Arthroscopic Primary Posterior Cruciate Ligament Repair With Suture Augmentation

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Abstract: Isolated posterior cruciate ligament (PCL) injuries are relatively rare and PCL injuries most commonly occur in the setting of multiligamentous knee injuries. PCL injuries can be treated with primary repair, which has the advantages of preserving the native tissue, maintaining proprioception, and minimal invasive surgery when compared with reconstruction surgery. Historically, primary repair of PCL injuries was performed in all tear types using an open approach, and, although the subjective outcomes were relatively good, patients often had residual laxity. Modern advances and increasing knowledge could improve the outcomes of PCL repair. With magnetic resonance imaging patients with proximal tears and sufficient tissue quality can be selected, and with arthroscopy and suture anchors minimal invasive surgery with direct fixation can be performed. Furthermore, with suture augmentation the healing of the repaired PCL can be protected and the residual laxity can be prevented. In this Technical Note, we describe the surgical technique of arthroscopic primary repair of proximal PCL tears with suture anchors and suture augmentation. The goal of arthroscopic primary repair is the preservation of the native PCL using a minimally invasive method and subsequent protection of this repair using suture augmentation.

Patient Selection

Arthroscopic primary PCL repair with suture augmentation can be performed in patients with proximal soft tissue avulsion tears and sufficient tissue quality. Although preoperative MRI can be used to assess the PCL tear location and the eligibility for primary repair, the final
decision is always made during arthroscopy. Ligament remnants that can be reapproximated to the femoral wall and have sufficient tissue quality to withhold sutures will be treated with primary repair with suture augmentation, whereas ligament remnants with insufficient tissue length or tissue quality will be treated with PCL reconstruction. Patients of all ages and activity levels can be treated with this technique including pediatric patients and patients with multiligamentous injured knees. Surgeons should be aware of this type of injury because it is relatively common: 94% to 97% of all PCL injuries occur in multiligamentous injured knees and 46% of these PCL injuries have been described to be proximal avulsion type tears.

Surgical Technique

General Preparation

The patient is placed in the supine position, and the operative leg is prepped and draped in a sterile fashion with a tourniquet around the thigh. Anteromedial and anterolateral portals are created, and a general inspection of the knee joint is performed. A malleable passport cannula (Arthrex, Naples, FL) is placed in the anteromedial portal for suture management. Using arthroscopy the ligament is inspected, and the tear location and tissue quality are assessed (Fig 1A, Video 1). The distal remnant of the PCL is then mobilized toward the femoral footprint using a grasper to assess if sufficient tissue length is present (Fig 1B). An anterior drawer force can be performed during the length assessment, because the tibia is sometimes subluxed posteriorly, which can lead to the false assessment that the distal remnant is too short for repair.

Table 1. Surgical Pearls and Pitfalls of Arthroscopic Primary Posterior Cruciate Ligament Repair With Suture Augmentation

| Pearls | Pitfalls |
|--------|----------|
| Use MRI to identify proximal tears preoperatively | Increased resistance with the SuturePasser could indicate a previously placed stitch |
| Assess tissue quality for eligibility of primary repair | Not deploying the suture anchor deep enough at the tibia can cause hardware irritation |
| Use a cannula for better suture management | |
| Use an accessory portal for docking sutures | |
| Perform anterior drawer force to reduce the tibia to the anatomic position before anchor fixation | |
| Load the anterolateral suture anchor with a suture augmentation | |
| Use a posteromedial portal for direct visualization of the tibial PCL footprint | |

MRI, magnetic resonance imaging; PCL, posterior cruciate ligament.
FiberWire suture is passed through the anterolateral bundle starting distally as close to the tibial insertion as possible. Then the SuturePasser is reloaded, and each subsequent stitch is passed more proximally in the opposite direction, thus creating an alternating-interlocking Bunnell pattern toward the avulsed proximal end. Using multiple stitches will increase the pullout strength, and starting distally ensures that the sutures also rely on the distal part that has the best tissue quality. If resistance is experienced with a pass, the SuturePasser should be repositioned to avoid cutting of a previously placed suture. Then, the same process is repeated for the posteromedial bundle using No. 2 TigerWire sutures (Fig 2A). The sutures of both bundles are then guided outside the knee via an additional accessory portal just above the anteromedial portal. Although the sutures and the PCL are protected via the accessory portal, the femoral footprint is roughened with a burr or shaver.

**Suture Fixation**

The arthroscope is now switched to the anteromedial portal to enable suture anchor management from the anterolateral portal, because this provides a better angle. With the knee at 90° of flexion, coming through the anterolateral portal, a suture hole is tapped, drilled, or punched (depending on the bone density) at the anterolateral origin of the PCL footprint. The sutures of the anterolateral bundle are then passed through the eyelet of a 4.75-mm Vented Biocomposite SwiveLock suture anchor, which is preloaded with a No. 2 FiberTape that will function as the suture augmentation. After an anterior drawer force is applied to restore the tibia to its anatomic position, the suture anchor is deployed and the anterolateral bundle is reapproximated to the footprint. Then, the same process is repeated for the posteromedial bundle using a suture anchor that is not preloaded with FiberTape. If a small gap exists between the PCL and the footprint, a core stitch from one of the suture anchors can be passed through the PCL from medial to lateral, and tied down with a Knot pusher (Arthrex) toward the femoral wall to compress the PCL back to the footprint (Fig 2B). After both bundles are reapproximated to the medial femoral condyle, the core stitches are removed, and the repair stitches are cut flush to the wall. The FiberTape is now docked via the accessory portal.

**Suture Augmentation**

For the distal fixation of the suture augmentation, a posteromedial portal is created under direct visualization using a spinal needle for localization. The arthroscope is then placed in the posteromedial portal. Although the tibial PCL footprint is visualized from posterior, a curved tibial guide is placed from the anteromedial portal down to the tibial PCL insertion. A cannulated drill is then used to drill up from the anteromedial cortex of the tibia to the tibial PCL footprint. The drill is retrieved, and a Micro SutureLasso (Arthrex) is passed up to the tibial PCL footprint. After the SutureLasso is retrieved through the anteromedial portal, the FiberTape is also retrieved through the anteromedial portal, and the FiberTape is passed through the SutureLasso. Then, the SutureLasso is retrieved distally through the knee joint and the tibial drill hole. The suture augmentation runs now from the

![Fig 2](image-url). (A) Arthroscopic view of a right knee, viewed from the anterolateral portal with the patient supine and the knee in 90° flexion. A suture passer (asterisk) is used to pass FiberWire sutures (arrow) to the posteromedial part of the posterior cruciate ligament (PCL). A TigerWire suture (arrowhead) is used to keep the PCL anteriorly and visible. (B) Arthroscopic view of a right knee, viewed from the anterolateral portal with the patient supine and the knee in 90° flexion. The PCL is reapproximated toward the femoral PCL footprint (asterisk) using both the anterolateral (arrow) and posteromedial (arrowhead) suture anchors. The suture augmentation, consisting of TigerTape, exits the anterolateral suture anchor (arrow).
anterolateral suture anchor down along the repaired PCL (Fig 3A) through the tibial and exits at the anteromedial tibial cortex. The FiberTape is tensioned, whereas an anterior drawer force is placed on the tibia with the knee at 90° of flexion, and fixed into the anteromedial tibial cortex using a 4.75-mm Vented Biocomposite suture anchor. The repair with suture augmentation is now complete (Fig 3B), and the knee stability is tested using the posterior drawer test.

Rehabilitation

The main goals of rehabilitation are controlling edema and regaining range of motion (ROM), while preventing quadriceps atrophy. The exact rehabilitation program depends on the other ligamentous injuries, because PCL injuries most often occur with other ligamentous injuries. Generally, patients leave the operating room with a hinged knee brace locked in extension, which is worn for 4 weeks. If volitional quadriceps has returned, the brace can be unlocked for ambulation. Patients are allowed to weight bear as tolerated, again depending on the concomitant injury pattern, and can start ROM exercises the first day after surgery. Patients are advanced slowly to strengthening and a standard knee ligament protocol after 4 to 6 weeks, when also closed chain hamstring exercises are started. Muscle strength and ROM generally return quickly after the procedure, due to the minimal invasive nature of the surgery, and the preservation of the native tissue and proprioception. Gradual return to sports is generally indicated around 6 months postoperatively.

Discussion

In the 1980s and 1990s, several studies reported on outcomes of open primary PCL repair. It should be noted that it is difficult to review outcomes of PCL treatment due to the often heterogeneous populations with regard to concomitant injuries. Hughston et al. were the first to report on 29 patients undergoing primary PCL repair in 1980, of whom 55% had proximal tears. At minimum 5-year follow-up, they found that 90% of patients were scored subjectively as good, whereas 65% of patients were scored objectively as good. A few years later, in 1984, Strand et al. reported their outcomes of 32 PCL injuries at 4-year follow-up. They noted, despite good or excellent outcomes in 81% of patients, that 56% of patients had 1+ posterior drawer or more. Pournaras et al. reported on their outcomes of 20 patients treated with open primary repair in 1991, and they noted that all patients had 1+...
Preservation of native tissue and proprioception
Only in patients with proximal tears and sufficient tissue quality

Compared with PCL reconstruction
No posterior sag or posterior tibial translation
Additional small incision over the tibial cortex

Protection of ligament during healing phase
Surgeon should be able to perform posterior knee arthroscopy

Compared with primary PCL repair without a suture augmentation
No conflict with other tunnels in patients with concomitant ACL injury

Protection of ligament during healing phase
No posterior sag or posterior tibial translation

In conclusion, we present the surgical technique of arthroscopic primary repair of proximal PCL tears with suture augmentation. The advantages of this procedure are the minimal invasive nature of the procedure, quick recovery, and prevention of quadriceps atrophy. Furthermore, the native tissue and proprioception are preserved with primary PCL repair. Because historical results have shown that residual laxity often occurs after primary PCL repair, the suture augmentation is added to this technique to protect the ligament during the early phases of healing.

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