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Patient-Reported Outcomes After Multiligament Knee Injury

MCL Repair Versus Reconstruction

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Background: Management of the medial collateral ligament (MCL) in the setting of a multiligamentous knee injury (MLKI) represents an area of great controversy.

Purpose: Our study was designed to compare long-term patient-reported outcomes (PROs) after MCL repair versus reconstruction in the setting of a multiligamentous injury of the knee.

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

Methods: At a single institution, 68 patients were identified over a 10-year period as having MCL intervention in the setting of MLKI. Of these patients, 34 (50%) were successfully contacted via telephone to collect Lysholm and International Knee Documentation Committee (IKDC) scores. A retrospective chart review of these subjects was also conducted to identify patient and surgical factors affecting PROs.

Results: At a mean 6-year follow-up (range, 2-11 years), the mean Lysholm score was 77.4 ± 23.1 and mean IKDC score was 72.6 ± 23.6. Univariate analyses identified time to surgery ($P = .005$) and MCL reconstruction ($P = .001$) as risk factors for Lysholm score ≤ 75. Univariate analyses identified patient age ($P = .049$), time to surgery ($P = .018$), and MCL reconstruction ($P = .004$) as risk factors for IKDC score ≤ 75. On subsequent multivariate analysis, MCL reconstruction was found to be a predictor of Lysholm or IKDC score of ≤ 75.

Conclusion: Patients undergoing MCL repair in the setting of MLKI generally had higher PROs than those undergoing reconstructions at a mean 6 years of follow-up. Further work is needed to elucidate patient and surgical factors that may influence subjective outcomes after multiligament knee injuries.

Keywords: multiligament; knee; repair; reconstruction; outcomes; medial collateral ligament

The medial collateral ligament (MCL) is the most commonly injured ligament in the knee and is often damaged in patients with knee dislocations or multiligamentous knee injuries (MLKIs). MLKIs are defined as injury to at least 2 of the 4 major knee ligaments: the anterior cruciate ligament (ACL), the posterior cruciate ligament (PCL), posterolateral corner (PLC), and the MCL.[18,19] MLKIs present a unique problem to orthopaedic specialists, and optimal management of these devastating injuries is an area of continued debate.[6,18] There is little evidence to suggest the best strategy for managing MCL injury. Some suggest early conservative management of the MCL with bracing and delayed reconstruction of other injured ligaments.[6] With this approach, eventual surgical management of the MCL injury may be considered if excess valgus laxity is present intraoperatively after reconstruction of other ligaments.[3,18,24] Others recommend a 2-stage approach, with early primary MCL repair or reconstruction followed by reconstruction of other injured ligaments several weeks later.[1,11,18]

While there have been efforts to develop patient-reported outcome (PRO) instruments specifically for those with MLKI, a widely accepted, validated instrument is not available.[4] Of the studies evaluating outcomes in MLKIs, the

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Tegner Lysholm Knee Scoring Scale (Lysholm) and International Knee Documentation Committee (IKDC) Subjective Knee Evaluation PROs are most often used.[23] The Lysholm and IKDC PRO instruments are both reliable and valid assessments of the functional outcomes of patients with knee injuries.[9,17,26]

There is a paucity of previous literature directly comparing different management strategies for MCL tears in the setting of an MLKI.[6,11] This is likely because MLKIs are relatively uncommon, have varying mechanisms of injury, can be associated with multitrauma accidents, and are poorly suited for a randomized controlled trial design.[2] The purpose of this work was to (1) understand the long-term PROs of MCL repair and reconstruction in the setting of an MLKI and (2) identify risk factors for poor PRO measures in those who had an MCL repair or reconstruction as part of an MLKI.

METHODS

A retrospective chart review was conducted identifying all MLKIs with associated MCL repair or reconstruction at a single institution over a 10-year period. Surgery was performed by 1 of 3 surgeons at our institution (B.R.W., A.A., or M.B.). Surgical technique and indication for MCL intervention was uniform among all surgeons. The MCL was intervened upon if it was found to be Fetto-Marshall grade 3 on examination, defined as opening asymmetrically with valgus stress (>2-3 mm compared with the contralateral, unaffected limb) in full extension and 30° of flexion.[7] Fetto-Marshall grade 1 and 2 MCL injuries were managed nonoperatively and not included in this cohort.

In all cases, the superficial MCL (sMCL) was repaired or reconstructed. If tissue quality allowed, femoral and tibial avulsions that were 6 weeks out or less from injury were repaired using suture anchors or screws. After repair was performed, the posterior oblique ligament (POL) and posteromedial capsule (PMC) were mobilized and imbricated anteriorly over the sMCL using a pants-over-vest technique.

Reconstruction was chosen for chronic injuries (>6 weeks old) or acute tears not amenable to repair (midsubstance tears). All sMCL reconstructions were performed using nonirradiated semitendinosus allograft. The graft was attached using described landmarks on the femur and tibia for the sMCL: just proximal and posterior to medial femoral epicondyle and 6 cm distal to the joint line, just anterior to the crest.[12,13,28] Interference screws with sockets were used on both the femur and tibia, and the sMCL was tensioned at 30° of flexion. As with the repairs, the POL and PMC were translated anteriorly and imbricated over the top of the MCL reconstruction. The postoperative protocol was not standardized; however, patients undergoing PCL repair/reconstruction had a slower progression to full flexion than those who did not.

Retrospective review identified 68 potential patients meeting inclusion criteria. Subsequently, patients were individually contacted via telephone by members of the research team. Patients were first asked whether they would feel comfortable with a 5- to 10-minute phone interview that would involve the administrations of 2 validated PRO questionnaires (Lysholm and IKDC) over the phone.

TABLE 1
Patient Demographics and Injury Characteristics[a]

	Reconstruction (n = 17)		Repair (n = 49)	
Age, mean ± SD, y	27.47 ± 12.43		23.78 ± 9.06	
BMI, mean ± SD, kg/m^2	30.26 ± 8.26		27.08 ± 5.37	
Time to surgery, mean ± SD, d	207.12 ± 172.71		76.52 ± 177.00	
	n	%	n	%
ACL + MCL	11	64.71	24	48.98
PCL + MCL	1	5.88	4	8.16
ACL + MCL + PCL	3	17.64	18	36.74
ACL + MCL + PCL + MPFL	0	0	1	2.04
ACL + MCL + PCL + PLC	1	5.88	1	2.04
ACL + MCL + PCL + LCL	1	5.88	1	2.04

[a]ACL, anterior cruciate ligament; BMI, body mass index; LCL, lateral collateral ligament; MCL, medial collateral ligament; MPFL, medial patellofemoral ligament; PCL, posterior cruciate ligament; PLC, posterolateral corner.

Of the 68 potential patients, 34 (50%) were successfully contacted and subsequently included in the present study. No patients refused study participation if they were located and able to be contacted. To identify pertinent patient factors that were suspected to have an effect on patient outcome, a retrospective chart review was conducted for the 34 subjects included in the study.

A PRO instrument cutoff of ≤75 was utilized for both the Lysholm and IKDC instruments (range, 0-100) to provide 2 comparative patient cohorts for each variable considered in univariate and multivariate analyses. Univariate and subsequent multivariate analyses were conducted to determine risk factors for a Lysholm or IKDC score of ≤75. Univariate analysis considered patient age, sex, body mass index (BMI), mechanism of injury (high vs low energy), nerve injury, meniscal repair or debridement, presence of fracture at time of injury, time to surgery after injury, concomitant ACL surgery, concomitant PCL surgery, and MCL repair versus reconstruction. High-energy mechanisms were defined as motor vehicle collisions, pedestrian versus car, all-terrain vehicle (ATV) accidents, or falls more than 5 feet.

Statistical analyses conducted included Student *t* tests for continuous variables and chi-square or exact tests for categorical variables. We then attempted to control for confounders by conducting a multivariate logistic regression analysis. We identified any variable as fit for our multivariate model if $P < .2$ in the univariate analysis. Odds ratios (OR) with 95% CIs were calculated. Statistical significance across the multivariate model was considered as $P < .05$. SAS (version 9.3; SAS Institute) was utilized to perform the statistical analysis.

RESULTS

Of the 34 responders, 76.5% were male and 23.5% female; mean follow-up was 6 ± 2.64 years (range, 2-11 years). Mean BMI was 29.2 kg/m^2, with 65% of patients having a

TABLE 2
Univariate Lysholm Score Results of Patients Undergoing Knee Surgery for Multiligament Knee Injury[a]

Characteristic	Lysholm >75, %	Lysholm ≤75, %	Unadjusted *P* Value
Age at injury, y			
<25	70.8	40	.243
25-35	12.5	30	
>35	16.7	30	
Sex			
Male	70.8	90	.386
Female	29.2	10	
BMI, kg/m^2			
<30	66.7	60	.714
≥30	33.3	40	
Mechanism of injury			
High	37.5	50	.704
Low	62.5	50	
Nerve injury			
Yes	4.2	0	>.999
Meniscal repair or reconstruction			
Yes	37.5	40	>.999
Nonorthopaedic injury			
Yes	12.5	20	.618
Fracture			
Yes	20.8	30	.666
Days to surgery			
0-30	75	20	*.005*
31-90	8.3	10	
>90	16.7	70	
MCL repair vs reconstruction			
Repair	87.5	40	*.001*
Reconstruction	12.5	60	
ACL repair or reconstruction			
Yes	87.5	80	.618
PCL repair or reconstruction			
Yes	45.83	70	.270

[a]Italicized *P* values indicate statistical significance. ACL, anterior cruciate ligament; BMI, body mass index; MCL, medical collateral ligament; PCL, posterior cruciate ligament.

TABLE 3
Univariate IKDC Results of Patients Undergoing Knee Surgery for Multiligament Knee Injury[a]

Characteristic	IKDC >75, %	IKDC ≤75, %	Unadjusted *P* Value
Age at injury, y			
<25	79	40	*.049*
25-35	5.3	33.3	
>35	15.8	26.7	
Sex			
Male	68.4	86.7	.257
Female	31.6	13.3	
BMI, kg/m^2			
<30	68.4	60	.724
≥30	31.6	40	
Mechanism of injury			
High	68.4	53.3	.296
Low	31.6	46.7	
Nerve injury			
Yes	5.3	0	>.999
Meniscal repair or reconstruction			
Yes	31.6	46.7	.484
Nonorthopaedic injury			
Yes	10.5	20	.634
Fracture			
Yes	15.8	33.3	.417
Days to surgery			
0-30	78.95	33.33	*.018*
31-90	5.26	13.33	
>90	15.79	53.33	
MCL repair vs reconstruction			
Repair	94.7	46.7	*.004*
Reconstruction	5.3	53.3	
ACL repair or reconstruction			
Yes	84.2	86.7	>.999
PCL repair or reconstruction			
Yes	42.1	66.7	.185

[a]Italicized *P* values indicate statistical significance. ACL, anterior cruciate ligament; BMI, body mass index; IKDC, International Knee Documentation Committee; MCL, medical collateral ligament; PCL, posterior cruciate ligament.

BMI of <30 kg/m^2. Mean age was 26.1 years, with 62% of patients younger than of 25 years (Table 1). The sMCL was repaired in 25 patients (73%) and reconstructed in 9 patients (27%). Mean time to reconstruction was 207.1 days (range, 7-608 days), whereas mean time to repair was 76.5 days (range, 4-1109 days). There were 2 patients who had a combination of repair and reconstruction of their MCL. The mean Lysholm score was 77.4 ± 23.1, and the mean IKDC score was 72.6 ± 23.6 for all 34 patients undergoing either MCL repair or reconstruction in the setting of MLKI. The mean Lysholm score was 83.8 in those undergoing MCL repair versus 59.4 in those undergoing MCL reconstruction (*P* = .005), whereas the mean IKDC score was 79.1 in those undergoing MCL repair versus 54.3 in those undergoing MCL reconstruction (*P* = .006). Univariate analyses identified time to surgery (*P* = .005) and MCL reconstruction (*P* = .001) as risk factors for Lysholm score ≤75 (Table 2).

Univariate analyses identified patient age (*P* = .049), time to surgery (*P* = .018), and MCL reconstruction (*P* = .004) as risk factors for IKDC score ≤75 (Table 3). On subsequent multivariate analysis, MCL reconstruction was found to be a predictor of Lysholm or IKDC score ≤75. Those who underwent MCL reconstruction as opposed to MCL repair in the setting of MLKI were 10.5 times (95% CI, 1.82-60.45; *P* = .009) as likely to have a Lysholm score ≤75 and 23.9 times (95% CI, 2.21-258.37; *P* = .009) as likely to have an IKDC score ≤75.

DISCUSSION

The proper strategy for treatment of MLKIs is still an ongoing topic of debate.[14,15] We aimed to understand the long-term PROs of MCL repair and reconstruction in the setting of MLKI and to also identify risk factors for poor PRO measures. Mean PROs among those who undergo MCL repair or reconstruction in the setting of MLKI were studied at a mean 6-year follow-up. We found MCL repair to be predictive of higher PRO scores at mean 6-year follow-up. Notably, we found that BMI, concomitant injuries (orthopaedic or other), mechanism of injury, and associated knee damage (fracture, meniscal injury, etc) did not have an impact on PRO scores.

There is little known about outcomes after MCL repair versus reconstruction in the current literature, as MLKIs are rare and very difficult to directly compare. The mean Lysholm and IKDC scores reported in this study are consistent with other long-term PRO findings after MLKI.[10] Interestingly, our findings contradict prior work that identified MCL repair as a significant predictor of lower PROs[10] and failure after surgery.[25] We found that those who underwent MCL repair reported higher PRO measures than those who underwent MCL reconstruction.

Our findings are thought to be related to several complex independent factors, which are often difficult to quantify. First, timing of surgical intervention may be a major factor. Those with repairs tended to have earlier surgical intervention, which could influence PROs, and there are several studies that support the benefits of early surgical intervention.[8,14,16,27]

Furthermore, it is critical that the native anatomy and biomechanics are restored during surgical intervention on the MCL.[5,12] Reconstruction offers a greater technical challenge over repair, as the restoration of native anatomic alignment is often not straightforward.[5] In reconstructive surgery, attachments, graft type tensioning, and size are determined by the surgeon and can be quite variable. Additionally, differences in the location (midsubstance vs avulsion injury) and nature of the tear within the ligament may also be variables that influence outcomes. Ligaments are amenable to repair only if there is sufficient and robust tissue, which may suggest that these patients had a less severe soft tissue injury, and thus, better outcomes.

We acknowledge that there are several limitations to this retrospective review with only 50% follow-up. Patients undergoing MCL reconstruction did have a longer time to surgery than those undergoing repairs, which is recognized as a potential limitation as this may have confounded PROs. Oftentimes, it is a patient's clinical status, neurovascular examination, or other associated injuries that may drive a surgeon to perform surgery in a certain time frame. These factors may force a surgeon to operate later than anticipated, and delays in surgical intervention generally preclude the ability to repair the ligament because of poor-quality tissue. Although our patient population did not show any significant differences in the presence of additional injuries on patient outcomes, injury severity scores were not calculated. Second, we only have a small sample size from a single-center institution, and there were only 9 reconstructions evaluated. These patients were also treated by 3 separate surgeons, with no standardized postoperative protocol. Postoperative rehabilitation protocols have been suggested to be important in preventing physical limitations and poor outcomes in MLKIs treated in a single stage.[20-22] We have no ability to account for specific postoperative rehabilitation protocols experienced by patients in this study, which could have significantly influenced outcomes (final knee range of motion, strength, etc).

Finally, only PROs were assessed, which may not fully account for patient function. Objective outcomes, such as physical examination and radiographic findings, should also be considered to obtain a more thorough understanding of the long-term outcomes after MCL injury in the setting of MLKI. Furthermore, the addition of a nonoperative group for comparison of PROs would enhance the utility of this study in guiding when one should repair, reconstruct, or manage the injury conservatively. Despite the limitations of this study, the information is useful in understanding long-term outcomes after MLKI and adds to the growing body of literature on the management of MCL injuries in the multiligament knee.

CONCLUSION

MLKIs are rare but devastating injuries, and the most successful approach to MCL management in this setting is unclear. In this cohort, we found that patients undergoing MCL repair generally had higher PROs at a mean 6-year follow-up. We identify the need for further prospective work in this area, as it is critical to elucidate patient and surgical factors that may influence subjective outcomes after MLKIs.

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