The Fate of Meniscus Tears Left In Situ at the Time of Anterior Cruciate Ligament Reconstruction: A 6-Year Follow-up Study From the MOON Cohort

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The Fate of Meniscus Tears Left In Situ at the Time of Anterior Cruciate Ligament Reconstruction

A 6-Year Follow-up Study From the MOON Cohort

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Background: The management of meniscus tears identified at the time of primary anterior cruciate ligament (ACL) reconstruction is highly variable and includes repair, meniscectomy, and nontreatment.

Hypothesis/Purpose: The purpose of this study was to determine the reoperation rate for meniscus tears left untreated at the time of ACL reconstruction with a minimum follow-up of 6 years. The hypothesis was that small peripheral tears identified at the time of ACL reconstruction managed with ''no treatment'' would have successful clinical outcomes.

Study Design: Cohort study; Level of evidence, 3.

Methods: Patients with meniscus tears left untreated at the time of primary ACL reconstruction were identified from a multicenter study group with a minimum 6-year follow-up. Patient, tear, and reoperation data were obtained for analysis. The need for reoperation was used as the primary endpoint, with analysis performed to determine patient and tear characteristics associated with reoperation.

Results: There were 194 patients with 208 meniscus tears (71 medial, 137 lateral) left in situ without treatment with a complete follow-up for analysis. Of these, 97.8% of lateral and 94.4% of medial untreated tears required no reoperation. Sixteen tears (7.7%) left in situ without treatment underwent subsequent reoperation: 9 tears (4.3%) underwent reoperation in the setting of revision ACL reconstruction, and 7 tears (3.4%) underwent reoperation for an isolated meniscus injury. The patient age was significantly lower in patients requiring reoperation, while tears measuring $\geq$10 mm more frequently required reoperation.

Conclusion: Lateral and medial meniscus tears left in situ at the time of ACL reconstruction did not require reoperation at a minimum 6-year follow-up for 97.8% and 94.4% of tears, respectively. These findings re-emphasize the low reoperation rate after the nontreatment of small, peripheral lateral meniscus tears while noting less predictable results for medial meniscus tears left without treatment.

Keywords: meniscus; anterior cruciate ligament (ACL) reconstruction; nontreatment; in situ

Acute anterior cruciate ligament (ACL) tears are frequently accompanied by meniscus injuries.[5,18,30] The management of these associated meniscus lesions varies substantially and includes meniscus repair, partial meniscectomy, as well as leaving tears in situ without treatment at the time of ACL reconstruction. The knowledge of the anatomy and blood supply of the meniscus, as well as the location, length, tear type, and inherent stability of the tear, often guide the management of meniscus lesions identified at the time of arthroscopic surgery.[2,9,23,28]

The meniscus plays an important role in load transmission and contact stress in the knee.[3] The goals of meniscus treatment at the time of ACL reconstruction are to create a favorable environment for knee stability while preventing subsequent articular cartilage damage. Because of this fact, as well as the clinical and radiographic deterioration of knees over time after partial meniscectomy,[6,11,13] meniscus preservation is favored when possible. Therefore, determining which tears are amenable to nonoperative management, meniscectomy, or repair is essential for successful outcomes in patients who undergo ACL reconstruction with concomitant meniscus tears noted at the time of surgery.

Previous studies suggest that certain meniscus tears left in situ without treatment at the time of ACL reconstruction produce consistently positive clinical results.[§] However, clinical outcomes vary depending on meniscus

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[§]References 4, 7, 9, 12, 20, 23, 26, 28, 34, 37.

tear characteristics. Classically, meniscus tear "failures" are defined by subsequent reoperation. A systematic review revealed that lateral meniscus tears left in situ without treatment undergo subsequent reoperation in 4% to 22% of cases while medial meniscus tears undergo subsequent reoperation in 10% to 66% of cases.[21] Additionally, tear length and the location of the tear within the meniscus itself have been shown to influence outcomes as measured by clinical outcome scores and subsequent reoperation.[23,26,28] Several authors have suggested that longitudinal, peripheral one-third tears of the lateral meniscus measuring <10 mm in length can be left untreated at the time of ACL reconstruction with a predictably low reoperation rate.[9,20,22,23,34] Interestingly, lateral meniscus tears left in situ at the time of ACL reconstruction have been identified as a positive prognostic indicator,[7] while outcomes of medial meniscus tears left in situ without treatment are less predictable, particularly when measuring >10 mm in length.[20,24,26,37]

To date, there have been few studies to prospectively report the outcome of meniscus tears left in situ without treatment at the time of ACL reconstruction. The primary purpose of this study was to determine the rate of subsequent reoperation of meniscus tears left in situ without treatment at the time of ACL reconstruction with a minimum 6-year follow-up utilizing a previously established, prospectively collected, and longitudinally followed multicenter cohort. As a secondary aim, we described patient and tear characteristics that led to leaving tears in situ without treatment at the time of primary ACL reconstruction using the same cohort. We hypothesized that small peripheral tears in the meniscus identified at the time of ACL reconstruction managed with "no treatment" would have successful outcomes while also requiring less frequent reoperation.

METHODS

Data Sources

Data on ACL reconstructions were prospectively collected at 7 centers (University of Iowa, Washington University in St Louis, Vanderbilt University, Cleveland Clinic, The Ohio State University, University of Colorado, and Hospital for Special Surgery) between January 1, 2002 and December 31, 2004. The initial cohort included all patients who underwent unilateral primary or revision ACL reconstruction. Institutional review board approval was obtained from all centers before enrollment, and informed consent was obtained from all participants included in this study. Funding for the project was provided by the National Institutes of Health. The general methodology of the cohort has been described previously.[27,36] Briefly, each patient completed a 13-page questionnaire including patient demographics, health status, comorbidities, injury characteristics, prior surgeries, and sports participation at the time of enrollment as well as at 6-year follow-up.

At the time of the index procedure, surgeons completed a 49-page questionnaire detailing examinations under anesthesia, descriptions of meniscus injuries, and surgical techniques. Upon completion, all patient and surgeon questionnaires were sent to the data coordinating center (Vanderbilt University), where the information was scanned using Teleform software (Cardiff Software Inc) and exported to an electronic database.

Study Design

The database was queried to specifically identify patients who underwent unilateral primary ACL reconstruction with a meniscus tear identified at the time of surgery and left in situ without treatment between January 1, 2002 and December 31, 2004 using the previously described cohort. Treatment decisions at the time of surgery were made by the 12 participating surgeons included in the multicenter study, and no specific treatment algorithms or guidelines for meniscus tears were provided. Previous research using this cohort has indicated that surgeons consistently agree on descriptive tear characteristics and treatment choice when independently evaluating meniscus tears.[8] Exclusion criteria for this study included patients undergoing simultaneous, bilateral ACL reconstructions; those undergoing revision ACL reconstructions; and those with multiligament injuries requiring operation at the time of ACL reconstruction. For the primary aim, patients with tears left in situ without treatment in the same compartment as a tear treated with excision and/or repair, and patients with incomplete 6-year follow-up data (Figure 1), were also excluded. Patient demographic variables and comorbidities were obtained in addition to meniscus tear characteristics (compartment involvement, length, type of tear) and information regarding subsequent surgery. Patients with meniscus contusions without tears and those treated with abrasion and/or trephination were excluded. For the secondary aim, all tears were considered for analysis, regardless of other treatments in the same compartment or follow-up status to determine tear

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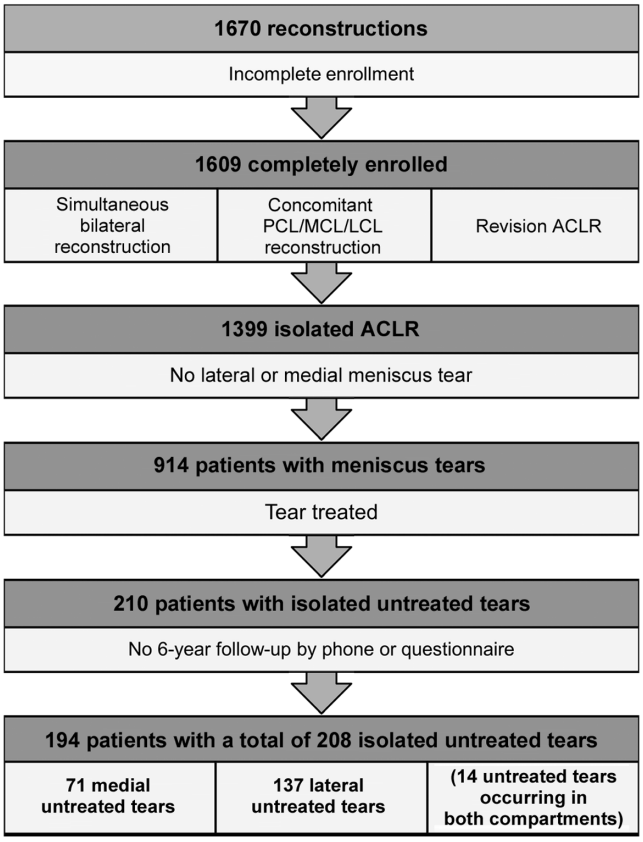

Figure 1. Flow diagram of meniscus tears identified at the time of primary anterior cruciate ligament reconstruction. Inclusion and exclusion criteria yield a cohort of patients with untreated meniscus tears with a minimum 6-year follow-up. ACLR, anterior cruciate ligament reconstruction; LCL, lateral collateral ligament; MCL, medial collateral ligament; PCL, posterior cruciate ligament.

characteristics that led to the decision to leave a tear in situ without treatment.

Statistical Analysis

Demographic variables (including patient sex, age, smoking status, body mass index [BMI], and ethnicity) and meniscus tear characteristics (including compartment(s) involved, partial vs complete tears, anterior-posterior location, coronal location, tear type, tear length, and degenerative tear status) were compared between patients who did and did not undergo reoperation for meniscus lesions within the same compartment. Based on previous literature,[9,21-23] tears were stratified by medial or lateral compartment involvement throughout the analysis. Reoperation for meniscus lesions was defined as any subsequent meniscus repair or meniscectomy within the same compartment, medial or lateral, as the meniscus tear left in situ without treatment at the time of the index ACL reconstruction procedure. For patients with meniscus tears left in situ without treatment in both the medial and lateral compartments at the time of the index ACL reconstruction procedure, any subsequent meniscus repair or meniscectomy was considered a reoperation for meniscus lesions regardless of the compartment(s) involved. Reoperation for meniscus lesions was further categorized into any reoperation, including meniscus reoperation with concomitant revision ACL reconstruction, as well as reoperation for an isolated meniscus injury, which excluded meniscus reoperations in the setting of concomitant revision ACL reconstructions. Univariate analysis, including χ^2 testing for categorical variables and the Student t test for continuous variables, was performed to compare the 2 cohorts. The Fisher exact test was used in place of χ^2 testing when categorical counts were <5. This portion of the statistical analysis was performed using SPSS version 21.0 (IBM Corp).

As a secondary aim, we utilized the entire dataset to better understand what predicted treatment, including cases of meniscus excision and/or repair, or no treatment for meniscus tears identified at the time of primary ACL reconstruction. Nomograms were created using patient and tear characteristics to help predict subsequent treatment. Medial and lateral tears were separated for the purpose of this analysis, and unlike previous analyses, tears left in situ without treatment that existed within the same compartment as treated tears were included for analysis. A proportional odds model was created for lateral and medial meniscus tears separately to determine the likelihood that tears were left in situ without treatment given several patient and tear characteristics. Patient and tear characteristics incorporated in the models included patient age and BMI as well as tear length, partial versus complete tears, tear type (longitudinal, bucket handle, complex, horizontal, oblique, radial), and tear location (peripheral third, central/middle third). This portion of the statistical analysis was performed with R version 3.1.1 (R Foundation for Statistical Computing).

Patients who had both a treated tear and a tear left in situ without treatment in the same compartment at the time of primary ACL reconstruction were considered as having been treated within the flow diagram (Figure 1) because we were unable to distinguish which tear subsequently underwent reoperation, the primary outcome. However, multiple tears within the same compartment at the time of primary ACL reconstruction were treated independently for the purpose of predicting treatment during the formulation of nomograms because data for each individual tear were collected separately at the time of primary ACL reconstruction.

RESULTS

Between 2002 and 2004, 1399 isolated, unilateral primary ACL reconstructions were listed in the multicenter study database. There were 914 patients (65.3%) who had concomitant meniscus tears at the time of their index ACL reconstruction procedure. Of these, 210 patients (23.0%) had meniscus tears left in situ without treatment at the time of surgery, with 194 patients (totaling 208 untreated meniscus tears in unique compartments) completing 6-year follow-up (92.4%) (Figure 1).

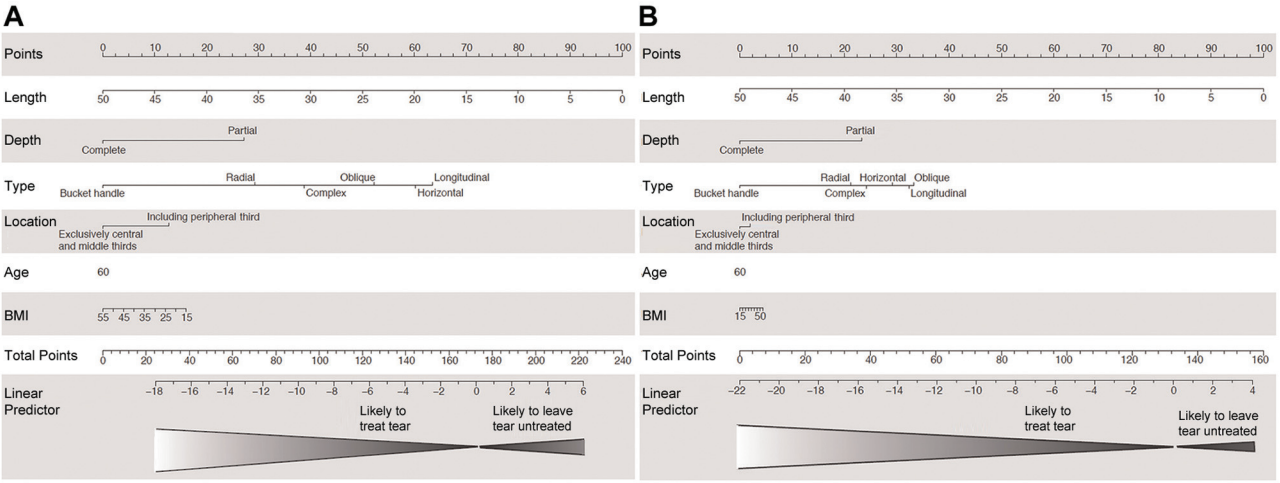

Figure 2. Nomogram for predicting which meniscus tears are left in situ without treatment at the time of primary anterior cruciate ligament reconstruction within the (A) lateral and (B) medial compartments. A vertical line is drawn independently for each variable of interest (tear length, depth, type, location, patient age, body mass index), intersecting the ''Points'' row. The values for each variable of interest are then added and the corresponding value located on the ''Total Points'' row located. A vertical line is then drawn from this point to the ''Linear Predictor'' row to determine whether a tear was more likely to be treated or left in situ without treatment.

To determine the likelihood that meniscus tears were left in situ without treatment or treated with excision and/or repair, proportional odds models were created utilizing several patient and tear characteristics. There were 719 lateral meniscus tears (532 treated, 187 not treated) and 545 medial meniscus tears (464 treated, 81 no treated) included for this model. All meniscus treatment decisions made at the time of primary ACL reconstruction were made by the treating surgeon without specific exclusion or inclusion criteria limiting treatment choices. On the lateral side, tear length ($P < .001$), partial versus complete tear ($P < .001$), tear type (longitudinal vs radial/complex/oblique; $P < .001$), and tear location (including peripheral third vs exclusively central/middle third; $P < .001$) were identified as significant predictors of the treatment type. Specifically, for each 1-mm increase in tear length, the odds of leaving a tear in situ without treatment decreased by 22% (95% CI, 15%-28%). Partial tears as compared with complete tears (odds ratio [OR], 27.3; 95% CI, 1.6-51.0); tears including the peripheral third as compared with tears exclusively in the central/middle third (OR, 4.7; 95% CI, 2.5-8.9); and longitudinal tears as compared with oblique (OR, 3.9; 95% CI, 1.9-8.3), complex (OR, 20.6; 95% CI, 6.1-68.9), or radial tears (OR, 65.2; 95% CI, 17.6-242.0) were all significantly ($P < .001$) more likely to be left in situ without treatment at the time of primary ACL reconstruction. There was no significant difference between the odds of longitudinal tears or horizontal tears left in situ without treatment ($P = .7$). All bucket-handle tears were treated. On the medial side, only tear length ($P < .001$) and complete versus partial tear type ($P < .001$) were significant predictors of the treatment type. Specifically, for each 1-mm increase in tear length, the odds of leaving a tear in situ without treatment decreased by 28% (95% CI, 18%-38%), while partial tears as compared with complete tears (OR, 47.9; 95% CI, 18.0-127.5) were more likely to be left in situ without treatment at the time of primary ACL reconstruction (Figure 2). All other factors were not statistically significant for the medial compartment ($P \geq .05$).

TABLE 1
Demographic Characteristics for Patients With Meniscus Tears Left Untreated at the Time of Primary Anterior Cruciate Ligament Reconstruction (N = 194)[a]

Sex	
Male	99 (51.0)
Female	95 (49.0)
Age, mean ± SD, y	24.9 ± 10.7
Smoking status	
No	160 (82.5)
Quit	18 (9.3)
Yes	14 (7.2)
Unknown	2 (1.0)
Body mass index (n = 189), mean ± SD, kg/m^2	24.8 ± 4.3
Ethnicity	
White	168 (86.6)
Black	16 (8.2)
Other	10 (5.2)
Compartment(s) involved	
Medial	57 (29.4)
Lateral	123 (63.4)
Both	14 (7.2)

[a]Results are reported as n (%) unless otherwise noted.

Tears left untreated were located in the lateral compartment in 123 patients (63.4%), the medial compartment in 57 patients (29.4%), and both the lateral and medial compartments in 14 patients (7.2%). The mean age of patients with meniscus tears left untreated was 24.9 ± 10.7 years,

TABLE 2
Characteristics of Tears Left Untreated After Primary Anterior Cruciate Ligament Reconstruction, Separated by Compartment[a]

	Medial	Lateral	Combined	*P* Value
No. of tears	71 (34.1)	137 (65.9)	208 (100)	
Partial vs complete				.013[b]
Partial	67 (94.4)	112 (81.8)	179 (86.1)	
Complete	4 (5.6)	25 (18.2)	29 (13.9)	
Anterior-posterior location				.086
Anterior	2 (2.8)	0 (0)	2 (1.0)	
Anterior + posterior	0 (0)	2 (1.5)	2 (1.0)	
Posterior	69 (97.2)	135 (98.5)	204 (98.1)	
Coronal location				.083
Central + middle + peripheral third	0 (0)	4 (2.9)	4 (1.9)	
Central + middle third	1 (1.4)	10 (7.3)	11 (5.3)	
Central third	5 (7.0)	8 (5.8)	13 (6.3)	
Middle + peripheral third	5 (7.0)	14 (10.2)	19 (9.1)	
Middle third	15 (21.1)	39 (28.5)	54 (26.0)	
Peripheral third	45 (63.4)	62 (45.3)	107 (51.4)	
Tear type				.091
Complex	1 (1.4)	6 (4.4)	7 (3.4)	
Horizontal	0 (0)	1 (0.7)	1 (0.5)	
Longitudinal (vertical)	64 (90.1)	105 (76.6)	169 (81.3)	
Oblique	3 (4.2)	21 (15.3)	24 (11.5)	
Radial	3 (4.2)	4 (2.9)	7 (3.4)	
Length (continuous), mean ± SD, mm	9.2 ± 2.9	9.5 ± 3.9	9.4 ± 3.6	.520
Length (categorical)				.314
<10 mm	29 (40.8)	66 (48.2)	95 (45.7)	
≥10 mm	42 (59.2)	71 (51.8)	113 (54.3)	
Degenerative tear				.450
No	67 (94.4)	133 (97.1)	200 (96.2)	
Yes	4 (5.6)	4 (2.9)	8 (3.9)	

[a]Results are reported as n (%) unless otherwise noted.
[b]Indicates statistical significance.

with female patients accounting for 49.0% of the cohort (Table 1). Overall, 208 meniscus tears were left untreated, 137 lateral (65.9%) and 71 medial (34.1%), within unique compartments. Lateral tears left untreated were more frequently complete tears as compared with tears left untreated in the medial compartment (18.2% vs 5.6%, respectively; $P = .013$). Otherwise, no differences in tear characteristics were identified between lateral and medial compartment tears (Table 2).

Subsequent ipsilateral knee surgery, including meniscus repair or excision within the same compartment of meniscus tears left untreated at the time of primary ACL reconstruction, was performed for 16 tears (7.7%) at a mean follow-up of 22.3 ± 19.7 months. Of these, 9 tears underwent meniscus reoperation in the setting of revision ACL reconstruction at a mean follow-up of 23.8 ± 21.1 months, leaving 7 tears (3.4%) that underwent isolated treatment of a meniscus injury at a mean follow-up of 20.4 ± 17.6 months. Surgery to address any meniscus lesions in these cases included excision for 13 tears (6.3%) and repair for 3 tears (1.4%) including meniscus surgery in the setting of revision ACL reconstruction. All lateral compartment tears left untreated that required subsequent surgery measured ≥10 mm, while several medial compartment tears that required reoperation measured <10 mm (see Appendix 1, available online at http://ajsm.sagepub.com/supplemental).

Univariate analysis of patient demographic variables and meniscus tear characteristics was performed to determine variables associated with increased rates of all reoperations and reoperations not in the setting of revision ACL reconstruction. Including all reoperations, there was a trend toward more reoperations in medial compartment tears as compared with lateral compartment tears left untreated (12.7% vs 5.1%, respectively; $P = .052$) (see Appendix 2, available online). This trend was less apparent when excluding patients who underwent reoperation with concomitant revision ACL reconstruction. Including all reoperations, tears measuring ≥10 mm underwent reoperation more frequently than tears measuring <10 mm (11.5% vs 3.2%, respectively; $P = .035$). This relationship was not seen when excluding tears treated in the setting of concomitant revision ACL reconstruction. Not including reoperations in the setting of revision ACL reconstruction, patients who underwent reoperation for meniscus tears left untreated at the time of primary ACL reconstruction were significantly younger compared with patients who did not require reoperation (18.6 vs 25.1 years, respectively; $P = .026$).

DISCUSSION

The primary purpose of this study was to determine the rate of subsequent reoperation of meniscus tears left in situ without treatment at the time of primary ACL reconstruction using a well-established, multicenter ACL reconstruction database. Several studies have previously reported clinical outcomes and reoperation rates for meniscus tears left untreated at the time of ACL reconstruction,[‖] but to date, no studies have provided clinical data at a minimum 6-year follow-up in a prospectively collected cohort. In the present study, 91.8% of patients did not require reoperation for meniscus lesions at 6-year follow-up. Excluding meniscus reoperations performed in the setting of revision ACL reconstruction, an even greater number of patients, 96.4%, did not require reoperation for meniscus lesions. This reoperation rate compares favorably with the reoperation rate for intact menisci at the time of ACL reconstruction using the same dataset, with 97.4% of intact menisci not requiring reoperation at a minimum 6-year follow-up.[35] Meniscus tears left in situ without treatment measuring ≥10 mm in length underwent a higher rate of reoperation, with a trend toward more reoperations in medial meniscus tears left in situ without treatment as compared with lateral meniscus tears when using any reoperation that addressed meniscus lesions as an endpoint. However, the overall low number of reoperations, and subsequently low statistical power, must be considered when evaluating these comparisons. Excluding meniscus reoperation in the setting of concomitant revision ACL reconstruction, patients who underwent reoperation of meniscus tears left in situ at the time of primary ACL reconstruction were significantly younger compared with their counterparts.

Failure after meniscus repair, meniscectomy, or leaving tears in situ without treatment at the time of ACL reconstruction has classically been defined and reported throughout the literature as the need for reoperation. While this definition allows for simple comparisons to be made between reoperation rates reported in the literature, it fails to acknowledge the ultimate goal when treating meniscus injuries at the time of ACL reconstruction, which is to create a favorable environment for knee stability while preventing subsequent articular cartilage damage. Additionally, a reinjury to the previously reconstructed ACL may be considered a separate injury event, and reporting meniscus reoperations in this setting may unnecessarily increase the reporting of reoperation rates. In the largest report on the outcome of stable lateral meniscus tears, defined as those tears that could not be moved with a probe into the intercondylar notch, left in situ at the time of ACL reconstruction by Shelbourne and Heinrich,[23] reoperation rates were categorized by tear type and location. Posterior horn and posterior peripheral tears were noted to have a reoperation rate of less than 3%, while radial flap tears underwent reoperation in 6% of patients. These findings expanded upon the previous literature on lateral meniscus tears by Fitzgibbons and Shelbourne,[9] which reported successful outcomes after "aggressive" nontreatment of lateral meniscus tears during ACL reconstruction. Talley and Grana[26] noted similar results to Shelbourne and colleagues[23] when leaving lateral meniscus tears in situ, with 4% of patients undergoing reoperation for meniscus lesions. In a systematic review of meniscus tears left in situ at the time of ACL reconstruction, Pujol and Beaufils[21] reported reoperation rates ranging from 0% to 22%, with an average rate of failure of 4.8% at a minimum 16-month follow-up. The results of the present study are consistent with those previously reported and may provide even more optimism for leaving certain lateral compartment tears in situ without treatment at the time of primary ACL reconstruction, given the reported 5.1% reoperation rate for lateral meniscus tears treated in any setting and a reoperation rate of 2.2% reported for the treatment of lateral meniscus tears not in the setting of revision ACL reconstruction at a minimum 6-year follow-up.

Results after the nontreatment of medial meniscus tears have been consistently less satisfying in the previous literature. Compared with their lateral meniscus cohort, Shelbourne and Rask[24] reported a 10.8% rate of reoperation for patients with medial meniscus tears left in situ compared with a 13.6% and 6% reoperation rate for tears treated with repair or abrasion and trephination, respectively. The authors concluded that medial meniscus tears, especially tears measuring ≥10 mm, are best treated with abrasion and trephination. Vermesan et al[28] reported equivalent outcomes between medial and lateral meniscus tears left in situ. However, lateral meniscus tears were longer than medial meniscus tears in the study and were more often accompanied by severe chondromalacia at the time of surgery. Results of a systematic review[21] reported reoperation rates for medial meniscus tears left in situ from 0% to 33%, with an average failure rate of 14.8% at a minimum 16-month follow-up. The results of the present study are consistent with those previously reported, with a reoperation rate of 12.7% for medial meniscus tears in any setting and 5.6% when excluding meniscus reoperation in the setting of revision ACL reconstruction, with both values higher than those reported for lateral tears left in situ without treatment.

While the discrepancy in reoperation rates between medial and lateral tears left untreated at the time of ACL reconstruction has been previously reported, determining with certainty which tears can be left without treatment has proven more difficult to predict. Previous studies have noted that peripheral lateral meniscus tears that measure <10 mm and do not extend anteriorly have predictably low reoperation rates.[9,20,21,23] Reoperation rates after leaving medial meniscus tears in situ without treatment have been much less predictable.[24,26,37] The findings of the present study are in agreement with those of previous reports, with no reoperations reported for lateral tears measuring <10 mm, while finding the fate of medial meniscus tears left in situ at the time of ACL reconstruction to be less predictable. Furthermore, while excluding meniscus reoperation in the setting of concomitant revision ACL reconstruction, we found that patients requiring reoperation were significantly younger than those who did not require reoperation. While younger

[‖]References 4, 9, 20, 23, 26, 28, 34, 37, 38.

patient age has been identified as a risk factor for graft failure[1,32,33] and revision surgery[10] after ACL reconstruction in addition to the need for reoperation after isolated meniscus repair,[16] this finding has not been previously reported when evaluating meniscus tears left untreated at the time of primary ACL reconstruction and warrants further investigation.

Moving forward, future directions for the evaluation of meniscus treatment must coincide with the primary goal of meniscus treatment at the time of ACL reconstruction, which is to create a favorable environment for knee stability while preventing subsequent articular cartilage damage. While the importance of the meniscus in transmitting loads across the knee has been well established,[3,29] the long-term effects of meniscus treatment strategies on the preservation of articular cartilage have been less conclusive. Meniscus repair techniques continue to improve and serve as an attempt to restore the load-bearing characteristics of the native meniscus. While early results of meniscus repair have been promising,[15,25] particularly when performed at the same time as ACL reconstruction,[19,31] there is some concern that clinical as well as radiographic results may deteriorate over time, particularly for tears within the medial compartment.[7,14,17,35] Whether leaving meniscus tears in situ without treatment serves as a viable long-term option for the preservation of articular cartilage has yet to be established as well.

Assessing nonoperatively managed meniscus tears provides several points to consider. As is the case with much of the literature regarding the nontreatment of meniscus tears, a great deal of surgeon selection bias may come into play when choosing meniscus tears to leave in situ without treatment. It is frequently reported that stable meniscus tears, particularly those involving the lateral meniscus, can reliably be left in situ without treatment with good clinical results. Several authors have attempted to define what encompasses a stable tear,[24,26,34] but there is little consistency between definitions. Additionally, we believe that meniscus reoperation in the setting of revision ACL reconstruction, and presumed recurrent instability, differs from isolated meniscus surgery. While we elected to distinguish these 2 unique cohorts, this is not consistently done throughout the literature. While a randomized design would help eliminate this shortcoming, previous research has indicated that surgeons consistently agree upon treatment choice when independently evaluating tears.[8] In light of this, we elected to provide analysis from surgeons participating in the multicenter study as to which types of tears are most likely to be left in situ without treatment at the time of primary ACL reconstruction. For lateral meniscus tears, we identified decreasing tear length, partial tears, longitudinal tears, and tears including the peripheral third as predictors of leaving tears in situ without treatment, while decreasing tear length and partial tears predicted leaving tears in situ without treatment within the medial compartment. While we acknowledge that these findings are limited to the current cohort in question and guided by the treatment decisions made by the participating surgeons at the time of ACL reconstruction, the generally favorable results for both lateral and medial meniscus tears left in situ without treatment could potentially help guide surgeons in the future while serving as a baseline for future comparative studies.

The present study does have several limitations. Failure in the present study and throughout the majority of the existing literature is defined by reoperation. More specific to the present study, failure was defined as any reoperation focused on meniscus lesions within the same compartment, medial or lateral, as the meniscus tear left in situ without treatment at the time of the index ACL reconstruction procedure because of symptomatic failure, although the exact symptoms necessitating reoperation are not implicitly defined within the database. This definition fails to address the primary goal of meniscus repair at the time of ACL reconstruction, which is to provide a stable knee with preservation of articular cartilage. The present study does not report clinical outcome data on meniscus tears left in situ without treatment at the time of ACL reconstruction, as this subset of data has previously been reported by the multicenter study.[7] As such, clinically symptomatic knees that have not undergone reoperation may not be captured. Lastly, this study was not designed to compare different treatment strategies for meniscus tears found at the time of ACL reconstruction, and such comparisons are beyond the scope of this article. An idealized situation would allow the randomization of treatment options using an algorithmic approach based on tear length, location, and chronicity. The multicenter study has reported on multivariate analysis of outcomes after ACL reconstruction, and the treatment of meniscus and cartilage lesions is only one of many factors influencing outcomes after ACL reconstruction.[7]

CONCLUSION

Utilizing a prospectively collected multicenter database with a minimum 6-year follow-up, the present study reemphasizes the low reoperation rate after the nontreatment of small, peripheral lateral meniscus tears at the time of ACL reconstruction while noting less predictable results for medial meniscus tears left untreated at the time of ACL reconstruction. While the decision to treat or leave tears in situ without treatment may be at least partially surgeon dependent, we have identified several tear characteristics that predict leaving meniscus tears in situ without treatment at the time of primary ACL reconstruction. Further studies should aim to better characterize appropriate tears to leave untreated at the time of ACL reconstruction while also studying the role that age plays on outcomes for meniscus tears left in situ without treatment.

CONTRIBUTING AUTHORS

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