Technical Note

Primary Repair of the Lateral Collateral Ligament Using Additional Suture Augmentation

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Abstract: Injuries to the lateral collateral ligament (LCL) most commonly occur with concomitant cruciate ligament tears. Over the past decade, there has been increased interest in anatomic reconstruction of the posterolateral corner (PLC). Not much attention has been paid to anatomic primary LCL repair given the historically high failure rates of primary repair of lateral sided knee ligaments, but better outcomes can now be expected because of recent developments in additional suture augmentation. The purpose of this Technical Note is to describe the surgical technique of primary distal LCL repair using suture augmentation. Using this procedure, the native ligament is preserved while allowing early mobilization as suture augmentation is protective of the repaired ligament.

Injuries to the lateral collateral ligaments (LCL) often occur along with concomitant anterior cruciate ligament (ACL) tears because isolated tears remain a rare entity (27%).[1] The LCL is 1 of 3 main components of the posterolateral corner (PLC) and recognized as an important passive stabilizer of the lateral aspect of the knee. Following injury, patients may complain of posterolateral instability including varus deformity, and, secondarily, external rotation instability.[2] Failure to recognize PLC instability may not only lead to symptomatic varus instability, but also can result in graft failure following ACL surgery.[2] Therefore, the literature supports conservative management of grade I and II (sprain or partial) injuries, whereas surgical management is frequently recommended in symptomatic grade III injuries (complete tears).[3]

Currently, the majority of patients with LCL injuries are treated with primary anatomic reconstruction of the PLC, which has shown to correct both varus deformity as well as restoration of external rotatory stability.[4] Recently, there has been resurgence of interest in ligament-preservation techniques.[5] This resurgence is driven by several factors. The first factor is that emerging research suggests that highly selective indications for ligament-preserving techniques can lead to better patient outcomes.[6] A second factor for the resurgent interest in ligament-preserving methods is due to the recent developments of additional suture augmentation, which is thought to protect the repaired ligament during healing, while allowing for early mobilization.[7] Although high failure rates of primary repair of lateral-sided knee ligaments have been reported historically, as compared with reconstruction,[8,9] improved surgical outcomes can now be expected based on these factors.

The purpose of this Technical Note is to describe the surgical technique of primary distal LCL repair using additional suture augmentation. This technique can either be used for isolated LCL injuries (Fig 1), or in the setting of injury to the LCL and other injuries to the posterolateral corner.

Surgical Technique

General Preparation

The patient is placed in supine position, and examination under anesthesia is performed on both knees to verify injury of the affected leg. A tourniquet is placed high around the upper thigh, and the operative leg is prepped and draped in standard sterile fashion. Before incision, the knee is positioned in 30° of flexion,

whereas the hip should be placed in slight internal rotation to visualize the lateral side of the knee fully (Video 1).

Primary LCL Repair

First, a 5-cm curvilinear skin incision is made over the fibular head, allowing adequate exposure of the distal insertion of the LCL (Fig 2). Dissection of subcutaneous tissue is carefully performed continuously to the level of the iliotibial band. Anterior and posterior skin flaps are then elevated while hemostasis is controlled. Following opening of the anterolateral fascia at the level of the fibula head, the distal aspect of the LCL can be identified. Once identified, the ligament should be dissected free from underlying capsular tissue. Care must be taken not to damage the peroneal nerve. Subsequently, a locking stitch of No. 2 FiberWire is placed into the proximal remnant of the torn LCL.

Suture Augmentation

Next, attention is turned to the fibular head. Following roughening of the cortex, a small oblique tunnel (2.4 mm) is drilled through the fibula head from anterolateral to posteromedial (Fig 3). Using a straight Micro SutureLasso (Arthrex, Naples, FL), a FiberTape (Arthrex) is then passed through this tunnel from posteromedial to anterolateral, which will be functioning as the suture augmentation to protect the

Fig 2. View of the lateral side of a left knee in 30° flexion. A curvilinear skin incision is made over the fibular head to expose the distal insertion of the LCL (asterisk). (LCL, lateral collateral ligament.)

repaired ligament from varus stress during rehabilitation.

LCL Fixation

A second tunnel is drilled under fluoroscopic guidance from anterolateral to inferomedial (Fig 4). The LCL repair stitches are passed through a proximal biceps tenodesis button, which is then passed, again, under fluoroscopic guidance through this tunnel from anterolateral to inferomedial. The button is then released, locked, and used to tension the repair stitches which are finally tied with alternating half-hitches against the fibula head cortex using a knot pusher.

Additional Suture Augmentation

Attention is then turned to the lateral epicondyle and a second incision of 2 cm is made over the proximal insertion of the LCL. Dissection is then made through

Fig 1. Coronal T2-weighted image of the left knee demonstrates a distal LCL tear (arrow). (LCL, lateral collateral ligament.)

Fig 3. View of the lateral side of a left knee in 30° flexion. An oblique tunnel is drilled from anterolateral to posteromedial aspect (arrow) of the fibular head (asterisk), which will be functioning as a tunnel for the additional suture augmentation.

the layers to expose the proximal fibers of the LCL. A curved clamp is subsequently placed through the proximal insertion and follows the LCL under the iliotibial band until the distal insertion is reached (Fig 5). Using this clamp, both limbs of the FiberTape are retrieved distally and channeled along the LCL to exit proximally. A 4.5 × 20 mm socket is then punched and/or tapped at the femoral insertion of the LCL. Care is taken not to damage the origin of other lateral sided structures. The next step is to pass both limbs of the FiberTape through the eyelet of a 4.75-mm Vented BioComposite SwiveLock suture anchor (Arthrex). With the knee in 60° of flexion and using slight valgus force in neutral rotation, the construct is tensioned firmly before the suture anchor is deployed partially into the femoral cortex (Fig 6).

Before final suture anchor fixation, the knee is tested for range of motion (ROM) and varus stability. It is important to assess if overconstraining of the knee has occurred. Once deemed satisfactory, the anchor is fully deployed in 60° of flexion and flush with the cortex. If needed, the core and repair stitches can be used to repair other injured lateral sided structures. Finally, the core stitches are removed, the FiberTape is cut short, and the knee is again tested for ROM, varus stability, and posterolateral stability. Then, the wounds are closed in standard layer fashion, and primary distal LCL repair with suture augmentation is completed. Pearls and pitfalls of this technique are shown in Table 1.

Postoperative Management

The main goals during rehabilitation are regaining early ROM and controlling edema. Considering the majority of LCL injuries occur with combined ACL injury or in the setting of a multiple ligament injured knee, the rehabilitation protocol consequently depends on other significant injuries. In general, all patients
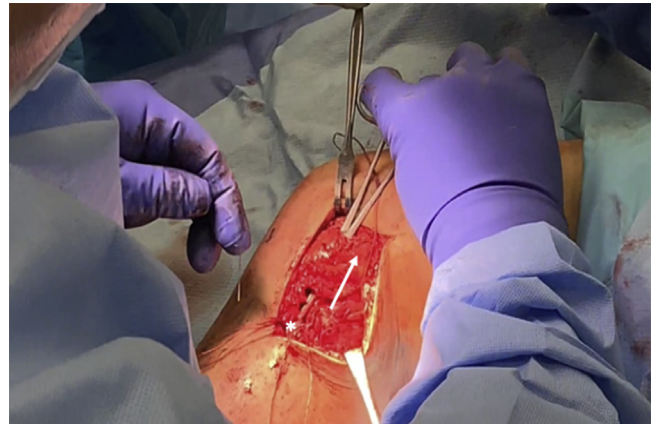

Fig 5. View of the lateral side of a left knee in 60° flexion. The FiberTape is grabbed distally (asterisk) and then channeled proximally under the iliotibial band along the repaired LCL (arrow). (LCL, lateral collateral ligament.)

wear a hinged brace for 4 weeks after surgery, which is locked in extension during ambulation and provides varus stress protection. Partial weightbearing is allowed as tolerated by the patient. Rehabilitation starts the first day after surgery when ROM exercises are initiated. After 4 to 6 weeks, formal physical therapy can usually be followed as standardized knee ligament protocols prescribe.

Discussion

PLC injuries are commonly associated with ACL tears, as isolated injuries remain a rare entity.[3] Failure to recognize can result in persistent instability and failure of cruciate ligament reconstruction or repair.[2] Most surgeons therefore advocate surgical management over conservative treatment in the presence of symptomatic

Fig 4. A second tunnel is drilled under fluoroscopic guidance from anterolateral to inferomedial (arrow) through the fibula head (asterisk). The repair stitches are channeled through this tunnel before anatomical fixation of the LCL using a proximal biceps tenodesis button. (LCL, lateral collateral ligament.)
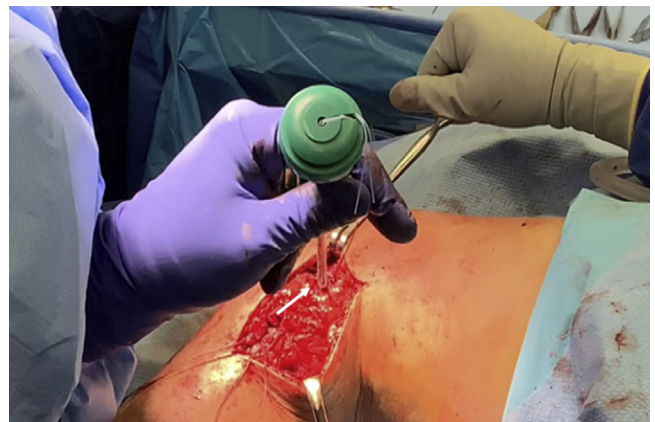

Fig 6. View of the lateral side of a left knee in 60° flexion. First, the suture anchor is deployed partially in the lateral epicondyle after tensioning the FiberTape (arrow). The knee is then tested for range of motion to assess for any over-constraint of the knee. Finally, the suture anchor is deployed fully.

Table 1. Surgical Pearls and Pitfalls of Primary LCL Repair with Additional Suture Augmentation

Pearls	Pitfalls
Use MRI scan to predict tear location	Care must be taken not to overconstrain the knee
Identify al lateral-sided injured ligaments	Peroneal nerve may be exposed during surgery
Repair the torn LCL using a locking stitch	
Drill through the fibula head from anterolateral to posteromedial and anterolateral to inferomedial	
Use a clamp to retrieve the FiberTape distally	
Sufficient tension the repair stitches in 60° of flexion and slight valgus before deploying suture anchor	
Deploy the second anchor first partially to adjust tension if necessary	
Test for ROM and varus stability	
Deploy the second suture anchor in 30° of flexion fully	

LCL, lateral collateral ligament; MRI, magnetic resonance imaging; ROM, range of motion.

Table 2. Advantages and Disadvantages of Primary LCL Repair with Additional Suture Augmentation

Advantages	Disadvantages
Preservation of the native LCL	Not deemed possible in chronic setting
Minimally invasive surgical approach	Potentially overconstraining knee
The repaired LCL is protected by suture augmentation	
Enables early postoperative mobilization	

LCL, lateral collateral ligament.

laxity. Over the past decade, numerous treatments for LCL injuries have been described, including several repair and reconstructive techniques.[2,8]

Historically, acceptable outcomes have been reported following repair of lateral-sided injuries. In 1 of the first studies on this topic, Baker et al. performed repair for acute posterolateral instability in 17 consecutive patients, of which 11 (65%) had associated ACL injury. At final follow-up (mean 53 months), no instability was found, whereas 85% returned to their preinjury levels of sports participation in 13 patients available for follow-up.[10] DeLee et al. supported these outcomes by also reporting achievement of stability in 8 of 11 patients (73%) treated with repair for isolated PLC instability.[11] Contrary to these results, Stannard et al. reported significantly higher failures rates in patients undergoing repair (37%) compared with reconstruction (9%) of the PLC,[9] whereas Levy et al. confirmed these results by reporting comparable findings.[8]

To date, some surgeons advocate for preservation techniques as a result of the potential advantages of native tissue preservation.[5] Furthermore, primary repair is less invasive compared with reconstructive surgery, which requires graft harvesting and drilling of larger tunnels.[4] In addition, better outcomes can now be expected because of recent developments in additional suture augmentation, which is believed to protect the repaired ligament until healing has occurred.[7] The construct is therefore expected to be sufficient to allow for early mobilization, potentially leading to both improved outcomes and shorter rehabilitation times. There are additional important surgical factors that are

prerequisite to achieving successful outcomes. This procedure is recommended to be performed acutely (within 3 weeks from injury) to allow optimal identification of each individual anatomical structure, and for the tissue to withhold intraligamentary sutures because tissue quality is known to decrease over time.[3]

When evaluating the recent literature, Westermann et al. compared repair (n = 15) versus reconstruction (n = 19) of the PLC in patients with concurrent ACL reconstruction. In both groups, 1 patient required revision surgery at 6-year follow-up.[12] McCarthy et al. supported these results by reporting similar failures rates (11.1% vs 4.7%, $P = .57$), IKDC subjective (71 vs 68, $P = .72$), and Lysholm scores (83 vs 83, $P = .97$) between repair and reconstruction of the PLC.[13] In their study, all repair patients underwent surgery within 21 days in which a high incidence of avulsion type tears was reported (89%). Similarly, Heitmann et al. described repair of all injured ligaments with suture augmentation in 69 multiple ligament injured knee patients, of which 45 had associated PLC injury (65%).[14] At a mean follow-up of 14 months, 91.3% of cases were considered clinically stable; 2 patients underwent revision ACL surgery and 2 underwent multiligament reconstruction without specific specification of the affected ligaments.

With the current surgical technique, primary repair is performed using a minimally invasive approach to restore lateral stability. In the lateral-sided injured knee, implementation of suture augmentation has recently been described by Hopper et al., who recommended restoring soft-tissue balance around the fibula head.[2] Additionally, our proposed technique uses a transfibular tunnel in an oblique fashion, as described by Arciero.[15] Benefits of both studies are therefore combined because native tissue is preserved in anatomical fashion while restoring posterolateral stability and reinforcing the LCL. Unique to this technique is the fixation of the LCL primary repair portion of the case to the far cortex of the fibula. Historically, surgeons

have had difficulty anchoring the ligament to the fibular head resulting from weak bone and difficulty in in gaining purchase with suture anchors. This technique used a flip anchor on the far cortex theoretically optimizing fixation while minimizing neurovascular injury. Nonetheless, further long-term follow-up studies are needed to better assess the clinical contribution of this suture augmented repair.

There are several limitations of this technique. First, tissue quality is, as mentioned, time-dependent and therefore lateral-sided injury repair is only deemed possible in the (sub)acute seeting.[16] Second, suture augmentation may theoretically cause knee over-constraint, although biomechanical or clinical studies are needed to better evaluate if this indeed may actually occur in a clinical setting. Potential advantages and disadvantages are shown in Table 2.

In conclusion, we presented the surgical technique of primary repair for distal LCL tears using supplemental suture augmentation. With this surgical procedure, the native ligament is preserved and fixed in a unique fashion to the far cortex of the fibula while allowing for early mobilization as the suture augmentation protects the repaired ligament.

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