No Difference Between Posterolateral Corner Repair and Reconstruction With Concurrent ACL Surgery

Results From a Prospective Multicenter Cohort

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Background: Injuries to the posterolateral corner (PLC) may occur concurrently with anterior cruciate ligament (ACL) injury.

Purpose/Hypothesis: This study evaluated the outcomes of patients who underwent operative management of PLC injuries concurrently with ACL reconstruction in a prospective multicenter cohort. We hypothesized that there would be no differences in outcomes between patients who were treated with PLC repair and PLC reconstruction.

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

Methods: Patients undergoing ACL reconstruction were enrolled into a prospective longitudinal multicenter cohort between 2002 and 2008. Those with complete 6-year follow-up data (patient-reported outcomes and subsequent surgery information) were identified. Excluded from the study were patients with posterior cruciate ligament injuries. Patients who underwent PLC repair were compared with those who underwent PLC reconstruction with regard to interval from injury to surgery, need for revision surgery, and long-term outcomes at 6 years.

Results: During the identified time frame, 3026 identified patients underwent primary ACL reconstruction; 34 (1.1%) also underwent concurrent PLC surgery (15 repairs, 19 reconstructions [18 allografts, 1 autograft]). With the numbers available, we did not detect significant differences between groups regarding the rate of meniscal or chondral injuries. Median time to PLC reconstruction was 121 days as compared with 19 days for concurrent ACL reconstruction and PLC repair ($P = .01$). There were no between-group differences in Marx activity scores prior to surgery ($P = .4$). At 6-year follow-up, there were no between-group differences in Knee injury and Osteoarthritis Outcome Score ($P = .36-.83$) or International Knee Documentation Committee score ($P = .84$); however, patients treated with PLC reconstructions had lower Marx activity scores (4.1 vs 9.4; $P = .02$). There was 1 ACL revision in the PLC reconstruction group, and 1 of the PLC repairs was revised to a reconstruction during the follow-up period.

Conclusion: Good outcomes were achieved at 6-year follow-up with both repair and reconstruction of PLC injuries treated concurrently with ACL reconstruction. The PLC reconstruction group had lower activity levels 6 years after surgery. The present data suggest that, for appropriately selected patients undergoing acute surgical treatment of combined ACL and PLC injuries, PCL repair can achieve good long-term outcomes.

Keywords: ACL; posterolateral corner; outcomes; repair; reconstruction

Injuries to the posterolateral corner (PLC) of the knee often involve concurrent damage to the anterior cruciate ligament (ACL), and they can be disabling without proper treatment. Over the past 3 decades, our understanding of the functional anatomy and biomechanics of the posterolateral knee has tremendously improved.[6,9] Restoring posterolateral stability is important for the promotion of functional knee biomechanics and also protection of concurrent cruciate ligament reconstructions.[2,6] While we have gained important insights regarding the basic science aspects of PLC injury, debates continue regarding which surgical techniques (repair or reconstruction) are associated with meaningful improvements in patient outcomes.

Studying patient outcomes in the multiligament knee injury population has posed a challenging task. These patients often have traumatic knee injuries, and some have

concurrent fractures or nerve or vascular injuries.[4,5] These combined factors are known to influence patient outcomes. Furthermore, studies evaluating the outcomes after PLC and ACL surgery try to combine staged surgery (performing the ACL reconstruction [ACLR] at a different time than the PLC repair or reconstruction) with combined surgery (performing the ACLR at the same time as the PLC is addressed) at different decision points after injury. Given these weaknesses, the current literature does not clearly support a single technique or surgical approach to these complex knee injuries.

Two retrospective studies[7,11] have demonstrated increased revision surgery rates in patients treated with staged ACLR and PLC repair as compared with PLC reconstruction. No prospective study has sought to answer if the technique (repair or reconstruction) for combined PLC and ACL injuries influences the outcome of the patient. We hypothesized that there would be no difference in patient-reported outcomes or revision surgery between those treated with ACLR and PLC repair and those treated with ACLR and PLC reconstruction.

METHODS

In an ongoing, institutional review board—approved, multicenter prospective cohort study, 3026 patients were identified to have undergone ACLR between 2002 and 2008. Of the cases identified, 2589 (86%) had 2-year follow-up, and 2553 (84%) had 6-year follow-up. There were 17 surgeons contributing cases in this multicenter study.

All patients undergoing an ACLR consented to participate in the study. Following consent, each patient completed a 13-page questionnaire, and this was considered time 0. The same questionnaire was completed again at 2- and 6-year follow-up. Data derived from the questionnaire included demographics, injury information, previous knee surgery, current therapy, and comorbidities. The questionnaire also contained a series of validated patient-reported outcome instruments, including the Knee injury and Osteoarthritis Outcome Scores (KOOS),[10] the International Knee Documentation Committee (IKDC)[1] Subjective Knee Evaluation Form, and the Marx activity rating scale.[8]

At the time of ACLR, surgeons completed a detailed questionnaire about the examination, observed pathology and treatment, and surgical technique utilized. All examinations of the collateral ligaments and PLC were performed under anesthesia prior to ACLR, and these findings were documented. Patient and surgeon forms were then scanned with Teleform software (OpenText) and managed in a central database.

Patients who underwent either repair or reconstruction of the PLC in conjunction with ACLR were included in the analysis. Those with concurrent medial collateral ligament and posterior cruciate ligament injuries were excluded. If surgery occurred within 30 days of the injury, it was classified as "acute." Time of injury was self-reported by patients and documented at the time of surgery. Timing of surgery was made on a case-by-case basis by the treating surgeon. The decision to repair or reconstruct the PLC was ultimately up to the treating surgeon and was based on diagnostic imaging (magnetic resonance imaging) and an examination under anesthesia; in general, patients with avulsions, if seen acutely, were treated with repair. Patients presenting on a delayed basis or those with midsubstance injuries were offered reconstruction. At time 0 and at 2- and 6-year follow-up, patient-reported outcomes (KOOS, IKDC, and Marx scores) were assessed in the study group. Group outcomes were compared with the Student t test for continuous variables and the chi-square test for categorical variables; significance was set to $P < .05$.

RESULTS

Initially, 3026 patients were identified to have undergone primary ACLR during the identified time frame, with 34 of 3026 (1.1%) also undergoing PLC surgery: 15 repairs and 19 reconstructions (18 allografts, 1 autograft). Baseline information is shown in Table 1.

Of the patients in the study group, 70.5% (24 of 34) were male; the mean ± SD age was 27.2 ± 13.5 years; and the mean body mass index was 27.5 ± 5.2. The mean age of patients undergoing PLC reconstruction was 30.2 versus 23.2 years for PLC repair ($P = .12$). The mean body mass index for patients undergoing reconstruction was 27.4 versus 27.6 for repair ($P = .91$). Males composed 58% (11 of 19) of the reconstruction group and 87% (13 of 15) of the repair group ($P = .04$). The median time from injury to combined reconstruction was 121 days, which was significantly

TABLE 1
Patient Demographics

	Reconstruction (n = 19)	Repair (n = 15)	P
Mean age, y	30.2	23.2	.12
Mean body mass index	27.4	27.6	.91
Male, %	58	87	.04

TABLE 2
Concurrent Intraarticular Pathology (Already Present)

Concurrent Intra-articular Pathology	n	%
Meniscal tear		
Medial	5	15
Lateral	10	29
Femoral condyle articular injury		
Medial	7	21
Lateral	6	18
Tibial plateau articular injury		
Medial	2	6
Lateral	6	18
Patellofemoral articular injury	6	18

longer than the time between injury and repair (median, 19 days; P = .01). Overall, there were 5 medial meniscal tears (15%) and 10 lateral meniscal tears (29%). Articular cartilage injuries to the lateral femoral condyle were seen in 6 of 34 (18%); lateral tibial plateau, 6 of 34 (18%); medial femoral condyle, 7 of 34 (21%); medial tibial plateau, 2 of 34 (6%); and patellofemoral compartments, 6 of 34 (18%) (Table 2). There were no differences in the rate of meniscal or chondral injuries between the repair and reconstruction groups.

Baseline Data

Mean preoperative scores were significantly lower in the repair group with respect to KOOS pain (57.4 vs 74.4), KOOS Activities of Daily Living (62.3 vs 76.2), KOOS Knee-Related Quality of Life (17.5 vs 30.9), and IKDC (29.2 vs 48.4, P = .004) (Table 3). There were no differences between groups in Marx activity scores prior to surgery (P = .4). Outcome instruments at baseline likely reflect the impairment seen from the acute knee injury in the repair group.

Six-Year Follow-up

At 6-year follow-up, there were no between-group differences with regard to KOOS (P = .36-.83) or IKDC scores (P = .84). Patients treated with lateral reconstructions had lower Marx activity scores at 6 years (4.1 vs 9.4, P = .02). There was 1 ACL revision in the PLC reconstruction group, and 1 of the PLC repairs (1 of 15, 6.7%) was revised to a reconstruction during the follow-up period.

TABLE 3
Patient-Reported Outcomes[a]

	PLC Reconstruction[b]			PLC Repair[b]		
	Enrollment	2 y	6 y	Enrollment	2 y	6 y
KOOS						
Symptoms	68.8	78.8	80.5	57.1	79.1	75.6
Pain[c]	74.4	85.2	87.2	57.4	87.4	78.9
ADL[c]	76.2	91.5	90.0	62.3	93.8	88.2
Sports/ Recreation	43.9	70.8	72.9	40.8	77.7	62.5
KRQOL[c]	30.9	60.9	63.2	17.5	59.6	54.2
Marx	11.0	6.9	4.1	12.7	8.2	9.4
IKDC[c]	48.4	73.6	71.2	29.2	77.3	67.3

[a]ADL, activities of daily living; IKDC, International Knee Documentation Committee; KOOS, Knee injury and Osteoarthritis Outcome Score; KRQOL, Knee-Related Quality of Life; PLC, posterolateral corner.

[b]Each comparison between preoperative (enrollment) scores and 6-year outcomes was significant at P < .01.

[c]Clinically significant difference at the time of enrollment between the PLC reconstruction and PLC repair groups.

Post Hoc Power Analysis

A post hoc power analysis was performed (P = .8, alpha = 0.05), and a sample size of 212 cases would be required to reach sufficient power.

DISCUSSION

The present work demonstrates that combined ACL and PLC surgery is rare, representing about 1% of the multicenter cohort's study population. PLC repairs were performed acutely (usually within 3 weeks), while PLC reconstructions were performed further from the time of injury. Patient-reported outcomes were similar between the reconstruction and repair groups at 6 years, with no statistically or clinically relevant differences between them. However, patients treated with PLC reconstruction had significantly lower activity scores 6 years after surgery as compared with patients with repairs. Only 1 PLC repair was revised to a reconstruction. Several of these findings warrant further discussion.

Performing PLC reconstructions has been a growing trend owing to concerns of high failure of repair. Historical reports cite a high failure rate for PLC repair in the setting of ACLR.[7,11] Stannard et al[11] in a level 2 study evaluated 56 patients with minimum 2-year follow-up who underwent either repair or reconstruction of the PLC depending on tissue characteristics. While no differences were noted in 36-Item Short Form Health Survey, IKDC, and Lysholm scores between PLC repairs and reconstructions, repairs were revised more frequently (37% vs 9%, P = .04). Cruciate reconstructions were more commonly staged in the PLC repair group than the reconstruction group in their study. This could be offered as an explanation for the high failure rates of PLC repairs; with staged reconstruction of the

ACL, perhaps increased forces were seen at the repair site, leaving the tissue susceptible to failure.

Levy et al[7] in a level 3 study evaluated 42 patients with minimum 2-year follow-up after PLC repair or reconstruction. They noted that PLC repairs were associated with an increased failure rate as compared with reconstructions (40% in the repair group vs 6% in the reconstruction group). They did not detect differences in subjective outcomes (Lysholm or IKDC scores) or clinical examinations (range of motion, varus stress laxity). Patients in the repair group had surgery in a staged fashion. The collaterals were repaired first (mean time, 19 days from injury), followed by delayed cruciate reconstructions. The PLC reconstructions were all performed in a single stage with ACLR. Our present data corroborate findings by Levy et al and Stannard et al[11] that PLC technique was not associated with differences in patient-reported outcomes. However, our failure rate for PLC repairs was 7%, as opposed to 37% and 40% from previously reported studies.[7,11] This could partially be explained by single-stage surgery for PLC repairs in our cohort—with the addition of a cruciate reconstruction, the knees may be more stable and protective of lateral repairs. Another possible explanation might be that cases included in the previously published series[7,11] were more commonly 3- or 4-ligament injuries and therefore inherently less stable. PLC repairs in the studies by Levy and Stannard were generally performed in isolation, followed by a delayed ACLR. With appropriately selected cases, single-stage surgery (repair or reconstruction and ACLR) appears to be safe, with low failure rates for combined injuries if treated with PLC repair.

Patients treated with PLC repair in the present study had a higher postoperative activity level 6 years after surgery when compared with PLC reconstruction patients (Marx scores, 9.4 vs 4.1). Preoperative activity levels were similar between groups. Other outcome metrics used (KOOS, IKDC) found no such difference between techniques. One potential explanation is that patients in the reconstruction group were older and more commonly female, and these could be potential confounders on activity scores.[3,8] Also, early surgery (repair) may have been chosen for less severe injuries, introducing a selection bias that could explain the differences in activity after surgery.

The present study has several strengths. It is the first report, to our knowledge, that evaluates combined ACLR and PLC repairs and reconstructions 6 years from surgery. The study was prospectively conducted, and the multicenter study design leads toward generalizable findings and conclusions. Validated patient-reported outcome instruments were used to define patient outcomes. Injury characteristics known to influence outcome (meniscal and articular cartilage) were accurately captured as part of the study design.

The present study does have several limitations. These include a low sample size, leaving the data at risk for type II error. It should be recognized that these injuries are rare, and an extremely large data set of ACLRs would be required to obtain a robustly powered cohort on this topic. Physical and stress examinations were not performed at 6-year follow-up, although physical examination metrics have not proven significant in following this injury pattern.[7,11] The study is subject to selection bias, as the decision to repair or reconstruct was at the surgeon's discretion. Patients who underwent acute repairs may have injuries that were less severe than those for patients who were delayed for reconstruction, and this could have introduced bias as well.

CONCLUSION

Good outcomes were achieved at 6-year follow-up with both repair and reconstruction of PLC injuries treated concurrently with ACLR. Patients treated with PLC reconstruction had lower activity levels 6 years after surgery. Lower KOOS and IKDC scores in the PLC repair group at the time of surgery may be explained by the increased time interval between injury and surgery in the PLC reconstruction group. One of the 15 PLC repairs required a later reconstruction. Contrary to recent reports, our data suggest that appropriately selected patients may be successfully treated with acute PLC repair with good long-term outcomes.

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