawed Domains = High Quality Study 1 Flawed Domain = Moderate Quality Study 2 Flawed Domains = Low Quality Study ≥ 3 Flawed Domains = Very Low Quality Study
2	Power: Whether the study had sufficient statistical power to detect a prognostic variable as statistically significant.	
3	Analysis: Whether the statistical analyses used to determine that a variable was rigorous to provide sound results.	
4	Model: Whether the final statistical model used to evaluate a prognostic accounted for enough variance to be statistically significant.	
5	Bias: Whether there was evidence of investigator bias.	

Quality Domains for Treatment studies

#	Domains	Relationship between Quality and Domain Scores for Treatment studies
1	The study addressed a hypothesis	0 Flawed Domains = High Quality Study 1 – 2 Flawed Domain = Moderate Quality Study 3 – 4 Flawed Domains = Low Quality Study ≥ 5 Flawed Domains = Very Low Quality Study
2	The assignment of patients to groups was unbiased	
3	There was sufficient blinding to mitigate against a placebo effect	
4	The patient groups were comparable at the beginning of the study	
5	The treatment was delivered in such a way that any observed effects could reasonably be attributed to that treatment	
6	Whether the instruments used to measure outcomes were valid	
7	Whether there was evidence of investigator bias	

APPLICABILITY

We determine the applicability of a study using the PRECIS instrument.[135] This instrument consists of 10 questions. The domains that each question applies to are shown in the table below.

Applicability Questions and the Domains for Studies of Interventions

Question	Domain
All Types of Patients Enrolled	Participants
Flexible Instructions to Practitioners	Interventions and Expertise
Full Range of Expt'l Practitioners	Interventions and Expertise
Usual Practice Control	Interventions and Expertise
Full Range of Control Practitioners	Interventions and Expertise
No Formal Follow-up	Interventions and Expertise
Usual and Meaningful Outcome	Interventions and Expertise
Compliance Not Measured	Compliance and Adherence

No Measure of Practitioner Adherence	Compliance and Adherence
All Patients in Analysis	Analysis

Applicability Domains for Incident and Prevalence studies

Domain	Relationship between Applicability and Domain Scores for Incidence and Prevalence studies
Participants (i.e. whether the participants in the study were like those seen in the population of interest)	0 Flawed Domains = High Quality Study 1 – 2 Flawed Domain = Moderate Quality Study ≥ 3 Flawed Domains = Low Quality Study
Analysis (i.e., whether participants were appropriately included and excluded from the analysis)	
Outcome (i.e., whether the incidence/prevalence estimates being made were of a clinically meaningful outcome)	

Applicability Questions and Domains for Screening and Diagnostic Studies

Domain	Relationship between Applicability and Domain Scores for Screening and Diagnosis studies
Participants: whether the patients in the study are like those seen in actual clinical practice	0 Flawed Domains = High Quality Study 1 – 3 Flawed Domain = Moderate Quality Study ≥ 4 Flawed Domains = Low Quality Study
Index Test: whether the test under study could be used in actual clinical practice and whether it was administered in a way that reflects its use in actual practice	
Directness: whether the study demonstrated that patient health is affected by use of the diagnostic test under study	
Analysis: whether the data analysis reported in the study was based on a large enough percentage of enrolled patients to ensure that the analysis was not conducted on "unique" or "unusual" patients	

Applicability Domains for Prognostic studies

Domain	Relationship between Applicability and Domain Scores for Prognostic Studies

1	Patients: Whether the patients in the study and in the analysis were like those seen in actual clinical practice.	0 Flawed Domains = High Quality Study 1 – 2 Flawed Domain = Moderate Quality Study ≥ 3 Flawed Domains = Low Quality Study
2	Analysis: Whether the analysis was not conducted in a way that was likely to describe variation among patients that might be unique to the dataset the authors used.	
3	Outcome: Whether the prognostic was a predictor of a clinically meaningful outcome.	

Applicability Domains for Treatment studies

Domain		Relationship between Applicability and Domain Scores for Treatment Studies
1	Patients: whether the patients in the study are like those seen in actual clinical practice	0 Flawed Domains = High Quality Study 1 – 3 Flawed Domain = Moderate Quality Study ≥ 4 Flawed Domains = Low Quality Study
2	Interventions and Expertise: whether the treatments are delivered as they would be in actual clinical practice and whether the clinicians providing then are like those in actual clinical practice	
3	Compliance and Adherence (i.e., whether the steps taken in the study to ensure patient compliance and adherence to treatment regimens would make the compliance/adherence in the study different from that seen in actual clinical practice)	
4	Analysis: whether the data analysis reported in the study was based on a large enough percentage of enrolled patients to ensure that the analysis was not conducted on "unique" or "unusual" patients.	

Criteria to upgrade the Quality of a research article

Research articles may be adjusted upwards if the research is of high applicability or if providing the intervention decreases the potential for catastrophic harm, such as loss of life or limb. The EBQV expanded the above criteria based on the G.R.A.D.E. methodology, so that it now includes the following:

- The study has a large (>2) or very large (>5) magnitude of treatment effect: used for non-retrospective observational studies;
- All plausible confounding factors would reduce a demonstrated effect or suggest a spurious effect when results show no effect;
- Consideration of the dose-response effect.

Reference: *GRADE handbook for grading quality of evidence and strength of recommendation.* The GRADE Working Group; 2009.

APPENDIX VII
OPINION BASED RECOMMENDATIONS

A guideline can contain recommendations for which there is no evidence. Work groups might make the decision to issue opinion-based recommendations. Although expert opinion is a form of evidence, it is also important to avoid liberal use in a guideline since research shows that expert opinion can be incorrect.

Opinion-based recommendations are developed only in instances where not establishing a recommendation would lead to catastrophic consequences for a patient (e.g. loss of life or limb). To ensure that an opinion-based recommendation is absolutely necessary, the AAOS has adopted rules to guide the content of the rationales that are based on those outlined by the U.S. Preventive Services Task Force (USPSTF).[136] Specifically, rationales based on expert opinion must:

- Not contain references to or citations from articles not included in the systematic review.

- Not contain the AAOS guideline language "the practitioner should/should not", "the practitioner could/could not" or "The practitioner might/might not."

- Contain an explanation of the potential preventable burden of disease. This involves considering both the incidence and/or prevalence of the disease, disorder, or condition and the associated burden of suffering. To paraphrase the USPSTF, when evidence is insufficient, provision of a treatment (or diagnostic) for a serious condition might be viewed more favorably than provision of a treatment (or diagnostic) for a condition that does not cause as much suffering. The AAOS understands that evaluating the "burden of suffering" is subjective and involves judgment. This evaluation should be informed by patient values and concerns. It is not appropriate for a guideline to recommend widespread use of a technology backed by little data and for which there is limited experience. Such technologies are addressed in the AAOS' Technology Overviews.

- Address potential harms.

- Address apparent discrepancies in the logic of different recommendations. If there are no relevant data for several recommendations and the work group chooses to issue an opinion-based recommendation in some cases but not in other cases, the rationales must explain why.

- Consider current practice. The USPSTF specifically states that clinicians justifiably fear not providing a service that is practiced on a widespread basis will lead to litigation.[136] Not providing a service that is not widely available or commonly used has less serious consequences than not providing a treatment accepted by the medical profession that patients expect. The patient's "expectation of treatment" must be tempered by the treating physician's guidance about the reasonable outcomes that the patient can expect.

- Justify when applicable why a more costly device, drug, or procedure is being recommended.

Work group members write the rationales for opinion based recommendations on the first day of the final work group meeting. When the work group reconvenes on the second day, members approve the rationales. If the work group cannot adopt a rationale after three votes, the rationale and the opinion-based recommendation will be withdrawn, and a "recommendation" stating that the group can neither recommend for or against the recommendation in question will appear in the guideline.

Sometimes work group members change their views. At any time during the discussion of the rationales, any member of the work group can make a motion to withdraw a recommendation. The guideline will state that the work group can neither recommend for or against the recommendation in question.

APPENDIX VIII

STRUCTURED PEER REVIEW FORM

Peer reviewers are asked to read and review the draft of the clinical practice guideline with a particular focus on their area of expertise. Their responses to the answers below are used to assess the validity, clarity, and accuracy of the interpretation of the evidence.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. The overall objective(s) of the guideline is (are) specifically described.	○	○	○	○	○
2. The health question(s) covered by the guideline is (are) specifically described.	○	○	○	○	○
3. The guideline's target audience is clearly described.	○	○	○	○	○
4. The guideline development group includes individuals from all the relevant professional groups.	○	○	○	○	○
5. There is an explicit link between the recommendations and the supporting evidence.	○	○	○	○	○
6. Given the nature of the topic and the data, all clinically important outcomes are considered.	○	○	○	○	○
7. The patients to whom this guideline is meant to apply are specifically described.	○	○	○	○	○
8. The criteria used to select articles for inclusion are appropriate.	○	○	○	○	○
9. The reasons why some studies were excluded are clearly described.	○	○	○	○	○
10. All important studies that met the article inclusion criteria are included.	○	○	○	○	○
11. The validity of the studies is appropriately appraised.	○	○	○	○	○
12. The methods are described in such a way as to be reproducible.	○	○	○	○	○
13. The statistical methods are appropriate to the material and the objectives of this guideline.	○	○	○	○	○
14. Important parameters (e.g., setting, study population, study design) that could affect study results are systematically addressed.	○	○	○	○	○
15. Health benefits, side effects, and risks are adequately addressed.	○	○	○	○	○
16. The writing style is appropriate for health care professionals.	○	○	○	○	○
17. The grades assigned to each recommendation are appropriate.	○	○	○	○	○

Please provide a brief explanation of both your positive and negative answers in the preceding section. If applicable, please specify the draft page and line numbers in your comments. Please feel free to also comment on the overall structure and content of the Guideline.

Would you recommend these guidelines for use in clinical practice?*

- Strongly Recommend
- Recommend
- Would Not Recommend
- Unsure

Additional Comments:

To view an example of the structured peer review form, please select the following link: [Structured Peer Review Form]

APPENDIX IX
PARTICIPATING PEER REVIEW ORGANIZATIONS

Peer review of the guideline is completed by interested external organizations. The AAOS solicits reviewers for each guideline. They consist of experts in the topic area and represent professional societies other than AAOS. Review organizations are nominated by the work group at the introductory meeting. For this guideline, twenty-six organizations were invited to review the full guideline. Eleven societies participated in the review of the guideline on anterior cruciate ligament injuries and have given consent to be listed below:

American Association of Family Practioners
American Academy of Pediatrics
American Academy of Physical Medicine & Rehabilitation
American Medical Society for Sports Medicine
American Orthopaedic Society for Sports Medicine
American Physical Therapy Association
American Osteopathic Association for Sports Medicine
British Association for Surgery of the Knee
Pediatric Orthopaedic Society of North America

Peer review comments are available on www.aaos.org.

APPENDIX X
INTERPRETING THE FOREST PLOTS

We use descriptive diagrams known as forest plots to present data from studies comparing the differences in outcomes between two treatment groups when a meta-analysis has been performed (combining results of multiple studies into a single estimate of overall effect). The overall effect is shown at the bottom of the graph as a diamond to illustrate the confidence intervals. The standardized mean difference or odds ratio are measures used to depict differences in outcomes between treatment groups. The horizontal line running through each point represents the 95% confidence interval for that point estimate. The solid vertical line represents “no effect” and is where the standardized mean difference = 0 or odds ratio = 1.

APPENDIX XI
CONFLICT OF INTEREST

Prior to the development of this guideline, work group members disclose conflicts of interest. They disclose COIs in writing to the American Academy of Orthopaedic Surgeons via a private on-line reporting database and also verbally at the recommendation approval meeting.

Disclosure Items: (n) = Respondent answered 'No' to all items indicating no conflicts. 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/Orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society.

Kevin G Shea, MD, Workgroup Chair: 9 (American Orthopaedic Society for Sports Medicine; North Pacific Orthopedic Society; Pediatric Orthopaedic Society of North America; Pediatric Orthopaedic Society of North America); Submitted on: 05/09/2014

James L Carey, MD, Workgroup Vice-Chair: 8 (The American Journal of Sports Medicine); 9 (AAOS); Submitted on: 05/14/2014

Allen F Anderson, MD: 2 (ETO); 3B (Mitek; Orthopediatrics); 8 (am j sports med , orthopedic journal sports med); 9 (American Orthopaedic Society for Sports Medicine; herodicus society); Submitted on: 04/08/2014

Constance R Chu, MD: 9 (American Orthopaedic Association; American Orthopaedic Society for Sports Medicine); Submitted on: 06/12/2014

Mark Ellen: 4 (Pfizer; teva pharmaceuticals); 8 (AAPNR); 9 (AAOS; AAOS); Submitted on: 08/05/2014

Cynthia R Labella, MD: 7 (american academy of pediatrics); 9 (American Academy of Pediatrics); Submitted on: 08/07/2014

Volker Musahl, MD: 8 (Knee Surgery, Sports Traumatology, Arthroscopy); 9 (American Orthopaedic Society for Sports Medicine); Submitted on: 04/02/2014

Gregory Donald Myer, PhD: (n); Submitted on: 08/06/2014

Ryan T Pitts, MD: (n); Submitted on: 08/05/2014

John D Polousky, MD: 4 (Abbott; Addendum; Johnson & Johnson; Norvartis; Organovo; Procter & Gamble); Submitted on: 04/16/2014

John C Richmond, MD: 3B (Histogenics Corporation); 7 (Springer; Wolters Kluwer Health - Lippincott Williams & Wilkins); 9 (American Orthopaedic Society for Sports

Medicine; Arthroscopy Association of North America; Eastern Orthopaedic Association); Submitted on: 07/30/2014

Robert H Sandmeier, MD: 9 (AAOS; American Orthopaedic Society for Sports Medicine; north pacific orthopedic society); Submitted on: 04/02/2014

Sandra J Shultz, PhD: 7 (Human Kinetics); 8 (Journal of Athletic Training; Journal of Sports Health; Medicine and Science in Sport and Exercise); Submitted on: 08/05/2014

Angela D Smith, MD: 8 (Current Sports Medicine Reports; International Journal of Sports Medicine (e-journal)); 9 (American College of Sports Medicine; International Federation of Sports Medicine (FIMS)); Submitted on: 04/29/2013

David Jevsevar, MD, MBA: (n); Submitted on: 04/19/2014

Kevin John Bozic, MD, MBA: 9 (AAOS; American Association of Hip and Knee Surgeons; American Orthopaedic Association; California Joint Replacement Registry Project; California Orthopaedic Association; Orthopaedic Research and Education Foundation); Submitted on: 04/01/2014

William Shaffer: (n); Submitted on: 04/13/2014

Deborah Cummins, PhD: (n); Submitted on: 05/22/2014

Jayson Murray, MA: (n); Submitted on: 06/02/2014

Nilay Patel: (n); Submitted on: 07/31/2014

Anne Woznica: (n); Submitted on: 04/01/2014

Yasseline Martinez: (n); Submitted on: 07/31/2014

Kaitlyn Sevarino: (n); Submitted on: 07/22/2014

Peter Shores: (n); Submitted on: 07/31/2014

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METHODS

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TABLES OF LOWER QUALITY STUDIES THAT MET THE INITIAL INCLUSION CRITERIA BUT WERE NOT BEST AVAILABLE EVIDENCE

Table 125. Articles Excluded for Recommendation 3 for Not Best Available Evidence

Author	Year	Title
Applegate G; Flannigan B; Tolin B; Fox J; Pizzo W;	1993	MR Diagnosis of Recurrent Tears in the Knee: Value of Intraaticular Contrast Material
Araki, Y; Ootani F; Tsukaguchi I; Ootani M; Furukawa T; Yamamoto T; Tomoda K; Mitomo M;	1992	MR Diagnosis of Meniscal Tears of the Knee: Value of Axial Three-Dimensional Fourier Transformation GRASS Images
Bari V;Murad M;	2003	Accuracy of magnetic resonance imaging in the knee
Barnett MJ;	1993	MR diagnosis of internal derangements of the knee: effect of field strength on efficacy
Barry KP;Mesgarzadeh M;Triolo J;Moyer R;Tehranzadeh J;Bonakdarpour A;	1996	Accuracy of MRI patterns in evaluating anterior cruciate ligament tears
Boeree NR;Watkinson AF;Ackroyd CE;Johnson C;	1991	Magnetic resonance imaging of meniscal and cruciate injuries of the knee
Brandser EA;Riley MA;Berbaum KS;El-Khoury GY;Bennett DL;	1996	MR imaging of anterior cruciate ligament injury: independent value of primary and secondary signs
Challen J;Tang Y;Hazratwala K;Stuckey S;	2007	Accuracy of MRI diagnosis of internal derangement of the knee in a non-specialized tertiary level referral teaching hospital
Chan WP;Peterfy C;Fritz RC;Genant HK;	1994	MR diagnosis of complete tears of the anterior cruciate ligament of the knee: importance of anterior subluxation of the tibia
Chen MC;Shih TT;Jiang CC;Su CT;Huang KM;	1995	MRI of meniscus and cruciate ligament tears correlated with arthroscopy
Chung HW;Kim YH;Hong SH;Kim SS;Chung JK;Seong SC;Kang HS;	2000	Indirect signs of anterior cruciate ligament injury on SPET: comparison with MRI and arthroscopy
Cotten A;Delfaut E;Demondion X;Lapegue F;Boukhelifa M;Boutry N;Chastanet P;Gougeon F;	2000	MR imaging of the knee at 0.2 and 1.5 T: correlation with surgery
Craig J; Lily G; Bechinger J; Hearshen D; Bouffard A; Diamond M; van Holsbeeck M;	2005	Three-tesla imaging of the knee: initial experience
De Smet AA;Nathan DH;Graf BK;Haaland BA;Fine JP;	2008	Clinical and MRI findings associated with false-positive knee MR diagnoses of medial meniscal tears

Table 125. Articles Excluded for Recommendation 3 for Not Best Available Evidence

Author	Year	Title
Dongola N and Gishen P;	2004	Comparison between arthroscopy and 3 dimensional double echo steady state sequences in magnetic resonance imaging of internal derangements of the knee
Esmaili Jah AA;Keyhani S;Zarei R;Moghaddam AK;	2005	Accuracy of MRI in comparison with clinical and arthroscopic findings in ligamentous and meniscal injuries of the knee
Fanucci E; Varrucciu V; Masala S; Maiotti M; Simonetti G;	2001	The value of secondary MRI signs of an ACL lesion: comparison with arthroscopy
Fitzgerald SW;Remer EM;Friedman H;Rogers LF;Hendrix RW;Schafer MF;	1993	MR evaluation of the anterior cruciate ligament: value of supplementing sagittal images with coronal and axial images
Gelb HJ;Glasgow SG;Sapega AA;Torg JS;	1996	Magnetic resonance imaging of knee disorders. Clinical value and cost-effectiveness in a sports medicine practice
Gentili A;Seeger LL;Yao L;Do HM;	1994	Anterior cruciate ligament tear: indirect signs at MR imaging
Ghanem I; Jaoude A; Kharrat K; Dagher F;	2002	Is MRI effective in detecting intra-articular abnormalities of the injured knee?
Halinen J;Koivikko M;Lindahl J;Hirvensalo E;	2009	The efficacy of magnetic resonance imaging in acute multi-ligament injuries
Higueras G;Torregrosa AA;Marti-Bonmati L;Casillas C;Sanfeliu M;	1999	Synovialisation of the torn anterior cruciate ligament of the knee: comparison between magnetic resonance and arthroscopy
Jee WH;McCauley TR;Kim JM;	2004	Magnetic resonance diagnosis of meniscal tears in patients with acute anterior cruciate ligament tears
Justice W; Quinn S;	1995	Error patterns in the MR Imaging Evaluation of Menisci of the Knee
Khanda GE;Akhtar W;Ahsan H;Ahmad N;	2008	Assessment of menisci and ligamentous injuries of the knee on magnetic resonance imaging: correlation with arthroscopy
Kijowski R;Davis KW;Woods MA;Lindstrom MJ;De Smet AA;Gold GE;Busse RF;	2009	Knee joint: comprehensive assessment with 3D isotropic resolution fast spin-echo MR imaging--diagnostic performance compared with that of conventional MR imaging at 3.0 T
King SJ;Carty HM;Brady O;	1996	Magnetic resonance imaging of knee injuries in children
Kocabey Y;Tetik O;Isbell WM;Atay OA;Johnson	2004	The value of clinical examination versus magnetic resonance imaging in the diagnosis of meniscal tears and

Table 125. Articles Excluded for Recommendation 3 for Not Best Available Evidence

Author	Year	Title
DL;		anterior cruciate ligament rupture
Laoruengthana A; Jarusriwanna A;	2012	Sensitivity and Specificity of Magnetic Resonance Imaging for Knee injury and Clinical Application for the Naresuan University Hospital
LaPrade R; Burnett Q; Veenstra M; Hodgman G;	1994	The Prevalence of Abnormal Magnetic Resonance Imaging Findings in Asymptomatic Knees
Lee K;Siegel MJ;Lau DM;Hildebolt CF;Matava MJ;	1999	Anterior cruciate ligament tears: MR imaging-based diagnosis in a pediatric population
Lefevre N;Naouri JF;Bohu Y;Klouche S;Herman S;	2012	Partial tears of the anterior cruciate ligament: diagnostic performance of isotropic three-dimensional fast spin echo (3D-FSE-Cube) MRI
Lerman JE;Gray DS;Schweitzer ME;Bartolozzi A;	1995	MR evaluation of the anterior cruciate ligament: value of axial images
Liu S; Osti L; Henry M; Bocchi L;	1995	The diagnosis of acute complete tears of the anterior cruciate ligament: Comparison of MRI, Arthrometry and Clinical examination
McCauley TR;Moses M;Kier R;Lynch JK;Barton JW;Jokl P;	1994	MR diagnosis of tears of anterior cruciate ligament of the knee: importance of ancillary findings
McDermott MJ;Bathgate B;Gillingham BL;Hennrikus WL;	1998	Correlation of MRI and arthroscopic diagnosis of knee pathology in children and adolescents
Mellado JM;Calmet J;Olona M;Gine J;Sauri A;	2004	Magnetic resonance imaging of anterior cruciate ligament tears: reevaluation of quantitative parameters and imaging findings including a simplified method for measuring the anterior cruciate ligament angle
Miller G	1996	A Prospective Study Comparing the Accuracy of the Clinical Diagnosis of Meniscus Tear With Magnetic Resonance Imaging and its Effect on Clinical Outcome
Muhle C;Ahn JM;Dieke C;	2013	Diagnosis of ACL and meniscal injuries: MR imaging of knee flexion versus extension compared to arthroscopy
Munk B;Madsen F;Lundorf E;Staunstrup H;Schmidt SA;Bolvig L;Hellfritzsch MB;Jensen J;	1998	Clinical magnetic resonance imaging and arthroscopic findings in knees: a comparative prospective study of meniscus anterior cruciate ligament and cartilage lesions
Munk PL;Hilborn MD;Vellet AD;Dumas MD;Romano CC;	1997	Diagnostic equivalence of conventional and fast spin echo magnetic resonance imaging of the anterior cruciate ligament of the knee
Murao H;Morishita S;Nakajima M;Abe M;	1998	Magnetic resonance imaging of anterior cruciate ligament (ACL) tears: diagnostic value of ACL-tibial plateau angle

Table 125. Articles Excluded for Recommendation 3 for Not Best Available Evidence

Author	Year	Title
Naranje S;Mittal R;Nag H;Sharma R;	2008	Arthroscopic and magnetic resonance imaging evaluation of meniscus lesions in the chronic anterior cruciate ligament-deficient knee
Ng AW;Griffith JF;Hung EH;Law KY;Yung PS;	2012	MRI diagnosis of ACL bundle tears: value of oblique axial imaging
Nishikawa H;Imanaka Y;Sekimoto M;Ikai H;	2010	Verification bias in assessment of the utility of MRI in the diagnosis of cruciate ligament tears
Palle L;Reddy B;Reddy J;	2010	Sensitivity and specificity of vertically oriented lateral collateral ligament as an indirect sign of anterior cruciate ligament tear on magnetic resonance imaging
Quinn S; Brown T;	1991	Meniscal Tears Diagnosed with MR Imaging versus Arthroscopy: How Reliable a Standard Is Arthroscopy?
Rose NE;Gold SM;	1996	A comparison of accuracy between clinical examination and magnetic resonance imaging in the diagnosis of meniscal and anterior cruciate ligament tears
Rubin DA;Kettering JM;Towers JD;Britton CA;	1998	MR imaging of knees having isolated and combined ligament injuries
Sanchis-Alfonso V;Martinez-Sanjuan V;Gastaldi-Orquin E;	1993	The value of MRI in the evaluation of the ACL deficient knee and in the post-operative evaluation after ACL reconstruction
Savoye PY;Ravey JN;Dubois C;Barbier LP;Courvoisier A;Saragaglia D;Ferretti G;	2011	Magnetic resonance diagnosis of posterior horn tears of the lateral meniscus using a thin axial plane: the zip sign--a preliminary study
Schaefer F; Schaefer P; Brossmann J; Frahm M; Muhle C;Hilgert R;	2006	Value of fat-suppressed PD-weighted TSE-sequences for detection of anterior and posterior cruciate ligament lesions—Comparison to arthroscopy
Schub DL;Altahawi F;Meisel F;Winalski C;Parker RD;Saluan M;	2012	Accuracy of 3-Tesla magnetic resonance imaging for the diagnosis of intra-articular knee injuries in children and teenagers
Thomas S; Pullagura M; Robinson E; Cohen A; Banaszkiewicz P;	2007	The value of magnetic resonance imaging in our current management of ACL and meniscal injuries
Tung GA;Davis LM;Wiggins ME;Fadale PD;	1993	Tears of the anterior cruciate ligament: primary and secondary signs at MR imaging
Umans H;Wimpfheimer O;Haramati N;Applbaum YH;Adler M;Bosco J;	1995	Diagnosis of partial tears of the anterior cruciate ligament of the knee: value of MR imaging
Vahey TN;Broome DR;Kayes KJ;Shelbourne KD;	1991	Acute and chronic tears of the anterior cruciate ligament: differential features at MR imaging

Table 125. Articles Excluded for Recommendation 3 for Not Best Available Evidence

Author	Year	Title
Van DP;Gielen JL;Vanhoenacker FM;Wouters K;Dossche L;Parizel PM;	2012	Stable or unstable tear of the anterior cruciate ligament of the knee: an MR diagnosis?
Van DP;Vanhoenacker FM;Lambrecht V;Wouters K;Gielen JL;Dossche L;Parizel PM;	2013	Prospective Comparison of 1.5 and 3.0-T MRI for Evaluating the Knee Menisci and ACL
Weinstabl R; Mullner T; Vecsei V; Kainberger F; Kramer M;	1997	Economic Considerations for the Diagnosis and Therapy of Meniscal Lesions: Can Magnetic Resonance Imaging Help Reduce the Expense?
Winters K;Tregonning R;	2005	Reliability of magnetic resonance imaging of the traumatic knee as determined by arthroscopy
Yoon S; Kim S; Chung H; Choe B; Ahn H;	2007	Diagnostic Efficacy in Knee MRI Comparing Conventional Technique and Multiplanar Reconstruction with One-Millimeter FSE PDW Images

Table 126. Articles Excluded for Recommendation 8 for Not Best Available Evidence

Author	Year	Title
Ageberg E;Pettersson A;Friden T;	2007	15-year follow-up of neuromuscular function in patients with unilateral nonreconstructed anterior cruciate ligament injury initially treated with rehabilitation and activity modification: a longitudinal prospective study
Buss DD;Min R;Skyhar M;Galinat B;Warren RF;Wickiewicz TL;	1995	Nonoperative treatment of acute anterior cruciate ligament injuries in a selected group of patients
Casteleyn PP;Handelberg F;	1996	Non-operative management of anterior cruciate ligament injuries in the general population
Demirag B;Ozturk C;Bilgen OF;Durak K;	2004	Knee dislocations: an evaluation of surgical and conservative treatment
Engstrom B;Gornitzka J;Johansson C;Wredmark T;	1993	Knee function after anterior cruciate ligament ruptures treated conservatively
Friden T; Roberts D; Zatterstrom R; Lindstrand A; Mortiz U;	1997	Proprioception after an Acute Knee Ligament Injury: A Longitudinal Study on 16 Consecutive Patients

Table 126. Articles Excluded for Recommendation 8 for Not Best Available Evidence

Author	Year	Title
Kessler MA;Behrend H;Henz S;Stutz G;Rukavina A;Kuster MS;	2008	Function, osteoarthritis and activity after ACL-rupture: 11 years follow-up results of conservative versus reconstructive treatment
Lehnert M;Eisenschenk A;Zellner A;	1993	Results of conservative treatment of partial tears of the anterior cruciate ligament
Neusel E;Maibaum S;Rompe G;	1996	Five-year results of conservatively treated tears of the anterior cruciate ligament
Neuman P; Kostogiannis I; Friden T; Roos H;	2012	Knee laxity after complete anterior cruciate ligament tear: a prospective study over 15 years
Shirakura K;Kobuna Y;Kizuki S;Terauchi M;Fukasawa N;	1995	Untreated acute anterior cruciate ligament tears of the knee: progression and the influence of associated injuries
Swirtun LR;Renstrom P;	2008	Factors affecting outcome after anterior cruciate ligament injury: a prospective study with a six-year follow-up

Table 127. Articles Excluded for Recommendation 12 for Not Best Available Evidence

Author	Year	Title
Asagumo H;Kimura M;Kobayashi Y;Taki M;Takagishi K;	2007	Anatomic reconstruction of the anterior cruciate ligament using double-bundle hamstring tendons: surgical techniques, clinical outcomes, and complications
Ferretti A;Monaco E;Labianca L;Conteduca F;De CA;	2008	Double-bundle anterior cruciate ligament reconstruction: a computer-assisted orthopaedic surgery study
Fu FH;Shen W;Starman JS;Okeke N;Irrgang JJ;	2008	Primary anatomic double-bundle anterior cruciate ligament reconstruction: a preliminary 2-year prospective study
Gerhard P;Bolt R;Duck K;Mayer R;Friederich NF;Hirschmann MT;	2012	Long-term results of arthroscopically assisted anatomical single-bundle anterior cruciate ligament reconstruction using patellar tendon autograft: are there any predictors for the development of osteoarthritis?
Hatayama K;Terauchi M;Saito K;Higuchi H;Yanagisawa S;Takagishi K;	2013	The importance of tibial tunnel placement in anatomic double-bundle anterior cruciate ligament reconstruction
Hofbauer <; Valentin P; Kdolsky R; Ostermann R; Graf A; Figl M; Aldrrain S;	2010	Rotational and translational laxity after computer-navigated single- and double-bundle anterior cruciate ligament reconstruction

Table 127. Articles Excluded for Recommendation 12 for Not Best Available Evidence

Author	Year	Title
Hussein M;van Eck CF;Cretnik A;Dinevski D;Fu FH;	2012	Individualized anterior cruciate ligament surgery: a prospective study comparing anatomic single- and double-bundle reconstruction
Kim SJ;Chang JH;Kim TW;Jo SB;Oh KS;	2009	Anterior cruciate ligament reconstruction with use of a single or double-bundle technique in patients with generalized ligamentous laxity
Kim SJ;Jo SB;Kumar P;Oh KS;	2009	Comparison of single- and double-bundle anterior cruciate ligament reconstruction using quadriceps tendon-bone autografts
Kondo E;Yasuda K;Azuma H;Tanabe Y;Yagi T;	2008	Prospective clinical comparisons of anatomic double-bundle versus single-bundle anterior cruciate ligament reconstruction procedures in 328 consecutive patients
Mae T; Shino K; Matsumoto N; Natsu-ume T;Yoneda K; Yoshikawa H; Yoneda M;	2010	Anatomic Double-Bundle Anterior Cruciate Ligament Reconstruction Using Hamstring Tendons With Minimally Required Initial Tension
Muneta T;Hara K;Ju YJ;Mochizuki T;Morito T;Yagishita K;Sekiya I;	2010	Revision anterior cruciate ligament reconstruction by double-bundle technique using multi-strand semitendinosus tendon
Niki Y;Hakozaki A;Iwamoto W;Kanagawa H;Matsumoto H;Toyama Y;Suda Y;	2012	Factors affecting anterior knee pain following anatomic double-bundle anterior cruciate ligament reconstruction
Otsubo H;Shino K;Nakamura N;Nakata K;Nakagawa S;Koyanagi M;	2007	Arthroscopic evaluation of ACL grafts reconstructed with the anatomical two-bundle technique using hamstring tendon autograft
Park SY; Oh H; Park SW; Lee JW; Lee SH; yoon KH;	2012	Clinical Outcomes of Remnant-Preserving Augmentation Versus Double-Bundle Reconstruction in the Anterior Cruciate Ligament Reconstruction
Siebold R;Branch TP;Freedberg HI;Jacobs CA;	2011	A matched pairs comparison of single- versus double-bundle anterior cruciate ligament reconstructions, clinical results and manual laxity testing
Toritsuka Y; Amano H; Kuwano M; Iwai T; Mae T; Ohzono K; Shino K;	2009	Outcome of double-bundle ACL reconstruction using hamstring tendons
Tsarouhas A;Iosifidis M;Kotzamitelos D;Spyropoulos G;Tsatalas T;Giakas G;	2010	Three-dimensional kinematic and kinetic analysis of knee rotational stability after single- and double-bundle anterior cruciate ligament reconstruction
van Eck CF;Schkrohowsky JG;Working ZM;Irrgang JJ;Fu FH;	2012	Prospective analysis of failure rate and predictors of failure after anatomic anterior cruciate ligament reconstruction with allograft

Table 127. Articles Excluded for Recommendation 12 for Not Best Available Evidence

Author	Year	Title
Ventura A;Legnani C;Terzaghi C;Borgo E;	2012	Single- and Double-Bundle Anterior Cruciate Ligament Reconstruction in Patients Aged Over 50 Years
Xu Y; Ao Y; Wang J; Yu J; Cui G;	2011	Relation of Tunnel Enlargement and Tunnel Placement After Single-Bundle Anterior Cruciate Ligament Reconstruction
Yasuda K;Kondo E;Ichiyama H;Tanabe Y;Tohyama H;	2006	Clinical evaluation of anatomic double-bundle anterior cruciate ligament reconstruction procedure using hamstring tendon grafts: comparisons among 3 different procedures
Zaffagnini S;Signorelli C;Lopomo N;Bonanzinga T;Marcheggiani Muccioli GM;Bignozzi S;Visani A;Marcacci M;	2012	Anatomic double-bundle and over-the-top single-bundle with additional extra-articular tenodesis: an in vivo quantitative assessment of knee laxity in two different ACL reconstructions

Table 128. Articles Excluded for Recommendation 13 for Not Best Available Evidence

Author	Year	Title
Ageberg E; Roos H; Silbernagel G; Thomee R; Roos E	2009	Knee extension and flexion muscle power after anterior cruciate ligament reconstruction with patellar tendon graft or hamstring tendons graft: a cross-sectional comparison 3 years post surgery
Aglietti P; Zaccherotti G; Buzzi R; De Biase P;	1997	A comparison between patellar tendon and doubled semitendinosus/gracilis tendon for anterior cruciate ligament reconstruction. A minimum five-year follow-up
Aglietti P;Buzzi R;Giron F;Simeone AJ;Zaccherotti G;	1997	Arthroscopic-assisted anterior cruciate ligament reconstruction with the central third patellar tendon. A 5-8-year follow-up
Aglietti P;Buzzi R;Zaccherotti G;De BP;	1994	Patellar tendon versus doubled semitendinosus and gracilis tendons for anterior cruciate ligament reconstruction
Ahn JH;Wang JH;Lee YS;Kim JG;Kang JH;Koh KH;	2011	Anterior cruciate ligament reconstruction using remnant preservation and a femoral tensioning technique: clinical and magnetic resonance imaging results
Ahn J; Kim J; Wang J; Jung C; Lim C	2012	Long-Term Results of Anterior Cruciate Ligament Reconstruction Using Bone-Patellar Tendon-Bone: An Analysis of the Factors Affecting the Development of Osteoarthritis
Ali S; Kumar A; Adnaan S; Hislop;	2006	Anterior cruciate ligament reconstruction using hamstring tendon graft without detachment of the tibial insertion
Bach BR;Jones GT;Sweet FA;Hager CA;	1994	Arthroscopy-assisted anterior cruciate ligament reconstruction using patellar tendon substitution. Two- to four-year follow-up results
Bak K;Jorgensen U;Ekstrand J;Scavenius M;	2001	Reconstruction of anterior cruciate ligament deficient knees in soccer players with an iliotibial band autograft. A prospective study of 132 reconstructed knees followed for 4 (2-7) years
Barber FA;Aziz-Jacobo J;Oro FB;	2010	Anterior cruciate ligament reconstruction using patellar tendon allograft: an age-dependent outcome evaluation

Table 128. Articles Excluded for Recommendation 13 for Not Best Available Evidence

Author	Year	Title
Barker JU;Drakos MC;Maak TG;Warren RF;Williams RJ;Allen AA;	2010	Effect of graft selection on the incidence of postoperative infection in anterior cruciate ligament reconstruction
Barrett GR;Field LD;	1993	Comparison of patella tendon versus patella tendon/Kennedy ligament augmentation device for anterior cruciate ligament reconstruction: study of results, morbidity, and complications
Barrett GR;Noojin FK;Hartzog CW;Nash CR;	2002	Reconstruction of the anterior cruciate ligament in females: A comparison of hamstring versus patellar tendon autograft
Bourke HE;Gordon DJ;Salmon LJ;Waller A;Linklater J;Pinczewski LA;	2012	The outcome at 15 years of endoscopic anterior cruciate ligament reconstruction using hamstring tendon autograft for 'isolated' anterior cruciate ligament rupture
Bourke HE;Salmon LJ;Waller A;Patterson V;Pinczewski LA;	2012	Survival of the Anterior Cruciate Ligament Graft and the Contralateral ACL at a Minimum of 15 Years
Brandsson S;Faxen E;Kartus J;Jerre R;Eriksson BI;Karlsson J;	2001	A prospective four- to seven-year follow-up after arthroscopic anterior cruciate ligament reconstruction
Chen C; Chen W; Shih C;	1998	Quadriceps Tendon-Patellar Bone Autograft for Arthroscopic Anterior Cruciate Ligament Reconstruction
Chouliaras V;Ristanis S;Moraiti C;Stergiou N;Georgoulis AD;	2007	Effectiveness of reconstruction of the anterior cruciate ligament with quadrupled hamstrings and bone-patellar tendon-bone autografts: an in vivo study comparing tibial internal-external rotation
Clark R;Olsen RE;Larson BJ;Goble EM;Farrer RP;	1998	Cross-pin femoral fixation: a new technique for hamstring anterior cruciate ligament reconstruction of the knee
Corry IS;Webb JM;Clingeleffer AJ;Pinczewski LA;	1999	Arthroscopic reconstruction of the anterior cruciate ligament. A comparison of patellar tendon autograft and four-strand hamstring tendon autograft
Deehan DJ;Salmon LJ;Webb VJ;Davies A;Pinczewski LA;	2000	Endoscopic reconstruction of the anterior cruciate ligament with an ipsilateral patellar tendon autograft. A prospective longitudinal five-year study
Dheerendra SK;Khan WS;Singhal R;Shivarathre DG;Pydisetty R;Johnstone D;	2012	Anterior cruciate ligament graft choices: a review of current concepts

Table 128. Articles Excluded for Recommendation 13 for Not Best Available Evidence

Author	Year	Title
Eriksson K;Anderberg P;Hamberg P;Olerud P;Wredmark T;	2001	There are differences in early morbidity after ACL reconstruction when comparing patellar tendon and semitendinosus tendon graft. A prospective randomized study of 107 patients
Feagin J; Wills R; Lambert K; Mott W; Cunningham R;	1997	Anterior Cruciate Ligament Reconstruction
Fink C;Zapp M;Benedetto KP;Hackl W;Hoser C;Rieger M;	2001	Tibial tunnel enlargement following anterior cruciate ligament reconstruction with patellar tendon autograft
Forssblad M;Valentin A;Engstrom B;Werner S;	2006	ACL reconstruction: patellar tendon versus hamstring grafts--economical aspects
Francis A;Thomas RD;McGregor A;	2001	Anterior cruciate ligament rupture: reconstruction surgery and rehabilitation. A nation-wide survey of current practice
Giron F; Aglietti P; Cuomo P; Mondanelli N; Ciadullo A	2005	Anterior cruciate ligament reconstruction with double-looped Semitendinosus and gracilis tendon graft directly fixed to cortical bone: 5-year results
Glenn R; Bach B; Joseph C;	2005	Anterior Cruciate Ligament Reconstruction: The Rush Experience
Gobbi A;Mahajan S;Zanazzo M;Tuy B;	2003	Patellar tendon versus quadrupled bone-semitendinosus anterior cruciate ligament reconstruction: a prospective clinical investigation in athletes
Goradia VK;Grana WA;	2001	A comparison of outcomes at 2 to 6 years after acute and chronic anterior cruciate ligament reconstructions using hamstring tendon grafts
Harreld K;Nyland J;Cottrell B;Caborn DN;	2006	Self-reported patient outcomes after ACL reconstruction with allograft tissue
Hasebe Tanabe Y; Yasuda K;	2005	Anterior-Cruciate-Ligament Reconstruction Using Doubled Hamstring-Tendon Autograft
Hersekli MA;Akpinar S;Ozalay M;Ozkoc G;Cesur N;Uysal M;Pourbagher A;Tandogan RN;	2004	Tunnel enlargement after arthroscopic anterior cruciate ligament reconstruction: comparison of bone-patellar tendon-bone and hamstring autografts
Janssen RP;du Mee AW;van VJ;Sala HA;Tseng CM;	2012	Anterior cruciate ligament reconstruction with 4-strand hamstring autograft and accelerated rehabilitation: a 10-year prospective study on clinical results, knee osteoarthritis and its predictors
Jarvela T;Kannus P;Jarvinen M;	2001	Anterior cruciate ligament reconstruction in patients with or without accompanying injuries: A re-examination of subjects 5 to 9 years after reconstruction

Table 128. Articles Excluded for Recommendation 13 for Not Best Available Evidence

Author	Year	Title
Jomha N; Pinczewski L; Clingelegger A; Otto D	1999	Arthroscopic reconstruction of the anterior cruciate ligament with patellar-tendon autograft and interference screw fixation
Keays S; Saxton J; Keays A; Newcombe P; Bullock M;	2007	A 6-Year Follow-up of the Effect of GraftSite on Strength, Stability, Range of Motion, Function, and Joint Degeneration After Anterior Cruciate Ligament Reconstruction Patellar Tendon Versus Semitendinosus and Gracilis Tendon Graft
Kim SJ;Kumar P;Oh KS;	2009	Anterior cruciate ligament reconstruction: autogenous quadriceps tendon-bone compared with bone-patellar tendon-bone grafts at 2-year follow-up
Kleipool AE;van LT;Marti RK;	1994	Pain after use of the central third of the patellar tendon for cruciate ligament reconstruction. 33 patients followed 2-3 years
Lautamies R; Harilainen A; Kettunen J; Sandelin J; Kujala U;	2008	Isokinetic quadriceps and hamstring muscle strength and knee function 5 years after anterior cruciate ligament reconstruction: comparison between bone-patellar tendon-bone and hamstring tendon autografts
Laxdal G;Kartus J;Ejerhed L;Sernert N;Magnusson L;Faxen E;Karlsson J;	2005	Outcome and risk factors after anterior cruciate ligament reconstruction: a follow-up study of 948 patients
Leys T; Salmon L; Waller A; Linklater J; Pinczewski L;	2012	Clinical Results and Risk Factors for Reinjury 15 Years After Anterior Cruciate Ligament Reconstruction A Prospective Study of Hamstring and Patellar Tendon Grafts
Liden M;Sernert N;Rostgard-Christensen L;Kartus C;Ejerhed L;	2008	Osteoarthritic changes after anterior cruciate ligament reconstruction using bone-patellar tendon-bone or hamstring tendon autografts: a retrospective, 7-year radiographic and clinical follow-up study
Liu Z; Zhang ZL; Jian Y; Zeng BF;	2010	Four-strand hamstring tendon autograft versus LARS artificial ligament for anterior cruciate ligament reconstruction
Maeda A;Shino K;Horibe S;Nakata K;Buccafusca G;	1996	Anterior cruciate ligament reconstruction with multistranded autogenous semitendinosus tendon
Magnussen RA;Lawrence JT;West RL;Toth AP;Taylor DC;Garrett WE;	2012	Graft size and patient age are predictors of early revision after anterior cruciate ligament reconstruction with hamstring autograft
Maletis GB;Cameron SL;Tengan JJ;Burchette RJ;	2007	A prospective randomized study of anterior cruciate ligament reconstruction: a comparison of patellar tendon and quadruple-strand semitendinosus/gracilis tendons fixed with bioabsorbable interference screws

Table 128. Articles Excluded for Recommendation 13 for Not Best Available Evidence

Author	Year	Title
Marcacci M; Zaffagnini S; Iacono F; Neri M; Loreti I; Petitto A;	1998	Arthroscopic intra- and extra-articular anterior cruciate ligament reconstruction with gracilis and semitendinosus tendons
Mok DW;Dowd GS;	1993	Long-term results of anterior cruciate reconstruction with the patellar tendon
Nin JR;Leyes M;Schweitzer D;	1996	Anterior cruciate ligament reconstruction with fresh-frozen patellar tendon allografts: sixty cases with 2 years' minimum follow-up
Noyes FR;Barber-Westin SD;	2001	Revision anterior cruciate surgery with use of bone-patellar tendon-bone autogenous grafts
Noyes FR;Barber-Westin SD;	1997	A comparison of results in acute and chronic anterior cruciate ligament ruptures of arthroscopically assisted autogenous patellar tendon reconstruction
Noyes FR;Barber-Westin SD;	1996	Reconstruction of the anterior cruciate ligament with human allograft. Comparison of early and later results
Odat M;	2001	Reconstruction of the Anterior Cruciate Ligament using the Central Third of the Patellar Tendon
Opstelten W;Scholten RJ;	2007	Physical diagnostic tests for assessing ruptures of the anterior cruciate ligament
O'Shea JJ;Shelbourne KD;	2002	Anterior cruciate ligament reconstruction with a reharvested bone-patellar tendon-bone graft
Patel JV;Church JS;Hall AJ;	2000	Central third bone-patellar tendon-bone anterior cruciate ligament reconstruction: a 5-year follow-up
Pathania; Gupta S; Joshi L;	2004	Anterior Cruciate Ligament Reconstruction with Bone Patellar Tendon Bone Graft through a Mini Arthrotomy
Prodromos CC;Han YS;Keller BL;Bolyard RJ;	2005	Stability results of hamstring anterior cruciate ligament reconstruction at 2- to 8-year follow-up
Raffo C; Richmond J;	2005	Hamstring Anterior Cruciate Ligament Reconstruction With Rigid, 360°, Near-Aperture Fixation
Rubinstein R; Shelbourne D; VanMeter C; McCarroll J; Retting A;	1994	Isolated Autogenous Bone-Patellar Tendon-Bone Graft Site Morbidity*
Rudroff T;	2003	Functional capability is enhanced with semitendinosus than patellar tendon ACL repair
Salmon L;Russell V;Musgrove T;Pinczewski L;Refshauge K;	2005	Incidence and risk factors for graft rupture and contralateral rupture after anterior cruciate ligament reconstruction

Table 128. Articles Excluded for Recommendation 13 for Not Best Available Evidence

Author	Year	Title
Salmon LJ;Pinczewski LA;Russell VJ;Refshauge K;	2006	Revision anterior cruciate ligament reconstruction with hamstring tendon autograft: 5- to 9-year follow-up
Salmon LJ;Refshauge KM;Russell VJ;Roe JP;Linklater J;Pinczewski LA;	2006	Gender differences in outcome after anterior cruciate ligament reconstruction with hamstring tendon autograft
Salmon LJ;Russell VJ;Refshauge K;Kader D;Connolly C;Linklater J;Pinczewski LA;	2006	Long-term outcome of endoscopic anterior cruciate ligament reconstruction with patellar tendon autograft: minimum 13-year review
Siebold R; Webster K; Feller J; Sutherland A; Elliott J;	2006	Anterior cruciate ligament reconstruction in females: a comparison of hamstring tendon and patellar tendon autografts
Snow M;Campbell G;Adlington J;Stanish WD;	2010	Two to five year results of primary ACL reconstruction using doubled tibialis anterior allograft
Spicer DD;Blagg SE;Unwin AJ;Allum RL;	2000	Anterior knee symptoms after four-strand hamstring tendon anterior cruciate ligament reconstruction
Struewer J;Frangen TM;Ishaque B;Bliemel C;Efe T;Ruchholtz S;Ziring E;	2012	Knee function and prevalence of osteoarthritis after isolated anterior cruciate ligament reconstruction using bone-patellar tendon-bone graft: long-term follow-up
Struewer J; Ziring E; Frangen T; Efe T; Meibner S; Buecking B; Bliemel C;	2012	Clinical outcome and prevalence of osteoarthritis after isolated anterior cruciate ligament reconstruction using hamstring graft: follow-up after two and ten years
Sutherland A; Cooper K; Alexander L; Nicol M; Smith F; Scptland T;	2010	The long-term functional and radiological outcome after open reconstruction of the anterior cruciate ligament
Thompson J;Harris M;Grana WA;	2005	Patellofemoral pain and functional outcome after anterior cruciate ligament reconstruction: an analysis of the literature
Toritsuka Y;Horibe S;Mitsuoka T;Nakamura N;Hamada M;Shino K;	2003	Comparison between the cross-sectional area of bone-patellar tendon-bone grafts and multistranded hamstring tendon grafts obtained from the same patients
Torry MR;Decker MJ;Jockel JR;Viola R;Sterett WI;Steadman JR;	2004	Comparison of tibial rotation strength in patients' status after anterior cruciate ligament reconstruction with hamstring versus patellar tendon autografts
Tudisco C; Blasucci C; SimonelliM; Gatti S;	1997	Arthroscopic anterior cruciate ligament reconstruction with the patellar tendon for chronic laxity: follow-up of 69 cases

Table 128. Articles Excluded for Recommendation 13 for Not Best Available Evidence

Author	Year	Title
van der Hart CP;van den Bekerom MP;Patt TW;	2008	The occurrence of osteoarthritis at a minimum of ten years after reconstruction of the anterior cruciate ligament
van Dijck RA;Saris DB;Willems JW;Fievez AW;	2008	Additional surgery after anterior cruciate ligament reconstruction: can we improve technical aspects of the initial procedure?
Vorlat P;Verdonk R;Arnauw G;	1999	Long-term results of tendon allografts for anterior cruciate ligament replacement in revision surgery and in cases of combined complex injuries
Wagner M; Kaab M; Schallock J; Haas N; Weiler A;	2005	Hamstring Tendon Versus Patellar Tendon Anterior Cruciate Ligament Reconstruction Using Biodegradable Interference Fit Fixation
Webster KE;Wittwer JE;O'Brien J;Feller JA;	2005	Gait patterns after anterior cruciate ligament reconstruction are related to graft type
Wilcox JF;Gross JA;Sibel R;Backs RA;Kaeding CC;	2005	Anterior cruciate ligament reconstruction with hamstring tendons and cross-pin femoral fixation compared with patellar tendon autografts
Williams III RJ;Hyman J;Petrigliano F;Rozental T;Wickiewicz TL;	2005	Anterior cruciate ligament reconstruction with a four-strand hamstring tendon autograft
Witvrouw E;Bellemans J;Verdonk R;Cambier D;Coorevits P;Almqvist F;	2001	Patellar tendon vs. doubled semitendinosus and gracilis tendon for anterior cruciate ligament reconstruction
Wojtys EM;Huston LJ;	2000	Longitudinal effects of anterior cruciate ligament injury and patellar tendon autograft reconstruction on neuromuscular performance
Wredmark T;Engstrom B;	1993	Five-year results of anterior cruciate ligament reconstruction with the Stryker Dacron high-strength ligament
Zaccherotti G; Aglietti P; Bandinelli I;	1997	Long-term isokinetic evaluation of quadriceps and hamstrings strength following ACL reconstruction. A case-control study

Table 129. Articles Excluded for Recommendation 14 for Not Best Available Evidence

Author	Year	Title
Bach B; Aadalen K; Dennis M; Carreira D; Bojchuk J; Hayden J;	2005	Primary Anterior Cruciate Ligament Reconstruction Using Fresh-Frozen, Nonirradiated Patellar Tendon Allograft Minimum 2-Year Follow-up
Barrett AM;Craft JA;Replogle WH;Hydrick JM;Barrett GR;	2011	Anterior cruciate ligament graft failure: a comparison of graft type based on age and Tegner activity level
Barrett GR;Luber	2010	Allograft anterior cruciate ligament reconstruction in the

Table 129. Articles Excluded for Recommendation 14 for Not Best Available Evidence

Author	Year	Title
K;Replogle WH;Manley JL;		young, active patient: Tegner activity level and failure rate
Chang SK;Egami DK;Shaieb MD;Kan DM;Richardson AB;	2003	Anterior cruciate ligament reconstruction: allograft versus autograft
Ellis H; Matheny L; Briggs K; Pennock A; Steadman R;	2012	Outcomes and Revision Rate After Bone-Patellar Tendon-Bone Allograft Versus Autograft Anterior Cruciate Ligament Reconstruction in Patients Aged 18 Years or Younger With Closed Physes
Greenberg DD;Robertson M;Vallurupalli S;White RA;Allen WC;	2010	Allograft compared with autograft infection rates in primary anterior cruciate ligament reconstruction
Guo L;Yang L;Duan XJ;He R;Chen GX;Wang FY;Zhang Y;	2012	Anterior cruciate ligament reconstruction with bone-patellar tendon-bone graft: comparison of autograft, fresh-frozen allograft, and gamma-irradiated allograft
Harner CD;Olson E;Irrgang JJ;Silverstein S;Fu FH;Silbey M;	1996	Allograft versus autograft anterior cruciate ligament reconstruction: 3- to 5-year outcome
Holm I; Risberg M; Aune A; Tjomsland O Steen H	2000	Muscle strength recovery following anterior cruciate ligament reconstruction: A prospective study of 151 patients with a two-year follow-up
Hui C;Salmon LJ;Kok A;Maeno S;Linklater J;Pinczewski LA;	2011	Fifteen-year outcome of endoscopic anterior cruciate ligament reconstruction with patellar tendon autograft for 'isolated' anterior cruciate ligament tear
Indelicato PA;Linton RC;Huegel M;	1992	The results of fresh-frozen patellar tendon allografts for chronic anterior cruciate ligament deficiency of the knee
Johnson DL;Fu FH;	1993	Total quadriceps sparing, endoscopic single-incision anterior cruciate ligament reconstruction using fresh frozen allograft tissue: surgical technique and potential pitfalls
Kleipool AE;Zijl JA;Willems WJ;	1998	Arthroscopic anterior cruciate ligament reconstruction with bone-patellar tendon-bone allograft or autograft. A prospective study with an average follow up of 4 years
Lebel B;Hulet C;Galaud B;Burdin G;Locker B;Vielpeau C;	2008	Arthroscopic reconstruction of the anterior cruciate ligament using bone-patellar tendon-bone autograft: a minimum 10-year follow-up
Li H;Tao H;Cho S;Chen S;Yao	2012	Difference in graft maturity of the reconstructed anterior cruciate ligament 2 years postoperatively: a comparison

Table 129. Articles Excluded for Recommendation 14 for Not Best Available Evidence

Author	Year	Title
Z;Chen S;		between autografts and allografts in young men using clinical and 3.0-T magnetic resonance imaging evaluation
Magnussen R; Fkanigan D; Pedroa A; Heinlein K; Kaeding C;	2013	Platelet rich plasma use in allograft ACL reconstructions: Two-year clinical results of a MOON cohort study
Mascarenhas R;Tranovich M;Karpie JC;Irrgang JJ;Fu FH;Harner CD;	2010	Patellar tendon anterior cruciate ligament reconstruction in the high-demand patient: evaluation of autograft versus allograft reconstruction
Mauro CS;Irrgang JJ;Williams BA;Harner CD;	2008	Loss of extension following anterior cruciate ligament reconstruction: analysis of incidence and etiology using IKDC criteria
Mayr HO;Willkomm D;Stoehr A;Schettle M;Suedkamp NP;Bernstein A;Hube R;	2012	Revision of anterior cruciate ligament reconstruction with patellar tendon allograft and autograft: 2- and 5-year results
Mitsou A;Vallianatos P;	1996	Reconstruction of the anterior cruciate ligament using a patellar tendon autograft. A long term follow up
Nakamura N;Horibe S;Sasaki S;Kitaguchi T;Tagami M;Mitsuoka T;Toritsuka Y;Hamada M;Shino K;	2002	Evaluation of active knee flexion and hamstring strength after anterior cruciate ligament reconstruction using hamstring tendons
Nin J; Leyes M; Schweitzer D;	1996	Anterior cruciate ligament reconstruction with fresh-frozen patellar tendon allografts: sixty cases with 2 years' minimum follow-up
Oneill D;	2001	Arthroscopically Assisted Reconstruction of the Anterior Cruciate Ligament
Saddemi SR;Frogameni AD;Fenton PJ;Hartman J;Hartman W;	1993	Comparison of perioperative morbidity of anterior cruciate ligament autografts versus allografts
Siebold R;Buelow JU;Bos L;Ellermann A;	2003	Primary ACL reconstruction with fresh-frozen patellar versus Achilles tendon allografts
Sterling JC;Meyers MC;Calvo RD;	1995	Allograft failure in cruciate ligament reconstruction. Follow-up evaluation of eighteen patients
Tsuda E; Okamura	2001	Techniques for Reducing Anterior Knee Symptoms after

Table 129. Articles Excluded for Recommendation 14 for Not Best Available Evidence

Author	Year	Title
Y; Ishibashi Y; Otsuka H; Toh S;		Anterior Cruciate Ligament Reconstruction Using a Bone-Patellar Tendon-Bone Autograft
Webb J; Corry I; Clingeleffer A; Pinczewski L;	1998	Endoscopic reconstruction for isolated anterior cruciate ligament rupture

Table 130. Articles Excluded for Recommendation 15 for Not Best Available Evidence

Author	Year	Title
Howell SM;Deutsch ML;	1999	Comparison of endoscopic and two-incision techniques for reconstructing a torn anterior cruciate ligament using hamstring tendons
Karlsson J;Kartus J;Brandsson S;Magnusson L;Lundin O;Eriksson BI;	1999	Comparison of arthroscopic one-incision and two-incision techniques for reconstruction of the anterior cruciate ligament
Merchant TC;	2001	Comparison of three patellar tendon anterior cruciate ligament reconstruction techniques with emphasis on tunnel location and outcome. Are our results improving?
Moisala AS;Jarvela T;Harilainen A;Sandelin J;Kannus P;Jarvinen M;	2007	The effect of graft placement on the clinical outcome of the anterior cruciate ligament reconstruction: a prospective study
O'Neill DB;	2001	Arthroscopically assisted reconstruction of the anterior cruciate ligament. A follow-up report
Sgaglione NA;Schwartz RE;	1997	Arthroscopically assisted reconstruction of the anterior cruciate ligament: initial clinical experience and minimal 2-year follow-up comparing endoscopic transtibial and two-incision techniques
Webb JM;Corry IS;Clingeleffer AJ;Pinczewski LA;	1998	Endoscopic reconstruction for isolated anterior cruciate ligament rupture

Table 131. Articles Excluded for Recommendation 16 for Not Best Available Evidence

Author	Year	Title
Birmingham TB;Kramer JF;Kirkley A;	2002	Effect of a functional knee brace on knee flexion and extension strength after anterior cruciate ligament reconstruction
Howell SM;Taylor	1996	Brace-free rehabilitation, with early return to activity, for

MA;	knees reconstructed with a double-looped semitendinosus and gracilis graft

Table 132. Articles Excluded for Recommendation 19 for Not Best Available Evidence

Author	Year	Title
Decarlo MS;Shelbourne KD;McCarroll JR;Rettig AC;	1992	Traditional versus Accelerated Rehabilitation following ACL Reconstruction: A One-Year Follow-Up
Donatelli R; Cole SP; Greenfield B; Wooden M Joseph S. Wilkes, Cassie Lackey	1996	Open and closed kinetic chain strength training verse functional exercises to improve performance in patients with ACL reconstructed knees: a prospective study
Draper V;Ladd C;	1993	Subjective evaluation of function following moderately accelerated rehabilitation of anterior cruciate ligament reconstructed knees
Iriuchishima T;Horaguchi T;Morimoto Y;Negishi S;Kubomura T;Motojima S;Tokuhashi Y;Suzuki S;Saito A;	2010	Intensity of physiotherapy after anterior cruciate ligament reconstruction: a comparison of two rehabilitation regimen
Karasel S;Akpinar B;Gulbahar S;Baydar M;El O;Pinar H;Tatari H;Karaoglan O;Akalin E;	2010	Clinical and functional outcomes and proprioception after a modified accelerated rehabilitation program following anterior cruciate ligament reconstruction with patellar tendon autograft
Keays SL;Bullock-Saxton J;Keays AC;	2000	Strength and function before and after anterior cruciate ligament reconstruction
Revana SA; Johansson A; Leppert J	2009	A randomized study of two physiotherapeutic approaches after knee ligament reconstruction
Shelbourne KD;Nitz P;	1992	Accelerated rehabilitation after anterior cruciate ligament reconstruction
Shelbourne KD ; Gray T	1997	Anterior Cruciate Ligament Reconstruction with Autogenous Patellar Tendon Graft Followed by Accelerated Rehabilitation A Two- to Nine-Year Followup

ARTICLES EXCLUDED FROM THE AAOS SYSTEMATIC REVIEW AND REASON FOR EXCLUSION

Table 133. Articles Excluded for ACL Radiographs for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Anderson A; Lipscomb B;	1986	Clinical diagnosis of meniscal tears	Insufficient data to calculate diagnostic test performance
Anderson A; Lipscomb B;	1989	Preoperative instrumented testing of anterior and posterior knee laxity	Not relevant, not a diagnostic test performance study
Anderson A; Snyder R; Federspiel C; Lipscomb B	1992	Instrumented evaluation of knee laxity: A comparison of five arthrometers	Not relevant, not a diagnostic test performance study
Araki D; Kuroda R; Kubo S; Nagamune K; Hoshino Y; Nishimoto K;	2011	The Use of an Electromagnetic Measurement System for Anterior Tibial Displacement During the Lachman Test	Not relevant, not a diagnostic test performance study
Bach B; Warren R; Wickiewicz T;	1988	The Pivot shift phenomenon: Results and description of a modified clinical test for anterior cruciate ligament insufficiency	Not relevant, not a diagnostic test performance study
Barry O; Smith H; Mcmanus F; MacAuley P;	1983	Clinical assessment of suspected meniscal tears	Insufficient data to calculate diagnostic test performance
Curtin W; O'Farrell; McGoldrick F; Dolan M; Mullan G; Walsh M;	1992	The Correlation between Clinical Diagnosis of Knee Pathology and Findings at Arthroscopy	Not relevant, not a diagnostic test performance study
Dahlstedt and Dalen	1989	Knee laxity in cruciate ligament injury Value of examination under anesthesia	Not relevant, not a diagnostic test performance study
Daniel	1991	Assessing the limits of knee motion	Not relevant, not a diagnostic test performance study
Daniel D; Stone M; Sachs R; Malcom L;	1985	Instumented measurement of anterior knee Laxity In patients with acute anterior cruciate ligament disruption	Not relevant, not a diagnostic test performance study
Dejour D;Ntagiopoulos PG;Saggin PR;Panisset JC;	2013	The diagnostic value of clinical tests, magnetic resonance imaging, and instrumented laxity in the differentiation of complete versus partial anterior cruciate ligament tears	Not relevant, not a diagnostic test performance study
Delcogliano A; Fabbriciani C; Panni S; Pamphilis F	1992	Attendibilita dell'artrometro KT 1000 nella diagnosi di lesione del LeA	Not relevant, not a diagnostic test performance study
Dodd M; Trompeter A; Harrison T; Palmer S;	2010	The Pivot-Shift test is of limited clinical relevance in the Arthritic Anterior Cruciate Ligament-Deficient knee	Not relevant, not a diagnostic test performance study

Table 133. Articles Excluded for ACL Radiographs for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Donaldson W; Warren R; Wickiewicz T;	1985	A comparison of acute anterior cruciate ligament examinations	Not relevant, not a diagnostic test performance study
Ganko A; Engebretsen L; Ozer H;	2000	The Rolimeter: a new arthrometer compared with the KT-1000	Not relevant, Rolimeter study
Gillies H; Seligson D;	1979	Precision in the Diagnosis of Meniscal Lesions: A Comparison of Clinical Evaluation, Arthrography, and Arthroscopy	Insufficient data to calculate diagnostic test performance
Gomes J; Castro J; Becker R;	2008	Decreased Hip Range of Motion and Non-contact Injuries of the Anterior Cruciate Ligament	Not relevant, not a diagnostic test performance study
Graham GP;Johnson S;Dent CM;Fairclough JA;	1991	Comparison of clinical tests and the KT1000 in the diagnosis of anterior cruciate ligament rupture	Not a diagnostic test performance study
Harilainen	1987	Evaluation of knee instability in acute ligamentous injuries	Not relevant, not a diagnostic test performance study
Hiemstra LA;Veale K;Sasyniuk T;	2006	Knee immobilization in the immediate post-operative period following ACL reconstruction: a survey of practice patterns of Canadian orthopedic surgeons	Not a diagnostic test performance study
Hughston	1988	The absent posterior drawer test in some acute posterior cruciate ligament tears of the knee	Not relevant, not a diagnostic test performance study
Hurd W; Axe M; Mackler S;	2008	A 10-Year Prospective Trial of a Patient Management Algorithm and Screening Examination for Highly Active Individuals With Anterior Cruciate Ligament Injury	Not relevant, not a diagnostic test performance study
Johnson L; Johnson A; Colquitt J; Simmering M; Pittsley W;	1996	Is It Possible to Make an Accurate Diagnosis Based Only on a Medical History? A Pilot Study on Women's Knee Joints	Insufficient data to calculate diagnostic test performance
Jonsson H;Karrholm J;Elmqvist LG;	1993	Laxity after cruciate ligament injury in 94 knees. The KT-1000 arthrometer versus roentgen stereophotogrammetry	Insufficient data to test diagnostic test performance

Table 133. Articles Excluded for ACL Radiographs for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Lerat JL;Moyen B;Jenny JY;Perrier JP;	1993	A comparison of pre-operative evaluation of anterior knee laxity by dynamic X-rays and by the arthrometer KT 1000	Not a diagnostic test performance study
Liu S; Osti L; Henry M; Bocchi L;	1995	The Diagnosis of acute complete tears of the anterior cruciate ligament	Insufficient data to calculate diagnostic test performance, only Sensitivity data given.
Logan M; William A; Lavelle J; Gedroyc W; Freeman M;	2004	What Really Happens During the Lachman Test? A Dynamic MRI Analysis of Tibiofemoral Motion	Not relevant, not a diagnostic test performance study
Loos; Fox J; Blazina M; Pizzo W; Friedman M;	1981	Acute posterior cruciate ligament injuries	Not relevant, not a diagnostic test performance study
Lucie S; Wiedel J; Messner D;	1984	The acute pivot shift: Clinical correlation	Not relevant, not a diagnostic test performance study
Merlo F; Cerullo G; Osti L; Dirienzo G; Filisio M;	1997	Diagnosis of anterior cruciate ligament lesions: comparison between acute and chronic cases. Analysis of clinical and arthrometric evaluation	Insufficient data to calculate diagnostic test performance
Myer G; Ford K; Khoury J; Succop P; Hewett T;	2010	Development and Validation of a Clinical-Based Prediction Tool to Identify Female Athletes at High risk of Anterior Cruciate Ligament Injury	Not relevant, not a diagnostic test performance study
Peeler J; Leiter J; Macdonald P;	2010	Accuracy and Reliability of Anterior Cruciate Ligament Clinical Examination in a Multidisciplinary Sports Medicine Setting	Not relevant, not a diagnostic test performance study
Warren RF; Marshall JL;	1978	Injuries of the Anterior Cruciate and Medial Collateral Ligaments of the Knee	Not relevant, not a diagnostic test performance study

Table 134. Articles Excluded for ACL Magnetic Resonance Imaging (MRI) for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion

Table 134. Articles Excluded for ACL Magnetic Resonance Imaging (MRI) for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Ai T;Zhang W;Priddy NK;Li X;	2012	Diagnostic performance of CUBE MRI sequences of the knee compared with conventional MRI	Not relevant, comparing two different MRI sequences
Bari V;Murad M;	2003	Accuracy of magnetic resonance imaging in the knee	Insufficient data to calculate diagnostic test performance
Bin S; Kim JM; Shin SJ;	2004	Radial tears of the posterior horn of the medial meniscus	Not relevant, not a diagnostic test performance study
Chang CB;Seong SC;Kim TK;	2009	Preoperative magnetic resonance assessment of patellar tendon dimensions for graft selection in anterior cruciate ligament reconstruction	Not an ACL diagnosis study
Cook G; Ryan P; Clarke S; Forgelman I;	1996	SPECT bone Scientigraphy of Anterior cruciate ligament injury	Not relevant, Not an MRI diagnostic study
Dhillon AK;Al-Dadah O;Servant CT;	2013	Diagnostic accuracy of ACL tears according to tear morphology	Not a diagnostic test performance study
Disler DG;McCauley TR;Kelman CG;Fuchs MD;Ratner LM;Wirth CR;Hospodar PP;	1996	Fat-suppressed three-dimensional spoiled gradient-echo MR imaging of hyaline cartilage defects in the knee: Comparison with standard MR imaging and arthroscopy	Not relevant, not ACL diagnostic test performance study
Ekelund L; Bjornebrink J; Elmqvist L;	1991	Ultra-low field magnetic resonance imaging of acute cruciate ligament tears	Not relevant, not a diagnostic test performance study
Fickert S;Niks M;Dinter DJ;Hammer M;Weckbach S;Schoenberg SO;Lehmann L;Jochum S;	2012	Assessment of the diagnostic value of dual-energy CT and MRI in the detection of iatrogenically induced injuries of anterior cruciate ligament in a porcine model	Not relevant, Not a diagnostic test performance study
Figueroa D;Calvo R;Vaisman A;Carrasco MA;Moraga C;Delgado I;	2007	Knee chondral lesions: incidence and correlation between arthroscopic and magnetic resonance findings	Not relevant, not a ACL diagnostic test performance study
Fujimoto E;Sumen Y;Deie M;Yasumoto M;Kobayashi K;Ochi M;	2004	Anterior cruciate ligament graft impingement against the posterior cruciate ligament: diagnosis using MRI plus three-dimensional reconstruction software	Insufficient data for diagnostic test accuracy
Gay S; Chen N; Burch J; Gleason T; Sagman A	1992	Multiplanar Reconstruction in Magnetic Resonance Evaluation of the Knee	Less than 10 patients in the study

Table 134. Articles Excluded for ACL Magnetic Resonance Imaging (MRI) for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Heron CW;Calvert PT;	1992	Three-dimensional gradient-echo MR imaging of the knee: comparison with arthroscopy in 100 patients	Retrospective non consecutive case control study Very low
Hong SH;Choi JY;Lee GK;Choi JA;Chung HW;Kang HS;	2003	Grading of anterior cruciate ligament injury. Diagnostic efficacy of oblique coronal magnetic resonance imaging of the knee	Insufficient data to calculate diagnostic test performance
Irie K; Yamada T; Inoue K;	2000	A comparison of magnetic resonance imaging and arthroscopic evaluation of Chondral lesions of the Knee	Insufficient data to test diagnostic test performance
Krampla W;Roesel M;Svoboda K;Nachbagauer A;Gschwantler M;Hruby W;	2009	MRI of the knee: how do field strength and radiologist's experience influence diagnostic accuracy and interobserver correlation in assessing chondral and meniscal lesions and the integrity of the anterior cruciate ligament?	Not relevant, Not a diagnostic test performance study
Laundre BJ;Collins MS;Bond JR;Dahm DL;Stuart MJ;Mandrekar JN;	2009	MRI accuracy for tears of the posterior horn of the lateral meniscus in patients with acute anterior cruciate ligament injury and the clinical relevance of missed tears	Insufficient data for diagnostic test accuracy
Lerman JE;Gray DS;Schweitzer ME;Bartolozzi A;	1995	MR evaluation of the anterior cruciate ligament: value of axial images	Very low quality retrospective study, Recruited subjects with surgically proven complete ACL tears
Pandey UC;Qadur MA;Ezzeldin T;Grand F;	1995	Value of anterior subluxation of the tibia in the MR diagnosis of torn and atrophic anterior cruciate ligaments	Not relevant, not ACL diagnostic test performance study
Potter HG;Weinstein M;Allen AA;Wickiewicz TL;Helfet DL;	2002	Magnetic resonance imaging of the multiple-ligament injured knee	Insufficient data to calculate diagnostic test performance
Rasenberg EI;Lemmens JA;van KA;Schoots F;Bloo HJ;Wagemakers HP;Blankevoort L;	1995	Grading medial collateral ligament injury: comparison of MR imaging and instrumented valgus-varus laxity test-device. A prospective double-blind patient study	Not relevant, Not a diagnostic test performance study
Ruwe PA;Wright J;Randall RL;Lynch JK;Jokl P;McCarthy S;	1992	Can MR imaging effectively replace diagnostic arthroscopy?	Cost analysis of MRI, not a diagnostic test performance study

Table 134. Articles Excluded for ACL Magnetic Resonance Imaging (MRI) for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Subhas N;Kao A;Freire M;Polster JM;Obuchowski NA;Winalski CS;	2011	MRI of the knee ligaments and menisci: comparison of isotropic-resolution 3D and conventional 2D fast spin-echo sequences at 3 T	Not relevant, Not a diagnostic test performance study
Tsai KJ;Chiang H;Jiang CC;	2004	Magnetic resonance imaging of anterior cruciate ligament rupture	Insufficient data for diagnostic test accuracy
Umans H;Wimpfheimer O;Haramati N;Applbaum YH;Adler M;Bosco J;	1995	Diagnosis of partial tears of the anterior cruciate ligament of the knee: value of MR imaging	Retrospective review, Low quality study
Vellet AD;Lee DH;Munk PL;Hewett L;Eliasziw M;Dunlavy S;Vidito L;Fowler PJ;Miniaci A;Amendola A;	1995	Anterior cruciate ligament tear: prospective evaluation of diagnostic accuracy of middle- and high-field-strength MR imaging at 1.5 and 0.5 T	Insufficient data to test diagnostic test performance.
Vogl TJ;Schmitt J;Lubrich J;Hochmuth K;Diebold T;Del TK;Sudkamp N;	2001	Reconstructed anterior cruciate ligaments using patellar tendon ligament grafts: diagnostic value of contrast-enhanced MRI in a 2-year follow-up regimen	Post operative MRI study
Yoon JP;Chang CB;Yoo JH;Kim SJ;Choi JY;Choi JA;Seong SC;Kim TK;	2010	Correlation of magnetic resonance imaging findings with the chronicity of an anterior cruciate ligament tear	Insufficient data for diagnostic test accuracy

Table 135. Articles Excluded for ACL Pediatric for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Anderson AF;	2003	Transepiphyseal replacement of the anterior cruciate ligament in skeletally immature patients. A preliminary report	Commentary
Anderson AF;	2004	Transepiphyseal replacement of the anterior cruciate ligament using quadruple hamstring grafts in skeletally immature patients	Commentary
Andrews M;Noyes FR;Barber-Westin SD;	1994	Anterior cruciate ligament allograft reconstruction in the skeletally immature athlete	<10 patients per group
Arbes S;Resinger C;Vecsei V;Nau T;	2007	The functional outcome of total tears of the anterior cruciate ligament (ACL) in the skeletally immature patient	<10 patients per group
Aronowitz E; Ganley T; Goode J; Gregg J; Meyer J;	2000	Anterior Cruciate Ligament Reconstruction In Adolescents With Open Physes	Retrospective case series

Table 135. Articles Excluded for ACL Pediatric for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Barber FA;	2000	Anterior cruciate ligament reconstruction in the skeletally immature high-performance athlete: what to do and when to do it?	Case report
Bonnard C;Fournier J;Babusiaux D;Planchenault M;Bergerault F;de Court;	2011	Physeal-sparing reconstruction of anterior cruciate ligament tears in children: results of 57 cases using patellar tendon	Retrospective non-comparative case series
Courvoisier A;Grimaldi M;Plaweski S;	2011	Good surgical outcome of transphyseal ACL reconstruction in skeletally immature patients using four-strand hamstring graft	Retrospective case series
Da Silva JJ;Bach J;	2009	Hamstring allograft anterior cruciate ligament reconstruction in the skeletally immature patient	Commentary
Domzalski M;Grzelak P;Gabos P;	2010	Risk factors for Anterior Cruciate Ligament injury in skeletally immature patients: analysis of intercondylar notch width using Magnetic Resonance Imaging	Very low level medical records retrospective review study
Dumont G; Hogue G; Padalecki J; Okoro N; Wilson P;	2012	Meniscal and Chondral Injuries Associated With Pediatric Anterior Cruciate Ligament Tears	Retrospective medical records chart review
Edwards PH;Grana WA;	2001	Anterior cruciate ligament reconstruction in the immature athlete: long-term results of intra-articular reconstruction	<2 year follow up
Ellis HB;Matheny LM;Briggs KK;Pennock AT;Steadman JR;	2012	Outcomes and revision rate after bone-patellar tendon-bone allograft versus autograft anterior cruciate ligament reconstruction in patients aged 18 years or younger with closed physes	Less than two year follow up
Fuchs R;Wheatley W;Uribe JW;Hechtman KS;Zvijac JE;Schurhoff MR;	2002	Intra-articular anterior cruciate ligament reconstruction using patellar tendon allograft in the skeletally immature patient	Retrospective non-comparative case series
Gaulrapp H; Haus J;	2006	Intra-articular stabilization after anterior cruciate ligament tear in children and adolescents: results 6 years after surgery	Retrospective medical records review

Table 135. Articles Excluded for ACL Pediatric for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Gebhard F;Ellermann A;Hoffmann F;Jaeger JH;Friederich NF;	2006	Multicenter-study of operative treatment of intraligamentous tears of the anterior cruciate ligament in children and adolescents: comparison of four different techniques	<2 year follow up, Retrospective review
Guzzanti V; Falciglia F; Stanitski C;	2003	Preoperative Evaluation and Anterior Cruciate Ligament Reconstruction Technique for Skeletally Immature Patients in Tanner Stages 2 and 3	Retrospective medical records review
Hofmeister EP;Gillingham BL;Bathgate MB;Mills WJ;	2001	Results of anterior cruciate ligament reconstruction in the adolescent female	Low level retrospective medical records review
Hui JH;Chowdhary A;	2011	Reconstruction of anterior cruciate ligament in children: hamstring versus bone patella tendon bone graft	Narrative review, bibliography screened
Kocher M; Smith J; Zoric B; Lee B; Micheli L;	2007	Transphyseal Anterior Cruciate Ligament Reconstruction in Skeletally Immature Pubescent Adolescents	Retrospective case series
Kocher MS;	2006	Anterior cruciate ligament reconstruction in the skeletally immature patient	Commentary
Kocher MS;Garg S;Micheli LJ;	2006	Physeal sparing reconstruction of the anterior cruciate ligament in skeletally immature prepubescent children and adolescents. Surgical technique	Commentary
Kocher MS;Garg S;Micheli LJ;	2005	Physeal sparing reconstruction of the anterior cruciate ligament in skeletally immature prepubescent children and adolescents	Low level retrospective case series
Krych AJ;Pitts RT;Dajani KA;Stuart MJ;Levy BA;Dahm DL;	2010	Surgical repair of meniscal tears with concomitant anterior cruciate ligament reconstruction in patients 18 years and younger	Retrospective non-comparative case series
Kumar S; AhearneD; Hunt D;	2013	Transphyseal Anterior Cruciate Ligament Reconstruction in the Skeletally Immature	Retrospective case series

Table 135. Articles Excluded for ACL Pediatric for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Kumar S;Ahearne D;Hunt DM;	2013	Transphyseal anterior cruciate ligament reconstruction in the skeletally immature: follow-up to a minimum of sixteen years of age	Retrospective case series
Lawrence JT;Argawal N;Ganley TJ;	2011	Degeneration of the knee joint in skeletally immature patients with a diagnosis of an anterior cruciate ligament tear: is there harm in delay of treatment?	Retrospective review
Lo IK;Kirkley A;Fowler PJ;Miniaci A;	1997	The outcome of operatively treated anterior cruciate ligament disruptions in the skeletally immature child	<10 patients case series
Lykissas MG;Nathan ST;Wall EJ;	2012	All-Epiphyseal Anterior Cruciate Ligament Reconstruction in Skeletally Immature Patients: A Surgical Technique Using a Split Tibial Tunnel	
Matava MJ;Siegel MG;	1997	Arthroscopic reconstruction of the ACL with semitendinosus-gracilis autograft in skeletally immature adolescent patients	Retrospective non comparative review
McIntosh AL;Dahm DL;Stuart MJ;	2006	Anterior cruciate ligament reconstruction in the skeletally immature patient	Retrospective non-comparative case series
Memeo A;Pedretti L;Miola F;Albisetti W;	2012	Anterior cruciate ligament recostruction with bone-patellar tendon-bone autograft in Tanner 3 stage patients with open physes	<2 year follow up time
Micheli L; Rask B; Gerberg L	1999	Anterior Cruciate Ligament Reconstruction in Patients Who Are Prepubescent	Less than 10 patients per group
Millett PJ;Willis AA;Warren RF;	2002	Associated injuries in pediatric and adolescent anterior cruciate ligament tears: does a delay in treatment increase the risk of meniscal tear?	Retrospective medical records case series
Moksnes H;Engebretsen L;Eitzen I;Risberg MA;	2013	Functional outcomes following a non-operative treatment algorithm for anterior cruciate ligament injuries in skeletally immature children 12 years and younger. A prospective cohort with 2 years follow-up	Commentary
Nikolaou P;Kalliakmanis A;Bousgas D;Zourntos S;	2011	Intra-articular stabilization following anterior cruciate ligament injury in children and adolescents	Retrospective non-comparative case series

Table 135. Articles Excluded for ACL Pediatric for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Nwachukwu B; Mcfeely E; Naresddine A; Udall J; Finlayson C; Shearer D;	2011	Arthrofibrosis After Anterior Cruciate Ligament Reconstruction in Children and Adolescents	Retrospective case series
Paletta GA;	2011	Complete transphyseal reconstruction of the anterior cruciate ligament in the skeletally immature	Narrative review, bibliography screened
Paletta J;	2003	Special considerations Anterior cruciate ligament reconstruction in the skeletally immature	Commentary
Parkkari J;Pasanen K;Mattila VM;Kannus P;Rimpela A;	2008	The risk for a cruciate ligament injury of the knee in adolescents and young adults: a population-based cohort study of 46 500 people with a 9 year follow-up	Not relevant, ACL risk cohort from a survey
Redler L; Brafman R; Trentacosta N; Ahmad C;	2012	Anterior Cruciate Ligament Reconstruction in Skeletally Immature Patients With Transphyseal Tunnels	Retrospective case series
Reinhardt K; Hammound S; Bowers A; Umunna B; Cordasco F	2012	Revision ACL Reconstruction in Skeletally Mature Athletes Younger Than 18 Years	Retrospective medical records case series
Sankar WN;Wells L;Sennett BJ;Wiesel BB;Ganley TJ;	2006	Combined anterior cruciate ligament and medial collateral ligament injuries in adolescents	Retrospective case series
Shea KG;Grimm NL;Belzer JS;	2011	Volumetric injury of the distal femoral physis during double-bundle ACL reconstruction in children: a three-dimensional study with use of magnetic resonance imaging	Not relevant, No patient oriented outcomes
Shea KG;Grimm NL;Laor T;Wall E;	2011	Bone bruises and meniscal tears on MRI in skeletally immature children with tibial eminence fractures	Retrospective non-comparative review
Shelbourne KD;Gray T;Wiley BV;	2004	Results of transphyseal anterior cruciate ligament reconstruction using patellar tendon autograft in tanner stage 3 or 4 adolescents with clearly open growth plates	Retrospective non-comparative case series
Slough JM;Hennrikus W;Chang Y;	2013	Reliability of tanner staging performed by orthopedic sports medicine surgeons	Tanner outcome reliability study
Takahashi K;Suzu F;Yamashita F;Takai S;Hara K;Kitamura S;Kann T;Hirasawa Y;	1992	Treatment of anterior cruciate ligament injuries in children and adolescents	<2 year follow up time, trial used invalidated outcome measures

Table 135. Articles Excluded for ACL Pediatric for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Vaquero J; Vidal C; Cubillo A;	2005	Intra-articular Traumatic Disorders of the Knee in Children and Adolescents	Commentary
Vyas S;van Eck CF;Vyas N;Fu FH;Otsuka NY;	2011	Increased medial tibial slope in teenage pediatric population with open physes and anterior cruciate ligament injuries	Not relevant, study looking at medial tibial slope
Wells L;Dyke JA;Albaugh J;Ganley T;	2009	Adolescent anterior cruciate ligament reconstruction: a retrospective analysis of quadriceps strength recovery and return to full activity after surgery	Retrospective non-comparative case series
Woods GW;O'Connor DP;	2004	Delayed anterior cruciate ligament reconstruction in adolescents with open physes	Retrospective medical records review
Xerogeanes JW;Hammond KE;Todd DC;	2012	Anatomic landmarks utilized for physeal-sparing, anatomic anterior cruciate ligament reconstruction: an MRI-based study	Does not report patient oriented outcomes
Yoo W; Kocher M; Micheli L;	2011	Growth Plate Disturbance After Transphyseal Reconstruction of the Anterior Cruciate Ligament in Skeletally Immature Adolescent Patients: An MR Imaging Study	Retrospective case series

Table 136. Articles Excluded for ACL Young Active Adult for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Barber F; Elrod B; Mcguire D; Paulos L;	1996	Is An Anterior Cruciate Ligament ReconstructionOutcome Age Dependent?	Less than two year follow up
Jerr R; Ejerhed R; Katus E; Brandsson S; Karlsson J;	2001	Functional outcome of anterior cruciate ligament reconstruction inrecreational and competitive athletes	Not relevant, age.
Johnson DL;Fu FH;	1995	Anterior cruciate ligament reconstruction: why do failures occur?	Commentary
Kinugasa K;Mae T;Matsumoto N;Nakagawa S;Yoneda M;Shino K;	2011	Effect of patient age on morphology of anterior cruciate ligament grafts at second-look arthroscopy	Not relevant Prognostic study
Kocher MS;Steadman JR;Briggs K;Zurakowski D;Sterett WI;Hawkins RJ;	2002	Determinants of patient satisfaction with outcome after anterior cruciate ligament reconstruction	Not relevant

Table 136. Articles Excluded for ACL Young Active Adult for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Meystre JL;Vallotton J;Benvenuti JF;	1998	Double semitendinosus anterior cruciate ligament reconstruction: 10-year results	Retrospective non comparison
Ochiai S; Hagino T; Tonotuska H; Haro H;	2011	Prospective analysis of health-related quality of life and clinical evaluations in patients with anterior cruciate ligament injury undergoing reconstruction	Not relevant

Table 137. Articles Excluded for ACL Meniscal Repair for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Abdelkafy; Aigner N; Zada M; Elghoul Y; Abdelsadek H; Landsiedl F;	2007	Two to nineteen years follow-up of arthroscopic meniscal repair using the outside-in technique: a retrospective study	Retrospective case series
Ahn JH; Wang JH; Yoo JC;	2004	Arthroscopic All-Inside Suture Repair of Medial Meniscus Lesion in Anterior Cruciate Ligament-Deficient Knees: Results of Second-Look Arthroscopies in 39 Cases	Less than two year follow up
Albrecht-Olsen and Bak	1993	Arthroscopic repair of the bucket-handle meniscus	Less than two year follow up
Asahina S;Muneta T;Hoshino A;Niga S;Yamamoto H;	1998	Intermediate-term results of meniscal repair in anterior cruciate ligament-reconstructed knees	Less than two year follow up
Barber FA;Johnson DH;Halbrecht JL;	2005	Arthroscopic meniscal repair using the BioStinger	Less than two year follow up
Barrett GR;Field MH;Treacy SH;Ruff CG;	1998	Clinical results of meniscus repair in patients 40 years and older	Less than two year follow up
Benazzo F;Zanon G;	2010	Meniscal sutures	Commentary
Bohnsack M; Borner C; Schmolke S; Moller H; Wirth CJ; Ruhmann O;	2003	Clinical results of arthroscopic meniscal repair using biodegradable screws	Less than two year follow up
Bolano L; Grana W;	1993	Isolated arthroscopic partial meniscectomy	Not relevant, no concurrent ACLR
Bonneux I; Vanderkerckhove B;	2002	Arthroscopic partial lateral meniscetomy log term results in athletes	Retrospective case series

Table 137. Articles Excluded for ACL Meniscal Repair for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Borchers J; Kaeding C; Pedroza A; Huston L; Spindler K;Wright W;	2011	Intra-articular Findings in Primary and Revision Anterior Cruciate Ligament Reconstruction Surgery	Retrospective cohort
Brophy RH;Gill CS;Lyman S;Barnes RP;Rodeo SA;Warren RF;	2009	Effect of anterior cruciate ligament reconstruction and meniscectomy on length of career in National Football League athletes: a case control study	Retrospective medical records review no concurrent ACLR
Cannon WD;Vittori JM;	1992	The incidence of healing in arthroscopic meniscal repairs in anterior cruciate ligament-reconstructed knees versus stable knees	Less than two year follow up
Chatain F; Adeleine P; Chambat P; Neyret P;	2003	A Comparative Study of Medial Versus Lateral Arthroscopic Partial Meniscectomy on Stable Knees: 10-Year Minimum Follow-up	Not relevant, no concurrent ACLR
Chatain F; Robinson H; Adeleine P; Chambat P; Neyret P;	2001	The natural history of the knee following arthroscopic medial meniscectomy	Not relevant retrospective no concurrent ACLR
Ciccotti MG;Lombardo SJ;Nonweiler B;Pink M;	1994	Non-operative treatment of ruptures of the anterior cruciate ligament in middle-aged patients. Results after long-term follow-up	Retrospective non comparative study
Cohen M;Amaro JT;Ejnisman B;Carvalho RT;Nakano KK;Peccin MS;Teixeira R;Laurino CF;Abdalla RJ;	2007	Anterior cruciate ligament reconstruction after 10 to 15 years: association between meniscectomy and osteoarthrosis	Retrospective case series
Diamantopoulos AP;Lorbach O;Paessler HH;	2008	Anterior cruciate ligament revision reconstruction: results in 107 patients	Retrospective medical records review
Englund M and Logmander	2004	Risk factors for symptomatic knee osteoarthritis fifteen to twenty two years after meniscetomy	Retrospective medical records review no concurrent ACLR
Englund M; Roos EM; Roos PS; Lohmander LS;	2001	Patient-relevant outcomes fourteen years after meniscectomy: influence of type of meniscal tear size of resection	Retrospective medical records review no concurrent ACLR

Table 137. Articles Excluded for ACL Meniscal Repair for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Feng W;Xu J;Xin R;Wu Z;	2011	Rigidfix and endobutton femoral fixation device, intrafix tibial fixtaion device in arthroscopic reconstruction of anterior cruciate ligament using autografts of hamstring tendon	Not relevant, Prevalence study of ramp lesion
Fetzer GB;Spindler KP;Amendola A;Andrish JT;Bergfeld JA;Dunn WR;	2009	Potential market for new meniscus repair strategies: evaluation of the MOON cohort	Commentary
Fitzgibbons RE;Shelbourne KD;	1995	'Aggressive' nontreatment of lateral meniscal tears seen during anterior cruciate ligament reconstruction	Less than two year follow up
Frolke JP;Oskam J;Vierhout PA;	1998	Primary reconstruction of the medial collateral ligament in combined injury of the medial collateral and anterior cruciate ligaments. Short-term results	Less than two year follow up.
Frosch KH;Fuchs M;Losch A;Sturmer KM;	2005	Repair of meniscal tears with the absorbable Clearfix screw: results after 1-3 years	Les than 2 year follow up
Gallacher P; Gillbert R; Kanes G; Robert S; Rees D;	2012	Outcome of meniscal repair prior compared with concurrent ACL reconstruction	Less than two year follow up
Gifstad T; Gronvedt T; Drogset JO;	2007	Meniscal repair with Biofix Arrows	Less than two year follow up
Graf KW;Sekiya JK;Wojtys EM;	2004	Long-term results after combined medial meniscal allograft transplantation and anterior cruciate ligament reconstruction: minimum 8.5-year follow-up study	Less than 10 patients in the study
Haas AL;Schepsis AA;Hornstein J;Edgar CM;	2005	Meniscal repair using the FasT-Fix all-inside meniscal repair device	No concurrent ACL injury
Hanks GA;Gause TM;Sebastianelli WJ;O'Donnell CS;Kalenak A;	1991	Repair of peripheral meniscal tears: open versus arthroscopic technique	Not relevant, no concurrent ACLR
Hantes ME;Zachos VC;Varitimidis SE;Dailiana ZH;Karachalios T;Malizos KN;	2006	Arthroscopic meniscal repair: a comparative study between three different surgical techniques	Less than 2yr follow-up

Table 137. Articles Excluded for ACL Meniscal Repair for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Hanypsiak BT;Spindler KP;Rothrock CR;Calabrese GJ;Richmond B;Herrenbruck TM;Parker RD;	2008	Twelve-year follow-up on anterior cruciate ligament reconstruction: long-term outcomes of prospectively studied osseous and articular injuries	Not relevant prognosis study on bone bruise and ACL injury
Hazel WA;Rand JA;Morrey BF;	1993	Results of meniscectomy in the knee with anterior cruciate ligament deficiency	Very low level retrospective study
Hede A; Larsen E; Sandberg H	1992	Partial versus total meniscectomy	Not relevant, no concurrent ACLR
Herrlin S; Hallander M; Wang P; Weidenhielm L; Werner S;	2007	Arthroscopic or conservative treatment of degenerative medial meniscal tears: a prospective randomised trial	Not relevant, no concurrent ACLR
Higuchi H; Kimura Ml Shirakura K; Teraucho M; Takagishi K;	2000	Factors Affecting Long-Term Results After Arthroscopic Partial Meniscectomy	Not relevant, No concurrent ACLR, retrospective case series
Hill CL;Seo GS;Gale D;Totterman S;Gale ME;Felson DT;	2005	Cruciate ligament integrity in osteoarthritis of the knee	Not relevant, Study of prevalence of ACL and PCL ruptures with symptomatic OA
Horibe S; Shino K; Maeda A; Nakamura N; Matsumoto N;	1996	Results of Isolated Meniscal Repair Evaluated by Second-Look Arthroscopy	Less than two year follow up
Horibe S;Shino K;Nakata K;Maeda A;Nakamura N;Matsumoto N;	1995	Second-look arthroscopy after meniscal repair. Review of 132 menisci repaired by an arthroscopic inside-out technique	Not relevant, No concurrent ACL injury
Huetink K;Nelissen RG;Watt I;van Erkel AR;Bloem JL;	2010	Localized development of knee osteoarthritis can be predicted from MR imaging findings a decade earlier	Not relevant, MR imaging study to predict OA
Jarvela T;Paakkala T;Kannus P;Jarvinen M;	2001	The incidence of patellofemoral osteoarthritis and associated findings 7 years after anterior cruciate ligament reconstruction with a bone-patellar tendon-bone autograft	Not relevant, no meniscal treatment studied

Table 137. Articles Excluded for ACL Meniscal Repair for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Jensen NC;Riis J;Robertsen K;Holm AR;	1994	Arthroscopic repair of the ruptured meniscus: one to 6.3 years follow up	Less than 10 patients with concurrent ACLR
Johnson M; Lucas G; Dusek J; Henning C	1999	Isolated Arthroscopic Meniscal Repair: A Long-Term Outcome Study (More Than 10 Years)*	Not relevant, no concurrent ACLR
Jones HP;Lemos MJ;Wilk RM;Smiley PM;Gutierrez R;Schepsis AA;	2002	Two-year follow-up of meniscal repair using a bioabsorbable arrow	Retrospective medical records case series
Kalliakmanis A;Zourntos S;Bousgas D;Nikolaou P;	2008	Comparison of arthroscopic meniscal repair results using 3 different meniscal repair devices in anterior cruciate ligament reconstruction patients	Less than two year follow up
Kartus JT;Russell VJ;Salmon LJ;Magnusson LC;Brandsson S;Pehrsson NG;Pinczewski LA;	2002	Concomitant partial meniscectomy worsens outcome after arthroscopic anterior cruciate ligament reconstruction	Less than two year follow up
Keays SL; Newcombe P; Bullock-Saxton J; Keays A;	2010	Factors involved in the development of osteoarthritis after anterior cruciate ligament surgery	Not relevant, prognosis study on OA after ACLR
Kimura M;Shirakura K;Higuchi H;Kobayashi Y;Takagishi K;	2004	Eight- to 14-year followup of arthroscopic meniscal repair	Less than two year follow up
Kocabey Y;Nyland J;Isbell WM;Caborn DN;	2004	Patient outcomes following T-Fix meniscal repair and a modifiable, progressive rehabilitation program, a retrospective study	Retrospective non comparison case series
Kruger Frank M; Siebert CH: Kugler A; Trouillier H; Rosemeyer B;	1999	Late results after arthroscopic partial medial meniscectomy	Not relevant, no concurrent ACLR
Krych A; McIntosh A; Voll A; Stuart M; Dahm D;	2008	Arthroscopic Repair of Isolated Meniscal Tears in Patients 18 Years and Younger	Not relevant, no concurrent ACLR

Table 137. Articles Excluded for ACL Meniscal Repair for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Kullmer K;Letsch R;Turowski B;	1994	Which factors influence the progression of degenerative osteoarthritis after ACL surgery?	Not relevant, progression of degenerative osteoarthritis after ACL surgery study
Kurzweil PR;Tifford CD;Ignacio EM;	2005	Unsatisfactory clinical results of meniscal repair using the meniscus arrow	
Li RT;Lorenz S;Xu Y;Harner CD;Fu FH;Irrgang JJ;	2011	Predictors of radiographic knee osteoarthritis after anterior cruciate ligament reconstruction	Not relevant, study of predictors of OA after ACLR
Liu X;Feng H;Zhang H;Hong L;Wang XS;Zhang J;	2011	Arthroscopic prevalence of ramp lesion in 868 patients with anterior cruciate ligament injury	Not relevant, Prevalence study of ramp lesion
Logan M; Watts M; Watts M; Owen J; Myers P;	2009	Meniscal repair in the elite athlete	Retrospective case series
Lohmander LS;Englund PM;Dahl LL;Roos EM;	2007	The long-term consequence of anterior cruciate ligament and meniscus injuries: osteoarthritis	Not relevant, Prevalence study of OA after ACL injury
Lynch MA;Henning CE;Glick KR;	1983	Knee joint surface changes. Long-term follow-up meniscus tear treatment in stable anterior cruciate ligament reconstructions	Study published before 1990
Maletius and Messner	1996	Chondral damage and age depress the long term prognosis after partial meniscectomy	Not relevant, study about Chondral damage
Maletius W;Messner K;	1999	Eighteen- to twenty-four-year follow-up after complete rupture of the anterior cruciate ligament	Not relevant, does not report meniscal treatment results alone
Marinescu R; Laptoiu D; Negreusoiu M;	2003	Outside-in meniscus suture technique: 5 years' follow-up	Not relevant, no concurrent ACLR
Matsusue Y; Thomson N;	1996	Arthroscopic Partial Medial Meniscectomy in Patients Over 40 Years Old: A 5- to II-Year Follow-Up Study	Retrospective case series
McNicholas M; Rowley D; Mcgurty D; Adalberth T; Abdon P; Lindstrand A; Lohmander L	2000	Total meniscectomy in adolescence	Not relevant, no concurrent ACLR
Mintzer C; Richmond J; Taylor J;	1998	Meniscal Repair in the Young Athlete	Retrospective case series

Table 137. Articles Excluded for ACL Meniscal Repair for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Morgan CD;Wojtys EM;Casscells CD;Casscells SW;	1991	Arthroscopic meniscal repair evaluated by second-look arthroscopy	Less than two year follow up
Munshi M;Davidson M;MacDonald PB;Froese W;Sutherland K;	2000	The efficacy of magnetic resonance imaging in acute knee injuries	Not relevant, practice patterns for combined ACL and meniscal surgery
Nelson F;Billinghurst RC;Pidoux I;Reiner A;Langworthy M;McDermott M;Malogne T;Sitler DF;Kilambi NR;Lenczner E;Poole AR;	2006	Early post-traumatic osteoarthritis-like changes in human articular cartilage following rupture of the anterior cruciate ligament	Not relevant articular cartilage study
Neuman P;Kostogiannis I;Friden T;Roos H;Dahlberg LE;Englund M;	2009	Patellofemoral osteoarthritis 15 years after anterior cruciate ligament injury--a prospective cohort study	Not relevant, Prevalence study of OA after ACL injury
Neyret P;Donell ST;Dejour D;Dejour H;	1993	Partial meniscectomy and anterior cruciate ligament rupture in soccer players. A study with a minimum 20-year followup	Retrospective case series
Neyret P;Donell ST;Dejour H;	1993	Results of partial meniscectomy related to the state of the anterior cruciate ligament. Review at 20 to 35 years	Low level retrospective review
Noble j; Krat K;	1980	In defense of the meniscus	Not relevant, no concurrent ACLR
Noyes FR;Barber SD;	1991	The effect of an extra-articular procedure on allograft reconstructions for chronic ruptures of the anterior cruciate ligament	
Obrien W;	1993	Degenerative Arthritis of the Knee Following Anterior Cruciate Ligament Injury: Role of the Meniscus	Medical records case series
Oiestad BE;Holm I;Engebretsen L;Aune AK;Gunderson R;Risberg MA;	2012	The prevalence of patellofemoral osteoarthritis 12 years after anterior cruciate ligament reconstruction	Prevalence study of OA after ACLR

Table 137. Articles Excluded for ACL Meniscal Repair for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Oiestad BE;Holm I;Engebretsen L;Risberg MA;	2011	The association between radiographic knee osteoarthritis and knee symptoms, function and quality of life 10-15 years after anterior cruciate ligament reconstruction	Not relevant, Association/prognosis study of OA
Olsen A; Kristensen G; Burgaard P; Joergensen U; Toerholm C;	1999	The arrow versus horizontal suture in arthroscopic meniscus repair A prospective randomized study with arthroscopic evaluation	Less than two year follow up
Osti L;Papalia R;Del BA;Leonardi F;Denaro V;Maffulli N;	2011	Surgery for ACL deficiency in patients over 50	Not relevant, not a meniscal surgery study
Papachristou G; Efstathopoulos N; Plessas S; Levidiotis C; Chronopoulos E; Sourlas J;		Isolated meniscal repair in the avascular area	Not relevant, no concurrent ACLR
Paradowski PT;Englund M;Lohmander LS;Roos EM;	2005	The effect of patient characteristics on variability in pain and function over two years in early knee osteoarthritis	Retrospective medical records case series
Perdue P; Hummer C; Colosimo A; Heidt R; Dormer S	1996	Meniscal Repair: Outcomes and Clinical Follow-up	Retrospective case series
Pernin J;Verdonk P;Si Selmi TA;Massin P;Neyret P;	2010	Long-term follow-up of 24.5 years after intra-articular anterior cruciate ligament reconstruction with lateral extra-articular augmentation	Retrospective case series
Plasschaert F;Vandekerckhove B;Verdonk R;	1998	A known technique for meniscal repair in common practice	Retrospective non comparison case series
Porat A; Roos E; Roos H;	2003	High prevalence of osteoarthritis 14 years after an anterior cruciate ligament tear in male soccer players: a study of radiographic and patient relevant outcomes	Not relevant, not a meniscal treatment study
Rockborn P; Gillquist J;	1996	Long Term Results After Arthroscopic Meniscectomy	Not relevant, no concurrent ACLR
Roos H;Adalberth T;Dahlberg L;Lohmander LS;	1995	Osteoarthritis of the knee after injury to the anterior cruciate ligament or meniscus: the influence of time and age	Retrospective case series

Table 137. Articles Excluded for ACL Meniscal Repair for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Rubman MH;Noyes FR;Barber-Westin SD;	1998	Arthroscopic repair of meniscal tears that extend into the avascular zone. A review of 198 single and complex tears	Not relevant retrospective review ACLR subjects not specified
Sarino J; Rantainen T; Tarvainen T; Harkonen M; Orava S;	2005	Evaluation of the second-generation Meniscus Arrow in the fixation of bucket-handle tears in the vascular area of the meniscus A prospective study of 20 patients with a mean follow-up of 26 months	Less than two year follow up
Selmi T; Fithian D; Neyret P;	2006	The evolution of osteoarthritis III 103 patients with ACL reconstruction at 17 years follow-up	Retrospective case series
Seon JK;Song EK;Park SJ;	2006	Osteoarthritis after anterior cruciate ligament reconstruction using a patellar tendon autograft	Retrospective case series
Shelbourne KD;Dickens JF;	2006	Digital radiographic evaluation of medial joint space narrowing after partial meniscectomy of bucket-handle medial meniscus tears in anterior cruciate ligament-intact knees	Not relevant, Patients with intact ACL
Shelbourne KD;Heinrich J;	2004	The long-term evaluation of lateral meniscus tears left in situ at the time of anterior cruciate ligament reconstruction	Very low level retrospective review
Shelbourne KD;Johnson GE;	1993	Locked bucket-handle meniscal tears in knees with chronic anterior cruciate ligament deficiency	Retrospective case series
Steenbrugge F;Van NW;Verdonk R;Verstraete K;	2005	Arthroscopic meniscus repair in the ACL-deficient knee	Not relevant, <10 patients with ACLR
Steenbrugge F;Verdonk R;Hurel C;Verstraete K;	2004	Arthroscopic meniscus repair: inside-out technique vs. Biofix meniscus arrow	Less than 10 patients per group with ACL injury
Stone RG;Frewin PR;Gonzales S;	1990	Long-term assessment of arthroscopic meniscus repair: a two- to six-year follow-up study	Not relevant, no concurrent ACLR
Talley MC;Grana WA;	2000	Treatment of partial meniscal tears identified during anterior cruciate ligament reconstruction with limited synovial abrasion	Retrospective medical records case series

Table 137. Articles Excluded for ACL Meniscal Repair for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Tenuta J; Arciero R;	1994	Arthroscopic Evaluation of Meniscal Repairs Factors That Effect Healing	Less than two year follow up
Tucciarone A;Godente L;Fabbrini R;Garro L;Salate SF;Chillemi C;	2012	Meniscal tear repaired with Fast-Fix sutures: clinical results in stable versus ACL-deficient knees	Very low quality evidence
Wasserstein D;Dwyer T;Gandhi R;Austin PC;Mahomed N;Ogilvie-Harris D;	2013	A matched-cohort population study of reoperation after meniscal repair with and without concomitant anterior cruciate ligament reconstruction	Retrospective medical records review
Wong JM;Khan T;Jayadev CS;Khan W;Johnstone D;	2012	Anterior cruciate ligament rupture and osteoarthritis progression	Commentary
Zemanovic JR;McAllister DR;Hame SL;	2004	Nonoperative treatment of partial-thickness meniscal tears identified during anterior cruciate ligament reconstruction	Less than two year follow up

Table 138. Articles Excluded for ACL Recurrent Instability for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
MARS Group	2013	Radiographic Findings in Revision Anterior Cruciate Ligament Reconstructions from the MARS Cohort	Not relevant, not reporting patient oriented outcome
Chen CH;Chen WJ;Shih CH;	1999	Arthroscopic anterior cruciate ligament reconstruction with quadriceps tendon-patellar bone autograft	Less than two year follow up
Chen JL;Allen CR;Stephens TE;Feeley BT;	2013	Differences in Mechanisms of Failure, Intraoperative Findings, and Outcomes Between Single- and Multiple-Revision ACL Reconstructions: A MARS Cohort Study	Not relevant, MARS cohort data
Eberhardt C; Wentz S; Leonhard T; Zixhner L;	2000	Effects of revisional ACL surgery in semi-professional athletes in high-risk pivoting sports with chronic anterior instability of the knee	Retrospective case series

Table 138. Articles Excluded for ACL Recurrent Instability for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Franceschi F;Papalia R;Del BA;Zampogna B;Diaz BL;Maffulli N;Denaro V;	2013	Two-stage procedure in anterior cruciate ligament revision surgery: a five-year follow-up prospective study	Retrospective case series
Garofalo R;Djahangiri A;Siegrist O;	2006	Revision anterior cruciate ligament reconstruction with quadriceps tendon-patellar bone autograft	Retrospective case series
Griffith TB;Allen BJ;Levy BA;Stuart MJ;Dahm DL;	2013	Outcomes of repeat revision anterior cruciate ligament reconstruction	Retrospective case series
Harner CD;Giffin JR;Dunteman RC;Annunziata CC;Friedman MJ;	2001	Evaluation and treatment of recurrent instability after anterior cruciate ligament reconstruction	Commentary
Hettrich CM;Dunn WR;Reinke EK;Spindler KP;	2013	The Rate of Subsequent Surgery and Predictors After Anterior Cruciate Ligament Reconstruction: Two- and 6-Year Follow-up Results From a Multicenter Cohort	Not relevant
Hurd W; Axe M; Mackler LS;	2008	Influence of Age, Gender, and Injury Mechanism on the Development of Dynamic Knee Stability After Acute ACL Rupture	Not relevant, prognostic study
Jarvinen M;Natri A;Lehto M;Kannus P;	1995	Reconstruction of chronic anterior cruciate ligament insufficiency in athletes using a bone-patellar tendon-bone autograft. A two-year follow up study	Less than two year follow up
Jonsson H; Ahlstrom R; Lind J;	2004	Positive pivot shift after ACL reconstruction predicts later osteoarthrosis	Not relevant, study of factors affecting later OA
Kdolsky R; Gibbons DF; Kwasny O; Schabus R; Plenk H	1997	Braided Polypropylene Augmentation Device in Reconstructive Surgery of the Anterior Cruciate Ligament: Long-Term Clinical Performance of 594 Patients and Short-Term Arthroscopic Results, Failure Analysis by Scanning Electron Microscopy, and Synovial Histomorphology	Not relevant, biomechanical study

Table 138. Articles Excluded for ACL Recurrent Instability for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Kievit AJ;Jonkers FJ;Barentsz JH;Blankevoort L;	2013	A cross-sectional study comparing the rates of osteoarthritis, laxity, and quality of life in primary and revision anterior cruciate ligament reconstructions	Retrospective medical records review
Morgan JA;Dahm D;Levy B;Stuart MJ;	2012	Femoral tunnel malposition in ACL revision reconstruction	Not relevant, MARS cohort data
Petrovic K;Vanhoenacker FM;Nikolic O;Vandenberk P;	2012	Tunnel enlargement and recurrent graft tear after ACL reconstruction	Commentary
Shino K; Mae T; Nakamura N;	2012	Surgical Technique Revision ACL Reconstruction With a Rectangular Tunnel Technique	Retrospective case series
Ventura A;Legnani C;Terzaghi C;Borgo E;Albisetti W;	2012	Revision surgery after failed ACL reconstruction with artificial ligaments: clinical, histologic and radiographic evaluation	Retrospective case series

Table 139. Articles Excluded for ACL Conservative Treatment for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Harvard Health Letter	2010	You've torn your ACL. Now what? A new study sheds light on treatment choices for torn knee ligaments. Surgery may not be necessary	Commentary
Ahn JH;Chang MJ;Lee YS;Koh KH;Park YS;Eun SS;	2010	Non-operative treatment of ACL rupture with mild instability	Less than two year follow up
Andersson AC;	1993	Knee laxity and function after conservative treatment of anterior cruciate ligament injuries. A prospective study	Less than two year follow up
Andersson C;Odensten M;Good L;Gillquist J;	1989	Surgical or non-surgical treatment of acute rupture of the anterior cruciate ligament. A randomized study with long-term follow-up	Study published before 1990
Arbuthnot JE;Brink RB;	2010	The role of anterior cruciate ligament reconstruction in the older patients, 55 years or above	Retrospective medical records case series

Table 139. Articles Excluded for ACL Conservative Treatment for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Chung HW;Ahn JH;Ahn JM;Yoon YC;Hong HP;Yoo SY;Kim S;	2007	Anterior cruciate ligament tear: reliability of MR imaging to predict stability after conservative treatment	Not relevant MRI study
Dahlstedt L;Dalen N;	1991	Outcome of patients with anterior cruciate ligament injuries selected for conservative treatment	Retrospective non comparison study
Delince P; Ghafil D;	2012	Anterior cruciate ligament tears: conservative or surgical treatment?	Commentary
Doral MN;Leblebicioglu G;Atay AO;Aksoy C;Gogus T;	1996	Conservative treatment of anterior cruciate ligament ruptures in patients with repaired meniscal lesions: Early clinical and second-look arthroscopy results	Less than 10 patients per group
Eitzen I;Moksnes H;Snyder-Mackler L;Engebretsen L;Risberg MA;	2010	Functional tests should be accentuated more in the decision for ACL reconstruction	Less than two year follow up
Farshad M;Gerber C;Meyer DC;Schwab A;Blank PR;Szucs T;	2011	Reconstruction versus conservative treatment after rupture of the anterior cruciate ligament: cost effectiveness analysis (Provisional abstract)	Not relevant Cost effectiveness analysis
Hurd W; Axe M; Mack;er LS;	2008	A 10-Year Prospective Trial of a Patient Management Algorithm and Screening Examination for Highly Active Individuals With Anterior Cruciate Ligament Injury Part 2, Determinants of Dynamic Knee Stability	Not relevant, Screenig examination study
Moksnes H;Risberg MA;	2009	Performance-based functional evaluation of non-operative and operative treatment after anterior cruciate ligament injury	Less than two year follow up
Moksnes H;Snyder-Mackler L;Risberg MA;	2008	Individuals with an anterior cruciate ligament-deficient knee classified as noncopers may be candidates for nonsurgical rehabilitation	Not relevant, Screening test of copers and noncopers
Nisonson B;	1991	Anterior cruciate ligament injuries: Conservative vs surgical treatment	Commentary
Pappas AM;	1999	Conservative ACL treatment	Commentary
Segawa H;Omori G;Koga Y;	2001	Long-term results of non-operative treatment of anterior cruciate ligament injury	Retrospective case series

Table 139. Articles Excluded for ACL Conservative Treatment for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Seng K; Appleby D; Lubowitz W;	2008	Operative Versus Nonoperative Treatment of Anterior Cruciate Ligament Rupture in Patients Aged 40 Years or Older: An Expected-Value Decision Analysis	Not relevant, expected value decision analysis
Strehl A;Eggli S;	2007	The value of conservative treatment in ruptures of the anterior cruciate ligament (ACL)	Less than two year follow up
Streich N; Zimmermann F; Bode G; Schmitt H	2011	Reconstructive versus non-reconstructive treatment of anterior cruciate ligament insufficiency. A retrospective matched-pair long-term follow-up	Retrospective case series
Vyas D;Semakula B;Elson LE;Chimes GP;	2012	Anterior cruciate ligament tear: surgical reconstruction versus nonsurgical management	Commentary

Table 140. Articles Excluded for ACL Surgery Timing for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Ahlen M;Liden M;	2011	A comparison of the clinical outcome after anterior cruciate ligament reconstruction using a hamstring tendon autograft with special emphasis on the timing of the reconstruction	Less than two year follow up
Barenius B; Forssblad M; Engstrom B; Eriksson K;	2012	Functional recovery after anterior cruciate ligament reconstruction, a study of health-related quality of life based on the Swedish National Knee Ligament Register	Swedish national registry data
Bernstein J;	2011	Early Versus Delayed Reconstruction of the Anterior Cruciate Ligament A Decision Analysis Approach	Not relevant,Decision analysis approach

Table 140. Articles Excluded for ACL Surgery Timing for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Bottoni C; Liddell T; Trainer T; Freccero D; Lindell KK:	2007	Postoperative Range of Motion Following Anterior Cruciate Ligament Reconstruction Using Autograft Hamstrings A Prospective, Randomized Clinical Trial of Early Versus Delayed Reconstructions	Less than two year follow up
Demirag B;Aydemir F;Danis M;Ermutlu C;	2011	Incidence of meniscal and osteochondral lesions in patients undergoing delayed anterior cruciate ligament reconstruction	Retrospective case series
Graf BK;Ott JW;Lange RH;Keene JS;	1994	Risk factors for restricted motion after anterior cruciate reconstruction	Retrospective medical records review
Ichiba A;Kishimoto I;	2009	Effects of articular cartilage and meniscus injuries at the time of surgery on osteoarthritic changes after anterior cruciate ligament reconstruction in patients under 40 years old	Very low level retrospective study
Karlsson J;Kartus J;Magnusson L;Larsson J;Brandsson S;Eriksson BI;	1999	Subacute versus delayed reconstruction of the anterior cruciate ligament in the competitive athlete	Less than two year follow up
Kostogiannis I;Ageberg E;Neuman P;Dahlberg LE;Friden T;Roos H;	2008	Clinically assessed knee joint laxity as a predictor for reconstruction after an anterior cruciate ligament injury: a prospective study of 100 patients treated with activity modification and rehabilitation	Very low prognostic study
Larkin JJ;Barber-Westin SD;	1998	The effect of injury chronicity and progressive rehabilitation on single-incision arthroscopic anterior cruciate ligament reconstruction	Less than two year follow up
Logerstedt D;Lynch A;Axe MJ;Snyder-Mackler L;	2013	Pre-operative quadriceps strength predicts IKDC2000 scores 6 months after anterior cruciate ligament reconstruction	Less than two year follow up

Table 140. Articles Excluded for ACL Surgery Timing for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Magnussen RA;Pedroza AD;Donaldson CT;Flanigan DC;Kaeding CC;	2013	Time from ACL injury to reconstruction and the prevalence of additional intra-articular pathology: is patient age an important factor?	Not relevant, follow up time not given, study not reporting patient oriented outcome
Meighan AA;Keating JF;Will E;	2003	Outcome after reconstruction of the anterior cruciate ligament in athletic patients. A comparison of early versus delayed surgery	Less than two year follow up
Melikoglu MA;Balci N;Samanci N;Filiz MB;Gurbuz U;Dagseven T;Ozenci AM;Gur S;	2008	Timing of surgery and isokinetic muscle performance in patients with anterior cruciate ligament injury	Less than two year follow up
Millett P; Pennock A; Sterett W; Steadman R;	2004	Early ACL Reconstruction in Combined ACL-MCL Injuries	Retrospective case series
Seon JK; Soong EY; Park SJ;	2006	Osteoarthritis after anterior cruciate ligament reconstruction using a patellar tendon autograft	Retrospective case series
Slauterbeck JR;Kousa P;Clifton BC;Naud S;Tourville TW;Johnson RJ;Beynnon BD;	2009	Geographic mapping of meniscus and cartilage lesions associated with anterior cruciate ligament injuries	Retrospective non comparison
Swirtun LR;Eriksson K;Renstrom P;	2006	Who chooses anterior cruciate ligament reconstruction and why? A 2-year prospective study	Not relevant does not report post injury data
Tayton E;Verma R;Higgins B;Gosal H;	2009	A correlation of time with meniscal tears in anterior cruciate ligament deficiency: stratifying the risk of surgical delay	Retreospective non comparative

Table 141. Articles Excluded for ACL Combined MCL for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Aglietti P; Buzzi R; Zaccherotti G; Dandria S;	1991	Complete Lesions of the nterior Cruciate an Medial Collateral Ligaments	Case series of MCL treated surgically
Canata GL;Chiey A;Leoni T;	2012	A 4 ... to 7-Year Follow-Up Study Surgical technique: does mini-invasive medial collateral ligament and posterior oblique ligament repair restore knee stability in combined chronic medial and ACL injuries?	Case series of MCL treated surgically

Table 141. Articles Excluded for ACL Combined MCL for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Halinen J;Lindahl J;Hirvensalo E;Santavirta S;	2006	Operative and nonoperative treatments of medial collateral ligament rupture with early anterior cruciate ligament reconstruction: a prospective randomized study	Less than 2 year follow up
Hillard-Sembell D;Daniel DM;Stone ML;Dobson BE;Fithian DC;	1996	Combined injuries of the anterior cruciate and medial collateral ligaments of the knee. Effect of treatment on stability and function of the joint	Retrospective medical records review
Hughston JC; Georgia C;	1994	The importance of the posterior oblique ligament in repairs of acute tears of the medial ligaments in knee with and witout an associated rupture of the anterior cruciate ligament	No data from concurrent ACLR subjects
Ihara H;Miwa M;Takayanagi K;Nakayama A;	1994	Acute torn meniscus combined with acute cruciate ligament injury. Second look arthroscopy after 3-month conservative treatment	Less than 2 year follow up
Jari S;Shelbourne KD;	2001	Nonoperative or delayed surgical treatment of combined cruciate ligaments and medial side knee injuries	Commentary
Kitamura N;Ogawa M;Kondo E;Kitayama S;Tohyama H;Yasuda K;	2013	A novel medial collateral ligament reconstruction procedure using semitendinosus tendon autograft in patients with multiligamentous knee injuries: clinical outcomes	Retrospective case series
Lundberg IE;	2005	The prognosis of mixed connective tissue disease	Commentary
Mok DW;Good C;	1989	Non-operative management of acute grade III medial collateral ligament injury of the knee: a prospective study	Less than two year follow up
Nakamura N;Horibe S;Toritsuka Y;Mitsuoka T;Yoshikawa H;Shino K;	2003	Acute grade III medial collateral ligament injury of the knee associated with anterior cruciate ligament tear. The usefulness of magnetic resonance imaging in determining a treatment regimen	Not relevant, Less than 10 patients with concurrent ACLR
Robins AJ;Newman AP;Burks RT;	1993	Postoperative return of motion in anterior cruciate ligament and medial collateral ligament injuries. The effect of medial collateral ligament rupture location	Less than two year follow up

Table 141. Articles Excluded for ACL Combined MCL for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Schierl M;Petermann J;Trus P;Baumgartel F;Gotzen L;	1994	Anterior cruciate and medial collateral ligament injury. ACL reconstruction and functional treatment of the MCL	Less than two year follow up
Shelbourne KD;Freeman HE;	2007	Nonoperative management of acute medial collateral ligament injuries	Commentary
Shelbourne KD;Porter DA;	1992	Anterior cruciate ligament-medial collateral ligament injury: nonoperative management of medial collateral ligament tears with anterior cruciate ligament reconstruction. A preliminary report	Less than 2 year follow up
Shirakura K;Terauchi M;Katayama M;Watanabe H;Yamaji T;Takagishi K;	2000	The management of medial ligament tears in patients with combined anterior cruciate and medial ligament lesions	ACL injury treated non surgically
Yagishita K;Muneta T;Ogiuchi T;Sekiya I;Shinomiya K;	2004	Healing potential of meniscal tears without repair in knees with anterior cruciate ligament reconstruction	Less than 2 year follow up
Yoshiya S; Kuroda R; Mizuno K; Yamamoto T; Kurisaka M;	2005	Medial Collateral Ligament Reconstruction Using Autogenous Hamstring Tendons Technique and Results in Initial Cases	Case series of MCL treated surgically
Zaffagnini S;Bignozzi S;Martelli S;Lopomo N;Marcacci M;	2007	Does ACL reconstruction restore knee stability in combined lesions?: An in vivo study	Does not report follow up time
Zemanovic JR;McAllister DR;Hame SL;	2004	Nonoperative treatment of partial-thickness meniscal tears identified during anterior cruciate ligament reconstruction	Less than 2 year follow up

Table 142. Articles Excluded for ACL Locked Knee for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Beldame J;Wajfisz A;Lespagnol F;Hulet C;Seil R;	2009	Lateral meniscus lesions on unstable knee	Retrospective case series
Papastergiou SG;Koukoulias NE;Mikalef P;Ziogas E;Voulgaropoulos H;	2007	Meniscal tears in the ACL-deficient knee: correlation between meniscal tears and the timing of ACL reconstruction	Not relevant, Very low level retrospective study not a meniscal repair study

Table 143. Articles Excluded for ACL Single or Double Bundle Reconstruction for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Araki D; Kuroda R; Kubo S; Fujita N; Tei K; Nishimoto K; Hoshino Y	2011	A prospective randomised study of anatomical single-bundle versus double-bundle anterior cruciate ligament reconstruction: quantitative evaluation using an electromagnetic measurement system	Less than two year follow up
Branch T; Siebold R; Freedberg H; Jacobs C;	2011	Double-bundle ACL reconstruction demonstrated superior clinical stability to single-bundle ACL reconstruction: a matched-pairs analysis of instrumented tests of tibial anterior translation and internal rotation laxity	Less than two year follow up
Chae IJ;Bae JH;Wang JH;Jeon J;Park JH;	2013	Double-bundle anterior cruciate ligament reconstruction with split Achilles allograft and single tibia tunnel for small ACL tibial footprint : technical note with clinical results	Retrospective case series
Claes S; Neven E; Callewaert B; Desloovere K; bellemans J;	2011	Tibial rotation in single- and double-bundle ACL reconstruction: a kinematic 3-D in vivo analysis	Less than two year follow up
Dejour D;Vanconcelos W;Bonin N;Saggin PR;	2013	Comparative study between mono-bundle bone-patellar tendon-bone, double-bundle hamstring and mono-bundle bone-patellar tendon-bone combined with a modified Lemaire extra-articular procedure in anterior cruciate ligament reconstruction	Less than two year follow up
Debieux P; Carneiro M; Altenor A; Queiroz B; Vinivius M; Luzo M; Granata G; Ferreira FP;	2012	Sagittal and rotational knee stability following singleand double-bundle reconstruction of the anterior cruciate ligament: a randomized clinical trial	Less than two year follow up

Table 143. Articles Excluded for ACL Single or Double Bundle Reconstruction for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Dunn WR;Spindler KP;	2010	Predictors of activity level 2 years after anterior cruciate ligament reconstruction (ACLR): a Multicenter Orthopaedic Outcomes Network (MOON) ACLR cohort study	Not relevant does not compare single vs. double bundle
Eriksson E;	2007	Double bundle or single bundle plus an extra articular tenodesis?	Commentary
Ettinger M;Petri M;Guenther D;Liu C;Krusche C;Liodakis E;Albrecht UV;Krettek C;Jagodzinski M;	2012	Anatomic double-bundle ACL reconstruction restricts knee extension in knees with hyperextension	Not relevant
Fu FH;	2011	Double-bundle ACL reconstruction	Commentary
Giron F;Aglietti P;Cuomo P;Losco M;Mondanelli N;	2009	Comparison between single and double bundle ACL reconstruction. A randomised clinical trial [abstract]	Abstract
Giron F;Aglietti P;Cuomo P;Losco M;Mondanelli N;	2006	Single versus double bundle technique in ACL reconstruction using DSTG graft. Preliminary results	Abstract
Harner CD;Sandoval CM;	2009	Anterior Cruciate Ligament Injuries: Evaluation and Management	Commentary
Hemmerich A; Merwe W; Batterham M; Vaughan C;	2011	Knee Rotational Laxity in a Randomized Comparison of Single- Versus Double- Bundle Anterior Cruciate Ligament Reconstruction	Less than two year follow up
Hemmerich A; Merwe W; Batterham M; Vaughan C;	2011	Double-bundle ACL surgery demonstrates superior rotational kinematics to single-bundle technique during dynamic task	Not relevant, does not report patient oriented outcome
Izawa T;Okazaki K;Tashiro Y;Matsubara H;Miura H;Matsuda S;Hashizume M;Iwamoto Y;	2011	Comparison of rotatory stability after anterior cruciate ligament reconstruction between single-bundle and double-bundle techniques	Less than two year follow up
Jarvela T;	2007	Double-bundle versus single-bundle anterior cruciate ligament reconstruction: a prospective, randomize clinical study	Less than two year follow up

Table 143. Articles Excluded for ACL Single or Double Bundle Reconstruction for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Jarvela T;Jarvinen M;	2009	Double-bundle versus single-bundle anterior cruciate ligament reconstruction: a prospective, randomize clinical study [abstract]	Abstract
Kawaguchi Y;Kondo E;Kitamura N;Kai S;Inoue M;Yasuda K;	2011	Comparisons of femoral tunnel enlargement in 169 patients between single-bundle and anatomic double-bundle anterior cruciate ligament reconstructions with hamstring tendon grafts	Does not report patient oriented outcomes
Kim Sj; Jung KA; Song DH;	2006	Arthroscopic Double-Bundle Anterior Cruciate Ligament Reconstruction Using Autogenous Quadriceps Tendon	Commentary
Kim SJ;Jo SB;Kumar P;Oh KS;	2009	Comparison of single- and double-bundle anterior cruciate ligament reconstruction using quadriceps tendon-bone autografts	Retrospective medical records review
Kurosaka M;Kuroda R;Kubo S;Hoshino Y;Araki D;Yoshiya S;	2008	Double-Bundle Anatomic Anterior Cruciate Ligament Reconstruction: The Technique and Clinical Experience	Commentary
Kyung BS;Kim JG;Chang M;Jang KM;Lee SS;Ahn JH;Wang JH;	2013	Anatomic double-bundle reconstruction techniques result in graft obliquities that closely mimic the native anterior cruciate ligament anatomy	Less than two year follow up
Lui PP;Cheng YY;Yung SH;Hung AS;Chan KM;	2012	A randomized controlled trial comparing bone mineral density changes of three different ACL reconstruction techniques	Less than two year follow up
Mae T;Shino K;Matsumoto N;Yoneda K;Yoshikawa H;Nakata K;	2013	Immediate postoperative anterior knee stability: double- versus triple-bundle anterior cruciate ligament reconstructions	Less than two year follow up
Martins CAQ;Kropf EJ;Shen W;van Eck CF;Fu FH;	2008	The Concept of Anatomic Anterior Cruciate Ligament Reconstruction	Commentary
Marx RG;	2013	Single- versus double-bundle anterior cruciate ligament reconstruction	Commentary
Massey PR;Tjoumakaris FP;Bernstein J;	2013	Eminence-based medicine versus evidence-based medicine: is anterior cruciate ligament reconstruction optimally performed with the double-bundle technique?	Commentary

Table 143. Articles Excluded for ACL Single or Double Bundle Reconstruction for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Misonoo G; Kanamori A; Ida H; Miyakawa S; Ochiai N	2012	Evaluation of tibial rotational stability of single-bundle vs. anatomical double-bundle anterior cruciate ligament reconstruction during a high-demand activity — A quasi-randomized trial	Less than two year follow up
Muneta T;Koga H;Mochizuki T;Ju YJ;Hara K;Nimura A;Yagishita K;Sekiya I;	2007	A prospective randomized study of 4-strand semitendinosus tendon anterior cruciate ligament reconstruction comparing single-bundle and double-bundle techniques	Less than two year follow up
Nakayama H;Yoshiya S;	2013	The effect of tourniquet use on operative performance and early postoperative results of anatomic double-bundle anterior cruciate ligament reconstruction	Less than two year follow up
Oberoi IPS;Jain V;Nahawat KS;	2010	Anatomical double bundle ACL reconstruction using hamstring tendon graft-clinical evaluation	Less than two year follow up
Paxton ES;Kymes SM;Brophy RH;	2010	Cost-effectiveness of anterior cruciate ligament reconstruction: a preliminary comparison of single-bundle and double-bundle techniques (Structured abstract)	Not relevant, Cost effectiveness analysis
Plaweski S; Grimaldi M; Courvoisier A; Wimsey S;	2011	Intraoperative comparisons of knee kinematics of double-bundle versus single-bundle anterior cruciate ligament reconstruction	Does not report patient oriented outcomes
Rue J;Busam ML;Bach J;	2008	Hybrid single-bundle anterior cruciate ligament reconstruction technique using a transtibial drilled femoral tunnel	Commentary
Samuelsson K;Desai N;McNair E;van Eck CF;Petzold M;Fu FH;Bhandari M;Karlsson J;	2013	Level of evidence in anterior cruciate ligament reconstruction research: a systematic review	Not relevant, Systematic review
Siebold R; Dehler C; Ellert T;	2008	Prospective Randomized Comparison of Double-Bundle Versus Single-Bundle Anterior Cruciate Ligament Reconstruction	Less than two year follow up

Table 143. Articles Excluded for ACL Single or Double Bundle Reconstruction for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Spindler K;	2007	MARS A prospective longitudinal cohort to define outcomes and independent predictors of outcomes for revision anterior cruciate ligament reconstruction	Commentary
Spindler K; Kuhn J; Dunn W; Matthews C; Harrell F; Dittus R;	2005	Reading and Reviewing the Orthopaedic Literature: A Systematic, Evidence-based Medicine Approach	Commentary
Streich NA; Friedrich K; Gotterbarm T; Schmitt H;	2008	Reconstruction of the ACL with a semitendinosus tendon graft: a prospective randomized single blinded comparison of double-bundle versus single-bundle technique in male athletes	Less than two year follow up
Tohyama H;Kondo E;Hayashi R;Kitamura N;Yasuda K;	2011	Gender-based differences in outcome after anatomic double-bundle anterior cruciate ligament reconstruction with hamstring tendon autografts	Not relevant, compares gender differences in double bundle technique
Volpi P;Cervellin M;Denti M;Bait C;Melegati G;Quaglia A;de GL;	2010	ACL reconstruction in sports active people: transtibial DB technique with ST/G vs. transtibial SB technique with BPTB: preliminary results	Less than two year follow up
Wang JQ;Ao YF;Yu CL;Liu P;Xu Y;Chen LX;	2009	Clinical evaluation of double-bundle anterior cruciate ligament reconstruction procedure using hamstring tendon grafts: a prospective, randomized and controlled study	Less than two year follow up
Xu Y;Ao YF;Wang JQ;Cui GQ;	2013	Prospective randomized comparison of anatomic single- and double-bundle anterior cruciate ligament reconstruction	Less than two year folllow up
Yogi M; Kuroda R; Nagamune K; Yoshiya S; Kurosaka M;	2007	Double-bundle ACL Reconstruction Can Improve Rotational Stability	Less than two year folllow up

Table 144. Articles Excluded for ACL Autograft Source for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Abbas MM;Abulaban AA;Darwish HH;	2013	Functional outcomes of bone tendon bone versus soft tissue arthroscopic anterior cruciate ligament reconstruction. A comparative study	Less than two year follow up
Ardern CL;Webster KE;Taylor NF;Feller JA;	2010	Hamstring strength recovery after hamstring tendon harvest for anterior cruciate ligament reconstruction: a comparison between graft types	Medical records review
Bach BR;Aadalen KJ;Dennis MG;Carreira DS;Bojchuk J;Hayden JK;Bush-Joseph CA;	2005	Primary anterior cruciate ligament reconstruction using fresh-frozen, nonirradiated patellar tendon allograft: minimum 2-year follow-up	Retrospective review
Barrett G;Stokes D;White M;	2005	Anterior cruciate ligament reconstruction in patients older than 40 years: allograft versus autograft patellar tendon	Not relevant, reporting non patient oriented outcome
Beard DJ;Anderson JL;Davies S;Price AJ;Dodd CA;	2001	Hamstrings vs. patella tendon for anterior cruciate ligament reconstruction: a randomised controlled trial	Not relevant, Polypropylene braid ligament augmentation device
Bizzini M; Gorelick M; Munzinger U; Drobny T;	2006	Joint Laxity and Isokinetic Thigh. Muscle.Strength Characteristics After Anterior Cruclate ' Ligament Reconstruction	Less than two year follow up
Buss DD;Warren RF;Wickiewicz TL;Galinat BJ;Panariello R;	1993	Arthroscopically assisted reconstruction of the anterior cruciate ligament with use of autogenous patellar-ligament grafts. Results after twenty-four to forty-two months	Not relevant, prosthesis ligament
Capuano L; Hardy P; Longo UG; Denaro V; Maffulli N;	2008	No difference in clinical results between femoral transfixation and bio-interference screw fixation in hamstring tendon ACL reconstruction A preliminary study	Less than two year follow up
Carter T; Edinger S;	1999	Isokinetic Evaluation of Anterior Cruciate Ligament Reconstruction: Hamstring Versus Patellar Tendon	Less than two year follow up

Table 144. Articles Excluded for ACL Autograft Source for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Charalambous CP;Kwaees TA;	2012	Anatomical considerations in hamstring tendon harvesting for anterior cruciate ligament reconstruction	Commentary
Chen CH;Chuang TY;Wang KC;Chen WJ;Shih CH;	2006	Arthroscopic anterior cruciate ligament reconstruction with quadriceps tendon autograft: clinical outcome in 4-7 years	Not relevant, cost analysis
Cooley VJ;Deffner KT;Rosenberg TD;	2001	Quadrupled semitendinosus anterior cruciate ligament reconstruction: 5-year results in patients without meniscus loss	Not relevant, ACL revision
Corry IS;Webb JM;Clingeleffer AJ;Pinczewski LA;	1999	Arthroscopic reconstruction of the anterior cruciate ligament. A comparison of patellar tendon autograft and four-strand hamstring tendon autograft	Not relevant postoperative MRI study
Doral MN; Leblebicioglu G; Atay O; Baydar M; Tetik O;	2000	Arthroscopy-Assisted Anterior Cruciate Ligament Reconstruction with Patellar Tendon or Hamstring Autografts	Less than two year follow up
Deehan DJ;Salmon LJ;Webb VJ;Davies A;Pinczewski LA;	2000	Endoscopic reconstruction of the anterior cruciate ligament with an ipsilateral patellar tendon autograft. A prospective longitudinal five-year study	Not best available evidence, case series
Eberhardt C; Kurth A; Hailer N; Jager A;	2000	Revision ACL reconstruction using autogenous patellar tendon graft	Retrospective case series
Eitzen I;Holm I;Risberg MA;	2009	Preoperative quadriceps strength is a significant predictor of knee function two years after anterior cruciate ligament reconstruction	Less than two year follow up
Feller J; Webster K; Garvin B;	2001	Early post-operative morbidity following anterior cruciate ligament reconstruction: patellar tendon versus hamstring graft	Less than two year follow up
Gao K;Chen S;Wang L;Zhang W;Kang Y;Dong Q;Zhou H;Li L;	2010	Anterior cruciate ligament reconstruction with LARS artificial ligament: a multicenter study with 3- to 5-year follow-up	Less than two year follow up

Table 144. Articles Excluded for ACL Autograft Source for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Ghalayini SR;Helm AT;Bonshahi AY;Lavender A;Johnson DS;Smith RB;	2010	Arthroscopic anterior cruciate ligament surgery: results of autogenous patellar tendon graft versus the Leeds-Keio synthetic graft five year follow-up of a prospective randomised controlled trial	This article has been retracted.
Gobbi A;Domzalski M;Pascual J;	2004	Comparison of anterior cruciate ligament reconstruction in male and female athletes using the patellar tendon and hamstring autografts	Less than two year follow up
Heijne A; Werner S;	2010	A 2-year follow-up of rehabilitation after ACL reconstruction using patellar tendon or hamstring tendon grafts: a prospective randomised outcome study	Less than two year follow up
Heier K; Mack D; Moseley B; Paine R; Bocell J;	1997	An Analysis of Anterior Cruciate Ligament Reconstruction in Middle-Aged Patients	Retrospective case series
Huang JM;Liu HY;Chen FR;Jian GJ;Chen Q;Wang ZM;Kang YF;	2012	Characteristics of bone tunnel changes after anterior cruciate ligament reconstruction using Ligament Advanced Reinforcement System artificial ligament	Not relevant case series of LAD non patient oriented outcome
Ibrahim SA;Ghafar S;Salah M;Abo AM;Al MA;Farouk H;Al HH;Khirait S;	2013	Surgical management of traumatic knee dislocation with posterolateral corner injury	Retrospective case series
Ishibashi Y;Tsuda E;Fukuda A;Tsukada H;Toh S;	2008	Intraoperative biomechanical evaluation of anatomic anterior cruciate ligament reconstruction using a navigation system: comparison of hamstring tendon and bone-patellar tendon-bone graft	Commentary
Jansson K; Linko E; Sandelin J; Harilainen A;	2003	A Prospective Randomized Study of Patellar versus Hamstring Tendon Autografts for Anterior Cruciate Ligament Reconstruction	Less than two year follow up

Table 144. Articles Excluded for ACL Autograft Source for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Jarvela T;Kannus P;Jarvinen M;	2000	Anterior knee pain 7 years after an anterior cruciate ligament reconstruction with a bone-patellar tendon-bone autograft	Retrospective case series
Jarvinen M;Jarvela TJ;	2007	Double-bundle ACL reconstruction using a hamstring autograft and bioabsorbable screw fixation [abstract]	Retrospective case series
Joseph M; Fulkerson J; Nissen C; Sheehan J;	2006	Short-Term Recovery After Anterior Cruciate Ligament Reconstruction: A Prospective Comparison of Three Autografts	Less than two year follow up
Laoruengthana A; Pattayakorn S; Chotanaputhi T; Kosiyatrakul A;	2009	Clinical Comparison between Six-Strand Hamstring Tendon and Patellar Tendon Autograft in Arthroscopic Anterior Cruciate Ligament Reconstruction: A Prospective, Randomized Clinical Trial	Less than two year follow up
Lavoie P;Fletcher J;Duval N;	2000	Patient satisfaction needs as related to knee stability and objective findings after ACL reconstruction using the LARS artificial ligament	Less than two year follow up
Laxdal G; Kartus J; Hansson L; Heidvall M; Ejerhed L; Karlsson J;	2005	A Prospective Randomized Comparison of Bone-Patellar Tendon-Bone and Hamstring Grafts for Anterior Cruciate Ligament Reconstruction	Less than two year follow up
Lee S;Seong SC;Jo H;Park YK;Lee MC;	2004	Outcome of anterior cruciate ligament reconstruction using quadriceps tendon autograft	Less than two year follow up
L'Insalata J; Klatt B; Fu F; Harner C;	1997	Tunnel expansion following anterior cruciate ligament reconstruction: a comparison of hamstring and patellar tendon autografts	Less than two year follow up
Maletis G; Cameron S; Tengan J; Burchette R;	2007	A Prospective Randomized Study of Anterior Cruciate Ligament Reconstruction	Less than two year follow up

Table 144. Articles Excluded for ACL Autograft Source for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Mascarenhas R;Tranovich MJ;Kropf EJ;Fu FH;Harner CD;	2012	Bone-patellar tendon-bone autograft versus hamstring autograft anterior cruciate ligament reconstruction in the young athlete: a retrospective matched analysis with 2-10 year follow-up	Retrospective case series
Ming H; Qian W; Feng S; Zi-Min W;	2010	Cruciate ligament reconstruction using LARS artificial ligament under arthroscopy: 81 cases report	Less than two year follow up
Matava MJ;	2006	Complications of anterior cruciate ligament reconstruction: graft issues	Not relevant, study looks at revision ACLR
Moisala AS;Jarvela T;Kannus P;Jarvinen M;	2007	Muscle strength evaluations after ACL reconstruction	Commentary
Moller E;Weidenhielm L;Werner S;	2009	Outcome and knee-related quality of life after anterior cruciate ligament reconstruction: a long-term follow-up	Not relevant, biomechanic study
Muneta T;Sekiya I;Yagishita K;Ogiuchi T;Yamamoto H;Shinomiya K;	1999	Two-bundle reconstruction of the anterior cruciate ligament using semitendinosus tendon with endobuttons: operative technique and preliminary results	Less than two year follow up
Murray JR;Lindh AM;Hogan NA;Trezies AJ;Hutchinson JW;Parish E;Read JW;Cross MV;	2012	Does anterior cruciate ligament reconstruction lead to degenerative disease?: Thirteen-year results after bone-patellar tendon-bone autograft	Retrospective case series
Noh JH;Yang BG;Roh YH;Lee JS;	2011	Synovialization on second-look arthroscopy after anterior cruciate ligament reconstruction using Achilles allograft in active young men	Not relevant comparison
Noyes FR;Barber-Westin SD;	2001	Revision anterior cruciate ligament reconstruction: report of 11-year experience and results in 114 consecutive patients	Retrospective case series
Otero AL;Hutcheson L;	1993	A comparison of the doubled semitendinosus/gracilis and central third of the patellar tendon autografts in arthroscopic anterior cruciate ligament reconstruction	Poster
Papadopoulos D;Efstathiou P;Iliadis A;Antonogiannakis E;	1996	Anterior cruciate ligament replacement using part of the patellar tendon as a free graft	Less than two year follow up

Table 144. Articles Excluded for ACL Autograft Source for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Rebeyrotte-Boulegue; Daviet; Salle J; Dudignon P; Mabit C;	2005	Isokinetic evaluation of anterior cruciate ligament reconstruction using a free fascia lata graft strengthened by gracilis tendon	Less than two year follow up
Rubinstein R; Shelbourne D; VanMeter C; McCarroll J; Rettig A;	1994	Isolated Autogenous Bone-Patellar Tendon-Bone Graft Site Morbidity*	Less than two year follow up
Ruiz AL;Kelly M;Nutton RW;	2002	Arthroscopic ACL reconstruction: a 5-9 year follow-up	Less than two year follow up
Rupp S;Muller B;Seil R;	2001	Knee laxity after ACL reconstruction with a BPTB graft	Not relevant, survey of current practice
Sajovic M;Strahovnik A;Komadina R;Dernovsek MZ;	2008	The effect of graft choice on functional outcome in anterior cruciate ligament reconstruction	Less than two year follow up
Schultz WR;Carr CF;	2002	Comparison of clinical outcomes of reconstruction of the anterior cruciate ligament: autogenous patellar tendon and hamstring grafts	Less than two year follow up
Schwartzberg R;Burkhart B;Lariviere C;	2008	Prediction of hamstring tendon autograft diameter and length for anterior cruciate ligament reconstruction	Retrospective case series
Scranton PE;Bagenstose JE;Lantz BA;Friedman MJ;Khalfayan EE;Auld MK;	2002	Quadruple hamstring anterior cruciate ligament reconstruction: a multicenter study	Less than two year follow up
Sernert N; Kartus J; Kohler K; Stener S; Eriksson B; Karlsson J;	1999	Analysis of subjective, objective and functional examination tests after anterior cruciate ligament Reconstruction A follow-up of 527 patients	Less than two year follow up
Shelbourne KD;Liotta FJ;	1999	ACL reconstruction using an abnormally thick autogenous patellar tendon graft	Biomechanical evaluation of animal tissue
Sherman O; Banffy M;	2004	Anterior Cruciate Ligament Reconstruction: Which Graft Is Best?	Commentary
Stockle U;Hoffmann R;Schwedke J;Lubrich J;Vogl T;Sudkamp NP;Haas N;	1998	Anterior cruciate ligament reconstruction: the diagnostic value of MRI	Less than two year follow up

Table 144. Articles Excluded for ACL Autograft Source for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Spindler K; Warren T; Callison C; Secic M; Fleisch S; Wright R	2005	Clinical Outcome at a Minimum of Five Years After Reconstruction of the Anterior Cruciate Ligament	Prognosis study
Svensson M; Sernert N; Karlsson J; Kartus J;	2006	A prospective comparison of bone-patellar tendon-bone and hamstring grafts for anterior cruciate ligament reconstruction in female patients	Less than two year follow up
Tadokoro K;Matsui N;Yagi M;Kuroda R;Kurosaka M;Yoshiya S;	2004	Evaluation of hamstring strength and tendon regrowth after harvesting for anterior cruciate ligament reconstruction	Less than two year follow up
Taylor D; Deberardino M; Nelson B; Duffey M; Tenuta J; Stoneman P;	2009	Patellar Tendon Versus Hamstring Tendon Autografts for Anterior Cruciate Ligament Reconstruction : A Randomized Controlled Trial Using Similar Femoral and Tibial Fixation Methods	Less than two year follow up
Tunay V; Bataci G; Ergun N; Duzgun I; Yosmaoglu B;	2008	Quadriceps femoris strength and knee functions in soccer players after anterior cruciate ligament reconstruction: six month follow-up	Less than two year follow up
Ye JX;Shen GS;Zhou HB;Xu W;Xie ZG;Dong QR;Xu YJ;	2013	Arthroscopic reconstruction of the anterior cruciate ligament with the LARS artificial ligament: thirty-six to fifty-two months follow-up study	Retrospective case series

Table 145. Articles Excluded for ACL Autograft vs Allograft for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Bach BR;Jones GT;Hager CA;Sweet FA;Luergans S;	1995	Arthrometric results of arthroscopically assisted anterior cruciate ligament reconstruction using autograft patellar tendon substitution	Retrospective case series
Barrett A; Craft J; Replogle W; Hydrick J; Barrett G;	2011	Anterior Cruciate Ligament Graft Failure	Retrospective medical records review database
Cohen S; Yucha D; Ciccotti M; Goldstein D; Ciccotti M; Ciccotti M;	2009	Factors Affecting Patient Selection of Graft Type in Anterior Cruciate Ligament Reconstruction	Retrospective case series

Table 145. Articles Excluded for ACL Autograft vs Allograft for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Dahm D; Wulf C; Dajani K; Dobbs R; Levy B; Stuart M;	2008	Reconstruction of the anterior cruciate ligament in patients over 50 years	Retrospective case series
Dandy DJ;Edwards DJ;	1994	Problems in regaining full extension of the knee after anterior cruciate ligament reconstruction: does arthrofibrosis exist?	Less than two year follow up
DeAngelis JP;Fulkerson JP;	2007	Quadriceps tendon--a reliable alternative for reconstruction of the anterior cruciate ligament	Commentary
Engebretsen L;Benum P;Fasting O;Molster A;Strand T;	1990	A prospective, randomized study of three surgical techniques for treatment of acute ruptures of the anterior cruciate ligament	Not relevant, Comparing LAD and ACL Augmentation
Grontvedt T;Engebretsen L;	1995	Comparison between two techniques for surgical repair of the acutely torn anterior cruciate ligament. A prospective, randomized follow-up study of 48 patients	Not relevant, synthetic graft
Hamman D; Safran M;	2009	Allograft Anterior Cruciate Ligament Reconstruction	Commentary
Hu Jost PW;Dy CJ;Robertson CM;Kelly AM;	2011	Allograft use in anterior cruciate ligament reconstruction	Retrospective medical records review
Klimkiewicz J; Samsell B; Riff A; DeBerardino T; Moore A;	2011	Comparison of human tendon allografts and autografts used in knee reconstruction	Commentary
Kartus J;Stener S;Lindahl S;Engstrom B;Eriksson BI;Karlsson J;	1997	Factors affecting donor-site morbidity after anterior cruciate ligament reconstruction using bone-patellar tendon-bone autografts	Less than two year follow up
Krueger-Franke M;Siebert CH;Schupp A;	1998	Refixation of femoral anterior cruciate ligament tears combined with a semitendinosus tendon augmentation. Technique and results	Retrospective case series
Kuechle DK;Pearson SE;Beach WR;Freeman EL;Pawlowski DF;Whipple TL;Caspari Dagger RB;Meyers JF;	2002	Allograft anterior cruciate ligament reconstruction in patients over 40 years of age	Retrospective case series

Table 145. Articles Excluded for ACL Autograft vs Allograft for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Kustos T;Balint L;Than P;Bardos T;	2004	Comparative study of autograft or allograft in primary anterior cruciate ligament reconstruction	Less than two year follow up
Lephart SM;Kocher MS;Harner CD;Fu FH;	1993	Quadriceps strength and functional capacity after anterior cruciate ligament reconstruction. Patellar tendon autograft versus allograft	Less than two year follow up
Noh J; Yi S; Song S; Kim S; kim W;	2011	Comparison between hamstring autograft and free tendon Achilles allograft: minimum 2-year follow-up after anterior cruciate ligament reconstruction using EndoButton and Intrafix	Less than two year follow up
Novak PJ;Bach BR;Hager CA;	1996	Clinical and functional outcome of anterior cruciate ligament reconstruction in the recreational athlete over the age of 35	Medical records review
Osti L;Papalia R;Del BA;Leonardi F;Denaro V;Maffulli N;	2011	Surgery for ACL deficiency in patients over 50	Not relevant, graft types not compared
Poehling GG;Curl WW;Lee CA;Ginn TA;Rushing JT;Naughton MJ;Holden MB;Martin DF;Smith BP;	2005	Analysis of outcomes of anterior cruciate ligament repair with 5-year follow-up: allograft versus autograft	Less than two year follow up
Rihn JA;Irrgang JJ;Chhabra A;Fu FH;Harner CD;	2006	Does irradiation affect the clinical outcome of patellar tendon allograft ACL reconstruction?	Less than two year follow up
Shah AA;McCulloch PC;Lowe WR;	2010	Failure rate of Achilles tendon allograft in primary anterior cruciate ligament reconstruction	Retrospective case series
Shelbourne KD;	2002	Contralateral patellar tendon autograft for anterior cruciate ligament reconstruction	Commentary
Shino K;Nakata K;Horibe S;Inoue M;Nakagawa S;	1993	Quantitative evaluation after arthroscopic anterior cruciate ligament reconstruction. Allograft versus autograft	Less than two year follow up
Stringham DR;Pelmas CJ;Burks RT;Newman AP;Marcus RL;	1996	Comparison of anterior cruciate ligament reconstructions using patellar tendon autograft or allograft	Less than two year follow up
Sun K;Tian SQ;Zhang JH;Xia CS;Zhang CL;Yu TB;	2009	ACL reconstruction with BPTB autograft and irradiated fresh frozen allograft	Less than two year follow up

Table 145. Articles Excluded for ACL Autograft vs Allograft for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Valenti JR;Sala D;Schweitzer D;	1994	Anterior cruciate ligament reconstruction with fresh-frozen patellar tendon allografts	Less than two year follow up

Table 146. Articles Excluded for ACL Femoral Tunnel Technique for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Avadhani A;Rao PS;Rao SK;	2010	Effect of tibial tunnel position on arthroscopically assisted anterior cruciate ligament reconstruction using bone-patellar tendon-bone grafts: a prospective study	Not relevant, effect of tibial tunnel position
Bach BR;Tradonsky S;Bojchuk J;Levy ME;Bush-Joseph CA;Khan NH;	1998	Arthroscopically assisted anterior cruciate ligament reconstruction using patellar tendon autograft. Five- to nine-year follow-up evaluation	Retrospective case series
Barber FA;	2000	Flipped patellar tendon autograft anterior cruciate ligament reconstruction	Less than two year follow up
Barrett GR;Richardson K;	1996	Comparison of rear-entry (two-incision) and endoscopic techniques for reconstruction of the anterior cruciate ligament	Less than two year follow up
Barzegar H;Mohseni M;Sedighi A;Shahsavari A;Mohammadpour H;	2011	Arthroscopically-assisted vs. open surgery in repairing anterior cruciate ligament avulsion	Less than two year follow up
Bastian JD;Tomagra S;Schuster AJ;Werlen S;Jakob RP;Zumstein MA;	2013	ACL reconstruction with physiological graft tension by intraoperative adjustment of the anteroposterior translation to the uninjured contralateral knee	Less than two year follow up
Chhabra A; Kline A; Nilles K; Harner C;	2006	Tunnel Expansion After Anterior Cruciate Ligament Reconstruction With Autogenous Hamstrings: A Comparison of the Medial Portal and Transtibial Techniques	Less than two year follow up
Gokce A;Beyzadeoglu T;Ozyer F;Bekler H;Erdogan F;	2009	Does bone impaction technique reduce tunnel enlargement in ACL reconstruction?	Retrospective medical records review

Table 146. Articles Excluded for ACL Femoral Tunnel Technique for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Hwang D; Shetty G; Kim O; Kwon J; Song J; Munoz M;	2013	Does Press-Fit Technique Reduce Tunnel Volume Enlargement After Anterior Cruciate Ligament Reconstruction With Autologous Hamstring Tendons? A Prospective Randomized Computed Tomography Study	Less than two year follow up
Inderhaug E;Strand T;Fischer-Bredenbeck C;Solheim E;	2012	Long-term results after reconstruction of the ACL with hamstrings autograft and transtibial femoral drilling	Not best available evidence, case series of HT graft and transtibial technique
Kartus J;Ejerhed L;Sernert N;Brandsson S;Karlsson J;	2000	Comparison of traditional and subcutaneous patellar tendon harvest. A prospective study of donor site-related problems after anterior cruciate ligament reconstruction using different graft harvesting techniques	Less than two year follow up
Kim JG;Wang JH;Lim HC;Ahn JH;	2012	Femoral graft bending angle and femoral tunnel geometry of transportal and outside-in techniques in anterior cruciate ligament reconstruction: an in vivo 3-dimensional computed tomography analysis	Not relevant outcome reported
Koutras G;Papadopoulos P;Terzidis IP;Gigis I;Pappas E;	2012	Short-term functional and clinical outcomes after ACL reconstruction with hamstrings autograft: transtibial versus anteromedial portal technique	Less than two year follow up
McCormik W; Regan E;	2012	Rationale for Proper Arthroscopic Tunnel Placement in Anterior Cruciate Ligament Reconstruction	Commentary
Mardani-Kivi M;Madadi F;Keyhani S;Karimi-Mobarake M;Hashemi-Motlagh K;Saheb-Ekhtiari K;	2012	Antero-medial portal vs. transtibial techniques for drilling femoral tunnel in ACL reconstruction using 4-strand hamstring tendon: a cross-sectional study with 1-year follow-up	Less than two year follow up
Mitsou A;Valianatos P;Gavras M;	1997	Replacement of the anterior cruciate ligament. Comparison between the endoscopic and mini-open technique in 56 and 100 patients, respectively	Less than two year follow up

Table 146. Articles Excluded for ACL Femoral Tunnel Technique for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Mutsuzaki H; Kanamori A; Ikeda K; Hioki S; Kinugasa T; Sakane M	2012	Effect of Calcium Phosphate–Hybridized Tendon Graft in Anterior Cruciate Ligament Reconstruction	Not relevant, study of calcium phosphate hybridized tendon graft
Niceforo A; Bonaccorso G; Caminiti S;	1995	Reconstruction of the ACL with the middle third of the patellar tendon: The half-tunnel technique under arthroscopic control	Less than two year follow up
Oni OO;Crowder E;	1996	A comparison of isokinetics and muscle strength ratios following intra-articular and extra-articular reconstructions of the anterior cruciate ligament	Less than two year follow up
Rahr-Wagner L;Thillemann TM;Pedersen AB;Lind MC;	2013	Increased risk of revision after anteromedial compared with transtibial drilling of the femoral tunnel during primary anterior cruciate ligament reconstruction: results from the Danish Knee Ligament Reconstruction Register	Danish registery data
Reid S; Hanks G; Kalenak A; Kottmeier S; Aronoff V;	1992	The Ellison Iliotibial-Band Transfer for a Torn Anterior Cruciate Ligament of the Knee	Not relevant, extra-articular ACLR technique
Shelbourne KD;Patel DV;	1996	ACL reconstruction using the autogenous bone-patellar tendon-bone graft: open two-incision technique	Commentary
Silva A;Sampaio R;Pinto E;	2012	ACL reconstruction: comparison between transtibial and anteromedial portal techniques	Reporting imaging outcomes.
Solheim E;Strand T;	1993	Postoperative pain after anterior cruciate ligament reconstruction using a transligamentous approach	Less than two year follow up
Struewer J;Efe T;Frangen TM;Schwarting T;Buecking B;Ruchholtz S;Schuttler KF;Ziring E;	2012	Prevalence and influence of tibial tunnel widening after isolated anterior cruciate ligament reconstruction using patella-bone-tendon-bone-graft: long-term follow-up	Not relevant, tibial tunnel widening study
Wang H;Fleischli JE;Zheng NN;	2013	Transtibial Versus Anteromedial Portal Technique in Single-Bundle Anterior Cruciate Ligament Reconstruction: Outcomes of Knee Joint Kinematics During Walking	Biomechanical study

Table 146. Articles Excluded for ACL Femoral Tunnel Technique for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Yamaguchi S; Sasho T; Tsuchiya A; Wada Y; Moriya H;	2006	Long term results of anterior cruciate ligament reconstruction with iliotibial tract: 6-, 13-, and 24-year longitudinal follow-up	Retrospective case series
Yoon KH;Bae DK;Cho SM;Park SY;Lee JH;	2009	Standard anterior cruciate ligament reconstruction versus isolated single-bundle augmentation with hamstring autograft	Less than two year follow up
Wagner LR; Thillemann M; Pedersen AB; Lind MC;	2013	Increased Risk of Revision After Anteromedial Compared With Transtibial Drilling of the Femoral Tunnel During Primary Anterior Cruciate Ligament Reconstruction: Results from the Danish I(nee Ligament Reconstruction Register	Less than two year follow up

Table 147. Articles Excluded for ACL Post-op Functional Bracing for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Albright JC;Crepeau AE;	2011	Functional bracing and return to play after anterior cruciate ligament reconstruction in the pediatric and adolescent patient	Commentary
Benazzo F; Zanon G; Pederzini L; Modonesi F; Cardile C; Falez F;	2008	Effects of biophysical stimulation in patients undergoing arthroscopic reconstruction of anterior cruciate ligament: prospective, randomized and double blind study	Not relevant, not a bracing study
Beynnon BD;Good L;Risberg MA;	2002	The effect of bracing on proprioception of knees with anterior cruciate ligament injury	Narrative review, bibliography screened
Beynnon BD;Pope MH;Wertheimer CM;Johnson RJ;Fleming BC;Nichols CE;Howe JG;	1992	The effect of functional knee-braces on strain on the anterior cruciate ligament in vivo	Not relevant, subject with normal ACL and meniscus injury
Birmingham TB;Kramer JF;Kirkley A;Inglis JT;Spaulding SJ;Vandervoort AA;	2001	Knee bracing after ACL reconstruction: effects on postural control and proprioception	Biomechanical study
Davis AG;Pietrosimone BG;Ingersoll CD;Pugh K;Hart JM;	2011	Quadriceps function after exercise in patients with anterior cruciate ligament-reconstructed knees wearing knee braces	Not relevant, effect of knee brace and sleeves on quadriceps central activation ratio.

Table 147. Articles Excluded for ACL Post-op Functional Bracing for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Devita P;Hunter PB;Skelly WA;	1992	Effects of a functional knee brace on the biomechanics of running	Less than 10 patients per group
Devita P;Lassiter T;Hortobagyi T;Torry M;	1998	Functional knee brace effects during walking in patients with anterior cruciate ligament reconstruction	Less than 10 patients per group
Goodstadt NM;Hunter-Giordano A;Axe MJ;Snyder-Mackler L;	2013	Functional testing to determine readiness to discontinue brace use, one year after acl reconstruction	Less than two year follow up
Hiemsta LA; Heard SM Sasyniul TM; Buchko GL; Reed JG; Monteleone BJ	2009	Knee Immobilization for Pain Control After a Hamstring Tendon Anterior Cruciate Ligament Reconstruction	2 week follow up
Mallory N;Kelsberg G;Ketchell D;Lord JL;	2003	Clinical inquiries. Does a knee brace decrease recurrent ACL injuries?	Narrative review, bibliography screened
Muellner T;Alacamlioglu Y;Nikolic A;Schabus R;	1998	No benefit of bracing on the early outcome after anterior cruciate ligament reconstruction	Less than two year follow up
Nassif J;Nyland J;Johnson DL;	1998	Septic knee arthritis secondary to a functional brace after ACL reconstruction	Case report
Nazem K;Mehrbod M;Borjian A;Sadeghian H;	2006	Anterior cruciate ligament reconstruction with or without bracing	Less than two year follow up
Paluska SA;McKeag DB;	1999	Prescribing functional braces for knee instability	Commentary
Rebel M;Paessler HH;	2001	The effect of knee brace on coordination and neuronal leg muscle control: an early postoperative functional study in anterior cruciate ligament reconstructed patients	Not relevant, testing coordination and neuronal leg muscle control
Vandertuin JF; Grant JA	2004	The Role of Functional Knee Braces in Managing ACL Injuries	Commentary
Wojtys EM;Kothari SU;Huston LJ;	1996	Anterior cruciate ligament functional brace use in sports	Less than 10 patients per group
Zetterland AE; Serfass RC; Hunter RE	1986	The effect of wearing the complete Lenox Hill Derotation Brace on energy expenditure during horizontal treadmill running at 161 meters per minute*	Not relevant, not a study of bracing after ACLR

Table 148. Articles Excluded for ACL Prophylactic Braces for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Kocher MS;Sterett WI;Briggs KK;Zurakowski D;Steadman JR;	2003	Effect of functional bracing on subsequent knee injury in ACL-deficient professional skiers	Not relevant, functional knee brace for ACL deficient knee
Lu TW;Lin HC;Hsu HC;	2006	Influence of functional bracing on the kinetics of anterior cruciate ligament-injured knees during level walking	Not relevant, functional knee brace in ACL injured knees
Marans HJ;Jackson RW;Piccinin J;Silver RL;Kennedy DK;	1991	Functional testing of braces for anterior cruciate ligament-deficient knees	Not relevant, functional braces in ACL deficient knees
Rink PC; Scott RA; Lupo RL; Guest SJ	1989	A Comparative Study of Functional Bracing in the Anterior Cruciate Deficient Knee Peter	Study published before 1990
Smith J;Malanga GA;Yu B;An KN;	2003	Effects of functional knee bracing on muscle-firing patterns about the chronic anterior cruciate ligament-deficient knee	Not relevant, functional knee brace in chronic ACL deficient knee
Teitz CC; Hermanson BK; Kronmal RA; Dieher PH	1987	Evaluation of the Use of Braces to Prevent Injury to the Knee in Collegiate Football Players	Prevention study before 1990
Tegner Y;Lysholm J;	1985	Derotation brace and knee function in patients with anterior cruciate ligament tears	Not relevant, subjects with ACL tears
Volpi P; Melegati G; Cawley PW	1995	Biomechanical, functional and subjective assessment of a new functional knee brace for team sports	Not relevant, not a prophylactic knee bracing study
Wilson LQ;Weltman JY;Martin DE;Weltman A;	1998	Effects of a functional knee brace for ACL insufficiency during treadmill running	Not relevant, Functional knee brace for ACL insufficiency

Table 149. Articles Excluded for ACL Neuromuscular Training Programs for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Schultz SJ;Schmitz RJ;Nguyen AD;Chaudhari AM;Padua DA;McLean SG;Sigward SM;	2010	An update on ACL injury risk and prevention. Proceedings of the ACL Research Retreat V. March 25-27, 2010. Greensboro, North Carolina, USA	Commentary

Table 149. Articles Excluded for ACL Neuromuscular Training Programs for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Dai B;Herman D;Liu H;Garrett WE;Yu B;	2012	Prevention of ACL injury, part I: injury characteristics, risk factors, and loading mechanism	Commentary
DiStefano LJ ; Padua DA; DiStefano MJ; Marshall SW	2009	Influence of Age, Sex, Technique, and Exercise Program on Movement Patterns After an Anterior Cruciate Ligament Injury Prevention Program in Youth Soccer Players	Bio-mechanical study
Distefano LJ;Blackburn JT;Marshall SW;Guskiewicz KM;Garrett WE;Padua DA;	2011	Effects of an age-specific anterior cruciate ligament injury prevention program on lower extremity biomechanics in children	Biomechanical study
Faude O; Junge A; Kindermann W; Dvorak J	2006	Risk factors for injuries in elite female soccer players	Not relevant, Not an ACL prevention program study
Giza E;Silvers HJ;Mandelbaum BR;	2005	Anterior cruciate ligament tear prevention in the female athlete	Commentary
Goris JE;Graf BK;	1996	Risk factors for anterior cruciate ligament injury	Commentary
Greska EK;Cortes N;Van Lunen BL;Onate JA;	2012	A feedback inclusive neuromuscular training program alters frontal plane kinematics	Biomechanical study
Griffin LY;	2002	Anterior cruciate ligament injuries in female athletes: prevention strategies	Commentary
Griffin LY;Agel J;Albohm MJ;Arendt EA;Dick RW;Garrett WE;Garrick JG;Hewett TE;Huston L;Ireland ML;Johnson RJ;Kibler WB;Lephart S;Lewis JL;Lindenfeld TN;Mandelbaum BR;Marchak P;Teitz CC;Wojtys EM;	2000	Noncontact anterior cruciate ligament injuries: risk factors and prevention strategies	Commentary
Hagglund M;Walden M;Atroshi I;	2009	Preventing knee injuries in adolescent female football players - design of a cluster randomized controlled trial [NCT00894595]	Study protocol
Hewett TE;Di Stasi SL;Myer GD;	2013	Current concepts for injury prevention in athletes after anterior cruciate ligament reconstruction	Commentary

Table 149. Articles Excluded for ACL Neuromuscular Training Programs for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Hewett TE;Myer GD;Ford KR;Paterno MV;Quatman CE;	2012	The 2012 ABJS Nicolas Andry Award: The Sequence of Prevention: A Systematic Approach to Prevent Anterior Cruciate Ligament Injury	Commentary
Holm I;Fosdahl MA;Friis A;Risberg MA;Myklebust G;Steen H;	2004	Effect of neuromuscular training on proprioception, balance, muscle strength, and lower limb function in female team handball players	Not relevant, not a ACL neuromuscular training program to prevent injury
Hootman JM;Albohm MJ;	2012	Anterior cruciate ligament injury prevention and primary prevention of knee osteoarthritis	Commentary
Hootman JM;Dick R;Agel J;	2007	Epidemiology of collegiate injuries for 15 sports: summary and recommendations for injury prevention initiatives	Not relevant, not a neuromuscular ACL prevention training program
Irmischer BS;Harris C;Pfeiffer RP;DeBeliso MA;Adams KJ;Shea KG;	2004	Effects of a knee ligament injury prevention exercise program on impact forces in women	Biomechanical study
Junge A; Rosch D; Peterson L ; Graf-Baumann T; Dvorak J	2002	Prevention of Soccer Injuries: A Prospective Intervention Study in Youth Amateur Players	Not relevant, No ACL injury
Kristianslund E;Faul O;Bahr R;Myklebust G;Krosshaug T;	2013	Sidestep cutting technique and knee abduction loading: implications for ACL prevention exercises	Commentary
Myklebust G;Skjolberg A;Bahr R;	2013	ACL injury incidence in female handball 10 years after the Norwegian ACL prevention study: important lessons learned	Biomechanical study
Olsen O; Myklebust G ; Engebretsen L; Holme I; Bahr R	2005	Exercises to prevent lower limb injuries in youth sports: cluster randomised controlled trial	Not relevant, No ACL injury
Orchard J	2001	The AFL penetrometer Study: Work In Progress	Not relevant
Orchard J;	2001	The AFL penetrometer study: work in progress	Not relevant, not a neuromuscular training program
Padua DA;Distefano LJ;Marshall SW;Beutler AI;de la Motte SJ;DiStefano MJ;	2012	Retention of movement pattern changes after a lower extremity injury prevention program is affected by program duration	Biomechanical study

Table 149. Articles Excluded for ACL Neuromuscular Training Programs for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Pasanen K;Parkkari J;Kannus P;Rossi L;Palvanen M;Natri A;Jarvinen M;	2008	Injury risk in female floorball: a prospective one-season follow-up	Not relevant, study not of neuromuscular training program
Pollard CD;Sigward SM;Ota S;Langford K;Powers CM;	2006	The influence of in-season injury prevention training on lower-extremity kinematics during landing in female soccer players	Biomechanical study
Urabe Y;Ochi M;Onari K;Ikuta Y;	2002	Anterior cruciate ligament injury in recreational alpine skiers: analysis of mechanisms and strategy for prevention	Not relevant, not a ACL neuromuscular training prevention study
Vescovi JD;	2010	Effects of an anterior cruciate ligament injury prevention program on performance in adolescent female soccer players	Not relevant, ACL prevention program on performance
Wedderkopp N; Kaltoft M; Lundgaard B; Rosendahl M; Froberg K	1997	Prevention of injuries in young female players in European team handball. A prospective intervention study	Not relevant, No ACL injury
Wedderkopp N; Kaltoft M; Holm R ; Froberg K	2003	Comparison of two intervention programmes in young female players in European handball – with and without ankle disc	Type of injuries not specified

Table 150. Articles Excluded for ACL Post-op Physical Therapy for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Baltaci G;Harput G;Haksever B;Ulusoy B;Ozer H;	2012	Comparison between Nintendo Wii Fit and conventional rehabilitation on functional performance outcomes after hamstring anterior cruciate ligament reconstruction: prospective, randomized, controlled, double-blind clinical trial	Less than six month follow up
Barber FA;Click SD;	1997	Meniscus repair rehabilitation with concurrent anterior cruciate reconstruction	Not relevant, case series looking at meniscus healing after a repair
Barber-Westin SD;Noyes FR;	1993	The effect of rehabilitation and return to activity on anterior-posterior knee displacements after anterior cruciate ligament reconstruction	Not relevant outcome, AP displacement image analysis after ACLR

Table 150. Articles Excluded for ACL Post-op Physical Therapy for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Biernat R;Wolosewicz M;Tomaszewski W;	2007	A protocol of rehabilitation after ACL reconstruction using a hamstring autograft in the first month after surgery--a preliminary report	Less than six month follow up
Brunetti O ; Filippi GM; Lorenzini M; Liti A; Panichi R; Roscini M;	2006	Improvement of posture stability by vibratory stimulation following anterior cruciate ligament reconstruction	Not relevant
Can F	2003	Results of a specific rehabilitation protocol for anterior cruciate ligament reconstructed patients	Not relevant
Cascio BM;Culp L;Cosgarea AJ;	2004	Return to play after anterior cruciate ligament reconstruction	Narrative review, bibliography screened
Christensen JC; Goldfine LR; West HS	2013	The Effects of Early Aggressive Rehabilitation on Outcomes after Anterior Cruciate Ligament Reconstruction Using Autologous Hamstring Tendon: A Randomized Clinical Trial	Not published
Cooper RL;Taylor NF;Feller JA;	2005	A randomised controlled trial of proprioceptive and balance training after surgical reconstruction of the anterior cruciate ligament	Less than six month follow up
Cupal D; Brewer B	2001	Effects of Relaxation and Guided Imagery on Knee Strength, Reinjury Anxiety, and Pain Following Anterior Cruciate Ligament Reconstruction	Not relevant
Czamara A;	2010	Functional benchmarking of rehabilitation outcomes following anterior cruciate ligament reconstruction	Less than six month follow up
Fu FH;Woo Y;Irrgang JJ;	1992	Current Concepts for Rehabilitation following Anterior Cruciate Ligament Reconstruction	Commentary
Gerber JP; Marcus RL; Dibble LE; Greis PE; Burks RT; LaStayo PC	2007	Effects of Early Progressive Eccentric Exercise on Muscle Structure After Anterior Cruciate Ligament Reconstruction	< 6 mo follow up

Table 150. Articles Excluded for ACL Post-op Physical Therapy for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Grant JA;Mohtadi NG;Maitland ME;Zernicke RF;	2005	Comparison of home versus physical therapy-supervised rehabilitation programs after anterior cruciate ligament reconstruction: a randomized clinical trial	Less than six months follow up
Hartigan E; Axe MJ; Snyder-Mackler L	2009	Perturbation Training prior to ACL Reconstruction Improves Gait Asymmetries in Non-Copers	< 10 subjects per group
Kruse LM;Gray BL;Wright RW;	2011	Anterior cruciate ligament reconstruction rehabilitation in the pediatric population	Commentary
Kuhne C; Zirkel A	1996	Accelerated rehabilitation following patellar tendon autograft anterior cruciate ligament reconstruction using the aquajogging protocol: a primary study	< 6 mo follow up
Liu Ambrose T; Taunton JE; MacIntyre D; McConkey P; Khan KM	2003	The Effects of Proprioceptive or strength training on the neuromuscular function of the ACL reconstructed knee: a randomized clinical trial	< 6 mo follow up
Mangine RE;Noyes FR;	1992	Rehabilitation of the allograft reconstruction	Commentary
McCarty LP; Bach BR	2005	Rehabilitation After Patellar Tendon Autograft Anterior Cruciate Ligament Reconstruction	Commentary
Monissey MC; Hudson ZL; Drechsler WI; Coutts FJ; Knight PR; King JB	2000	Effects of open versus closed kinetic chain training on knee laxity in the early period after anterior cruciate ligament reconstruction	< 6 mo follow up
Myer GD;Paterno MV;Ford KR;Quatman CE;Hewett TE;	2006	Rehabilitation after anterior cruciate ligament reconstruction: criteria-based progression through the return-to-sport phase	Commentary
Pomphrey MM;	1992	Aggressive rehabilitation following anterior cruciate reconstruction: an update and protocol	Commentary
Puddu G; Selvanetti A	1997	Anterior cruciate ligament surgery, rehabilitation, and braces	Commentary

Table 150. Articles Excluded for ACL Post-op Physical Therapy for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Reid A;Birmingham TB;Stratford PW;Alcock GK;Giffin JR;	2007	Hop testing provides a reliable and valid outcome measure during rehabilitation after anterior cruciate ligament reconstruction	Less than 6 months follow up
Revana SA; Johansson A; Leppert J	2009	A randomized study of two physiotherapeutic approaches after knee ligament reconstruction	Very low base line outcome and demographic differences
Ross M	2000	The effect on neuromuscular electrical stimulation during closed kinetic chain excercise on lower extremity performance following anterior ligament reconstuction	< 6 mo follow up
Salvarani A; Agosti M; Zanre A; Ampollini A; Montagna L; Francheschini M	2003	Mechanical vibration in the rehabilition of patients with reconstructed anterior cruciate ligament	< 6 mo follow up
Sauter D ; Veraart B	1998	Functional knee rehabilitation after anterior cruciate ligament reconstruction	Commentary
Sauter DJM	1998	Functional rehabilitation after cruciate ligament surgery	Commentary
Shelbourne KD;Urch SE;Gray T;Freeman H;	2012	Loss of normal knee motion after anterior cruciate ligament reconstruction is associated with radiographic arthritic changes after surgery	Not relevant, prevalence study of OA
Smith FW;Rosenlund EA;Aune AK;MacLean JA;Hillis SW;	2004	Subjective functional assessments and the return to competitive sport after anterior cruciate ligament reconstruction	Retrospective case series
Tagesson S;Oberg B;Good L;Kvist J;	2008	A comprehensive rehabilitation program with quadriceps strengthening in closed versus open kinetic chain exercise in patients with anterior cruciate ligament deficiency: a randomized clinical trial evaluating dynamic tibial translation and muscle function	Less than six months follow up
Takahashi K;Hayashi M;Fujii T;Kawamura K;Ozaki T;	2012	Early rehabilitation with weight-bearing standing-shaking-board exercise in combination with electrical muscle stimulation after anterior cruciate ligament reconstruction	Less than six month follow up

Table 150. Articles Excluded for ACL Post-op Physical Therapy for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Tovin BJ;Wolf SL;Greenfield BH;Crouse J;Woodfin BA;	1994	Comparison of the effects of exercise in water and on land on the rehabilitation of patients with intra-articular anterior cruciate ligament reconstructions	Less than six month follow up
Vathrakokilis K ; Malliou P; Gioftsidou A ; Beneka A; Godolias G	2008	Effects of a balance training protocol on knee joint proprioception after anterior cruciate ligament reconstruction	Not relevant, not a rehabilitation study
Yates CK; McCarthy MR; Hirsch HS; Pascale MS	1992	Effects of Continuous Passive Motion Following ACL Reconstruction with Autogenous Patellar Tendon Grafts	< 6 mo follow up
Zamarioli A; Pezolato A; Mieli E; Shimano AC	2008	The significance of water rehabilitation in patients with anterior cruciate ligament reconstruction	< 6 mo follow up

Table 151. Articles Excluded for ACL Return to Sports for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Fujimoto E;Sumen Y;Urabe Y;Deie M;Murakami Y;Adachi N;Ochi M;	2004	An early return to vigorous activity may destabilize anterior cruciate ligaments reconstructed with hamstring grafts	Retrospective case series
O'Connor DP;Laughlin MS;Woods GW;	2005	Factors related to additional knee injuries after anterior cruciate ligament injury	Retrospective case series
Plancher KD;Steadman JR;Briggs KK;Hutton KS;	1998	Reconstruction of the anterior cruciate ligament in patients who are at least forty years old. A long-term follow-up and outcome study	Medical records review
Shah VM;Andrews JR;Fleisig GS;McMichael CS;Lemak LJ;	2010	Return to play after anterior cruciate ligament reconstruction in National Football League athletes	Retrospective case series
Ardern CL;Webster KE;Taylor NF;Feller JA;	2011	Return to the preinjury level of competitive sport after anterior cruciate ligament reconstruction surgery: two-thirds of patients have not returned by 12 months after surgery	Retrospective medical records review, case series

Table 151. Articles Excluded for ACL Return to Sports for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Busfield BT;Kharrazi FD;Starkey C;Lombardo SJ;Seegmiller J;	2009	Performance outcomes of anterior cruciate ligament reconstruction in the National Basketball Association	Retrospective case series
Della VS;Boldrini L;Ricci M;Danelon F;Snyder-Mackler L;Nanni G;Roi GS;	2012	Clinical Outcomes and Return-to-Sports Participation of 50 Soccer Players After Anterior Cruciate Ligament Reconstruction Through a Sport-Specific Rehabilitation Protocol	Retrospective case series
Di Stasi SL;Logerstedt D;Gardinier ES;Snyder-Mackler L;	2013	Gait Patterns Differ Between ACL-Reconstructed Athletes Who Pass Return-to-Sport Criteria and Those Who Fail	Biomechanical study
Feller J;Webster KE;	2013	Return to sport following anterior cruciate ligament reconstruction	Commentary
Hartigan EH;Zeni J;Di SS;Axe MJ;Snyder-Mackler L;	2011	Preoperative Predictors for Non-Copers to Pass Return to Sports Criteria After ACL Reconstruction	Part of another Hartigan et al. 2009 trial.
Keating J;	2002	Physical examination can detect the presence or absence of cruciate ligament injury	Commentary
Kvist J;Ek A;Sporrstedt K;Good L;	2005	Fear of re-injury: a hindrance for returning to sports after anterior cruciate ligament reconstruction	Not relevant, study looking at factors contributing to return to sports
Lee DY;Karim SA;Chang HC;	2008	Return to sports after anterior cruciate ligament reconstruction - a review of patients with minimum 5-year follow-up	Retrospective case series
Paterno MV;Rauh MJ;Schmitt LC;Ford KR;Hewett TE;	2012	Incidence of contralateral and ipsilateral anterior cruciate ligament (ACL) injury after primary ACL reconstruction and return to sport	Not relevant
Paterno MV;Schmitt LC;Ford KR;Rauh MJ;Myer GD;Huang B;Hewett TE;	2010	Biomechanical measures during landing and postural stability predict second anterior cruciate ligament injury after anterior cruciate ligament reconstruction and return to sport	Biomechanical study
Petersen W;Zantop T;	2013	Return to play following ACL reconstruction: survey among experienced arthroscopic surgeons (AGA instructors)	Not relevant, survey of surgeons

Table 151. Articles Excluded for ACL Return to Sports for Not Meeting Study Selection Criteria

Author	Year	Title	Reason for Exclusion
Schmitt LC;Paterno MV;Hewett TE;	2012	The impact of quadriceps femoris strength asymmetry on functional performance at return to sport following anterior cruciate ligament reconstruction	Not relevant, study of quadriceps strength in relation to hop test
Thomee R ; Petersen CL ; Carlsson L ; Karlsson J	2013	Return to sports after Anterior Cruciate Ligament reconstruction in women	Retrospective case series
Wells L;Dyke JA;Albaugh J;Ganley T;	2009	Adolescent anterior cruciate ligament reconstruction: a retrospective analysis of quadriceps strength recovery and return to full activity after surgery	Retrospective case series
White K;Di Stasi SL;Smith AH;Snyder-Mackler L;	2013	Anterior cruciate ligament-specialized post-operative return-to-sports (ACL-SPORTS) training: a randomized control trial	Not relevant, study protocol
Yabroudi MA;Irrgang JJ;	2013	Rehabilitation and return to play after anatomic anterior cruciate ligament reconstruction	Commentary

REVIEW ARTICLES SCREENED FOR FOR ADDITIONAL ARTICLES BY RECOMMENDATION

Table 152. Review Articles for ACL History and Physical

Author	Year	Title
Keene JS;	1989	Diagnosis of undetected knee injuries. Interpreting subtle clinical and radiologic findings
Patel RV;Haddad FS;	2002	Diagnosis and immediate care of soft tissue knee injuries

Table 153. Review Articles for ACL Radiographs

Author	Year	Title
Benjaminse A; Gokeler A; Schans C;	2006	Clinical Diagnosis of an Anterior Cruciate Ligament Rupture: A Meta-analysis
Malanga GA; Andrus S; Nadler SF; Mclean J;	2003	Physical Examination of the Knee: A Review of the Original Test Description and Scientific Validity of Common Orthopedic Tests
Ostrowski JA	2006	Accuracy of 3 Diagnostic Tests for Anterior Cruciate Ligament Tears
Scholten RJ;Opstelten W;van der Plas CG;Bijl D;Deville WL;Bouter LM;	2003	Accuracy of physical diagnostic tests for assessing ruptures of the anterior cruciate ligament: a meta-analysis (Structured abstract)
Solomon DH; Simel DL; Bates DW; Katz JN; Schaffer JL;	2002	What is the diagnostic accuracy of the clinical examination for meniscus or ligamentous knee injuries?
Solomon DH;Simel DL;Bates DW;Katz JN;Schaffer JL;	2001	Does this patient have a torn meniscus or ligament of the knee? Value of the physical examination
van Eck CF;van den Bekerom MP;Fu FH;Poolman RW;Kerkhoffs GM;	2012	Methods to diagnose acute anterior cruciate ligament rupture: a meta-analysis of physical examinations with and without anaesthesia
van Eck CF;Loopik M;van den Bekerom MP;Fu FH;Kerkhoffs GM;	2012	Methods to diagnose acute anterior cruciate ligament rupture: a meta-analysis of instrumented knee laxity tests

Table 154. Review Articles for ACL Magnetic Resonance Imaging (MRI)

Author	Year	Title
Barry N; Mcguire J;	1996	Acute injuries and specific problems in adult athletes
Bining J; Andrews G; Forster B	2012	The ABCs of the anterior cruciate ligament: a primer for magnetic resonance imaging assessment of the normal, injured and surgically repaired anterior cruciate ligament

Table 154. Review Articles for ACL Magnetic Resonance Imaging (MRI)

Author	Year	Title
Edwin H; Oei G;Nikken JJ; Verstijnen ACM;	2003	MR Imaging of the Menisci and Cruciate Ligaments: A Systematic Review
El-Khoury GY;Manning TA;Tearse DS;	1993	MRI in the diagnosis of knee injuries
Friedman and Jackson	1996	Magnetic resonance Imaging of the Anterior Cruciate Ligament
Guenoun D;Le CT;Amous Z;Pauly V;Sbihi A;Champsaur P;	2012	The contribution of MRI to the diagnosis of traumatic tears of the anterior cruciate ligament
Ho Fung V; Jaimes C; Jaramillo D;	2011	MR Imaging of ACL injuries in pediatric and Adolescent patients
Huie G;	2001	Diagnostic tools for ACL tears
Kalke R; Primio G; Schweitzer M;	2012	MR and CT Arthrography of the Knee
Klass; Toms A; Greenwood R; Hopgood P;	2007	MR imaging of acute anterior cruciate ligament injuries
Kuntz D; Rubin D; Harner C;	1995	Anterior cruciate ligament injuries as diagnosed through magnetic resonance imaging
Mackenzie R;Palmer CR; Lomas DJ;Dixon AK;	1995	Magnetic Resonance Imaging of the Knee: Diagnostic performance Statistics
Crawford R;Walley G;Bridgman S;Maffulli N;	2007	Magnetic resonance imaging versus arthroscopy in the diagnosis of knee pathology, concentrating on meniscal lesions and ACL tears: a systematic review
Sanders TG;	2002	MR imaging of postoperative ligaments of the knee
Sanders TG;Miller MD;	2005	A systematic approach to magnetic resonance imaging interpretation of sports medicine injuries of the knee
Stork A; Feller J; Sanders T; Triman P; Genant H;	2000	Magnetic resonance imaging of the knee ligaments
T. O. Smith, M. Lewis, F. Song, A. P. Toms, S. T. Donell,C. B. Hing	2012	The diagnostic accuracy of anterior cruciate ligament rupture using magnetic resonance imaging: a meta-analysis

Table 155. Review Articles for ACL Pediatric

Author	Year	Title
Beasley LS;Chudik SC	2003	Anterior cruciate ligament injury in children: update of current treatment options
Busch M; Fernandez M; Aarons C	2011	Partial Tears of the Anterior Cruciate Ligament in Children and Adolescents
Carey J	2011	Pediatric Anterior Cruciate Ligament Reconstruction with Autograft or Allograft
Fehnel DJ;Johnson R;	2000	Anterior cruciate injuries in the skeletally immature athlete: a review of treatment outcomes

Table 155. Review Articles for ACL Pediatric

Author	Year	Title
Finlayson C; Nasreddine A; Kocher M	2010	Current Concepts of Diagnosis and Management of ACL Injuries in Skeletally Immature Athletes
Frosch KH;Stengel D;Brodhun T;Stietencron I;Holsten D;Jung C;Reister D;Voigt C;Niemeyer P;Maier M;Hertel P;Jagodzinski M;Lill H;	2010	Outcomes and risks of operative treatment of rupture of the anterior cruciate ligament in children and adolescents (Provisional abstract)
Johnston DR;Ganley TJ;Flynn JM;Gregg JR;	2002	Anterior cruciate ligament injuries in skeletally immature patients
Kaeding C; Flanigan D; Donaldson C	2010	Surgical Techniques and Outcomes After Anterior Cruciate Ligament Reconstruction in Preadolescent Patients
Kocher MS	2006	Anterior cruciate ligament reconstruction in the skeletally immature patient
Lamprecht DE;Boyd JL	2006	Anterior cruciate ligament reconstruction in the skeletally immature
Milewski MD;Beck NA;Lawrence JT;Ganley TJ;	2011	Anterior cruciate ligament reconstruction in the young athlete: a treatment algorithm for the skeletally immature
Mohtadi N & Grant J	2006	Managing Anterior Cruciate Ligament Deficiency in the Skeletally Immature Individual: A Systematic Review of the Literature
Moksnes H;Engebretsen L;Risberg MA	2008	Performance-based functional outcome for children 12 years or younger following anterior cruciate ligament injury: a two to nine-year follow-up study
Moksnes H;Engebretsen L;Risberg MA;	2012	The current evidence for treatment of ACL injuries in children is low: a systematic review
Slattery T;Major N;	2010	Magnetic resonance imaging pitfalls and normal variations: The knee
Stanitski C	1995	Anterior Cruciate Ligament Injury in the Skeletally Immature Patient: Diagnosis and Treatment
Vavken P & Murray M	2011	Treating Anterior Cruciate Ligament Tears in Skeletally Immature Patients
Wall E; Myer G D; May M	2011	Anterior Cruciate Ligament Reconstruction Timing in Children with Open Growth Plates: New Surgical Techniques Including All-Epiphyseal
Fabricant PD;Jones KJ;Delos D;Cordasco FA;Marx RG;Pearle AD;Warren RF;Green DW;	2013	Reconstruction of the anterior cruciate ligament in the skeletally immature athlete: a review of current concepts: AAOS exhibit selection
Frank JS;Gambacorta PL;	2013	Anterior cruciate ligament injuries in the skeletally immature athlete: diagnosis and management

Table 156. Review Articles for ACL Young Active Adult

Author	Year	Title
McCarroll J; Shelbourne D; Patel D;	1995	Anterior cruciate ligament injuries in young athletes
Pujol N;Colombet P;Cucurulo T;Graveleau N;Hulet C;Panisset JC;Potel JF;Servien E;Sonnery-Cottet B;Trojani C;Djian P;	2012	Natural history of partial anterior cruciate ligament tears: a systematic literature review

Table 157. Review Articles for ACL Meniscal Repair

Author	Year	Title
Beaufils P;Hulet C;Dhenain M;Nizard R;Nourissat G;Pujol N;	2009	Clinical practice guidelines for the management of meniscal lesions and isolated lesions of the anterior cruciate ligament of the knee in adults
Magnussen RA;Mansour AA;Carey JL;Spindler KP;	2009	Meniscus status at anterior cruciate ligament reconstruction associated with radiographic signs of osteoarthritis at 5- to 10-year follow-up: a systematic review
Nepple J; Dunn W; Wright R;	2012	Meniscal Repair Outcomes at Greater Than Five Years A Systematic Literature Review and Meta-Analysis
Noyes FR;Barber-Westin SD;	1995	The treatment of acute combined ruptures of the anterior cruciate and medial ligaments of the knee
Oiestad BE;Engebretsen L;Storheim K;Risberg MA;	2009	Knee osteoarthritis after anterior cruciate ligament injury: a systematic review
Paxton S; Stock M; Brophy R;	2011	Meniscal Repair Versus Partial Meniscectomy: A Systematic Review Comparing Reoperation Rates and Clinical Outcomes
Pujol N;Beaufils P;	2009	Healing results of meniscal tears left in situ during anterior cruciate ligament reconstruction: a review of clinical studies
Roos EM;	2005	Joint injury causes knee osteoarthritis in young adults
Salata MJ;Gibbs AE;Sekiya JK;	2010	A systematic review of clinical outcomes in patients undergoing meniscectomy
Snoeker BA;Bakker EW;Kegel CA;Lucas C;	2013	Risk Factors for Meniscal Tears: A Systematic Review Including Meta-analysis

Table 158. Review Articles for ACL Recurrent Instability

Author	Year	Title
Feucht M; Mauro C; Brucker P; Imhoff A; Hinterwimmer S	2012	The role of the tibial slope in sustaining and treating anterior cruciate ligament injuries
Roos H; Karlsson J;	1998	Anterior cruciate ligament instability and reconstruction

Table 159. Review Articles for ACL Conservative Treatment

Author	Year	Title
Delince P; Ghafil D	2011	Anterior cruciate ligament tears: conservative or surgical treatment? A critical review of the literature
Legnani C; Terzaghi C; Borgo E; Ventura A	2011	Management of anterior cruciate ligament rupture in patients aged 40 years and older
Linko E;Harilainen A;Malmivaara A;Seitsalo S;	2005	Surgical versus conservative interventions for anterior cruciate ligament ruptures in adults
Muaidi Q;Nicholson LL;Refshauge KM;Herbert RD;Maher CG;	2007	Prognosis of conservatively managed anterior cruciate ligament injury: a systematic review (Provisional abstract)
Trees AH;Howe TE;Dixon J;White L	2009	Exercise for treating isolated anterior cruciate ligament injuries in adults

Table 160. Review Articles for ACL Surgery Timing

Author	Year	Title
Kwok CS;Harrison T;Servant C;	2013	The optimal timing for anterior cruciate ligament reconstruction with respect to the risk of postoperative stiffness
Shelbourne KD;Patel DV	1995	Timing of surgery in anterior cruciate ligament-injured knees
Smith TO;Davies L;Hing CB;	2010	Early versus delayed surgery for anterior cruciate ligament reconstruction: a systematic review and meta-analysis (Provisional abstract)

Table 161. Review Articles for ACL Combined MCL

Author	Year	Title
Duffy PS;Miyamoto RG;	2010	Management of medial collateral ligament injuries in the knee: An update and review
Grant JA;Tannenbaum E;Bedi A;Miller BS;	2012	Treatment of combined complete tears of the anterior cruciate and medial collateral ligament: A systematic review
Papalia R;Osti L;Del BA;Denaro V;Maffulli N;	2010	Management of combined ACL-MCL tears: a systematic review

Table 162. Review Articles for ACL Locked Knee

Author	Year	Title
Romanowski JR;Wong AK;Fu FH;	2009	Anatomic Double-Bundle Anterior Cruciate Ligament Reconstruction: The University of Pittsburgh Approach

Table 162. Review Articles for ACL Locked Knee

Author	Year	Title
Smith TO;Davies L;Hing CB;	2010	Early versus delayed surgery for anterior cruciate ligament reconstruction: a systematic review and meta-analysis (Provisional abstract)
van Eck CF;Schreiber VM;Mejia HA;Samuelsson K;van Dijk CN;Karlsson J;Fu FH;	2010	'Anatomic' anterior cruciate ligament reconstruction: a systematic review of surgical techniques and reporting of surgical data

Table 163. Review Articles for ACL Single or Double Bundle Reconstruction

Author	Year	Title
Bennett CH;Loper IM;	2008	Graft choices and fixation types in anterior cruciate ligament reconstruction
Calvisi V;Lupparelli S;Rinonapoli G;Padua R;	2007	Single-bundle versus double-bundle arthroscopic reconstruction of the anterior cruciate ligament: What does the available evidence suggest?
Crawford C;Nyland J;Landes S;Jackson R;Chang HC;Nawab A;Caborn DN;	2007	Anatomic double bundle ACL reconstruction: a literature review
Jarvela T;Jarvela S;	2013	Double-bundle versus single-bundle anterior cruciate ligament reconstruction
Jarvela T;Suomalainen P;	2011	ACL reconstruction with double-bundle technique: a review of clinical results
Lamsam C;Kaewpornsawan K;Luangsa-Ard J;Thephamongkhol K;Vanadurongwan B;Soparat K;	2012	Single-bundle versus double-bundle anterior cruciate ligament reconstruction: a meta-analysis
Li X;Xu CP;Song JQ;Jiang N;Yu B;	2013	Single-bundle versus double-bundle anterior cruciate ligament reconstruction: an up-to-date meta-analysis
Li YL;Ning GZ;Wu Q;Wu QL;Li Y;Hao Y;Feng SQ;	2013	Single-bundle or double-bundle for anterior cruciate ligament reconstruction: A meta-analysis
Longo UG;Buchmann S;Franceschetti E;Maffulli N;Denaro V;	2011	A systematic review of single-bundle versus double-bundle anterior cruciate ligament reconstruction
Meredick RB;Vance KJ;Appleby D;Lubowitz JH;	2008	Outcome of single-bundle versus double-bundle reconstruction of the anterior cruciate ligament: a meta-analysis
Rue J;Lewis PB;Parameswaran AD;Bach J;	2008	Single-bundle anterior cruciate ligament reconstruction: Technique overview and comprehensive review of results
Suomalainen P;Kannus P;Jarvela T;	2013	Double-bundle anterior cruciate ligament reconstruction: a review of literature

Table 163. Review Articles for ACL Single or Double Bundle Reconstruction

Author	Year	Title
Tiamklang T;Sumanont S;Foocharoen T;Laopaiboon M;	2010	Double-bundle versus single-bundle reconstruction for anterior cruciate ligament rupture in adults
Xu M;Gao S;Zeng C;Han R;Sun J;Li H;Xiong Y;Lei G;	2013	Outcomes of anterior cruciate ligament reconstruction using single-bundle versus double-bundle technique: meta-analysis of 19 randomized controlled trials
Zaffagnini S;Bruni D;Alessandro R;Marcheggiani Muccioli GM;Giordano G;Marcacci M;	2008	Double-Bundle Anterior Cruciate Ligament Reconstruction: The Italian Experience
Zaffagnini S;Marcheggiani Muccioli GM;Lopomo N;Signorelli C;Bonanzinga T;Musiani C;Vassilis P;Nitri M;Marcacci M;	2012	Can the pivot-shift be eliminated by anatomic double-bundle anterior cruciate ligament reconstruction?
Zhu Y;Tang RK;Zhao P;Zhu SS;Li YG;Li JB;	2012	Double-bundle reconstruction results in superior clinical outcome than single-bundle reconstruction

Table 164. Review Articles for ACL Autograft Source

Author	Year	Title
Biau DJ;Katsahian S;Kartus J;Harilainen A;Feller JA;Sajovic M;Ejerhed L;Zaffagnini S;Ropke M;Nizard R;	2009	Patellar tendon versus hamstring tendon autografts for reconstructing the anterior cruciate ligament: a meta-analysis based on individual patient data (Provisional abstract)
Biau DJ;Tournoux C;Katsahian S;Schranz P;Nizard R;	2007	ACL reconstruction: a meta-analysis of functional scores (Structured abstract)
Biau DJ;Tournoux C;Katsahian S;Schranz PJ;Nizard RS;	2006	Bone-patellar tendon-bone autografts versus hamstring autografts for reconstruction of anterior cruciate ligament: meta-analysis (Structured abstract)
Calvisi V;Lupparelli S;Padua R;	2006	Patellar tendon autograft versus hamstring tendon autograft in arthroscopic anterior cruciate ligament reconstruction: Appraisal of the evidence
Colvin A;Sharma C;Parides M;Glashow J;	2011	What is the best femoral fixation of hamstring autografts in anterior cruciate ligament reconstruction?: a meta-analysis
Dheerendra SK;Khan WS;Singhal R;Shivarathre DG;Pydisetty R;Johnstone D;	2012	Anterior cruciate ligament graft choices: a review of current concepts

Table 164. Review Articles for ACL Autograft Source

Author	Year	Title
Dong-liang S; Zhen-jun Y	2011	Knee function after anterior cruciate ligament reconstruction with patellar or hamstring tendon: a meta-analysis
Forster MC;Forster IW;	2006	Patellar tendon or four-strand hamstring? A systematic review of autografts for anterior cruciate ligament reconstruction
Freedman KB;D'Amato MJ;Nedeff DD;Kaz A;Bach BR;	2003	Arthroscopic anterior cruciate ligament reconstruction: a metaanalysis comparing patellar tendon and hamstring tendon autografts
Goldblatt J; Fitzsimmons S; Balk E; Richmond JC	2005	Reconstruction of the Anterior Cruciate Ligament: Meta-analysis of Patellar Tendon Versus Hamstring Tendon Autograft
Herrington L;Wrapson C;Matthews M;Matthews H;	2005	Anterior cruciate ligament reconstruction, hamstring versus bone-patella tendon-bone grafts: a systematic literature review of outcome from surgery
Hospodar MSJ;Miller MD;	2009	Controversies in ACL reconstruction: Bone-patellar tendon-bone anterior cruciate ligament reconstruction remains the gold standard
Jomha NM;Pinczewski LA;Clingeleffer A;Otto DD;	1999	Arthroscopic reconstruction of the anterior cruciate ligament with patellar-tendon autograft and interference screw fixation. The results at seven years
Krych AJ;Jackson JD;Hoskin TL;Dahm DL;	2008	A meta-analysis of patellar tendon autograft versus patellar tendon allograft in anterior cruciate ligament reconstruction (Structured abstract)
Li S;Su W;Zhao J;Xu Y;Bo Z;Ding X;Wei Q;	2011	A meta-analysis of hamstring autografts versus bone-patellar tendon-bone autografts for reconstruction of the anterior cruciate ligament (Provisional abstract)
Machotka Z;Scarborough I;Duncan W;Kumar S;Perraton L;	2010	Anterior cruciate ligament repair with LARS (ligament advanced reinforcement system): a systematic review
Magnussen RA;Carey JL;Spindler KP;	2011	Does autograft choice determine intermediate-term outcome of ACL reconstruction? (Structured abstract)
Mastrokalos DS;Springer J;Siebold R;Paessler HH;	2005	Donor site morbidity and return to the preinjury activity level after anterior cruciate ligament reconstruction using ipsilateral and contralateral patellar tendon autograft: a retrospective, nonrandomized study
Melick N; van Cingel R Tijssen M; Nijhuis-van der Sanden M	2012	Assessment of functional performance after anterior cruciate ligament reconstruction: a systematic review of measurement procedures
Mohtadi-Nicholas GH;Chan DS;Dainty KN;Whelan DB;	2011	Patellar tendon versus hamstring tendon autograft for anterior cruciate ligament rupture in adults
Mulford JS;Chen D;	2011	Anterior cruciate ligament reconstruction: a systematic review of polyethylene terephthalate grafts
Nedeff DD;Bach BR;	2001	Arthroscopic anterior cruciate ligament reconstruction using patellar tendon autografts: a comprehensive review of contemporary literature

Table 164. Review Articles for ACL Autograft Source

Author	Year	Title
Newman SD;Atkinson HD;Willis-Owen CA;	2013	Anterior cruciate ligament reconstruction with the ligament augmentation and reconstruction system: a systematic review
Paterno M ; Weed A ; Hewett T	2012	A Between Sex Comparison of Anterior-Posterior Knee Laxity after Anterior Cruciate Ligament Reconstruction with Patellar Tendon or Hamstrings Autograft
Poolman R; Farrokhyar F; Bhandari M	2007	Hamstring tendon autograft better than bone patellartendon bone autograft in ACL reconstruction
Poolman RW;Abouali JA;Conter HJ;Bhandari M;	2007	Overlapping systematic reviews of anterior cruciate ligament reconstruction comparing hamstring autograft with bone-patellar tendon-bone autograft: why are they different?
Prodromos C;Joyce B;Shi K; Keller B	2005	A meta-analysis of stability after Anterior Cruciate Ligament Reconstruction as a Function of Hamstring Versus Patellar Tendon Graft and Fixation Type
Reinhardt KR;Hetsroni I;Marx RG;	2010	Graft selection for anterior cruciate ligament reconstruction: a level I systematic review comparing failure rates and functional outcomes
Schultz WR;Carr CF;	2002	Comparison of clinical outcomes of reconstruction of the anterior cruciate ligament: autogenous patellar tendon and hamstring grafts
Seijas R;Cugat R;	2010	Anterior cruciate ligament graft: Bone-tendon-bone
Shelbourne K	1995	Donor site problems after anterior cruciate ligament reconstruction using the patellar tendon graft*
Spindler KP;Kuhn JE;Freedman KB;Matthews CE;Dittus RS;Harrell FE;	2004	Anterior cruciate ligament reconstruction autograft choice: bone-tendon-bone versus hamstring: does it really matter? A systematic review

Table 165. Review Articles for ACL Autograft vs Allograft

Author	Year	Title
Brown CA;Mcadams TR;Harris AH;Maffulli N;Safran MR;	2013	ACL Reconstruction in Patients Aged 40 Years and Older: A Systematic Review and Introduction of a New Methodology Score for ACL Studies
Carey J; Dunn WR; Dahm D; Zeger S; Spindler K	2009	A Systematic Review of Anterior Cruciate Ligament Reconstruction with Autograft Compared with Allograft
Foster T; Wolfe B; Ryan S; Silvestri L; Kaye EK	2010	Does the Graft Source Really Matter in the Outcome of Patients Undergoing Anterior Cruciate Ligament Reconstruction? An Evaluation of Autograft Versus Allograft Reconstruction Results: A Systematic Review

Table 165. Review Articles for ACL Autograft vs Allograft

Author	Year	Title
Hu J;Qu J;Xu D;Zhou J;Lu H;	2013	Allograft versus autograft for anterior cruciate ligament reconstruction: an up-to-date meta-analysis of prospective studies
Kraeutler MJ;Bravman JT;McCarty EC;	2013	Bone-Patellar Tendon-Bone Autograft Versus Allograft in Outcomes of Anterior Cruciate Ligament Reconstruction: A Meta-analysis of 5182 Patients
Lamblin CJ;Waterman BR;Lubowitz JH;	2013	Anterior Cruciate Ligament Reconstruction With Autografts Compared With Non-irradiated, Non-chemically Treated Allografts
Lunardini DJ;Hensler D;Illingworth KD;Musahl V;	2011	Single bundle anterior cruciate ligament reconstruction
Marrale J;Morrissey MC;Haddad FS;	2007	A literature review of autograft and allograft anterior cruciate ligament reconstruction
Ozenci AM;Gur S;	2001	ACL reconstruction with tendon allografts: Review of the current knowledge
Prodromos C;Joyce B;Shi K;	2007	A meta-analysis of stability of autografts compared to allografts after anterior cruciate ligament reconstruction
Young III SD;Toth AP;	2006	Complications of Allograft Use in Anterior Cruciate Ligament Reconstruction

Table 166. Review Articles for ACL Femoral Tunnel Technique

Author	Year	Title
Alentorn-Geli E;Lajara F;Samitier G;Cugat R;	2010	The transtibial versus the anteromedial portal technique in the arthroscopic bone-patellar tendon-bone anterior cruciate ligament reconstruction
Ameja S; McConkey M; Mulpuri K; Chin P; Gilbart M; Regan W;	2009	Graft Tensioning in Anterior Cruciate Ligament Reconstruction: A Systematic Review of Randomized Controlled Trials
Chalmers PN;Mall NA;Cole BJ;Verma NN;Bush-Joseph CA;Bach BR;	2013	Anteromedial Versus Transtibial Tunnel Drilling in Anterior Cruciate Ligament Reconstructions: A Systematic Review
George MS;Huston LJ;Spindler KP;	2007	Endoscopic versus rear-entry ACL reconstruction: a systematic review
Kirwan GW;Bourke MG;Chipchase L;Dalton PA;Russell TG;	2013	Initial graft tension and the effect on postoperative patient functional outcomes in anterior cruciate ligament reconstruction
Prodromos CC;Joyce BT;	2006	Hamstring ACL reconstruction: Technique, results, meta-analysis and posterior graft harvest technique
Samuelsson K;Andersson D;Karlsson J;	2009	Treatment of anterior cruciate ligament injuries with special reference to graft type and surgical technique: an assessment of randomized controlled trials

Table 167. Review Articles for ACL Post-op Functional Bracing

Author	Year	Title
Albright JC;Crepeau AE;	2011	Functional bracing and return to play after anterior cruciate ligament reconstruction in the pediatric and adolescent patient
Beynnon BD;Good L;Risberg MA;	2002	The effect of bracing on proprioception of knees with anterior cruciate ligament injury
Kramer J; Dubowitz T; Fowler P; Schachter C; Birmingham T	1997	Functional Knee Braces and Dynamic Performance: A Review
Kruse LM;Gray B;Wright RW;	2012	Rehabilitation after anterior cruciate ligament reconstruction: a systematic review
Paluska SA;McKeag DB;	1999	Prescribing functional braces for knee instability
Smith SD;LaPrade RF;Jansson KS;Aroen A;Wijdicks CA;	2013	Functional bracing of ACL injuries: current state and future directions
Smith TO;Davies L;	2008	A systematic review of bracing following reconstruction of the anterior cruciate ligament
Wright RW;Fetzer GB;	2007	Bracing after ACL reconstruction: a systematic review

Table 168. Review Articles for ACL Neuromuscular Training Programs

Author	Year	Title
Abernethy L;Bleakley C;	2007	Strategies to prevent injury in adolescent sport: A systematic review
Alentorn-Geli E;Myer GD;Silvers HJ;Samitier G;Romero D;Lazaro-Haro C;Cugat R;	2009	Prevention of non-contact anterior cruciate ligament injuries in soccer players. Part 1: Mechanisms of injury and underlying risk factors
Alentorn-Geli E;Myer GD;Silvers HJ;Samitier G;Romero D;Lazaro-Haro C;Cugat R;	2009	Prevention of non-contact anterior cruciate ligament injuries in soccer players. Part 2: a review of prevention programs aimed to modify risk factors and to reduce injury rates
Dai B;Herman D;Liu H;Garrett WE;Yu B;	2012	Prevention of ACL Injury, Part II: Effects of ACL Injury Prevention Programs on Neuromuscular Risk Factors and Injury Rate
Dai B;Herman D;Liu H;Garrett WE;Yu B;	2012	Prevention of ACL injury, part I: injury characteristics, risk factors, and loading mechanism
Donnelly CJ;Elliott BC;Ackland TR;Doyle TL;Beiser TF;Finch CF;Cochrane JL;Dempsey AR;Lloyd DG;	2012	An anterior cruciate ligament injury prevention framework: incorporating the recent evidence
Gagnier JJ;Morgenstern H;Chess L;	2012	Interventions Designed to Prevent Anterior Cruciate Ligament Injuries in Adolescents and Adults: A Systematic Review and Meta-analysis
Giza E;Silvers HJ;Mandelbaum BR;	2005	Anterior cruciate ligament tear prevention in the female athlete

Table 168. Review Articles for ACL Neuromuscular Training Programs

Author	Year	Title
Grimm NL;Shea KG;Leaver RW;Aoki SK;Carey JL;	2013	Efficacy and degree of bias in knee injury prevention studies: a systematic review of RCTs
Hagglund M;Walden M;Atroshi I;	2009	Preventing knee injuries in adolescent female football players - design of a cluster randomized controlled trial [NCT00894595]
Herman K ; Barton C; Malliaras P; Morrissey D	2012	The effectiveness of neuromuscular warm-up strategies, that require no additional equipment, for preventing lower limb injuries during sports participation: a systematic review
Hewett TE; Ford R; Myer G	2006	Anterior cruciate ligament injuries in female athletes: part 2, a meta-analysis of neuromuscular interventions aimed at injury prevention
Hewett TE;Myer GD;Ford KR;	2005	Reducing knee and anterior cruciate ligament injuries among female athletes: a systematic review of neuromuscular training interventions
Hewett TE;Myer GD;Ford KR;	2001	Prevention of anterior cruciate ligament injuries
Hewett TE;Myer GD;Ford KR;Paterno MV;Quatman CE;	2012	The 2012 ABJS Nicolas Andry Award: The Sequence of Prevention: A Systematic Approach to Prevent Anterior Cruciate Ligament Injury
Hrysomallis C;	2007	Relationship between balance ability, training and sports injury risk
Junge A;Dvorak J;	2004	Soccer injuries: a review on incidence and prevention
Labella C;Carl R;	2010	Preventing knee ligament injuries in young athletes
Ladenhauf HN;Graziano J;Marx RG;	2013	Anterior cruciate ligament prevention strategies: are they effective in young athletes - current concepts and review of literature
Myer GD;Ford KR;Hewett TE;	2004	Methodological approaches and rationale for training to prevent anterior cruciate ligament injuries in female athletes
Myer GD;Sugimoto D;Thomas S;Hewett TE;	2013	The influence of age on the effectiveness of neuromuscular training to reduce anterior cruciate ligament injury in female athletes: a meta-analysis
Noyes FR;Barber Westin SD;	2012	Anterior cruciate ligament injury prevention training in female athletes: a systematic review of injury reduction and results of athletic performance tests
Padua DA;Marshall SW;	2006	Evidence supporting ACL-injury-prevention exercise programs: A review of the literature
Paszkewicz J;Webb T;Waters B;Welch C;Van LB;	2012	The Effectiveness of Injury Prevention Programs on Reducing the Incidence of Anterior Cruciate Ligament Sprains in Adolescent Athletes
Postma WF;West RV;	2013	Anterior cruciate ligament injury-prevention programs
Powers C ;Fisher B	2010	Mechanisms Underlying ACL Injury-Prevention Training: The Brain-Behavior Relationship
Prodromos CC;Han Y;Rogowski J;Joyce B;Shi K;	2007	A meta-analysis of the incidence of anterior cruciate ligament tears as a function of gender, sport, and a knee injury-reduction regimen
Ringo S;Kelsberg G;St.Anna L;	2011	Reducing ACL injuries in female athletes

Table 168. Review Articles for ACL Neuromuscular Training Programs

Author	Year	Title
Sadoghi P; von Keudell A;Vavken P	2012	Effectiveness of Anterior Cruciate Ligament Injury Prevention Training Programs
Serpell B; Scarvell J; Ball N; Smith P	2012	Mechanisms and risk factors for noncontact ACL injury in age and mature athletes who engage in field or court sports: A summary of the literature since 1980
Shea KG;	2010	Training programs to reduce ACL injuries would benefit from higher level evidence to demonstrate effectiveness
Shimokochi Y;Shultz SJ;	2008	Mechanisms of noncontact anterior cruciate ligament injury
Shultz SJ; Schmitz RJ; Nguyen A; Chaudhari AM; Padua, D; McLean S; Sigward SM	2010	An update on ACL injury risk and prevention. Proceedings of the ACL Research Retreat V. March 25-27, 2010. Greensboro, North Carolina, USA
Silvers HJ;Mandelbaum BR;	2007	Prevention of anterior cruciate ligament injury in the female athlete
Stojanovic MD;Ostojic SM;	2012	Preventing ACL injuries in team-sport athletes: a systematic review of training interventions (Provisional abstract)
Sugimoto D;Myer GD;Bush HM;Klugman MF;Medina McKeon JM;Hewett TE;	2011	Compliance with neuromuscular training and anterior cruciate ligament injury risk reduction in female athletes: a meta-analysis
Sugimoto D;Myer GD;McKeon JM;Hewett TE;	2012	Evaluation of the effectiveness of neuromuscular training to reduce anterior cruciate ligament injury in female athletes: a critical review of relative risk reduction and numbers-needed-to-treat analyses
Voskanian N;	2013	ACL Injury prevention in female athletes: review of the literature and practical considerations in implementing an ACL prevention program
Yoo JH;Lim BO;Ha M;Lee SW;Oh SJ;Lee YS;Kim JG;	2010	A meta-analysis of the effect of neuromuscular training on the prevention of the anterior cruciate ligament injury in female athletes
Zech A;Hubscher M;Vogt L;Banzer W;Hansel F;Pfeifer K;	2009	Neuromuscular training for rehabilitation of sports injuries: a systematic review

Table 169. Review Articles for ACL Post-op Physical Therapy

Author	Year	Title
Augustsson J;	2012	Documentation of strength training for research purposes after ACL reconstruction
Bowditch M;	2001	Anterior cruciate ligament rupture and management
Cascio BM;Culp L;Cosgarea AJ;	2004	Return to play after anterior cruciate ligament reconstruction
Fu FH;Woo Y;Irrgang JJ;	1992	Current Concepts for Rehabilitation following Anterior Cruciate Ligament Reconstruction

Table 169. Review Articles for ACL Post-op Physical Therapy

Author	Year	Title
Imoto de Oliveira AM;Peccin S;Almeida GJM;Saconato H;Atallah AN;	2011	Effectiveness of electrical stimulation on rehabilitation after ligament and meniscal injuries: A systematic review
Koski S;	2005	ACL rehabilitation and injury prevention
Kristensen J;Franklyn-Miller A;	2012	Resistance training in musculoskeletal rehabilitation: a systematic review
Kruse LM;Gray B;Wright RW;	2012	Rehabilitation after anterior cruciate ligament reconstruction: a systematic review
Kruse LM;Gray BL;Wright RW;	2011	Anterior cruciate ligament reconstruction rehabilitation in the pediatric population
Lobb R;Tumilty S;Claydon LS;	2012	A review of systematic reviews on anterior cruciate ligament reconstruction rehabilitation
McCarroll J; Shelbourne K; Patel D	1995	Anterior Cruciate Ligament Injuries in Young Athletes- Recommendations for Treatment and Rehabiliation
Myer GD;Paterno MV;Ford KR;Quatman CE;Hewett TE;	2006	Rehabilitation after anterior cruciate ligament reconstruction: criteria-based progression through the return-to-sport phase
Risberg MA;Lewek M;Synder ML;	2004	A systematic review of evidence for anterior cruciate ligament rehabilitation: how much and what type? (Provisional abstract)
Shaw T	2002	Accelerated rehabilitation following anterior cruciate ligament surgery
Shaw T; Williams MT; Chipchase L	2005	A review and user's guide to measurement of rehabilitation adherence following anterior cruciate ligament reconstruction
Tegner Y;	1990	Strength training in the rehabilitation of cruciate ligament tears
van GS;van Cingel RE;Holla CJ;van Loon CJ;	2010	Evidence-based rehabilitation following anterior cruciate ligament reconstruction
Wright RW;	2008	A systematic review of anterior cruciate ligament reconstruction rehabilitation: part I: continuous passive motion, early weight bearing, postoperative bracing, and home-based rehabilitation
Wright RW;	2008	A Systematic Review of Anterior Cruciate Ligament Reconstruction Rehabilitation Part II : Open Versus Closed Kinetic Chain Exercises, Neuromuscular Electrical Stimulation, Accelerated Rehabilitation, and Miscellaneous Topics
Zech A;Hubscher M;Vogt L;Banzer W;Hansel F;Pfeifer K;	2009	Neuromuscular training for rehabilitation of sports injuries: a systematic review

Table 170. Review Articles for ACL Return to Sports

Author	Year	Title
Ardern CL;Webster KE;Taylor NF;Feller JA;	2011	Return to sport following anterior cruciate ligament reconstruction surgery: a systematic review and meta-analysis of the state of play
Barber-Westin SD;Noyes FR;	2011	Objective criteria for return to athletics after anterior cruciate ligament reconstruction and subsequent reinjury rates: a systematic review
Barber-Westin SD;Noyes FR;	2011	Systemic Review With Video Illustration Factors Used to Determine Return to Unrestricted Sports Activities After Anterior Cruciate Ligament Reconstruction
Cascio BM;Culp L;Cosgarea AJ;	2004	Return to play after anterior cruciate ligament reconstruction
De CM;Armstrong B;	2010	Rehabilitation of the Knee Following Sports Injury
Kruse LM;Gray B;Wright RW;	2012	Rehabilitation after anterior cruciate ligament reconstruction: a systematic review
Myer GD;Paterno MV;Ford KR;Quatman CE;Hewett TE;	2006	Rehabilitation after anterior cruciate ligament reconstruction: criteria-based progression through the return-to-sport phase
Myklebust G;Bahr R;	2005	Return to play guidelines after anterior cruciate ligament surgery
van GS;van Cingel RE;Holla CJ;van Loon CJ;	2010	Evidence-based rehabilitation following anterior cruciate ligament reconstruction
Warner SJ;Smith MV;Wright RW;Matava MJ;Brophy RH;	2011	Sport-specific outcomes after anterior cruciate ligament reconstruction
Ardern C; Webster K	2009	Knee flexor strength recovery following hamstring tendon harvest for anterior cruciate ligament reconstruction: a systematic review
Thomee´ R; Kaplan Y;Kvist J ; Myklebust G; Risberg MA;Theisen D; Tsepis E; Werner S; Wondrasch B; Witvrouw E	2011	Muscle strength and hop performance criteria prior to return to sports after ACL reconstruction
Ardern CL;Webster KE;Taylor NF;Feller JA;	2011	Return to sport following anterior cruciate ligament reconstruction surgery: a systematic review and meta-analysis of the state of play
Barber-Westin SD;Noyes FR;	2011	Objective criteria for return to athletics after anterior cruciate ligament reconstruction and subsequent reinjury rates: a systematic review
Barber-Westin SD;Noyes FR;	2011	Systemic Review With Video Illustration Factors Used to Determine Return to Unrestricted Sports Activities After Anterior Cruciate Ligament Reconstruction

Table 170. Review Articles for ACL Return to Sports

Author	Year	Title
Kruse LM;Gray B;Wright RW;	2012	Rehabilitation after anterior cruciate ligament reconstruction: a systematic review
Kvist J;	2004	Rehabilitation following anterior cruciate ligament injury: current recommendations for sports participation
Meisterling SW;Schoderbek J;Andrews JR;	2009	Anterior Cruciate Ligament Reconstruction

APPENDIX XIII
LETTERS OF ENDORSEMENT FROM EXTERNAL ORGANIZATIONS

National Academy of Sports Medicine
The National Academy of Sports Medicine has voted to endorse the AAOS Clinical Practice Guideline on the Management of Anterior Cruciate Ligament Injuries Clinical Practice Guideline. This endorsement implies permission for the AAOS to officially list our organization as an endorser of this guideline and reprint our logo in the introductory section of the guideline document.

Sincerely,
David Van Daff
Vice President, Business Development and Public Affairs
National Academy of Sports Medicine

The NASM-CPT certification is proudly accredited by the NCCA.

American Orthopaedic Society of Sports Medicine
Dear Dr. Jevsevar:

During a conference call last night, the Board of Directors of the American Orthopaedic Society for Sports Medicine (AOSSM) voted unanimously to endorse the AAOS Clinical Practice Guideline, "Management of Anterior Cruciate Ligament Injuries." In the discussion, Board members suggested wording changes for two of the recommendations. The first related to the ACL Prophylactic Braces recommendation:

"Limited evidence supports that the practitioner might not prescribe prophylactic knee braces to prevent ACL injury, because they do not reduce the risk for ACL injury."

We understand that the writing group had to conform to standard language stems for the recommendations but the Board felt this created an awkward and confusing statement. The Board would like you to consider the following wording modification which we believe retains the spirit of the recommendation while being easier for clinicians to interpret:

"Limited evidence suggests that prophylactic knee braces do not reduce the risk of ACL injury. Therefore, the evidence would support a decision by the practitioner to not prescribe ACL prophylactic knee braces."

The second suggested change relates to the Future Research section for the ACL Post-Op Physical Therapy recommendation. The relevant passage reads:

"Future Research should also address the influence of accelerated rehabilitation on graft integrity. This includes the use of imaging (MRI) to assess the effects of accelerated or delayed rehabilitation on graft healing and maturation."

Our Board would like you to consider making this section more expansive by including assessment of accelerated rehabilitation on the integrity of articular cartilage in addition to graft healing and maturation. Our suggested change is:

"Future Research should also address the influence of accelerated rehabilitation on graft integrity and the integrity of articular cartilage. This includes the use of imaging (MRI) to assess the effects of accelerated or delayed rehabilitation on graft healing and maturation and on the integrity of articular cartilage."

Please consider the above as friendly suggestions and our endorsement of the CPG is in no way contingent on your decision about whether to adopt these changes. In closing, I would like to underscore the appreciation by our Board to the Academy for including AOSSM in the development and review of this CPG and for being very responsive to our comments and concerns. Although we understand the initial decision by our peer review committee to not endorse the recommendation created a delay in the release of the CPG, we hope that our input has contributed to our mutual interest of producing the best possible document.

Best regards,

Robert A. Arciero, MD
AOSSM President

Dear Kevin Shea, MD,
The National Athletic Trainers' Association has voted to endorse the AAOS Clinical Practice Guideline on the Management of Anterior Cruciate Ligament Injuries. This endorsement implies permission for the AAOS to officially list our organization as an endorser of this guideline and reprint our logo in the introductory section of the guideline document.
Sincerely,

James Thornton, MA, ATC, CES
President

aaPM&R

American Academy of
Physical Medicine and Rehabilitation

Dear Dr. Shea,

The AAPM&R Board of Governors has voted to endorse the AAOS Clinical Practice Guidelines on the Management of Hip Fractures in the Elderly, and the Management of Anterior Cruciate Ligament Injuries. This endorsement implies permission for the AAOS to officially list our organization as an endorser of these guidelines.

Christina Hielsberg