All-arthroscopic Anatomic Repair of an Avulsed Popliteus Tendon in a Multiple Ligament–injured Knee

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abstract
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Multiple ligament–injured knees are a heterogeneous group of knee injuries that lack a clear consensus on optimal treatment. Current areas of controversy include optimal timing of surgery, ligamentous repair vs reconstruction, and combined vs staged procedures. In addition, multiple open, arthroscopic, and arthroscopic-assisted techniques exist for repair and reconstruction of the injured stabilizers of the knee.

Many open posterolateral corner reconstruction techniques have been described, and this article represents the first description of an arthroscopic technique for repair of an avulsed popliteus tendon. This was performed with a standard anterolateral portal in addition to anterior and posterior superolateral portals. Nonabsorbable sutures were passed through the avulsed popliteus tendon in an outside-in technique using a suture shuttle. The nonabsorbable sutures were threaded though a tibial Beath pin, which was then passed through the prepared popliteus footprint and brought out medially. The final position of the popliteus was confirmed arthroscopically, and the sutures were tied medially over a screw post with a washer.

Arthroscopic popliteus repair has many possible advantages. Because the popliteus tendon insertion is intracapsular, open repair necessitates a capsulotomy, with the potential for complications such as postoperative wound drainage, intra-articular sinus formation, infection, and stiffness. Arthroscopic repair may avoid these complications. The current case was performed in conjunction with an open but extracapsular posterolateral corner repair. Further experience with this technique is required to determine its safety and efficacy.
Management of the multiple ligament–injured knee has long been a challenge for orthopedic surgeons and is a popular topic in sports medicine. Posterolateral corner structures have been shown to biomechanically and clinically play an important role in the treatment outcomes of the multiple ligament–injured knee. These combined injuries can lead to either subtle or gross instability in 1 or more planes. In addition to combined injuries, isolated injuries to the posterolateral corner have been shown to significantly affect the forces across the anterior and posterior cruciate ligaments. Furthermore, when combined with posterior cruciate ligament reconstruction, repairing the posterolateral corner can decrease posterior cruciate ligament graft forces and increase varus and external rotational stability. Numerous open procedures have been described to reconstruct the posterolateral corner of the knee. This article represents the first description of an all-arthroscopic primary repair of a femoral popliteal avulsion in a patient with multiple ligament instability.

Case Report

A 46-year-old helmeted motorcyclist was struck by a motorist and sustained multiple injuries, including an intraparenchymal hemorrhage, an L1 burst fracture without neurologic involvement, a left distal humerus fracture, and a right knee dislocation. His intraparenchymal hemorrhage and L1 burst fracture were treated nonoperatively, and he underwent open reduction and internal fixation of his distal humerus fracture. His right lower extremity was neurovascularly intact, and magnetic resonance imaging of the knee demonstrated ruptures or avulsions of his anterior cruciate ligament, medial and lateral collateral ligaments, popliteus tendon, and posterolateral arcuate complex.

While under general anesthesia, the patient was examined and found to have a grade 2B Lachman’s test, a positive posterolateral drawer test, and a dial test demonstrating 10° of external rotation compared with the unaffected side; his posterior drawer had a firm endpoint. After examination, the patient was placed in the supine position on the operating table with his affected knee flexed to 90°. A tourniquet was applied to the thigh, and the patient was prepped and steriley draped in the usual fashion.

A routine diagnostic arthroscopy of the entire knee was performed with an evaluation of the lateral compartment as previously described in the literature. The popliteus tendon was well visualized and avulsed off its footprint (Figure 1). The popliteus tendon was intact but avulsed, not retracted, and had adequate substance and length for repair. With the arthroscope in the standard anterolateral portal, posterior superolateral and anterior superolateral working portals were created safely as working portals. These portals were made with the knee in 90° of flexion; they were placed slightly proximal and distal to the lateral collateral ligament and through the iliotibial band to safely access the popliteus tendon and its footprint (Figure 2).

Once the working portals were established, a burr was inserted through the anterior superolateral portal under direct arthroscopic view and into the center of the popliteus tendon footprint. Next, the popliteus tendon sutures were placed through the eyelet of the Beath pin, which was passed through the knee from lateral to medial, aiming for the medial epicondyle (Figure 4).

At this point, attention was turned to other intra- or extra-articular knee pathologies, such as concomitant ligamentous injuries (DePuy, Raynham, Massachusetts) were passed through the popliteus tendon via the 2 superolateral working portals using an outside-in technique with a suture shuttle and 0 PDS suture (Ethicon, Inc, Somerville, New Jersey) (Figure 3B, C). A tibial Beath pin was then placed in the knee through the anterior superolateral portal under direct arthroscopic view and into the center of the popliteus tendon footprint. The popliteus tendon sutures were placed through the eyelet of the Beath pin, which was passed through the knee from lateral to medial, aiming for the medial epicondyle (Figure 4).
injuries. An arthroscopic-assisted ACL reconstruction and open medial and lateral collateral and posterolateral arcuate complex reconstructions were performed. If surgical correction of a medial collateral ligament is to be performed, the authors recommend that this be completed prior to tying down the passed sutures from the popliteus tendon because they may need to be manipulated during the medial repair. When ready, the passed popliteus tendon sutures were tied down over a screw post with a washer on the medial side of the knee via a series of half hitches that were buried subcutaneously (Figure 4). After fixation, the lateral gutter was again examined to ensure that the popliteal recess was now closed off without the ability to easily drive through the recess.

The postoperative protocol was determined based on the other repairs performed during the procedure. The patient was kept partial weight bearing for 6 weeks with an unlocked hinged knee immobilizer. Active and passive range of motion exercises and isometric quadriceps exercises were started 2 weeks postoperatively. After 6 weeks, he progressed to weight bearing as tolerated with a short-hinged knee brace. Four months postoperatively, he transitioned to a light knee sleeve. One year postoperatively, the patient returned to work and full activities of daily living. His knee was stable, with 0° to 135° of flexion, good strength, and good patellar mobility.

**DISCUSSION**

The diagnosis of a popliteus tendon injury can be made either by using magnetic resonance imaging or arthroscopically by examining the footprint and driving the arthroscope between the popliteal tendon and lateral femoral condyle, known as the lateral gutter drive-through.15 Once the diagnosis is made, surgical planning involves an understanding of the concomitant knee injuries. Popliteus tendon injuries often occur in conjunction with injuries to the other posterolateral structures, such as the lateral collateral ligament and arcuate ligament complex, as well as with injuries to the anterior and posterior cruciate ligaments and medial and lateral menisci. These concomitant injuries must not be overlooked because they play a significant role in determining the treatment plan.16

To the authors’ knowledge, this is the first report of all-arthroscopic repair of an avulsed popliteus tendon. Recently, an all-arthroscopic technique for a posterolateral sling reconstruction of the popliteus tendon was described.17 The technique was reported in conjunction with a single-bundle posterior cruciate ligament reconstruction and differs significantly from the current technique, an anatomic repair. The all-arthroscopic repair technique allows for more accurate tensioning and does not require use of an allograft. However, because the current technique is anatomic, sufficient length and quality of the avulsed popliteus tendon must exist to replace a healthy tendon on its footprint with minimal tension.

The benefits of all-arthroscopic popliteus repair are many. It avoids the morbidities associated with an open technique. Specifically, because the insertion of the
popliteus is intra-articular, an open repair also necessitates a lateral capsulotomy. An arthroscopic repair that obviates the need for a capsulotomy may be able to decrease the risk of postoperative wound drainage, intra-articular sinus formation, infection, and stiffness that may accompany a capsulotomy. The potential for avoiding a lateral knee incision potentially decreases the risk of peroneal nerve injury. Furthermore, arthroscopic visualization of the portal creation and Beath pin placement allows the surgeon to safely avoid injuring the geniculate arteries. Finally, because of the popliteus footprint’s close proximity to the origin of the lateral collateral ligament, arthroscopic visualization could, in some cases, be better than open visualization of the footprint, which may allow for a more precise anatomic repair.

The current technique has some limitations. One limitation relates to the technique’s applicability to various knee injury patterns because many popliteal avulsions occur in conjunction with other injuries that necessitate open or mini-open procedures. However, isolated ruptures of the popliteus tendon and open isolated repairs have been described. The current all-arthroscopic repair technique can be performed in isolation or combined with other ligamentous repairs and reconstructions in the treatment of a multiple ligament–injured knee. Another limitation of the technique is that a healthy and viable tendon must be present. In addition, although an open capsulotomy can be avoided, the portal sites transverse the iliotibial band and may be placed near the lateral collateral ligament. Finally, additional experience with this technique is needed to provide more details on potential risks, complications, indications and contraindications, and outcomes compared with open or nonoperative treatment.

**CONCLUSION**

All-arthroscopic repair of an avulsed popliteus tendon has multiple uses. It can be performed in the case of an isolated avulsion or when the popliteus tendon is the only injured posterolateral structure with a mild rotatory instability. This technique may, in some cases, be able to eliminate the need for an open incision and may decrease the risk of complications associated with capsulotomy in open procedures.

**REFERENCES**


