Outcomes of Surgical Treatment of Posterolateral Instability of the Knee

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Abstract

The purpose of this review is to assess the outcomes of surgical treatment of posterolateral instability of the knee in an evidence-based manner. The majority of the existing outcomes literature on posterolateral instability consists of small, level IV case series and level III retrospective studies. Outcomes of surgical treatment of posterolateral instability of the knee are difficult to compare because of the heterogeneous presentation of posterolateral corner (PLC) injuries, the variability of their associated injuries, and their relative rarity. As such, three common types of surgical intervention for posterolateral instability are explored separately in this article, including acute repair, acute reconstruction, and chronic reconstruction. In general, the current literature supports early anatomic repair of all soft tissues and concomitant PLC reconstruction; however, because of the variability of posterolateral injury, surgical treatment options should be tailored to the patient, depending on the severity and chronicity of the posterolateral instability, as well as the associated injuries present.

Keywords
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The outcomes of surgical treatment for posterolateral knee instability are highly variable because of the heterogeneous presentation of posterolateral corner (PLC) injuries. The mechanism of injury to the PLC is most commonly a combined hyperextension and varus force to the knee, and it is frequently the result of high energy or sports trauma.[1] As such, PLC tears are rarely isolated (1.6% of all the knee ligament injuries) and are often associated with concomitant ligament injury.[2,3] Anterior cruciate ligament (ACL) or posterior cruciate ligament (PCL) injuries generally occur in conjunction with PLC injuries, and concomitant medial collateral ligament and posteromedial complex injuries also occur in the case of knee dislocations.[4] Other commonly associated pathologies include vascular compromise, neurological injury to the peroneal nerve, and periarticular fracture.[5–12] Outcomes of surgical treatment of the PLC vary significantly depending on the type and severity of these associated injuries.

The severity of PLC injuries determines whether nonoperative or operative treatment is recommended. Grade-I or grade-II PLC injuries with minimal or partial ligament tearing can often be treated nonoperatively with success.[2] Grade-III injuries (complete tears) of the PLC, however, have poor results when treated nonoperatively and lead to gait abnormalities, quadriceps atrophy, and chronic posterolateral instability of the knee.[13] The current treatment recommendation for grade-III PLC injuries, especially when combined with cruciate ligament injuries, is surgical repair with reconstruction.

The time from injury to surgery also affects the outcome of operative treatment for posterolateral instability. When a PLC injury is diagnosed at initial evaluation and the patient's condition and skin around the knee are amenable for repair or reconstruction, acute operative intervention has shown superior outcomes than chronic surgical intervention.[14–16] While the literature lacks a consensus definition for the acute

phase, it ranges from 2 to 6 weeks following PLC injury.[14,16] Acute operative treatment is not always performed, however, because of missed diagnosis or associated injuries at initial evaluation. In the case of missed diagnosis, chronic PLC injury has been identified as a factor in failed ACL or PCL reconstructions. In other cases, limb-threatening or life-threatening injuries may delay operative treatment. While acute surgical treatment of the PLC can involve either repair and/or reconstruction, reconstruction is recommended to treat chronic PLC injuries, as tissue retraction and scar-tissue formation in the chronic phase can limit the effectiveness of the repair.

The purpose of this review is to assess the outcomes of surgical treatment of posterolateral instability of the knee in an evidence-based manner. Because of the relative rarity of isolated PLC injuries, we will focus on nonisolated, grade-III PLC injuries treated with either reconstruction or repair. Studies that failed to distinguish the outcomes of isolated versus nonisolated PLC injuries were excluded from this review. Based on current clinical recommendations for PLC treatment, we explored the outcomes of three common types of surgical intervention: acute repair, acute reconstruction, and chronic reconstruction. The outcomes for each type of surgical intervention are reviewed separately.

Outcomes of Acute Repair

Acute repair of the PLC can be used to treat low-energy traumas in which the tissue condition is adequate to support repair. Noncontact sport injuries are the most common mechanism of injury amenable to acute repair in the existing literature.[3,14,17] Outcomes for PLC injuries amenable to repair are improved when operated on earlier rather than later in the acute stage. A recent study by Shelbourne et al found that PLC tears repaired by 4 weeks postinjury fared significantly better than those repaired between 4 and 6 weeks postinjury.[14] Outcomes of early repair are likely to be superior than late repair because of the problems presented by tissue retraction, adhesions, and scarring of the peroneal nerve that arise in the first few weeks after injury. If operated within the first 2 weeks, the anatomy is much easier to define and anatomic repair can often be achieved easily.

In a 1983 level IV case series of 17 patients treated with direct PLC repair by suture, Baker et al found that 77% were good objectively, 85% of the knees were good subjectively, and 85% returned to pre-injury activity level.[1] In a second study, Baker et al reported that 11/11 patients who had repair of both the PCL and the PLC had good functional outcomes, while 10 of those patients had good objective and 8 had good objective outcomes.[18] Along with a study published by DeLee et al showing good to fair long-term results for 10 patients with lateral laxity, these case series in the 1980s helped demonstrate the improved objective and subjective outcomes that could be achieved by acute PLC repair.[3] More recently, Shelbourne et al found that 17 patients with knee dislocations who underwent lateral side repair fared well, with mean subjective total scores of 91.3 points on the International Knee Documentation Committee (IKDC) survey and 93.0 points on the Noyes survey.[14]

In recent years, however, several studies have suggested that primary repair is not sufficient to treat injuries to the fibular collateral ligament (FCL), popliteus tendon, or popliteofibular ligament (PFL).[17,19,20] These reports, which compare outcomes of acute repair to acute reconstruction, will be addressed in the next section.

Outcomes of Acute Reconstruction

Acute reconstruction has been shown to be an effective treatment option for posterolateral instability caused by either low-energy injuries or higher-energy knee dislocations in which the soft tissue is not repairable. Ibrahim et al recently reported the outcomes of 20 patients who underwent acute bicruciate reconstruction and PLC reconstruction using contralateral hamstring autograft. At an average follow-up of 44 months, the mean Lysholm score was 90 points, and 80% of the patients had good subjective and functional stability according to the IKDC scale.[21] This level IV case series demonstrates improved outcome scores and knee instability with acute reconstruction.

Two cohort studies have shown that reconstruction can have superior outcomes than acute repair in certain injury settings. In a prospective cohort study of 35 patients treated with acute repair and 22 patients treated with reconstruction of the PLC, Stannard et al found a higher failure rate in the repair group (37%) than in the reconstruction group (9%).[20] Levy et al studied an initial cohort of 10 patients with multiligament knee injury who underwent repair of lateral-sided injuries, followed by delayed reconstruction of the cruciate ligaments. This cohort was compared with 18 patients who underwent a single-stage, multiligament reconstruction. There were four FCL/PLC repair failures (40%) in the staged cohort compared with one FCL/PLC reconstruction failure (6%) in the single-stage cohort.[19] Neither Levy et al nor Stannard et al found significant differences in IKDC subjective or Lysholm scores at a minimum follow-up of 2 years, but this occurred after revision reconstruction for failed repairs or failed reconstructions. While differences in failure rates in Levy's study may also be attributable to single-staged versus dual-staged operative intervention, the results are consistent with Stannard et al and support acute, single-stage reconstruction over acute repair without reconstruction.

A "hybrid" surgical treatment of acute posterolateral knee injury has also been studied. In a level IV case series, Geeslin and LaPrade found that acute repair of avulsed posterolateral knee structures combined with acute reconstruction of midsubstance tears significantly improved the outcomes of 26 knees in terms of both the IKDC and the Cincinnati objective scores.[17] When comparing 10 knees treated with anatomic PLC reconstruction (reconstruction group) to 16 knees treated with PLC repair or repair and reconstruction (hybrid group), there were no significant differences in four of the five IKDC objective stability subscores. The hybrid treatment group, however, had significantly superior scores on the one-leg hop test at final follow-up (range, 2–3.9 years). These results may be due to the fact that the reconstruction group

had a significantly lower baseline Cincinnati total and IKDC subjective scores than the hybrid cohort.[17] It is possible that hybrid treatments, such as that described by Geeslin and LaPrade, may also have the benefit of preserved propriceptive function in the native PLC structures. Lee et al have shown that increasing the amount of preserved remnant in arthroscopic ACL reconstruction, for instance, significantly improved the functional outcome and proprioception in a case series of 16 patients.[22]

Based on the current literature, acute reconstruction is the preferred treatment for midsubstance tears of the FCL, popliteus tendon, or PFL that can be surgically managed in the first few weeks after knee injury. In view of this data, the preferred technique is acute repair within 2 weeks with concomitant PLC reconstruction with soft-tissue allograft.

Outcomes of Chronic Reconstruction

For PLC injuries that either cannot be treated acutely or are missed upon initial evaluation, reconstruction has been shown to effectively treat chronic varus and external rotational instability. High-energy traumas, such as motor-vehicle accidents, are the most common mechanisms of injury necessitating PLC chronic reconstruction.[23–25] Surgical technique (including single fibula sling procedure and "anatomic" reconstruction to address individual components of the PLC) and graft choice (including Achilles tendon allograft and hamstring autograft) varies significantly in the existing literature on chronic PLC reconstruction. Many level IV case series have addressed chronic PLC reconstruction, and clinical outcome scores generally improve significantly for each type of surgical procedure.

In 1996, Larson et al demonstrated a single femur to fibula sling procedure to treat posterolateral instability, and several studies in subsequent years found improved outcome scores in patients treated with variations of this technique.[26–29] In a case series of 19 patients who underwent PCL reconstruction and a Larson-type PLC reconstruction, Khanduja et al reported significant increases in mean Lysholm score, from 41.2 to 76.5, and mean Tegner score, from 2.6 to 6.4.[27] Similarly, Rios et al reported on 29 consecutive patients who underwent PLC reconstruction using a variation of the Larson procedure with concomitant reconstruction of one or both the cruciate ligaments. At a mean of 39 months postoperatively (range, 24–81 months), the mean Lysholm and Tegner knee scores were 83 and 6, respectively, with only two patients reporting poor outcomes because of complications.[28] Other studies have found below-normal outcomes for rotational laxity[25] or anterior stress radiography,[30] but overall the Larson technique and its variations have demonstrated improved subjective and objective outcomes of the knee following PLC reconstruction.

A handful of studies have reported improved patient outcomes using an "anatomic" technique to reconstruct the PLC. In 2005, Stannard et al reported the outcomes of 15 patients with multiligament knee injuries who underwent such a technique; at a 2-year follow-up, these patients had improved stability, with a mean Lysholm knee score of 92 and failure

rate of 13%.[31] LaPrade et al demonstrated an anatomic PLC reconstruction technique in 2004 and later on published the outcomes of a cohort of 64 patients treated with the technique. At a mean follow-up of 4.3 years, 46 patients within the cohort who underwent concomitant reconstruction of one or both the crucial ligaments had an overall modified Cincinnati score of 68.1 points and a significant preoperative to postoperative improvement in IKDC objective scores. These outcome scores did not differ significantly from the 18 patients within the cohort who underwent isolated PLC reconstruction.[32,33]

While numerous PLC surgical techniques have been described in the literature with varying degrees of success, there is a paucity of level II or level III studies to compare the different techniques. In one level III study, Kim et al compared the outcomes of patients undergoing PCL reconstruction with concomitant PLC reconstruction using either anatomic PLC technique (Group A) or a modified biceps rerouting tenodesis technique (Group B). The 21 patients in Group A showed better postoperative improvement on the dial test, IKDC score, and Lysholm score than the 25 patients in Group B at the 2-year follow-up. Kim et al cautioned, however, that there were no significant differences found between the two groups in posterior stress radiography, and that the mean differences of varus and external rotator stability were small.[34] Separately, a biomechanical study by Nau et al compared the anatomic technique described by LaPrade et al to a technique that uses one Achilles tendon allograft to reconstruct the FCL, the popliteus tendon, and the PFL followed by posterolateral capsular shift. In cadaveric specimens, both techniques yielded similar varus and external rotator stability.[35] Schechinger et al described the outcomes of a technique similar to that of Nau's and found that patients with 2-ligament injuries fared similar to those patients with multiligament injuries in IKDC subjective (80 points for both groups) and Lysholm scores (90 and 89 points, respectively). Neither group of patients had postoperative rotatory instability upon dial and external rotation testing.[24] There are no studies to date that have shown conclusively superior outcomes of one surgical technique over another; however, level I and II studies are needed to address this question.

Conclusion

Outcomes of surgical treatment of posterolateral instability of the knee are difficult to compare because of the heterogeneous presentation of PLC injuries, the variability of their associated injuries, and their relative rarity. The majority of the existing literature consists of small, level IV case-series and level III retrospective studies, and many combine patients with different mechanisms of injury and different patterns of multiligamentous injury into single cohorts. Variation in surgical technique, graft choice, and other treatment factors may also affect outcomes. There is a need for level I randomized controlled trials or level II prospective cohort studies with long-term outcomes to determine the most effective surgical treatment for PLC injury; however, such an investigation would be practically very difficult to complete.

Despite these limitations, the current literature supports single-stage PLC reconstruction with concomitant treatment of associated knee ligament injuries. If a patient is seen within 2 weeks of injury and surgery can be performed, the literature supports anatomic repair of all soft tissues and concomitant PLC reconstruction. Surgical treatment should be tailored to the patient, depending on the severity and chronicity of the PLC injury, as well as the associated injuries present.

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