Autograft Versus Nonirradiated Allograft Tissue for Anterior Cruciate Ligament Reconstruction

CME

A Systematic Review

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Background: An autograft has traditionally been the gold standard for anterior cruciate ligament reconstruction (ACLR), but the use of allograft tissue has increased in recent years. While numerous studies have demonstrated that irradiated allografts are associated with increased failure rates, some report excellent results after ACLR with nonirradiated allografts. The purpose of this systematic review was to determine whether the use of nonirradiated allograft tissue is associated with poorer outcomes when compared with autografts.

Hypothesis: Patients undergoing ACLR with autografts versus nonirradiated allografts will demonstrate no significant differences in graft failure risk, laxity on postoperative physical examination, or differences in patient-oriented outcome scores.

Study Design: Systematic review.

Methods: A systematic review was performed to identify prospective or retrospective comparative studies (evidence level 1, 2, or 3) of autografts versus nonirradiated allografts for ACLR. Outcome data included graft failure based on clinical findings and instrumented laxity, postoperative laxity on physical examination, and patient-reported outcome scores. Studies were excluded if they did not specify whether the allograft had been irradiated. Quality assessment and data extraction were performed by 2 examiners.

Results: Nine studies comparing autografts and nonirradiated allografts were included. Six of the 9 studies compared bone–patellar tendon–bone (BPTB) autografts with BPTB allografts. Two studies compared hamstring tendon autografts to hamstring tendon allografts, and 1 study compared hamstring tendon autografts to tibialis anterior allografts. The mean patient age in 7 of 9 studies ranged from 24.5 to 32 years, with 1 study including only patients older than 40 years and another not reporting patient age. The mean follow-up duration was 24 to 94 months. Six of 9 studies reported clinical graft failure rates, 8 of 9 reported postoperative instrumented laxity measurements, 7 of 9 reported postoperative physical examination findings, and all studies reported patient-reported outcome scores. This review demonstrated no statistically significant difference between autografts and nonirradiated allografts in any outcome measure.

Conclusion: No significant differences were found in graft failure rate, postoperative laxity, or patient-reported outcome scores when comparing ACLR with autografts to nonirradiated allografts in this systematic review. These findings apply to patients in their late 20s and early 30s. Caution is advised when considering extrapolation of these findings to younger, more active cohorts.

Keywords: autograft; allograft; ACL; radiation

Surgical reconstruction of anterior cruciate ligament (ACL) injuries is recommended to restore knee stability and allow patients to return to cutting- and pivoting-type sports. There are many autograft and allograft options for reconstruction, and the decision of which graft type to use is typically based on surgeon and patient preference, patient age, activity level, and desired return to sport. Autografts have traditionally been the gold standard, with the bone–patellar tendon–bone (BPTB) and quadrupled hamstring tendon used most commonly.[24,28] Allograft use has increased over the past decade mainly because of the avoidance of donor site morbidity, less postoperative pain, and faster operating room time.[27,31] Disadvantages of allograft use include possible immunogenicity, delayed graft incorporation, and risk of disease transmission.[1,12,15]

Numerous studies have demonstrated the deleterious effects that irradiation has on the biomechanical properties and failure rates of ACL allografts.[8,34,36] A recent meta-analysis by Prodromos et al[33] demonstrated that irradiated allografts have an abnormal stability rate that is 2.5 times that of nonirradiated allografts. Borchers et al[4] showed

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that the odds of failure after ACL reconstruction with an irradiated allograft were 5.6 times those after reconstruction with an autograft.

Three previous systematic reviews have compared the outcomes of ACL reconstruction using autografts versus allografts.[5,10,18] These systematic reviews have varied in terms of their level of evidence, included graft types, and outcomes of interest. A common limitation of each review, however, is the inclusion of irradiated grafts in the allograft group. The purpose of the current systematic review was to determine whether the use of nonirradiated allograft tissue is associated with increased graft failure rates, postoperative laxity on physical examination, and/or poorer patient-reported outcome scores. We hypothesized that ACL reconstruction with nonirradiated allograft tissue was not associated with (1) an increased odds of graft failure as determined clinically or through instrumented laxity testing, (2) increased laxity on postoperative physical examination, or (3) decreased patient-reported outcome scores relative to ACL reconstruction with autograft tissue.

MATERIALS AND METHODS

Eligibility Criteria

All English-language prospective or retrospective comparative studies (evidence level 1, 2, or 3) comparing outcomes of primary ACL reconstruction with autograft tissue versus nonirradiated allograft tissue were eligible for inclusion in this review. Studies were excluded if it was not clearly stated whether the allograft had been irradiated. Patients of all ages were included. Each study was required to have a minimum of 15 patients in each group and a mean follow-up of at least 2 years. Outcome data including clinical or instrumented failure rates or patient-reported outcome scores were required for inclusion.

Literature Search and Study Selection

Literature review included a search of Scopus, Embase, CINAHL, and Cochrane Collaboration systematic reviews through October 12, 2012. Two independent reviewers (M.W.M. and D.M.) separately completed the search. Search terms included "autograft," "allograft," and "anterior cruciate ligament." This search yielded a total of 649 studies across all databases. After applying a filter to include only human, English-language, and comparative autograft and allograft studies, 114 studies remained. The title and abstract of all 114 studies were reviewed, and 36 duplicate studies were removed. Of the 78 remaining studies, 57 were excluded for the following reasons: study unrelated to the research question (n = 24), studies not published in the English language (n = 8), cost-effectiveness analyses

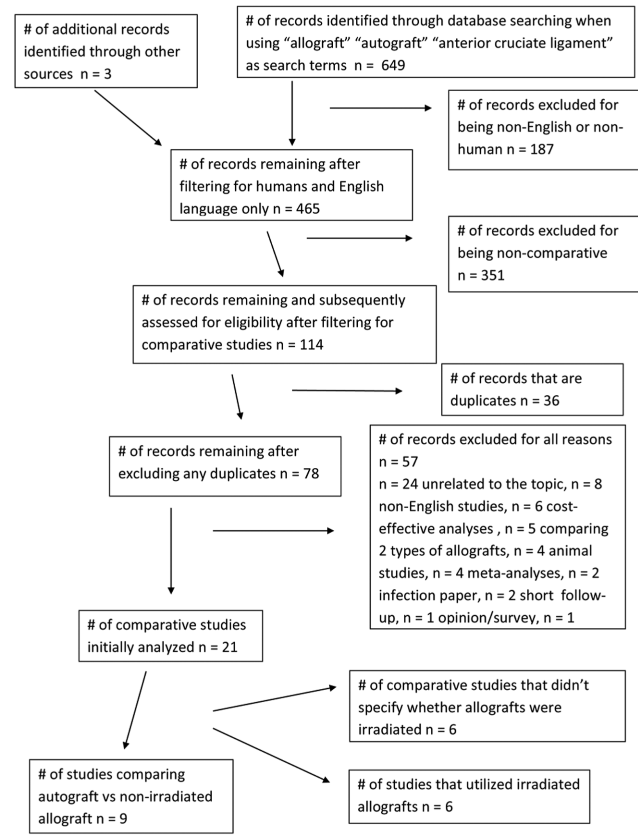

Figure 1. Flowchart describing the literature search and study selection.

(n = 6), studies comparing 2 types of allograft (n = 5), review papers with no original data (n = 4), animal studies (n = 4), papers focused on infection rates (n = 2), short follow-up (n = 2), 1 opinion/survey paper, and 1 paper utilizing nonstandard graft processing. This left a total of 21 comparative studies. Twelve of the 21 studies were excluded for not specifying whether the allografts had been irradiated (n = 6)[2,21,22,25,29,33] or including allografts that had been irradiated (n = 6).[6,11,26,36,37,39] The 9 remaining studies compared autograft and nonirradiated allograft tissue.[‡] The reference section of each included study was reviewed to ensure that no studies were missed in the literature review. The literature search is summarized in Figure 1.

Data Extraction

Two authors (M.W.M. and D.M.) independently extracted all relevant data. These data included the study's country

[‡]References 3, 9, 13, 17, 19, 20, 32, 38, 40.

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TABLE 1
Study Description[a]

Author	Journal	Year	Country	Procedure Date Range	Determination of Treatment	Level of Evidence
Sun et al[40]	AJSM	2011	China	2000-2004	Randomized	2
Lawhorn et al[20]	Arthroscopy	2012	USA	2002-2006	Randomized	2
Sun et al[38]	Arthroscopy	2009	China	2000-2004	Randomized	2
Edgar et al[9]	CORR	2008	USA	1997-2000	Patient choice 25%, randomized 75%	2
Barrett et al[3]	AJSM	2005	USA	1994-2000	Patient choice	3
Peterson et al[32]	Arthroscopy	2001	USA	1991-1992	Patient choice	2
Kleipool et al[17]	KSSTA	1998	Netherlands	1989-1991	Allograft availability	2
Harner et al[13]	CORR	1996	USA	1986-1989	Patient choice and allograft availability	3
Kustos et al[19]	Int Orthop	2004	Hungary	1996-2002	Patient choice	3

[a]AJSM, *American Journal of Sports Medicine*; CORR, *Clinical Orthopaedics and Related Research*; Int Orthop, *International Orthopaedics*; KSSTA, *Knee Surgery Sports Traumatology and Arthroscopy*.

of origin, procedure date range, number of surgeons, number of eligible patients, percentage of eligible patients with follow-up, mean follow-up time, study design, patient demographics, whether the injury involved a sports mechanism, time from injury to reconstruction, graft choice, surgical technique and graft fixation, physical examination findings, the use of independent and/or blinded examiners, clinical failure rates, instrumented laxity measurements (KT-1000 or KT-2000 arthrometer), and patient-reported outcome scores.

Methodological Quality Assessment

Two authors (M.W.M. and D.M.) separately graded the methodological quality of each eligible study using the Delphi list quality score and modified Coleman methodology score. The Delphi scoring system was based on 9 questions: Was a method of randomization used? Was the treatment allocation concealed? Were the groups similar at baseline? Were eligibility criteria specified? Was the outcome assessor blinded? Was the care provider blinded? Was the patient blinded? Were point estimates and measures of variability used? Was there an intention-to-treat analysis? Each question was given 1 point for "yes," 1 point was deducted for "no," and 0 points were given for "don't know."[42] The modified Coleman score included questions on study size, mean follow-up, percentage of patients with follow-up, number of interventions per group, study type, diagnostic certainty of ACL tear, description of ACL reconstruction procedure, description of postoperative rehabilitation, specifications of outcome criteria, procedures for assessing outcomes, and description of patient selection process.[7,23] The modified Coleman methodology score was based on a scaled maximum of 100 points. The study's rating was considered excellent if the score was 85 to 100 points, good if it was 70 to 84 points, fair if it was 55 to 69 points, and poor if it was $\leq$54 points.

Statistical Analysis

Each outcome measure (graft failure as determined clinically or via instrumented laxity as well as patient-reported outcome scores) was qualitatively assessed for homogeneity. In cases of qualitative homogeneity, statistical testing of homogeneity (χ^2) was performed. If the observed variation was inconsistent with the null hypothesis ($P < .1$), no meta-analysis was performed. In cases in which data were qualitatively heterogeneous, no statistical analysis of heterogeneity was performed. For outcome variables sufficiently homogeneous for meta-analysis, a Mantel-Haenszel analysis utilizing a random-effects model was used to pool results according to graft tissue (allograft vs autograft) while accounting for the number of patients in individual studies.[35]

RESULTS

Study Characteristics and Outcomes

Of the 9 included studies, 6 studies were level 2[9,17,20,32,38,40] and 3 studies were level 3.[3,13,19] Of the 6 level 2 studies, 3 were randomized controlled trials[20,38,40] (Table 1). Six of the 9 studies compared BPTB autografts and BPTB allografts. Two studies compared quadrupled hamstring tendon autografts and quadrupled hamstring tendon allografts, and 1 study compared quadrupled hamstring tendon autografts and anterior tibialis allografts (Table 2). The number of patients with follow-up ranged from 60 to 186. The mean follow-up duration ranged from 24 to 94 months. The mean patient age in 7 of 9 studies ranged from 24.5 to 32 years; 1 study reported a patient age of 40 to 54 years with no actual average, and another study did not report patient age (Table 3).

Clinical failure risk was reported in 6 of 9 studies, while instrumented laxity measurements were reported in 8 of 9 studies. Lachman test results were reported in 5 of 9 studies, and pivot-shift test results were reported in 7 of 9 studies. Patient-reported outcome scores were reported in all 9 studies and included the Lysholm, Cincinnati, International Knee Documentation Committee (IKDC) subjective, and Tegner activity scores.[14,30,41]

Study Methodological Quality

The Delphi list quality scores and the modified Coleman methodology scores were calculated for all 9 studies (see

TABLE 2
Surgical Details[a]

Author (Year)	No. of Surgeons	Autograft/Allograft Type	Approach	Femoral Fixation	Tibial Fixation
Sun et al[40] (2011)	1	Hamstring/hamstring	Endoscopic	Endobutton	Interference screw plus staple
Lawhorn et al[20] (2012)	5	Hamstring/tibialis anterior	Endoscopic	Cross pins	Spiked washer and compression screw
Sun et al[38] (2009)	1	BPTB/BPTB	Endoscopic	Interference screw	Interference screw
Edgar et al[9] (2008)	1	Hamstring/hamstring	Endoscopic	Endobutton plus interference screw	Interference screw plus spiked washer and screw
Barrett et al[3] (2005)	1	BPTB/BPTB	Endoscopic	Interference screw or Endobutton	Interference screw/ post, Endobutton/ post, staple
Peterson et al[32] (2001)	1	BPTB/BPTB	Endoscopic	Interference screw	Interference screw
Kleipool et al[17] (1998)	1	BPTB/BPTB	Endoscopic	Interference screw	Interference screw
Harner et al[13] (1996)	2	BPTB/BPTB	2 incision	NR	NR
Kustos et al[19] (2004)	NR	BPTB/BPTB	Endoscopic	Interference screw	Interference screw

[a]BPTB, bone–patellar tendon–bone; NR, not reported.

TABLE 3
Study Demographics and Follow-up[a]

	Autograft Group				Allograft Group			
Author (Year)	Age, Mean (Range), y	Sex, M:F, n	Follow-up, Mean (Range), mo	Follow-up,[b] %	Age, Mean (Range), y	Sex, M:F, n	Follow-up, Mean (Range), mo	Follow-up,[b] %
Sun et al[40] (2011)	30 (19-56)	71:20	91 (72-120)	88 (91/104)	31 (18-59)	78:17	95 (72-120)	91 (95/104)
Lawhorn et al[20] (2012)	32 (16-53)	32:22	24	72	33 (16-53)	38:10	24	67
Sun et al[38] (2009)	32 (20-54)	61:15	67 (48-95)	88	33 (19-65)	63:17	67 (50-96)	93
Edgar et al[9] (2008)	27	20:17	52 (38-70)	81 overall (37/NR)	31	26:20	48 (36-64)	81 overall (46/NR)
Barrett et al[3] (2005)	(40-54)	15:10	48 (24-99)	100 (25/25)	(40-58)	20:18	36 (24-74)	100 (38/38)
Peterson et al[32] (2001)	25 (15-43)	14:16	65 (57-78)	42 (30/71)	28 (15-55)	19:11	63 (55-73)	63 (30/48)
Kleipool et al[17] (1998)	28 (16-38)	9:17	52 (42-74)	90 (26/29)	28 (14-43)	17:19	46 (30-64)	92 (36/39)
Harner et al[13] (1996)	NR	21:5	45 (30-75)	32 (26/82)	NR	51:13	45 (30-75)	40 (64/162)
Kustos et al[19] (2004)	24.5	22:4	38 (12-72)	100 (26/26)	25.6	38:14	38 (12-72)	100 (53/53)

[a]NR, not reported.
[b]Numbers (n) of total are in parentheses.

the Appendix, available in the online version of this article at http://ajsm.sagepub.com/supplemental). Based on the scaled maximum of 100 points, the mean overall modified Coleman score for the 9 studies was 67. Two studies were categorized as excellent, 1 study was categorized as good, 4 studies were categorized as fair, and 2 studies were categorized as poor.

Failure Risk

Clinical failure risk (as defined by the authors) was compared between autografts and allografts in 6 studies. According to this definition of failure, the overall failure risk across the 6 studies was 3.0% (6/198) in the autograft group and 2.4% (6/251) in the allograft group. Meta-analysis indicated no increased risk of graft failure in the allograft group (Figure 2).

Failure risk as determined by instrumented laxity measurements was compared between autografts and allografts in 8 studies. Failure was defined as anterior laxity of at least 5 mm greater than the contralateral side. According to this definition of failure, the overall failure risk across the 8 studies was 6.0% (22/364) in the autograft group and 5.5% (24/437) in the allograft group. Meta-analysis indicated no increased risk of graft failure in the allograft group (Figure 3).

Laxity on Physical Examination

Anterior laxity as assessed with the Lachman examination was reported in 5 studies. No study noted a statistically significant difference between the autograft and allograft groups (Table 4). Meta-analysis indicated no difference in the risk of having a Lachman grade greater than 0 between the 2 treatment groups (Figure 4).

Rotational laxity as assessed with the pivot-shift examination was reported in 5 studies. No study noted a statistically significant difference between the autograft and allograft groups (Table 5). Meta-analysis indicated no difference in the risk of having a pivot shift greater than 0 between the 2 treatment groups (Figure 5). The Harner

Study or Subgroup	Allograft Events	Allograft Total	Autograft Events	Autograft Total	Weight	Risk Ratio M–H, Random, 95% CI
Barrett 2005	1	38	0	25	11.8%	2.00 [0.08, 47.23]
Edgar 2008	2	46	3	37	39.2%	0.54 [0.09, 3.04]
Kleipool 1998	0	36	0	26		Not estimable
Kustos 2004	2	53	1	26	21.3%	0.98 [0.09, 10.33]
Lawhorn 2012	0	48	1	54	11.7%	0.37 [0.02, 8.97]
Peterson 2001	1	30	1	30	15.9%	1.00 [0.07, 15.26]
Total (95% CI)		**251**		**198**	**100.0%**	**0.75 [0.25, 2.24]**
Total events	6		6			

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 0.79$, df = 4 (P = 0.94); $I^2 = 0\%$
Test for overall effect: Z = 0.51 (P = 0.61)

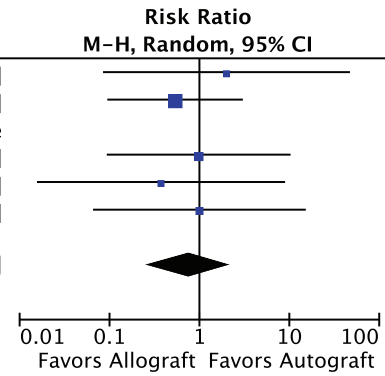

Figure 2. Forest plot of clinical failure risk for autografts versus allografts. The pooled odds ratio with 95% confidence intervals has been calculated with a Mantel-Haenszel (M-H) analysis utilizing a random-effects model.

Study or Subgroup	Allograft Events	Allograft Total	Autograft Events	Autograft Total	Weight	Risk Ratio M–H, Random, 95% CI
Barrett 2005	3	38	0	25	3.9%	4.67 [0.25, 86.64]
Edgar 2008	1	46	3	36	6.8%	0.26 [0.03, 2.40]
Harner 1996	4	64	2	26	12.5%	0.81 [0.16, 4.17]
Kleipool 1998	2	36	2	26	9.3%	0.72 [0.11, 4.80]
Lawhorn 2012	0	48	1	54	3.3%	0.37 [0.02, 8.97]
Peterson 2001	0	30	2	30	3.7%	0.20 [0.01, 4.00]
Sun 2009	6	80	5	76	25.4%	1.14 [0.36, 3.58]
Sun 2011	8	95	7	91	35.2%	1.09 [0.41, 2.90]
Total (95% CI)		**437**		**364**	**100.0%**	**0.89 [0.50, 1.59]**
Total events	24		22			

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 4.06$, df = 7 (P = 0.77); $I^2 = 0\%$
Test for overall effect: Z = 0.39 (P = 0.70)

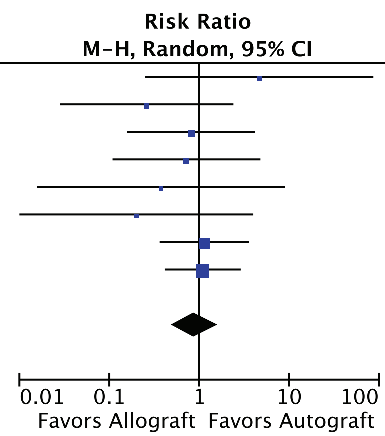

Figure 3. Forest plot of instrumented laxity failure risk for autografts versus allografts. The pooled odds ratio with 95% confidence intervals has been calculated with a Mantel-Haenszel analysis (M-H) utilizing a random-effects model.

Study or Subgroup	Allograft Events	Allograft Total	Autograft Events	Autograft Total	Weight	Risk Ratio M–H, Random, 95% CI
Barrett 2005	7	38	1	25	2.9%	4.61 [0.60, 35.19]
Kleipool 1998	15	36	9	26	27.6%	1.20 [0.63, 2.32]
Peterson 2001	6	30	7	30	12.7%	0.86 [0.33, 2.25]
Sun 2009	15	80	14	76	27.3%	1.02 [0.53, 1.96]
Sun 2011	17	95	15	91	29.6%	1.09 [0.58, 2.04]
Total (95% CI)		**279**		**248**	**100.0%**	**1.11 [0.79, 1.57]**
Total events	60		46			

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 2.32$, df = 4 (P = 0.68); $I^2 = 0\%$
Test for overall effect: Z = 0.60 (P = 0.55)

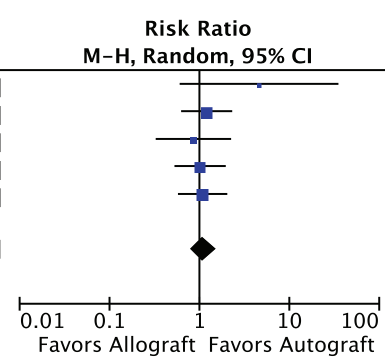

Figure 4. Forest plot of the risk of a Lachman grade greater than 0 for autografts versus allografts. The pooled odds ratio with 95% confidence intervals has been calculated with a Mantel-Haenszel (M-H) analysis utilizing a random-effects model.

et al[13] study did not differentiate between a pivot shift of 0 and 1 and was not included in the meta-analysis.

Patient-Reported Outcome Scores

Patient-reported outcome scores were reported in every study. All studies used the Lysholm or subjective IKDC score. Five studies used both scoring systems. The Cincinnati knee score was also used in 3 of the 9 studies. The Tegner activity score was reported in 6 studies. There was no statistically significant difference between autograft and allograft reconstructions in any patient-reported outcome score in any study (Table 6).

TABLE 4
Postoperative Lachman Results (in Percentages)[a]

	Lachman Grade								
	Autograft				Allograft				
Author (Year)	0	1	2	3	0	1	2	3	*P* Value
Sun et al[40] (2011)	84 (76/91)	9 (8/91)	7.7 (7/91)	0 (0/91)	82 (78/95)	10 (9/95)	8 (8/95)	0 (0/95)	NS
Sun et al[38] (2009)	82 (62/76)	12 (9/76)	7 (5/76)	0 (0/76)	81 (65/80)	11 (9/80)	8 (6/80)	0 (0/80)	NS
Barrett et al[3] (2005)	96 (24/25)	4 (1/25)	0 (0/25)	Not used	82 (31/38)	15 (6/38)	3 (1/38)	Not used	NS
Peterson et al[32] (2001)	77 (23/30)	20 (6/30)	3 (1/30)	Not used	80 (24/30)	10 (3/30)	10 (3/30)	Not used	NS
Kleipool et al[17] (1998)	65 (17/26)	19 (5/26)	15 (4/26)	0 (0/26)	58 (21/36)	28 (10/36)	14 (5/36)	0 (0/36)	NS

[a]Numbers (n) of total are in parentheses. NS, not significant.

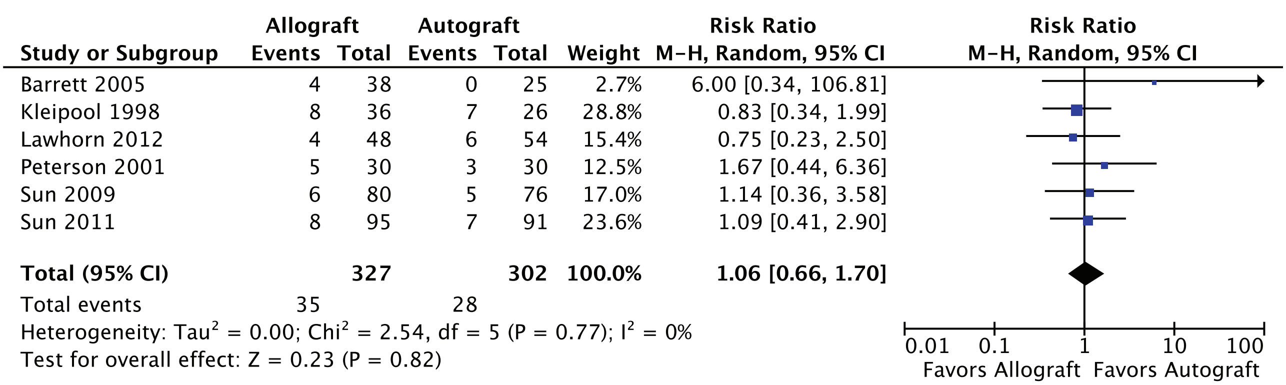

Figure 5. Forest plot of the risk of a pivot shift greater than 0 for autografts versus allografts. The pooled odds ratio with 95% confidence intervals has been calculated with a Mantel-Haenszel (M-H) analysis utilizing a random-effects model.

TABLE 5
Postoperative Pivot-Shift Results (in Percentages)[a]

	Pivot-Shift Grade								
	Autograft				Allograft				
Author (Year)	0	1	2	3	0	1	2	3	*P* Value
Sun et al[40] (2011)	92 (84/91)	8 (7/91)	0 (0/91)	0 (0/91)	92 (87/95)	8.4 (8/95)	0 (0/95)	0 (0/95)	NS
Lawhorn et al[20] (2012)	89 (48/54)	9 (5/54)	0 (0/54)	2 (1/54)	92 (44/48)	8 (4/48)	0 (0/48)	0 (0/48)	NS
Sun et al[38] (2009)	93 (71/76)	7 (5/76)	0 (0/76)	0 (0/76)	93 (74/80)	8 (6/80)	0 (0/80)	0 (0/80)	NS
Barrett et al[3] (2005)	100 (25/25)	0 (0/25)	0 (0/25)	Not used	89 (34/38)	8 (3/38)	3 (1/38)	Not used	NS
Peterson et al[32] (2001)	90 (27/30)	7 (2/30)	3 (1/30)	Not used	83 (25/30)	13 (4/30)	3 (1/30)	Not used	NS
Kleipool et al[17] (1998)	73 (19/26)	23 (6/26)	4 (1/26)	0 (0/26)	78 (28/36)	14 (5/36)	8 (3/36)	0 (0/36)	NS
Harner et al[13] (1996)	92 (24/26)		8 (2/26)		89 (57/64)		11 (7/64)		NS

[a]Numbers (n) of total are in parentheses. NS, not significant.

DISCUSSION

This systematic review is the first to compare outcomes of ACL reconstruction with autograft versus exclusively nonirradiated allograft tissue. This review demonstrates no statistically significant difference between autografts and nonirradiated allografts with regard to failure risk, physical examination findings, or patient-reported outcome scores. It is critically important to note that the results of this study can only be applied to patient populations that are similar to the patients included in the source studies. Mean patient age in the studies was generally in the late 20s to early 30s, with 1 study focused on patients in their 40s. It has also been shown that the risk of graft failure decreases with increasing age.[16] Therefore, the studies in this systematic review did not evaluate allograft use in the highest risk population for graft failure, and this fact could bias the findings. Application of the findings of this study to a younger, more active population would not be appropriate.

TABLE 6
Postoperative Patient-Reported Outcome Scores[a]

Author (Year)	Patient-Oriented Outcome Scores				Tegner Activity Scores		
	Form	Autograft	Allograft	*P* Value	Autograft	Allograft	*P* Value
Sun et al[40] (2011)	Lysholm	89	90	NS	7.7	7.6	NS
Lawhorn et al[20] (2012)	Cincinnati	90	91	NS			
Sun et al[38] (2009)	IKDC subjective	91	91	NS			
Edgar et al[9] (2008)	Lysholm	90	91	NS	7.8	7.6	NS
Barrett et al[3] (2005)	Cincinnati	91	92	NS			
Peterson et al[32] (2001)	IKDC subjective	88	87	NS	6.8	6.9	NS
Kleipool et al[17] (1998)	Lysholm	91	93	NS			
Harner et al[13] (1996)	Lysholm	92	91	NS	4.3	4.1	NS
Kustos et al[19] (2004)	Lysholm	89	90	NS	6.1	5.4	NS

[a]IKDC, International Knee Documentation Committee; NS, not significant.

Literature review demonstrated only 1 study that stratified outcomes based on age and activity level. Barrett et al[2] showed at a minimum 2-year follow-up that patients younger than 25 years (mean age, 18 years) had significantly increased failure rates regardless of graft type. Reported failure rates for patients younger than 25 years were 12% for patellar tendon autografts, 25% for hamstring tendon autografts, and 29% for allografts. In the allograft group, a combination of the patellar tendon and posterior tibialis were used, but it was not reported whether the allografts had been irradiated. In contrast, there was no statistically significant difference in failure rates among patients older than 25 years (mean age, 39 years) with different graft types.

The results of the current review are similar to previously published meta-analyses and systematic reviews comparing autograft and allograft usage in ACL reconstruction.[5,10,18] The most recent review identified 31 prospective studies that included either autograft patients alone (27 studies) or autograft and allograft groups (4 studies).[10] After pooling the data, the authors could not find any statistically significant difference in laxity or IKDC scores between groups. Although graft failure rates were noted to be 4.7 per 100 for autograft reconstructions and 8.2 per 100 for allograft reconstructions, this trend did not reach statistical significance. Carey et al[5] included 9 autograft versus allograft comparative studies. Three of the studies included irradiated allografts, while 1 did not report whether irradiation was used. They showed no significant difference in Lysholm scores and instrumented laxity measurements between the groups. Clinical failure was noted in 5 of 230 clinical failures in the autograft group and 11 of 240 in the allograft group, which was not statistically significant. Krych et al[18] performed a systematic review of 6 prospective nonrandomized cohort studies comparing patellar tendon autografts and patellar tendon allografts. When irradiated and chemically processed allografts were excluded, there was no significant difference in IKDC scores, Lachman/pivot-shift testing, graft rupture, or rate of reoperation.

Strengths of this study include the exclusive use of comparative studies and the inclusion of only studies that utilized nonirradiated allografts. These relatively homogeneous data allowed for meta-analysis and resulted in clear evidence that nonirradiated allografts do not compromise the results of ACL reconstruction in the population analyzed. The key limitation of this study is the inability to comment on the effect or role of nonirradiated allograft tissue in a younger, more active patient population. An additional limitation is that the majority of studies included in the review utilized patellar tendon grafts. It is unknown whether results would differ if younger patients and soft tissue grafts were more numerous in the dataset.

CONCLUSION

There were no significant differences in graft failure rate, postoperative laxity, or patient-reported outcome scores when comparing ACL reconstruction with autografts to nonirradiated allografts in this systematic review. These findings apply to patients in their late 20s and early 30s. We caution against extrapolating these findings to younger, more active cohorts.

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