Technical Note

Open Popliteus Tendon Reconstruction Using a Hamstring Tendon Autograft

Ariel N. Rodriguez, M.D., M.S., Daniel J. Liechti, M.D., and Robert F. LaPrade, M.D., Ph.D.

Abstract: The popliteus tendon plays a critical role in restraining the tibia against external rotation. It is often injured in the setting of posterolateral corner injuries. However, it is rarely injured in isolation from other structures of the posterolateral corner. This Technical Note describes an open anatomic reconstruction of the popliteus tendon. Although several techniques exist, this technique has been biomechanically validated and shown to have good outcomes. An early rehabilitation protocol focused on protected range of motion, edema control, quadriceps strengthening, and pain control is essential for maximizing patient outcomes.

The popliteus tendon plays a critical role in stabilizing the knee and is often called the fifth ligament of the knee.[1] The popliteus tendon acts as a primary restraint against external tibial rotation about the knee. The popliteus tendon also acts as a secondary stabilizer against anterior translation, posterior translation, internal rotation, and varus forces.[1-3] The popliteus tendon begins at the musculotendinous junction of the popliteus muscle and wraps around the lateral femoral condyle. The popliteus tendon continues through the popliteal sulcus and attaches to the femur on the anterior fifth of the popliteal sulcus.[4]

The popliteus tendon often is injured in the setting of posterolateral corner (PLC), with rates of concomitant injury reported to be as high as 68%.[5] However, the popliteus tendon may also be rarely injured in isolation. Isolated popliteus tendon may occur as a result of an external rotation and varus moment in slight knee flexion.[1,6] Many surgical techniques have been described to treat popliteus tendon injuries, including various debridement, repair, and reconstruction techniques.[7-11] This Technical Note will describe an anatomic-based reconstruction technique that has been biomechanically validated[12] to restore stability to a popliteus tendon–deficient knee.

Surgical Technique (With Video Illustration)

Patient Positioning

The patient is transported to the operating room and induced under general anesthesia. A well-padded high thigh tourniquet is placed on the operative leg. An examination is then performed under general anesthesia. Findings of the physical examination show 2 cm of heel height to 140° of flexion, which is symmetric to the contralateral knee. Lachman, pivot shift, and posterior drawer are performed, and all may be normal in the setting of isolated popliteus tendon injury. Varus and valgus stress is then performed with no valgus gapping, and varus gapping 1+ and symmetric bilaterally. The proximal tibiofibular joint is tested in flexion and found to be stable. Dial test and posterolateral drawer test show grade 2 increased external rotation compared with the contralateral right knee. Overall, the clinical examination is found to be consistent with the previous clinical examination. Intraoperative fluoroscopy may be used with varus and valgus stress testing. Preoperative antibiotic prophylaxis is then administered. The left lower extremity is prepped and draped in the usual sterile manner.

From Twin Cities Orthopedics Crosstown-Edina, Edina, Minnesota, U.S.A.

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Address correspondence to Robert F. LaPrade, M.D., Ph.D., Twin Cities Orthopedics, Edina-Crosstown, 4010 W 65th St, Edina, MN 55435. E-mail: lapradem dphd@gmail.com

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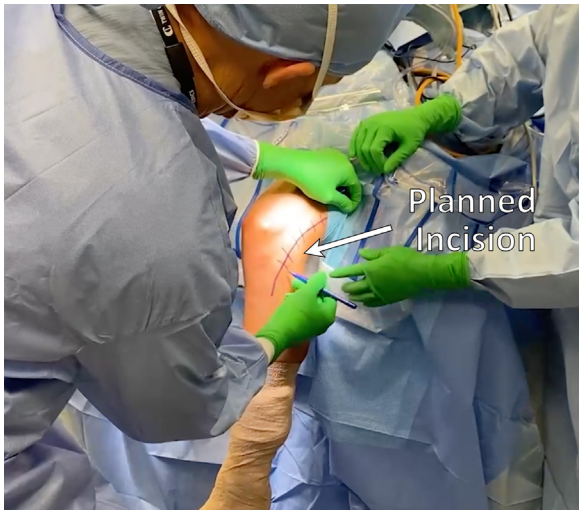

Fig 1. Preoperative image of the left knee with the patient supine illustrating the planned hockey stick incision (white arrow) used to perform a posterolateral approach. This approach is used for a variety of procedures, including neurolysis of the common peroneal nerve and reconstruction of structures of the posterolateral corner. This approach allows for excellent visualization of all structures during this procedure.

Posterolateral Approach

The posterolateral approach is performed first to visualize and identify structures before fluid extravasation of the knee arthroscopy. A standard lateral hockey-stick incision (Fig 1) is made over the inferior border of the iliotibial band and carried distally bisecting Gerdy's tubercle and the anterior border of the fibular head. Skin flaps are raised, and dissection is performed down over the long head of the biceps. The common peroneal nerve (CPN) is identified and palpated with extreme care. Upon identification, the CPN is visually irritable, and significant scarring is appreciated around the nerve. A 6-cm long CPN neurolysis is performed with extreme care to minimize the risk of footdrop postoperatively due to swelling, especially in the context of scar tissue entrapment (Table 1). Following neurolysis, the interval along the posterior border of the fibula and tibia is developed bluntly.

Attention is then turned to the tibia for creation of the tibial tunnel. The skin is dissected anteriorly to identify the "flat spot" on the tibia, which is distal and medial to Gerdy's tubercle and just lateral to the lateral edge of the patellar tendon. This area is cleaned off sharply as well as with the use of a rongeur. A Chandler retractor (V. Mueller; BD, Franklin Lakes, NJ) is then placed in the developed interval along the posterior tibia to protect the neurovascular structures and an ACUFEX guide (Smith & Nephew, Andover, MA) is used to drill a guidewire from anterior to posterior (Fig 2). Ideally, the guide pin should exit the posterior tibia at the musculotendinous junction of the popliteus. A 6-mm reamer is then drilled over the pin from anterior to posterior across the tibia bicortically.

The surgeon then proceeds to split the iliotibial band and enters the lateral capsule to identify the injured popliteus tendon. The large ACUFEX guide (Smith & Nephew) is used aiming both anteriorly and proximally (Fig 3). A pin is placed through the center of the femoral attachment of the popliteus, and the guide pin is angled to exit the thigh anteromedially. This is then over-reamed using a 6-mm reamer and is followed with a 7-mm tap. The Beath pin must be passed antegrade into the tunnel to tap and is driven retrograde after tap is complete. A passing stitch is then placed for passage of the graft later in the procedure.

Attention is then turned toward graft harvest and preparation. An incision is made over the hamstring tendons medial and distal to the tibial tubercle. Sharp dissection is carried out through the sartorial fascia until the semitendinosus tendon is identified. The semitendinosus tendon is then obtained using an open

Table 1. Pearls and Pitfalls

Pearls	Pitfalls
• Performing lateral dissection and peroneal nerve neurolysis before the arthroscopic procedure is advantageous in preventing tissue distortion from fluid extravasation • The flat spot of the tibial tunnel is distal and medial to Gerdy's tubercle and just lateral to the tibial tubercle • When placing guidewire in the tibia, palpate and aim toward the musculotendinous junction of the popliteus for anatomic placement and to avoid joint penetration • After arthrotomy, a Z-retractor placed across the front of the lateral femoral condyle aids in excellent visualization as well as acting as a landmark when looking to identify the popliteus tendon insertion	• Drilling directly anterior to posterior on the tibia may result in posterior tunnel that is lateral to the popliteus. • Failure to drill the femur aiming proximally and slightly anterior may increase the risk of joint penetration or tunnel convergence if concomitant procedures are performed. • Failure to pass the graft under the native fibular collateral ligament fails to restore native anatomy. • Failure to clear the posterior tibial tunnel aperture of soft tissue may lead to difficult graft passage • Improper identification and protection of the CPN and FCL can lead to possible iatrogenic injury. • Improper cycling of the knee after graft passage can result in residual laxity and instability.

CPN, common peroneal nerve; FCL, fibular collateral ligament.

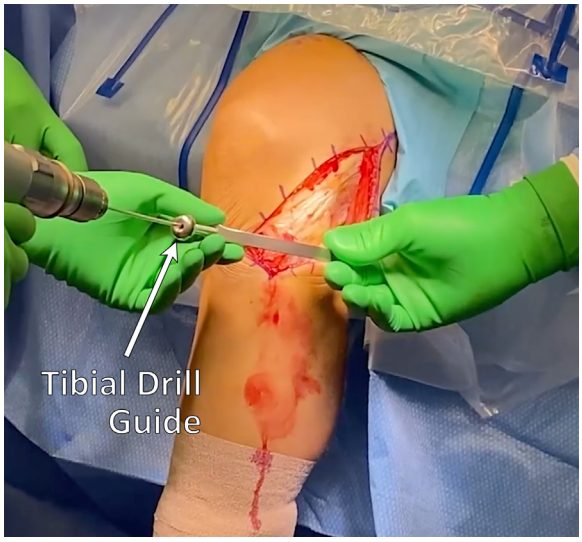

Fig 2. Intraoperative image of the left knee with the patient supine illustrating drilling of the tibial tunnel using a tibial drill guide (white arrow) and a guidewire. This guidewire is drilled from anterior to posterior at the flat spot distal and medial to Gerdy's tubercle. A 6-mm reamer is then used to over-ream the guidewire and prepare the tunnel for use later in the procedure.

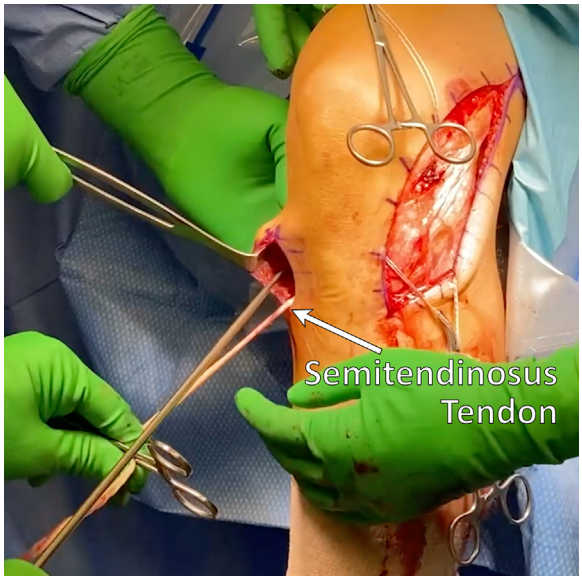

Fig 4. Intraoperative image of the left knee with the patient supine illustrating harvesting of the semitendinosus tendon (white arrow) for use during reconstruction of the popliteus tendon. Once the graft is harvested using a hamstring harvester tool, the graft is prepared on a back table by an assistant.

hamstring harvester tool (Fig 4). The graft is prepared by an assistant on the back table by whipstitching each end with #2 nonabsorbable sutures.

The diagnostic arthroscopy portion of the procedure is then performed. The popliteus tendon is confirmed to be torn and retracted distally. No other significant findings are identified.

The popliteus tendon graft is then shuttled into the femoral tunnel via passing suture and held in place with a 7 × 20-mm bioabsorbable screw (Fig 5). A Carmalt is then used to pass the graft down the

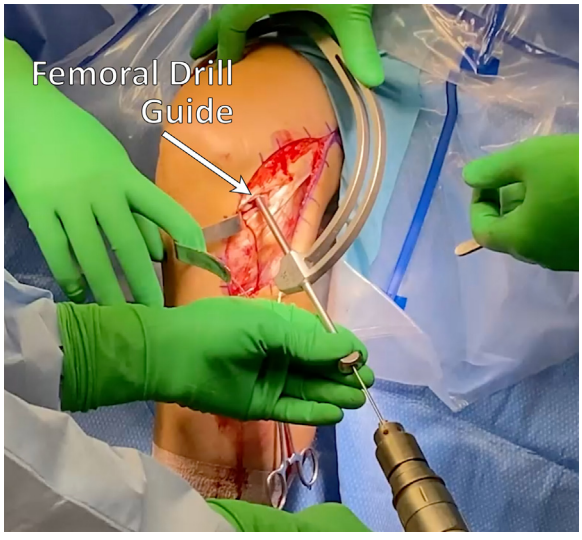

Fig 3. Intraoperative image of the left knee with the patient supine illustrating drilling of the femoral tunnel (white arrow) using a femoral drill guide and guidewire. The guidewire is aimed across the femur anteriorly and proximally so that it exits the thigh anteromedially and proximally from its entry site at the femoral attachment of the popliteus tendon. A 6-mm reamer is then used to over-ream the guidewire and prepare the tunnel for use later in the procedure.

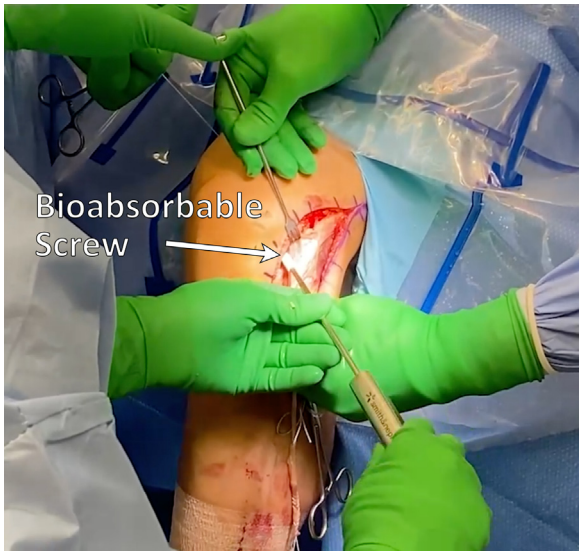

Fig 5. Intraoperative image of the left knee with the patient supine illustrating placement of the 7 × 20-mm bioabsorbable screw (white arrow) in the femoral tunnel for fixation of the popliteal tendon reconstruction graft. The graft is then passed down the popliteal hiatus, after which the sutures are retrieved.

popliteal hiatus, after which the sutures are retrieved. The sutures at the end of the passing stitch were now passed through the tibial tunnel using a previously placed passing suture and the graft is passed from posterior to anterior through the tibia. The knee is then cycled several times to ensure the graft is taut. The graft is then fixed within the tibia using a 7 × 20-mm bioabsorbable screw with the knee at 60° of flexion and the foot in neutral rotation and traction on the graft (Fig 6). The dial test and posterolateral corner test now return to normal (Video 1).

The tourniquet is let down and hemostasis is achieved. The deep tissues are closed with 0 and 2-0 VICRYL (Ethicon, Somerville, NJ), followed by a MONOCRYL stitch (Ethicon) for the skin. Steri-Strips (3M, St. Paul, MN) are applied followed by a sterile dressing and knee immobilizer in full extension.

Postoperative Protocol

Physical therapy should be initiated on postoperative day 1 with an emphasis on protected range of motion, quadriceps activation, and edema control. To maximize patient outcomes and minimize arthrofibrosis, early range-of-motion therapy is crucial. Patients should avoid hyperextension movements to minimize excessive strain on the graft. Weight-bearing status should be touchdown weight-bearing for the first 6 weeks. Flexion should be limited to 90° for the first 2 weeks and then increased as tolerated thereafter. Cryotherapy also can be used starting on postoperative day 1 to manage swelling and pain. Overall, the rehabilitation protocol is staged with focus primarily on range of motion early on and gradual progression to muscular endurance, strength, and power.

Discussion

The treatment of popliteal tendon injuries has resulted in the development of numerous different techniques in recent years to restore stability to the knee. The technique described in this Technical Note is based on anatomic principles and has been biomechanically validated.[1,4] When treating a popliteus tendon tear, it is important to differentiate between a complete PLC injury and an isolated popliteus tendon tear. The use of varus stress gapping in conjunction with increased rotatory instability should point the surgeon towards reconstruction of the PLC.[13]

In cases of isolated popliteus tendon tears, an anatomic based reconstruction technique has been shown to restore stability to the knee. One study by Chahla et al.[13] found that an anatomic based reconstruction technique used for popliteus tendon injuries resulted in improved patient outcome scores, satisfaction, and overall knee stability. Other surgical techniques have been described, including arthroscopic reconstruction and open repair.[9,14] However, these techniques have not been biomechanically validated and do not use an early postoperative rehabilitation protocol. Our technique focuses on reconstructing the popliteus tendon based on the anatomic properties of the native structure. In addition, the management protocol described here focuses on early and extensive rehabilitation that maximizes patient outcomes while

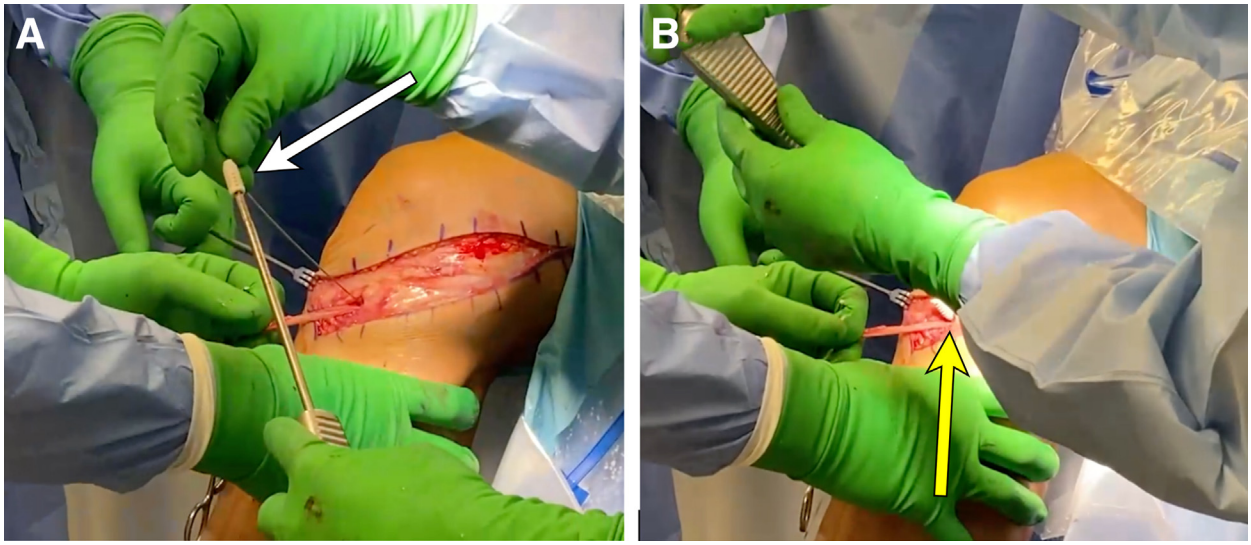

Fig 6. (A and B) Intraoperative images of the left knee with the patient supine illustrating placement of the 7 × 20-mm bioabsorbable screw (white arrow) in the tibial tunnel (yellow arrow) for final fixation of the popliteal tendon reconstruction graft with the knee at 60° of flexion and the foot in neutral rotation and traction on the graft. Following fixation of the graft within the tibial tunnel, all physical examination maneuvers should return to normal.

minimizing the risk of complications such as arthrofibrosis.

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