Anatomic Popliteus Tendon and Tibiofibular Joint Reconstructions

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Background: The popliteus tendon is a primary stabilizer of external knee rotation and has been described as the ''fifth ligament of the knee.'' Injuries involving the posterolateral corner of the knee commonly involve the popliteus tendon; isolated injury to the popliteus tendon is relatively rare and usually involves a rotatory injury mechanism and symptoms of instability and pain. In this patient, there was a concomitant injury to the proximal tibiofibular joint.

Indications: Popliteus tendon reconstruction is indicated for patients with abnormal external rotation on examination and symptoms of pain and instability. Proximal tibiofibular joint reconstruction is indicated for patients with instability of the tibiofibular joint.

Technique Description: Preoperative examination under anesthesia is essential to determine the extent of external rotation and assess for additional posterolateral pathology. The popliteus tendon procedure begins with a meticulous common peroneal nerve neurolysis to minimize nerve irritation and decrease the risk of a postoperative foot drop. Semitendinosus and gracilis graft harvest is performed with at least 16 cm of graft length followed by tunnel reaming of the popliteus tendon femoral attachment and tibia tunnel identification and reaming. The femoral attachment of the popliteus tendon is secured, and the semitendinosus graft is anatomically oriented along the native path and passed from posterior to anterior through the femoral tunnel. The gracilis graft for anatomic proximal tibiofibular joint reconstruction requires an anterior to posterior tunnel through the fibular head. Finally, both grafts are secured in the tibial tunnel with the application of an anterior traction force.

Results: A cadaveric study by LaPrade et al reported that an anatomic popliteus tendon reconstruction with a semitendinosus autograft significantly reduced external rotation laxity compared with the sectioned state. In addition, popliteus tendon reconstruction resulted in significantly decreased varus laxity, anterior tibial translation, and internal rotation.

Discussion: This is a technique that effectively restores external rotation knee stability utilizing an anatomically oriented reconstruction of the popliteus tendon and tibiofibular joint. The popliteus tendon serves as a primary stabilizer to external rotation and facilitates static function of the knee. The proximal tibiofibular joint reconstruction restores the function of the posterior proximal tibiofibular joint ligaments.

Patient Consent Disclosure Statement: The author(s) attests that consent has been obtained from any patient(s) appearing in this publication. If the individual may be identifiable, the author(s) has included a statement of release or other written form of approval from the patient(s) with this submission for publication.

Keywords: popliteus tendon reconstruction; tibiofibular joint reconstruction; external rotation; semitendinosus tendon autograft; gracilis tendon autograft

VIDEO TRANSCRIPT

This is a video presentation depicting an anatomic popliteus tendon and tibiofibular joint reconstruction.

Shown here are the author's disclosures.

The popliteus tendon is 1 of 3 major structures in the posterolateral corner and is commonly found injured in patients with posterolateral instability.[5] Biomechanical studies have reported that it acts as one of the primary external stabilizers of the knee, and a secondary stabilizer for internal rotation, varus alignment, and translation, thus it is often called the "fifth ligament" of the knee.[4,6] Isolated injuries to the popliteus tendon are rare and often present in the setting of posterolateral instability with concomitant injury to other posterolateral structures.[1] Anatomic popliteus tendon reconstruction and tibiofibular joint reconstruction effectively restore external rotation knee stability.[2,3]

The patient depicted here is a 21-year-old female presenting with right knee instability. She reported that pain began a year ago after hip arthroscopic surgery and believes it was due to the traction used during the surgery. She had performed taping of the proximal tibiofibular joint over the previous several months and had excellent relief. Injection of the proximal tibiofibular joint resulted in short-term relief.

Video Journal of Sports Medicine (VJSM®), 4(2), 26350254231212234
DOI: 10.1177/26350254231212234

Examination of the patient revealed 3-cm heel height and 140° of flexion bilaterally. The right knee showed a normal Lachman, valgus and varus stress, and posterior drawer. There was a 3 + posterolateral drawer and dial test at 90° of knee flexion. Increased proximal tibiofibular joint laxity was also noted. This examination was suggestive of anterolateral subluxation of the fibular head.

Radiographs demonstrated neutral long limb mechanical alignment, with no notable osseous pathology, joint space narrowing, or degenerative changes.

Magnetic resonance imaging revealed abnormal signal involving the popliteus insertion at the popliteal sulcus.

The final diagnosis was tibiofibular joint instability, external rotational instability suggestive of a popliteus tendon injury, mild scar tissue entrapment of the peroneal nerve, and mild chondromalacia on the distal medial patella. The patient elected to undergo surgery to stabilize her knee. This involved reconstructing her popliteus tendon with a semitendinosus tendon autograft, reconstructing her proximal tibiofibular joint with a gracilis tendon autograft, and performing a common peroneal nerve neurolysis.

The examination under anesthesia was consistent with the examination findings for proximal tibiofibular instability and for a concurrent popliteus tendon injury due to the increased posterolateral drawer and dial test.

The posterolateral corner was approached first to identify structures prior to fluid extravasation. A standard lateral hockey-stick incision was made centered over the midportion of the iliotibial band and carried down to the anterior compartment.

Sharp dissection down to the superficial layer of the iliotibial band and the long and short bicep tendons was carried out.

A slow and meticulous common peroneal nerve neurolysis was performed. The nerve was somewhat irritable. It was difficult to dissect out the nerve initially as we noted that the proximal tibiofibular joint was subluxing posterolaterally.

The proximal tibiofibular joint instability was again tested and the joint significantly subluxed anterolaterally compared with the normal contralateral knee. This confirmed the need for a proximal tibiofibular joint reconstruction. Dissection continued to the anterior part of the fibular head and a small portion of the posterior biceps tendon was dissected to drill a fibular tunnel from anterior to posterior.

Using a fibular head guide, a 2.4-mm guide pin was drilled from anterior to posterior. Care needs to be taken to ensure that the tunnel is anterior to the fibular insertion of the fibular collateral ligament (FCL) to avoid iatrogenic damage to the FCL. Once placed, the pin was palpated posteriorly to confirm it was in the proper location. The fibular head guide pin was over-reamed with a 6-mm reamer and a passing stitch was placed. The tunnels are drilled prior to graft harvest because prepping the grafts during the arthroscopy helps to decrease surgical time and increase efficiency. In addition, the hamstring autografts are small enough in diameter that they do not affect the screw size used.

The dissection continued anteriorly and identified the flat spot that is located distal and medial to Gerdy's tubercle. A tibial tunnel guide pin was drilled from anterior to posterior using the tibial collateral instrument guide. Then the posterior guide pin exit site was palpated to confirm it was in the desired location at the popliteus musculotendinous junction.

The tibial guide pin was left in place and focus shifted to the femur. The popliteus tendon femoral attachment was identified at this point. A horizontal splitting incision was made over the iliotibial band and then the lateral capsule. Next, the popliteus tendon was identified. The popliteus tendon had torn off the attachment site on the femur and was retracted 1 cm. Using a hemostat, the popliteus tendon was tightened, and her external rotation was being eliminated. This confirmed the need for the popliteus tendon reconstruction. A guide pin was drilled anteromedially across her thigh using the collateral instrument guides. This was then over-reamed with a 6-mm reamer followed by a 7-mm tap. A passing stitch was placed through the tunnel.

Using the previously drilled guide pin, the tibial tunnel was reamed to an 8-mm-diameter tunnel, this is 2 mm larger than the other 2 tunnels because both grafts must pass through it. A passing stitch was then placed through the tibial tunnel.

Next, an incision was made over the pes tendons to harvest the hamstring tendons with an open hamstring harvester. The gracilis tendon was to be used for the proximal tibiofibular joint and the semitendinosus tendon was to be used for the popliteus tendon reconstruction. Autografts are used due to the lower cost and faster healing compared with allografts.

The grafts were prepared on the back table and whipstitched on each end with #2 nonabsorbable sutures.

Arthroscopy proceeded with making medial and lateral portals.

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Submitted July 11, 2023; accepted October 18, 2023.

One or more of the authors has declared the following potential conflict of interest or source of funding: N.I.K. receives educational support from Foundation Medical and Smith & Nephew; travel and lodging from Zimmer Biomet Holdings; and food and beverage from Encore Medical. R.F.L. is a consultant for Ossur, Smith & Nephew, and Responsive Arthroscopy; receives royalties from Ossur, Smith & Nephew, Elsevier, and Arthrex; research grants from Ossur, Smith & Nephew, Arthroscopy Association of North America (AANA), and AOSSM; is on committees for International Society of Arthroscopy, Knee Surgery and Orthopaedic Sports Medicine, AANA, and AOSSM; is on the editorial board for *American Journal of Sports Medicine*, *Journal of Experimental Orthopaedics*, *Knee Surgery, Sports Traumatology, Arthroscopy*, *Journal of Knee Surgery*, *Journal of Orthopaedic & Sports Physical Therapy*, and *Operative Techniques in Sports Medicine*; and receives educational support from Foundation Medical. AOSSM checks author disclosures against the Open Payments Database (OPD). AOSSM has not conducted an independent investigation on the OPD and disclaims any liability or responsibility relating thereto.

The suprapatellar pouch was essentially normal. The distal medial patella had some articular cartilage flaps, and a gentle patellar chondroplasty was performed.

In the medial compartment, the patient's articular cartilage was normal and the medial meniscus including the root and ramp attachment areas were normal. The anterior cruciate ligament and posterior cruciate ligament were normal.

In the lateral compartment, the anterior medial aspect of the lateral tibial plateau had some mild chondromalacia. The lateral meniscus was normal.

Viewed from the lateral gutter, the popliteomeniscal fascicle attachment to the lateral meniscus was intact.

The popliteus tendon graft was passed into its femoral tunnel and held in place with a 7 mm $\times$ 20 mm bioabsorbable screw. The graft for the popliteus tendon was then passed down the popliteal hiatus using a Carmalt hemostat. The proximal tibiofibular joint graft was then passed from anterior to posterior through the fibular head and secured in the fibular head with a 7 mm $\times$ 20 mm bioabsorbable screw.

Both grafts were then passed from posterior-to-anterior through the tibial tunnel. Palpation occurred posterior to confirm the grafts were not bunched up.

This figure is included to show the placement of both grafts in the proper orientation and direction. The popliteus tendon graft is secured first at its anatomic attachment on the femur and routed through the popliteal hiatus. The proximal tibiofibular joint reconstruction graft is passed anterior to posterior through the fibular head tunnel. Both grafts are then passed from posterior to anterior through the tibial tunnel and secured anteriorly with a screw.

The grafts were fixed in the tibial tunnel with a 7 mm $\times$ 20 mm bioabsorbable screw with the knee flexed to 60° and the foot in neutral rotation. Palpation was used to ensure the proximal tibiofibular joint was well reduced. Proper reduction of the tibiofibular joint, as well as proper flexion and rotation of the knee, are critical for proper graft fixation and tension. Both grafts were palpated and were taut.

The deep and superficial tissues are closed with suture.

Postoperative rehabilitation begins with passive continuous motion on postoperative day 1. The goal is to reach at least 90° of knee flexion by 2 weeks. The patient was touchdown weightbearing on her right lower extremity for 6 weeks. This is followed by protective weightbearing in a brace. External rotation motion is avoided for the first 6 weeks to allow her grafts to heal, and isolated hamstring activity is avoided for the first 4 months to allow for adequate hamstring healing.

This is a relatively rare and complex procedure that is not without potential complications. This procedure requires the drilling of a tibial tunnel from anterior to posterior and as such there is a risk of injury to the popliteal neurovascular bundle. This can be minimized by meticulous dissection around the posterior aspect of the proximal tibiofibular joint as well as the posterolateral surface of the proximal tibia. Furthermore, placement of a large retractor posterior to the guide pin when drilling the tibial tunnel can act as a retractor/protector of the neurovascular bundle.

Another complication associated with this procedure is inappropriate tensioning of the proximal tibiofibular joint and the popliteus tendon reconstruction. Care should be taken to identify the femoral attachment of the popliteal tendon in the popliteal sulcus and to ensure the posteromedial aspect of the fibular tunnel exits at same height of the tibial tunnel. Second, the grafts should all be fixed in neutral rotation at 60° of flexion; final fixation with inappropriate rotation can lead to overconstraint or residual laxity.

Iatrogenic injury to the fibular collateral ligament can also occur during preparation and/or drilling the fibular tunnel. The fibular tunnel in this reconstruction should be located more anterior than the fibular attachment of the FCL, and the direction of the tunnel is anterior to posterior. Further when taking down the popliteus, placement of a hemostat underneath the popliteus in a proximal to distal direction between the popliteus and the FCL can help prevent iatrogenic injury of the FCL during preparation of the popliteus tendon tunnel in the sulcus.

A study by Dekker et al[3] including 15 patients and 16 isolated proximal tibiofibular joint (PTFJ) reconstructions reported that of the 13 patients who had full follow-up, 11 were able to return to sports or activities. In addition, patient-reported outcomes significantly improved in the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and Lysholm scores from preoperative to postoperative values.

A case study by Chahla et al[2] reported on midterm outcomes for 5 patients with popliteus tendon reconstructions. These patients had increases in both Lysholm and Tegner scores from preoperative to postoperative values. In addition, patients' satisfaction was an average of 9 out of 10 and dial tests improved at 30° and 90°.

Plain films were ordered and received in the clinic at postoperative day 1. There is no evidence of acute fracture or soft tissue abnormalities. Hardware is intact and nondisplaced.

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