

TABLE E-1 Search Terms and Number of Resulting PubMed Search Results\*

Search	Search Terms	No. of Studies
#1	“Anterior cruciate ligament”[MeSH]	7768
#2	“Child”[MeSH]	1,371,559
#3	“Adolescent”[MeSH]	1,392,328
#4	“Adult”[MeSH]	4,770,233
#5	“Reconstructive surgical procedures”[MeSH]	44,650
#6	“Surgery”[Subheading]	1,425,756
#7	(“Rehabilitation”[MeSH] OR “rehabilitation”[Subheading])	233,413
#8	“Exercise therapy”[MeSH]	22,764
#9	“Prevention and control”[Subheading]	861,445
#10	(#2) OR #3	2,113,011
#11	(#5) OR #6	1,436,491
#12	(#7) OR #8	233,413
#13	((((#1) AND #10) AND #11) NOT #4) NOT #9	209
#14	((((#1) AND #10) AND #12) NOT #4) NOT #9	22

\*The search was performed on May 24, 2011.

Table E-2 Coleman Methodology Score<sup>12</sup> Including Scoring Guidelines as Modified in the Present Study

Section	Number or Factor	Score	Details	Comments
Part A: only one score is to be given for each section				
1. Study size: number of patients			Included patients	
	>60	10		
	41-60	7		
	20-40	4		
	<20 or not stated	0		
2. Minimum follow-up in years			All studies included had an average follow-up of >2 years, but if the minimum was <2 years the score given is 0	
	>5	5		
	2-5	2		
	<2	0		
3. Number of different treatment procedures included in each reported outcome. More than one method may be assessed but separate outcomes should be reported			All treatments given	
	One procedure	10		
	More than one method, but ≥90% of subjects undergoing the one procedure	7		
	Not stated, unclear, or <90% of subjects undergoing the one procedure	0		
4. Type of study				
	Randomized controlled trial	15		
	Prospective cohort study	10		

	Retrospective cohort study or case series	0		
5. Diagnostic certainty			Arthroscopy or magnetic resonance imaging	
	In all	5		
	In $\geq 80\%$	3		
	In $< 80\%$	0		
6. Description of treatment given				
	Adequate (technique stated and necessary details of that type of procedure given)	5	Detailed description of graft type, drill hole direction, and placement of fixation	
	Fair (technique only stated without elaboration)	3	Technique only stated without elaboration	
	Inadequate, not stated, or unclear	0		
7. Description of preoperative and postoperative rehabilitation, and/or conservative treatment				The criterion of compliance with rehabilitation was excluded because we wanted to discriminate between studies that did report some information on rehabilitation protocols and those that did not provide any information
	Well described	10	Weight-bearing, brace/no brace, type of exercises, rehabilitation milestones, and return to sports criteria	
	Not adequately described	5	Only including weight-bearing, brace/no brace, and suggested	

			return to sports time	
	Protocol not reported	0	No information on rehabilitation	
Part A total score		60		
Part B: scores may be given for each option in each of the three sections if applicable				
Outcome criteria				If outcome criteria are vague and do not specify subjects' functional capacity, score is automatically 0 for this section
	8. Outcome measures clearly defined	2	Methods section	
	9. Timing of outcome assessment clearly stated	2	Timing of follow-up predefined and 95% of participants within a standard deviation of 5 months	
	10. Use of outcome criteria that have reported good reliability	3	Related to definition of outcome	There are no validated functional questionnaires for children with ACL injuries.
	11. Use of outcome with good sensitivity	3	Standing long radiographs to assess skeletal growth (1.5) AND isokinetic strength measurements or single-leg hop tests (1.5)	Return to sports rate, clinical tests (Lachman and pivot shift), and KT1000 were not regarded as essential functional outcomes

Procedure for assessing outcomes				
	12. Subjects recruited	5	Results not taken from surgeons' files	
	13. Investigator independent of surgeon/therapist	4	Independent of surgeon/therapist	
	14. Written assessment	3	Use of questionnaires for evaluation of knee function; IKDC, Lysholm, Cincinnati, Tegner, KOOS, or others*	
	15. Completion of assessment by subjects themselves with minimal investigator assistance	3	It should be clearly reported that the subjects completed the questionnaires	
Description of subject selection process				
	16. Selection criteria reported and unbiased	5	Inclusion criteria clearly reported	
	17. Recruitment rate reported		For radiographic and/or functional assessment on follow-up	
	≥80%	5		
	<80%	3		
	18. Eligible subjects not included in the study satisfactorily accounted for, or 100% recruitment	5	Drop-out analyses of the patients not going through follow-up and report on reinjuries	
Part B total score		40		

\*IKDC = International Knee Documentation Committee, and KOOS = Knee Injury and Osteoarthritis Outcome Score.

Table E-3 Overview of the Transphyseal Reconstruction Studies Included in the Systematic Review\*

Study	No. of Patients	Surgical Method	Concomitant Injuries	Postoperative Complications and Reinjuries	Rehabilitation	Outcome Measures
Aichroth et al. (2002)	45	4-strand HT with metaphyseal fixation	8 lateral and 9 medial meniscus injuries (38%). 10 menisci sutured. 6 osteochondral lesions	3 reruptures (7%)	“Slower.” Brace to resist extension in children with hyperextension of >5°	Lachman, PS, IKDC (reconstructed only), Lysholm
Arbes et al. (2007)	20	BPTB (n = 4), delayed BPTB (n = 3), primary repair (n = 3), nonop. (n = 10)	Not provided	Not provided	Not described	KOOS, IKDC, KT1000 (reconstructed only). Results of nonop. limited
Aronowitz et al. (2000)	21	Achilles tendon allograft	8 menisci repaired and 4 partially resected (57%)	3 secondary surgeries: one partial meniscus resection and two hardware removals	Cylinder cast for 1 week, physical therapy with ROM exercises, and quadriceps and hamstring strength from week 4. RTS when quadriceps strength 90% of contralateral	Lysholm, KT1000, Lachman, long-leg standing radiographs
Cohen et al. (2009)	26	4-strand HT with metaphyseal fixation	9 medial, 5 lateral, and 3 medial and lateral meniscus injuries (65%)	3 reruptures (12%). 5 patients (19%) had >3 mm difference on KT1000 at follow-up	Not described	Lachman, PS, IKDC, Lysholm, RTS, KT1000, radiographs for leg-length discrepancies
Courvoisier et al. (2011)	38	4-strand HT with femoral EndoButton and tibial interference screw	2 medial, 6 lateral, and 2 medial and lateral meniscus injuries at surgery (26%)	5 reruptures (13%). 1 cyclops lesion and 3 hematomas evacuated	Long leg splint. Crutches for 10 days. Not otherwise described	IKDC, KT1000, long-leg standing radiographs
Edwards et	20	HT with vertically	4 medial and 13	4 reruptures	Immediate weight-	Lachman, PS,

al. (2001)		drilled tunnels (n = 16), BPTB (n = 4)	lateral meniscus injuries (85%). 4 menisci sutured	(20%)	bearing, passive motion, and closed chain exercise. Not otherwise described	Lysholm, single-leg hop tests, isokinetic strength, radiographic confirmation of closed physis
Fuchs et al. (2002)	10	BPTB allograft with bone plugs and screws placed in the metaphysis	3 medial, 4 lateral, and 2 medial and lateral meniscus injuries (90%). 4 menisci sutured	Not provided	Not described	RTS, Lysholm, IKDC, radiographic confirmation of closed physis
Gaulrapp et al. (2006)	53	Primary repair (n = 24), semitendinosus augmentation (n = 15), BPTB (n = 14)	Concomitant injuries and additional procedures not reported	3 secondary reconstructions (6%). 5 meniscus revisions	Not described	Lysholm, Tegner, IKDC, KT-1000, radiographs
Henry et al. (2009)	56	Group 1: quadriceps tendon graft (n = 24) and iliotibial band “over the top” (n = 5). Group 2: BPTB (n = 27)	Group 1: 3 medial and 9 lateral meniscus injuries (41%); 5 menisci sutured. Group 2: 11 medial and 8 lateral meniscus injuries (70%); 3 menisci sutured	Group 1: 1 valgus deformity (iliotibial band group). Group 2: 1 rerupture and 1 failed meniscus repair	Group 1: removable brace in extension 30 days and full weight-bearing. Group 2: contention 2 weeks and full weight-bearing	IKDC, KT1000, RTS, clinical exam
Kocher et al. (2007)	59	4-strand HT with metaphyseal fixation	21 lateral, 6 medial, and 4 medial and lateral meniscus injuries (53%). 17 menisci sutured	3 arthrofibrosis. 2 reruptures (3%). 2 of 17 meniscus repairs failed (12%). 1 superficial infection	2 weeks of touch-down weight-bearing, immediate passive mobilization from 0° to 90°. A hinged brace was used for the first two weeks (4-6 weeks if a meniscus repair was	IKDC, Lysholm, RTS, radiographs for angular deformity and leg-length discrepancies

					performed). Further rehabilitation followed traditional rehabilitation guidelines for adults after ACL reconstruction. Patients should also use a custom functional knee brace during cutting and pivoting activities for the first two years after return to sports	
Kopf et al. (2010)	14	HT, not otherwise specified	2 medial and 1 lateral menisci sutured (21%). 1 lateral partially resected	Not provided	Knee brace 0°-90° 6 weeks after surgery. Not otherwise described	Change in tunnel size (MRI), KOS-ADLS, Lysholm, IKDC, KT1000
Liddle et al. (2008)	17	4-strand HT with metaphyseal fixation	3 medial, 6 lateral, and 1 medial and lateral meniscus injuries (59%). 2 menisci sutured	1 rerupture (6%). 1 superficial infection. 1 patient had 5° valgus deformity on operated side	Standard, “slowly”	Lysholm, Tegner, IKDC, KT1000, clinical exam, radiographic confirmation of closed physes
Marx et al. (2009)	55	4-strand HT with a femoral extracortical button and a tibial suture washer or staple	33 meniscus injuries (60%)	5 reruptures (9%)	Not described	IKDC2000, Lysholm, Cincinnati, Tegner, KT1000, clinical evaluation
McCarroll et al. (1994)	60	BPTB, although 2 patients were initially treated with a physeal-sparing procedure and later revised with BPTB	27 meniscus injuries in 40 patients (68%), and not reported in the 20 patients who underwent acute surgical reconstruction	3 reruptures (5%), 1 meniscus tear, 2 arthrofibrosis	Not described	Clinical exam, KT1000, RTS, growth after surgery



McIntosh et al. (2006)	16	4-strand HT with metaphyseal fixation (n = 13), 2-strand HT with metaphyseal fixation (n = 3)	4 medial, 2 lateral, and 2 medial and lateral meniscus injuries (50%). 7 menisci sutured	2 reruptures (13%). 3 failed meniscus sutures. One patient had 1.5-cm overgrowth on the operated side	Early range of motion, running at 3 months, and cutting/pivoting sports at 6 months if functionally stable (not specified)	IKDC, Lysholm, Tegner, Lachman, PS, radiographic confirmation of closed physes
Nikolaou et al. (2011)	94	4-strand HT with femoral and tibial RigidFix pins	36 meniscal tears in 33 patients (35%). 28 menisci sutured and 5 partially resected	4 reruptures (4%). 4 of 28 meniscus repairs failed (14%)	Hinged brace 0°-90° 4 weeks, no weight-bearing first 3 weeks. Not otherwise described	IKDC, Lysholm, Tegner, KT1000, standard radiographs to evaluate growth if clinical left-right discrepancy of 5° or 1 cm was observed
Seon et al. (2005)	11	HT with metaphyseal fixation	6 medial and 6 lateral meniscus injuries. 1 chondral defect on the medial femoral condyle and 1 medial collateral ligament injury	Not provided	Not described	Lysholm, ROM, RTS, limb length, radiographic confirmation of closed physes
Shelbourne et al. (2004)	16	BPTB with metaphyseal fixation	6 medial and 9 lateral meniscus injuries. 3 menisci sutured	1 rerupture (6%). 2 contralateral ruptures (13%). 1 failed meniscus suture	Reference to previously published rehab. program provided	KT1000, IKDC, RTS, Lachman, isokinetic strength, radiographic confirmation of closed physes, full body growth
Streich et al. (2010)	31	Surgical group: 4-strand HT with	12 medial and 4 lateral meniscus	No secondary surgical	Touch-down weight-bearing after 6 weeks	KT1000, IKDC, Lysholm, Tegner,

		metaphyseal fixation. Nonop. group: 4-strand HT with metaphyseal fixation after median 21 months of nonop. treatment on account of secondary injuries	injuries (52%). 7 menisci sutured. 4 osteochondral defects fixated	procedures reported	with brace, indoor cycling after 8 weeks, jogging after 16 weeks, and pivoting sports after 12 months	clinical limb length measurement
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\*HT = hamstring tendon graft, PS = pivot-shift test, IKDC = International Knee Documentation Committee, BPTB = bone-patellar tendon-bone graft, KOOS = Knee Injury and Osteoarthritis Outcome Score, ROM = range of motion, RTS = return to sports, MRI = magnetic resonance imaging, and KOS-ADLS = Knee Outcome Survey Activities of Daily Living Score.

Table E-4 Overview of the Physeal-Sparing Reconstruction Studies Included in the Systematic Review\*

Study	No. of Patients	Surgical Method	Concomitant Injuries	Postoperative Complications and Reinjuries	Rehabilitation	Outcome Measures
Anderson et al. (2004)	12	4-strand HT with all epiphyseal tunnels	8 (75%) concurrent meniscus repairs	Not described	Hinged brace	Full body length growth, IKDC, KT1000
Bonnard et al. (2011)	57	Clocheville technique. Patellar tendon with intra-articular sutures in a groove in tibial epiphysis and interference screw in metaphyseal femoral tunnel	16 meniscus injuries (28%): 2 medial and 6 lateral menisci sutured, 2 medial partially resected, 5 lateral and 1 medial untreated	3 reruptures (5%)	Long-leg cast in 10° flexion for 45 days. Not otherwise described	IKDC2000, Tegner, Rolimeter, single-leg hop. Standing anterior and lateral radiographs
Gebhard et al. (2006)	40	Quadriceps tendon (n = 12); fasciae latae (n = 12); 4, 3, or 2-strand HT (n = 16)	12 menisci repaired (30%)	3 reruptures of quadriceps tendon graft (25%), 4 meniscus sutures failed (33%), 2 mobilizations due to arthrofibrosis	Not described	Lysholm, IKDC, KT1000, radiographs
Janarv et al. (1996)	28	HT with distal insertion preserved, partial medial arthrotomy and tunnel through lateral femoral epiphysis (n = 12); BPTB with same procedure (n = 4); nonoperative (n = 12)	At least 3 meniscus injuries mentioned in the paper, but lack of consistent reporting make an estimate difficult	Not described	Surgically treated knees were immobilized for 6 weeks in 30° of flexion followed by 4 weeks with motion restricted to 30°-90°. Not otherwise described	Lysholm, Tegner, KT1000, isokinetic muscle strength
Kocher et al. (2005)	44	Iliotibial band graft. Combined intra-	4 medial and 23 lateral meniscus	2 reruptures (5%), 4 meniscus	2 weeks of touch-down weight-bearing,	IKDC, Lysholm, RTS,

		articular and extra-articular	injuries (61%). 23 menisci sutured	sutures failed (17%)	immediate passive 0°-90° mobilization. A hinged brace was used for the first two weeks (4-6 weeks if a meniscus repair was performed). Further rehabilitation followed traditional rehabilitation guidelines for adults after ACL reconstruction. Patients should also use a custom functional knee brace during cutting and pivoting activities for the first two years after RTS	radiographic leg length discrepancies
Lipscomb et al. (1986)	24	Intra-articular reconstruction supplemented with extra-articular Ellison or Losee reconstruction	12 medial and 7 lateral meniscectomies, 2 medial and 2 lateral menisci repaired (96%)	Not described	Immobilized 6 weeks in 15° flexion. Full weight-bearing from week 7. Isokinetic strength training from month 4. Swimming from month 5. Bicycling when 95° of flexion. Running from month 7. Full activity from month 9	KT1000, isokinetic strength, clinical evaluation, and radiographs
Micheli et al. (1999)	17	Extra-articular reconstruction using iliotibial band	6 meniscus injuries (35%): 2 medial menisci sutured, 1 lateral meniscus repaired, 1 medial and 2 lateral partial meniscectomies, 1 posterolateral corner repair	Not described	Not described	Lysholm, KT1000, physical examination
Steadman	13	“Healing response”	6 medial meniscus	3 reruptures	Brace and crutches for 6	Lysholm,

et al. (2006)		reinserting the ruptured proximal end of the ACL	injuries (46%), 1 patellar chondral defect	(23%) within 30-55 months	weeks. Stationary cycling for week 7. Progressive strengthening until week 24. Brace during athletic activities the first year	Tegner, Lachman, PS, KT1000, RTS
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\*HT = hamstring tendon graft, IKDC = International Knee Documentation Committee, BPTB = bone-patellar tendon-bone graft, RTS = return to sports, and PS = pivot-shift test.

Table E-5 Overview of the Nonoperative Treatment Studies Included in the Systematic Review\*

Study	No. of Patients	Concomitant Injuries	Post-Treatment Complications and Reinjuries	Rehabilitation	Outcome Measures
Graf et al. (1992)	12	At time of diagnosis, 4 medial and 4 lateral meniscus injuries in 6 patients (50%). 4 medial menisci sutured and 4 physeal-sparing reconstructions at arthroscopy	Nonop. group (n = 8): 7 new meniscus injuries (88%) and delayed reconstructions. Surgical group: 2 reruptures (50%)	Brace during sports. RTS when strength 90% of uninjured side	Arthroscopy, RTS
Mizuta et al. (1995)	18	At time of diagnosis, 8 medial and 7 lateral meniscus injuries in 13 patients (72%)	6 patients (33%) had ACL reconstruction during the follow-up period; 4 medial and 1 lateral meniscus injuries. Nonop. patients (n = 12) sustained 1 additional meniscus injury during follow-up (8%)	Brace during sports. Surgical group: immediate strength, and RTS when strength 90% of uninjured side	Lysholm, RTS, isokinetic strength, clinical exam, radiographs
Moksnes et al. (2008)	26	Not described	Nonop. group (n = 21): 2 medial meniscus injuries during follow-up period (10%). Delayed surgery group: 4-strand HT (n = 4), BPTB (n = 1). 1 medial and 3 lateral meniscus injuries in 3 patients (60%). 2 menisci sutured. Both sutures failed	Not described	KOS-ADLS, VAS, IKDC, Lysholm, single-leg hop tests, isokinetic strength, KT1000, RTS, Lachman, PS
Woods and O'Connor (2004)	13	Not described	At time of surgery, 1 medial, 2 lateral, and 1 medial and lateral meniscus injuries (31%)	Brace "at all times." No pivoting sports or physical education in school	Arthroscopic evaluation, clinical exam, radiographs

\*RTS = return to sports, HT = hamstring tendon graft, BPTB = bone-patellar tendon-bone graft, KOS-ADLS = Knee Outcome Survey Activities of Daily Living Score, VAS = visual analog scale, IKDC = International Knee Documentation Committee, and PS = pivot-shift test.