

Anterior Cruciate Ligament Tears

The Impact of Increased Time From Injury to Surgery on Intra-articular Lesions

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Background: Previous research has shown that meniscal and articular cartilage lesions increase with time in the anterior cruciate ligament (ACL)-deficient knee.

Purpose: To analyze the association between increased time from ACL injury to reconstruction and the presence of intra-articular lesions.

Design: Cross-sectional study; Level of evidence, 3.

Methods: A retrospective chart review was performed for patients who sustained an ACL injury and underwent reconstruction from January 1, 2009, to May 14, 2015. Factors analyzed included age, sex, and body mass index, as well as time from injury to surgery, the presence of meniscal tears, and the presence of cartilage lesions. The data were evaluated to quantify the association between time from ACL injury to reconstruction and presence of intra-articular lesions.

Results: Overall, 405 patients were included in this study. Regarding time from injury, 27.3% patients were treated at <3 months, 23.6% at 3 to <6 months, 18% at 6 to <12 months, 13.6% at 12 to <24 months, 10.6% at 24 to <60 months, and 6.9% at ≥60 months. When compared with the group treated <3 months from injury, a significant increase in the rate of medial meniscal tears was seen in the groups treated at 6 to <12 months (odds ratio [OR], 2.2), 12 to <24 months (OR, 3.5), 24 to <60 months (OR, 7.0), and ≥60 months (OR, 6.3). A similar trend was seen with medial femoral condyle lesions in the groups treated at 6 to <12 months (OR, 2.5), 12 to <24 months (OR, 2.6), 24 to <60 months (OR, 2.6), and ≥60 months (OR, 6.9). The prevalence of lateral tibial plateau and lateral femoral condyle lesions also significantly increased with increased time between ACL injury and reconstruction, but this association was not seen until 24 to <60 months (ORs, 5.1 and 11.5, respectively).

Conclusion: For patients undergoing ACL reconstruction, an interval >6 months between injury and surgery was associated with an increased prevalence of medial meniscal tears and medial compartment chondral lesions at the time of surgery. An interval >24 months between injury and surgery was associated with an increased prevalence of lateral compartment chondral lesions at the time of surgery.

Keywords: knee; ACL; arthroscopy; meniscus; cartilage

The anterior cruciate ligament (ACL) functions biomechanically to prevent anterior and rotational motion of the tibia relative to the femur.²⁴ Clinically, the ACL provides stability for cutting and pivoting activities.²⁴ It has been established that ACL and meniscal lesions lead to the development of knee osteoarthritis, with or without surgery.^{6,24} Previous studies have found that the risk of meniscal and articular cartilage lesions increase with time in the ACL-deficient knee.⁸ Although these injuries may occur at initial ACL

injury, continued activity, especially movements involved with cutting and pivoting, can result in further damage to the meniscus and articular cartilage.⁸ Several prospective studies have been performed to determine what factors can indicate whether a patient should undergo ACL reconstruction or nonoperative management and to elucidate the clinical course of patients treated nonoperatively.^{5,7,9,12-14} The Delaware Oslo-ACL Cohort study involved a prospective cohort of 143 patients with ACL injuries. The authors concluded that there were few differences between the clinical

The Orthopaedic Journal of Sports Medicine, 8(12), 2325967120967120
DOI: 10.1177/2325967120967120
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[§]References 2-4, 10, 11, 16-21, 23, 25, 26.

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courses after nonsurgical and surgical treatment of ACL injury and that a considerable number of patients did not fully recover after ACL injury, regardless of treatment choice.¹² The study also noted that the rate of concomitant surgery for meniscal tears was 32% in the operative group and that 21 (32.8%) of the 64 patients treated nonoperatively crossed over to the operative group at a mean 12.7 months. Unfortunately, the study was not powered to compare the late and early reconstruction groups to determine if there was any harm in delaying the reconstruction.^{8,12} In a 2005 prospective controlled clinical trial, Fithian et al⁹ demonstrated that initial nonoperative management resulted in more meniscal surgery >3 months after ACL injury as compared with ACL reconstruction within 3 months of injury.

Similarly, Cipolla et al⁴ suggested that undergoing surgical ACL reconstruction within 12 months could aid in preventing further meniscal and articular cartilage damage. Chhadia et al² retrospectively reviewed the cases of 1252 patients to determine the association between ACL rupture and time to surgery, age, and sex with meniscal and articular cartilage lesions. The authors found that increased medial meniscal tears (MMTs) and cartilage lesions were associated with older age and longer time to surgery, but they did not specify site of cartilage lesions or analyze associated injuries in ACL-deficient knees beyond 12 months.² In a prospective outcome study of acute hemarthrosis, Daniel et al⁵ observed 292 patients for a mean of 64 months to search for early identifiable factors that correlate with greater risk of functional impairment, secondary meniscal injuries, and joint arthrosis. The authors noted that a high percentage (49%) of patients with an acute ACL injury that had a concomitant meniscal tear and that most patients who had follow-up surgery for symptoms had done so within 2 years. This indicates that intervals >12 months between ACL injury and ACL reconstructive surgery should be investigated.

The purpose of this study was to quantify the association between increased interval from injury to ACL reconstruction and specific intra-articular lesions found at the time of surgery. We hypothesize that longer intervals between ACL injury and reconstruction will be associated with increasing rates of associated intra-articular lesions.

METHODS

After institutional review board approval, we conducted a retrospective cohort study using chart review for all patients who sustained an ACL injury and underwent

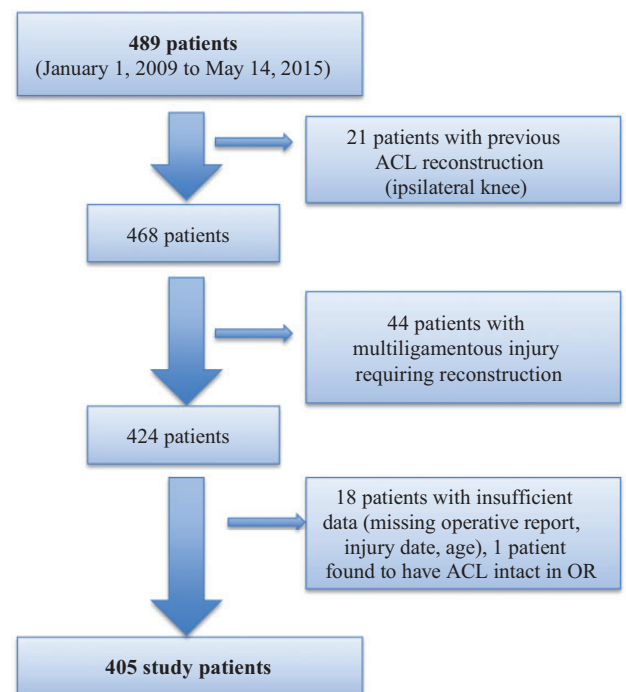


Figure 1. Study participant inclusion/exclusion flowchart. ACL, anterior cruciate ligament; OR, operating room.

reconstruction between January 1, 2009, and May 14, 2015, at an academic teaching institution in Dallas, Texas. All patients were treated by sports medicine–fellowship trained orthopaedic surgeons. For patients who attempt nonoperative management, it is the senior author’s (K.J.C.) practice to counsel them on activity modification and prescribe a formal physical therapy regimen. Nonoperative management includes lifestyle modification to avoid cutting/pivoting activities, restoration of range of motion and strength, and proprioceptive training.

Patients were excluded if they sustained a previous ipsilateral ACL reconstruction, had concomitant ligamentous injury requiring reconstruction, or the operative report was unavailable (Figure 1).

On chart review, descriptive variables obtained included age, sex, and body mass index (BMI). Date of injury was recorded as reported by the patient at the initial clinic visit. Surgical findings were recorded as the prevalence of MMT, lateral meniscal tear (LMT), medial femoral condyle (MFC) lesions, lateral femoral condyle (LFC) lesions, medial tibial

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Final revision submitted May 26, 2020; accepted June 17, 2020.

One or more of the authors has declared the following potential conflict of interest or source of funding: B.S. has received educational support from Pylant Medical. M.K. has received consulting fees and nonconsulting fees from Wright Medical and hospitality payments from Tornier. K.C. has received educational support from Arthrex and Pylant Medical, nonconsulting fees from Arthrex, and hospitality payments from Smith & Nephew. AOSSM checks author disclosures against the Open Payments Database (OPD). AOSSM has not conducted an independent investigation on the OPD and disclaims any liability or responsibility relating thereto.

Ethical approval for this study was obtained from the University of Texas Southwestern Medical Center.

TABLE 1
Demographics and Time to Anterior Cruciate Ligament Reconstruction^a

	0 to <3 mo	3 to <6 mo	6 to <12 mo	12 to <24 mo	24 to <60 mo	≥60 mo	Total
Total	110 (27.2)	96 (23.7)	73 (18.0)	55 (13.6)	43 (10.6)	28 (6.9)	405
Sex							
Male	66 (23.1)	69 (24.1)	53 (18.5)	47 (85.5)	30 (69.8)	22 (7.7)	286
Female	45 (37.5)	27 (22.5)	20 (16.7)	8 (14.5)	13 (30.2)	6 (0.5)	120
Body mass index							
<25	41 (29.9)	33 (24.1)	24 (17.5)	21 (38.2)	11 (25.6)	8 (5.8)	137
25 to <30	47 (28.5)	38 (23.0)	26 (15.8)	23 (41.8)	18 (41.9)	12 (7.3)	165
≥30	16 (21.9)	13 (17.8)	15 (20.5)	9 (16.4)	12 (27.9)	8 (11.0)	73
Age, y							
<20	32 (42.1)	16 (21.1)	16 (21.1)	8 (14.5)	4 (9.3)	0 (0.0)	76
20 to <30	48 (25.8)	46 (24.7)	31 (16.7)	28 (50.9)	23 (53.5)	11 (5.9)	186
30 to <40	22 (21.4)	23 (22.3)	16 (15.5)	16 (29.1)	12 (27.9)	13 (12.6)	103
≥40	8 (20.0)	11 (27.5)	10 (25.0)	3 (5.5)	0 (0)	4 (10)	40

^aValues are expressed as No. (%).

plateau (MTP) lesions, lateral tibial plateau (LTP) lesions, patellofemoral (PF) lesions, chondroplasty performed, and microfracture performed.

Statistical Analysis

Data were summarized using mean and standard deviation or proportion where appropriate. The chi-square test was used to identify variables that were associated with secondary intra-articular injuries.

Data for age, BMI, and time to surgery were divided into groups. For age, the following groups were created: <20 years, 20 to <30 years, 30 to <40 years, and ≥40 years. For BMI, patients were grouped according to standards of the US Centers for Disease Control and Prevention: <25, normal; 25 to <30, overweight; and ≥30, obese. Time from injury to surgery was recorded in months and divided into groups for the risk analysis: <3 months, 3 to <6 months, 6 to <12 months, 12 to <24 months, 24 to <60 months, and ≥60 months. Female sex, age <20 years, BMI <25, and surgery within 3 months of injury served as the reference groups in the statistical analysis.

To allow for adequate sample size for analysis, the MTP subgroup was divided into time frames of 0 to <6 months, 6 to <12 months, 12 to <60 months, and ≥60 months. Similarly, chondroplasty and microfracture were combined to increase the sample size for the analysis.

Logistic regression was used to evaluate the association between time to surgery and intra-articular lesions while adjusting for potential cofounders: age and BMI. Associations were reported as odds ratios (ORs) with 95% CIs. All analysis was conducted in SPSS (Version 23; IBM). A *P* value <.05 was considered statistically significant.

RESULTS

Of 424 patients identified as the population of interest, 405 (95.5%) had sufficient data to be included in the study (Figure 1). The mean ± SD age was 27 ± 8.8 years (range,

14-59 years; median, 26 years). More than half of the study participants (58.5%) had a BMI >25. The majority of the study population was male (70.5%). More than half of the study participants received surgery within the first 6 months after injury: 27.2% patients were treated at <3 months from injury, 23.7% at 3 to <6 months, 18% at 6 to <12 months, 13.6% at 12 to <24 months, 10.6% at 24 to <60 months, and 6.9% at ≥60 months (Table 1). A total of 61 patients underwent chondroplasty and/or microfracture.

Demographic Risk Factors: Univariate Analysis

Using univariable comparisons, male sex and older age were significant factors for longer time between ACL injury and surgery (*P* = .005 for both). Male sex was significantly associated with a higher prevalence of LMT (*P* < .001) and LFC lesions (*P* = .018). The ≥40-year age group was significantly more likely to have MFC lesions (*P* < .001), MTP lesions (*P* = .003), LTP lesions (*P* = .007), and PF lesions (*P* < .001) as compared with those aged <20 years. The 30- to <40-year age group was significantly more likely than the <20-year age group to have MFC, LTP, and PF lesions present at the time of surgery. Patients with a BMI >25 were significantly more likely to have MFC lesions (*P* = .007 for BMI = 25 to <30; *P* = .048 for BMI >30) (Table 2). Male patients were 2.3 times more likely than female patients to have an LMT and 3.2 more times likely to have LFC lesions present at the time of surgery. The MTP and PF variables had the highest increase in likelihood in the ≥40-year age group, with ORs of 25.0 and 24.0, respectively. They were also significantly less likely to have an LMT as compared with the <20-year age group.

Meniscal Tear and Chondral Lesions in Same Compartment: Logistic Regression Analysis

A logistic regression model was used, and there was a significant association of an MMT with MFC and MTP lesions (*P* < .001 [OR, 4.8] and *P* < .048 [OR, 2.6], respectively). There was also a significant association of LMT and LFC

TABLE 2
Demographic Factors and Associated Meniscal and Chondral Injuries Identified in Surgery^a

	MMT	LMT	MFC Lesion	LFC Lesion	MTP Lesion	LTP Lesion	PF Lesion
BMI							
<25	69/138 (50.0)	75/138 (54.3)	25/138 (18.1)	8/138 (5.8)	2/137 (1.5)	13/138 (9.4)	22/138 (15.9)
25 to <30	98/167 (58.7)	98/167 (58.7)	53/167 (31.7)	22/167 (13.2)	12/167 (7.2)	20/167 (12.0)	35/167 (21.0)
<i>P</i> value (OR; 95% CI)			.007 (2.1; 1.2-3.6)				
≥30	46/73 (63.0)	49/73 (67.1)	22/73 (30.1)	9/73 (12.3)	5/72 (6.9)	11/73 (15.1)	21/73 (28.8)
<i>P</i> value (OR; 95% CI)			.048 (1.9; 1.0-3.8)				
Age, y							
<20	39/77 (50.6)	49/77 (63.6)	12/77 (15.6)	1/76 (1.3)	1/76 (1.3)	2/76 (2.6)	5/77 (6.5)
20 to <30	101/187 (54.0)	119/188 (63.3)	47/188 (25.0)	26/188 (13.8)	4/187 (2.1)	18/188 (9.6)	17/188 (9.0)
30 to <40	64/104 (61.5)	58/104 (55.8)	33/104 (31.7)	11/104 (10.6)	6/104 (5.8)	19/104 (18.3)	35/104 (33.7)
<i>P</i> value (OR; 95% CI)			.015 (2.5; 1.2-5.3)			.005 (8.3; 1.9-36.7)	<.001 (7.3; 2.7-19.7)
≥40	27/40 (67.5)	15/40 (37.5)	19/40 (47.5)	2/40 (5.0)	10/40 (25.0)	8/40 (20.0)	25/40 (62.5)
<i>P</i> value (OR; 95% CI)		.008 (0.3; 0.16-0.76)	<.001 (4.9; 2.0-11.7)		.003 (25.0; 3.1-203.9)	.007 (9.2; 1.9-46.0)	<.001 (24.0; 7.9-72.8)
Sex^b							
Male	166/288 (57.6)	187/289 (64.7)	72/289 (24.9)	35/288 (12.1)	19/288 (6.6)	31/288 (10.8)	55/289 (19)
<i>P</i> value (OR; 95% CI)		<.001 (2.3; 1.5-3.5)		.018 (3.2; 1.2-8.4)			
Female	66/121 (54.5)	54/121 (44.6)	40/121 (33)	5/121 (4.1)	2/118 (1.7)	16/121 (13.2)	27/121 (22.3)

^aValues are expressed as No. (%) unless otherwise indicated. The OR (95% CI) is listed for groups significantly different from the comparison group ($P < .05$). LFC, lateral femoral condyle; LMT, lateral meniscal tear; LTP, lateral tibial plateau; MFC, medial femoral condyle; MMT, medial meniscal tear; MTP, medial tibial plateau; OR, odds ratio; PF, patellofemoral.

^bFemale sex was used as the comparison group for sex.

TABLE 3
Meniscal Tear Association With Chondral Lesions in the Same Compartment^a

	MFC	MTP	LFC	LTP
Meniscal tear	91/232 (39.2)	16/230 (6.9)	29/240 (12.1)	32/240 (13.3)
<i>P</i> value (OR; 95% CI)	<.001 (4.8; 2.8-8.1)	.048 (2.6; 0.92-7.2)	.043 (2.0; 0.95-4.07)	
No meniscal tear	21/177 (11.9)	5/177 (2.8)	11/169 (6.5)	15/169 (8.9)

^aValues are expressed as No. (%) unless otherwise indicated. The OR (95% CI) is listed for statistically significant associations ($P < .05$). LFC, lateral femoral condyle; LTP, lateral tibial plateau; MFC, medial femoral condyle; MTP, medial tibial plateau; OR, odds ratio.

lesions ($P = .043$ [OR, 2.0]). Although there was a higher percentage of LTP chondral lesions when an LMT was present (13.3% vs 8.9%), this was not statistically significant (Table 3).

Time to Surgery and Secondary Intra-articular Injuries

In longer intervals between injury and surgery, an increase in the prevalence of an MMT was seen ($P < .001$). When compared with the group treated at <3 months, the groups treated at 6 to <12 months (OR, 2.2), 12 to <24 months (OR, 3.5), 24 to <60 months (OR, 7.0), and ≥60 months (OR, 6.3) were more likely to have an MMT. A similar trend was seen with MFC lesions ($P < .001$) in the groups treated at 6 to <12 months (OR, 2.5), 12 to <24 months (OR, 2.6), 24 to <60 months (OR, 2.6), and ≥60 months (OR, 6.9). The prevalence of LMTs did not change significantly over time. The prevalence of LTP lesions and LFC lesions also significantly increased with increased time from injury to ACL surgery,

but this association did not occur until 24 to <60 months. LFC lesions were 11.5 times more likely to be present after an injury-to-surgery interval of 24 to <60 months and 25.0 times more likely after ≥60 months when compared with <3 months ($P < .001$). LTP lesions were 5.1 times more likely to be present after an injury-to-surgery interval of 24 to <60 months and 4.7 times more likely after >60 months versus <3 months ($P = .017$). MTP lesions were 5.7 times more likely to be present in the 6- to <12-month group, 6.3 times more likely in the 12- to <60-month group, and 13.4 times more likely in the >60-month group (Table 4). Figure 2 demonstrates a plot with time to surgery on the x -axis and the calculated OR on the y -axis for the significantly associated injuries.

DISCUSSION

After adjusting for BMI and age, this study demonstrated a statistically significant increase in meniscal and chondral injuries when the interval between ACL injury and

TABLE 4
Time From Injury and Associated Meniscal and Chondral Injuries^a

	MMT	LMT	MFC Lesion	LFC Lesion	MTP Lesion ^b	LTP Lesion	PF Lesion
<3 mo	46/111 (41.4)	68/111 (61.3)	16/111 (14.4)	3/110 (2.7)	0/111 (0)	5/110 (4.5)	23/111 (20.7)
3 to <6 mo	43/95 (45.3)	59/96 (61.4)	22/96 (23)	6/96 (6.2)	3/96 (3.1)	8/96 (8.3)	15/96 (15.6)
6 to <12 mo	44/73 (60.3)	43/73 (58.9)	23/73 (31.5)	5/73 (6.8)	6/71 (8.4)	8/73 (10.9)	17/73 (23.3)
OR (95% CI)	2.2 (1.2-4.1)		2.5 (1.2-5.5)		5.7 (1.3-25.0)		
12 to <24 mo	39/55 (70.9)	32/55 (58.2)	19/55 (34.5)	5/55 (9.1)	4/55 (7.3) ^c	9/55 (16.4)	10/55 (18.2)
OR (95% CI)	3.5 (1.7-7.1)		2.6 (1.2-5.6)				
24 to <60 mo	35/43 (81.4)	53/43 (48.8)	33/43 (32.6)	10/43 (23.3)	3/43 (7.0)	9/43 (20.9)	10/43 (23.3)
OR (95% CI)	7.0 (2.8-17.3)		2.6 (1.1-6.1)	11.5 (2.9-44.7)	6.3 (1.5-26.9)	5.1 (1.6-16.6)	
≥60 mo	23/28 (82.1) ^d	16/28 (57.1)	17/28 (60.7) ^d	11/28 (39.3) ^d	5/28 (17.8)	7/28 (25)	6/28 (21.4)
OR (95% CI)	6.3 (2.2-18.1)		6.9 (2.6-17.9)	25.0 (6.0-103.8)	13.4 (2.7-67.5)	4.7 (1.3-16.8)	

^aValues are expressed as No. (%) unless otherwise indicated. The OR (95% CI) is listed for groups significantly different from the comparison group ($P < .05$). LFC, lateral femoral condyle; LMT, lateral meniscal tear; LTP, lateral tibial plateau; MFC, medial femoral condyle; MMT, medial meniscal tear; MTP, medial tibial plateau; OR, odds ratio; PF, patellofemoral.

^bThe MTP comparison group was 0 to 6 months to have a larger sample size for statistical tests.

^cThe OR for the 12- to <24-month subgroup of the MTP was not calculated owing to the small sample size.

^d $P < .001$.

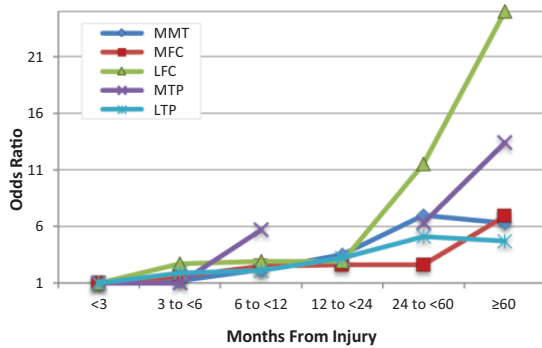


Figure 2. Time groups versus odds ratio for significantly associated injuries. The odds ratio for the 12- to <24-month subgroup of the MTP was not calculated owing to the small sample size. LFC, lateral femoral condyle; LTP, lateral tibial plateau; MFC, medial femoral condyle; MMT, medial meniscal tear; MTP, medial tibial plateau.

reconstructive surgery is >6 months. Specifically, the data showed that with increased time from ACL injury to reconstruction, there is at the time of surgery a significantly increased prevalence of MMTs but not LMTs. This corroborates findings in previous studies that have shown LMT acutely after ACL tears and increasing MMT among patients presenting with chronic ACL deficiency.^{1-4,6,15,16,18,22,25} Cipolla et al⁴ found a large incidence of LMT (61%) in acute ACL tears (treated within 1 week of injury) and a large incidence of MMT (69.8%) in chronic ACL tears. Daniel et al⁵ noted a similar trend in their prospective study of 292 patients who had sustained an acute hemarthrosis. In their early-phase arthroscopy group of 208 knees, they found 51 (25%) MMTs and 71 (34%) LMTs. Of their 45 patients undergoing late ACL reconstruction surgery, 29 (64%) had concomitant meniscal procedures performed.

A significantly higher prevalence of MMT in our study population was seen in patients undergoing ACL

reconstruction at 6 to <12 months when compared with those undergoing surgery <3 months after injury (OR, 2.2). This relationship increased with time for patients who were treated at 12 to <24 months, 24 to <60 months, and ≥60 months (ORs, 3.5, 7.0, and 6.3, respectively). Previous studies have found a similar relationship when surgery is performed >6 months after ACL injury.^{2,10} Chhadia et al² used a similar grouping as our study for time to surgery, with the exception that they combined >12 months as their longest time-to-surgery category. They also calculated a similar OR for their 6- to <12-month group (OR, 1.81). Daniel et al⁵ noted that a high percentage (49%) of patients with an acute ACL injury also had a concomitant meniscal tear and that most patients who underwent follow-up surgery for symptoms had done so within 2 years. This suggests that there is value in investigating intervals >12 months between ACL injury and surgery.

A similar trend was seen with MFC lesions ($P < .001$) in patients treated at 6 to <12 months, 12 to <24 months, 24 to <60 months, and ≥60 months (ORs, 2.5, 2.6, 2.6, and 6.9, respectively). The prevalence of LMTs did not change significantly over time. The prevalence of LTP and LFC lesions also significantly increased with increased interval from ACL injury to surgery, but this association did not occur until 24 to <60 months. LFC lesions were 11.5 times more likely to be present after an injury-to-surgery interval of 24 to <60 months and 25.0 times more likely after >60 months when compared with <3 months ($P < .001$). LTP lesions were 5.1 times more likely to be present after an interval of 24 to <60 months and 4.7 times more likely after >60 months when compared with <3 months ($P = .017$). MTP lesions were significantly increased with an interval >6 months versus 0 to <6 months ($P = .014$) (Table 4). Prospective studies on the outcomes of ACL-injured knees have found that rates of late surgery for treatment of meniscal or ligament injury fall off significantly after 2 years from the date of injury.^{5,9} As a result, the late development of lateral compartment changes raises the

possibility that these are degenerative changes rather than a direct result of the injury.

Limitations of this study include its retrospective nature and selection bias given that it involved patients at a single institution. The study population also included only those who elected to undergo surgery; thus, results may not be generalizable to patients with ACL injury being managed nonoperatively. It was unknown whether patients had initially attempted nonoperative treatment before undergoing ACL reconstruction. In addition, the creation of groups for time from injury to surgery lowered the statistical power of the analysis. However, we attempted to address this issue by combining subgroups when necessary. Another limitation of our study was the fact that we did not analyze injury severity, just the presence or absence of injury. Furthermore, as this was a retrospective chart review, we were limited to the variables available in the electronic medical record. We did not have data on level of activity before or after injury, which likely confounded our conclusions regarding the relationship of time from injury to surgery and the prevalence of other intra-articular injuries. We also did not have information regarding mechanism of injury; further study investigating its effects could be useful in clinical practice. Finally, although these data can be useful for patient counseling and education, we do not know if ACL reconstruction effectively prevents or slows the development of associated meniscal and chondral injuries. We can infer that for a given interval from ACL injury to reconstructive surgery the surgeon is likely to encounter certain associated pathologies. Specifically, the data showed that with intervals from 6 to <12 months between ACL injury and reconstruction, the prevalence of MMTs and MTP and MFC lesions was significantly increased. In patients with intervals from 24 to <60 months between ACL injury and reconstruction, there was an increased prevalence of lateral compartment chondral lesions, but it is unclear if this was due to injury or a result of degenerative changes.

A strength of this study is its sample size and frequency of increased time from injury to surgery. This allowed for a more accurate description of rates of intra-articular pathology with longer intervals between ACL injury and surgery. In addition, the use of logistic regression rather than a chi-square test allowed for control of factors that are known confounders for secondary intra-articular injuries, such as BMI and age.

CONCLUSION

This study showed that intervals ≥ 6 months between ACL injury and reconstructive surgery are associated with an increased prevalence of MMTs and medial compartment cartilage injury. Longer time from injury to surgery is associated with increased incidence of other intra-articular injuries. These data support reconstructing ACL tears within 6 months of injury to decrease the incidence of secondary meniscal tears and articular cartilage injury in patients with symptomatic ACL-deficient knees who desire surgery.

ACKNOWLEDGMENT

The authors acknowledge Sheena Black, MD.

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