

Open Popliteal Tendon Repair



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Abstract: Popliteal tendon tears without concomitant damage to the cruciate ligaments or other posterolateral corner ligaments are rare entities with few studies reporting on their existence, with rare case reports discussing their treatment. Continued pain, instability, and effusions are typical symptoms, with magnetic resonance imaging being the main tool for diagnosis. Furthermore, monosodium urate crystals that induce gout have been shown to collect in the popliteal groove and thus may lead to degeneration and isolated tearing. Most case reports have reviewed arthroscopic debridement of the tendon in patients with continued pain. However, in the young athletic population, open repair, if the tissue appears to be of adequate quality, should be a consideration. The use of suture anchors to restore the popliteus to its anatomic footprint is desired. This Technical Note describes a safe and reliable technique for open popliteal tendon repair of an isolated avulsion injury.

The structure and function of the popliteal tendon have been well described in recent years.¹⁻⁵ There is a consistent anatomic relation between the fibular collateral ligament (FCL) origin, lateral epicondyle, and popliteal tendon, with the popliteus inserting 18.5 mm anterodistal to the FCL. It then passes deep to the FCL and through the popliteal hiatus to the posterior aspect of the knee. This structure is critically important in providing stability to the posterolateral corner of the knee, and sequential sectioning studies have shown increased laxity in external rotation at higher knee flexion angles with an incompetent popliteus.⁶ The injury patterns of an isolated popliteal tendon tear are classically described as a varus and external rotation force in slight knee flexion, which puts elevated strain on the popliteus, but the FCL can remain intact.^{1,7}

Furthermore, monosodium urate crystals that induce gout commonly collect in the popliteal hiatus and may also weaken the tendon, thereby leading to a susceptibility for tearing.^{8,9}

The management of isolated popliteal tendon injuries remains controversial, with some authors favoring conservative management^{10,11} but others proposing surgical intervention for acute and chronic grade 3 injuries of the popliteus.^{7,12} The rationale for acute intervention in popliteal tendon injury is to restore the biomechanical integrity of the posterolateral corner, thereby decreasing stress on and potential future injury to the FCL, popliteofibular ligament, lateral compartment, and cruciate ligaments.

Surgical Technique

Indications, Patient Evaluation, and Imaging

Isolated popliteal tendon tears are rare; therefore, other concomitant injuries to the collateral ligament complex and meniscus must be evaluated closely and treated appropriately. Gout should be considered in patients with isolated tears.^{8,9} Preoperatively, a careful history and physical examination that includes the dial test, posterolateral external rotation test, reverse pivot-shift test, and varus stress test are essential. In patients with popliteal tendon tears in whom nonoperative treatment fails, operative repair can be considered. Magnetic resonance imaging is the mainstay to evaluate the popliteal tendon, but ultrasound may provide helpful information as well.

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Table 1. Pearls and Pitfalls**Pearls**

Proper identification of the popliteal insertion is essential, which is approximately 18.5 mm distal to the lateral epicondyle in the anterior one-fifth of the popliteal fossa.

Appropriate identification of the popliteal tendon is important, as is releasing its adhesions to the surrounding capsule, to allow for appropriate excursion and a tensionless repair.

The popliteal tendon should be fixed with the knee in 70° of flexion in both neutral rotation and neutral varus-valgus.

Two suture anchors may be used to provide fixation through the entire footprint with a horizontal mattress configuration after the whipstitched tendon undergoes tenodesis.

Pitfalls

Injury to the FCL as well as the peroneal nerve must be avoided during dissection.

If popliteal tissue quality is insufficient, a quality repair may not be possible and debridement or reconstruction is recommended.

Tears that are not avulsions from the femoral footprint have a low likelihood of successful repair and should be debrided or reconstructed.

Careful evaluation for concomitant knee injuries is paramount because isolated popliteal tears are rare.

FCL, fibular collateral ligament.

Details regarding the surgical technique are shown in [Video 1](#). Pearls and pitfalls are described in [Table 1](#), and advantages, disadvantages, and limitations are shown in [Table 2](#).

After regional and general anesthesia, the patient is placed supine on the operating table and a tourniquet is applied on the thigh. The operative thigh is then placed in a surgical leg holder and the contralateral leg, in a well-leg holder. The leg is sterilely prepared and draped in the standard fashion. Arthroscopy is first performed, and the popliteus is visualized. In this case, the tendon is found to have a full-thickness tear with retraction to the popliteal hiatus ([Fig 1](#)). The unhealthy tissue is gently debrided with a shaver. A vertical lateral meniscal tear in the red-red zone is also confirmed. Arthroscopic changes consistent with gout are visualized.

Table 2. Advantages, Disadvantages, and Limitations**Advantages**

Fixation of isolated popliteal tendon tears restores the anatomy, thereby protecting the surrounding structures from future injury.

Fixation of the popliteus in concert with other pathologies such as lateral meniscal tears restores the native anatomy.

Providing 2 locations of anchors along the popliteal footprint allows anatomic healing.

The anatomy is well described in this region, making intervention safe.

Disadvantages and limitations

If gout is the cause, tissue quality may be questionable.

There is no literature evaluating the outcomes of operative or nonoperative treatment of isolated popliteal tendon tears.

Popliteal debridement has been described in patients with isolated tears.

There is a risk of iatrogenic injury to the FCL or peroneal nerve.

FCL, fibular collateral ligament.



Fig 1. Arthroscopic view of popliteus showing complete tearing and minimal retraction (white arrow). The patient is positioned supine and the right knee is injured while viewing from the anterolateral portal.

Attention is then turned to the open portion of the procedure, in which a 6-cm oblique incision is made on the lateral knee centered over the lateral epicondyle proximally and extending distally between the fibular head and Gerdy tubercle ([Fig 2](#)). After skin flaps are made, the iliotibial band is split and the FCL is identified and protected. Knowledge of the location of the peroneal nerve is also essential, and the nerve is protected throughout the procedure by staying anterior to the biceps femoris. Next, the lateral epicondyle is identified



Fig 2. An approximately 6-cm incision is made, starting over the lateral epicondyle and extending distally between the Gerdy tubercle and the fibular head. The patient is positioned supine and the right knee is injured.



Fig 3. The lateral epicondyle is identified, and a ruler is used to mark 18.5 mm anterior to the insertion of the popliteus.

and palpated. A ruler is then used to mark 18.5 mm anterior to the epicondyle, where the popliteus inserts (Fig 3). In this case, the popliteal fossa is empty. The retracted tendon is then identified and grasped with a small Kocher instrument, adhesions to the capsule and other surrounding structures are released with Metzenbaum scissors, and appropriate tendon excursion is confirmed (Figs 4 and 5). The popliteal footprint is exposed and prepared appropriately to improve the healing environment (Fig 6). The popliteal tendon is then whipstitched with a No. 2 FiberLoop (Arthrex, Naples, FL), 2 cm in length (Fig 7). The inside-out meniscal repair is completed, and sutures are tied over the capsule.

A 4.75-mm SwiveLock anchor (Arthrex) is then drilled and tapped in the anatomic insertion within the anterior one-fifth of the popliteal fossa as previously marked (Fig 8). A G4 Mitek anchor (Johnson & Johnson, New Brunswick, NJ) is drilled and placed at a 30° angle inferiorly and 8 mm posteriorly to the previously marked popliteal footprint. The sutures are kept for later passage through the tendon (Fig 9). The knee is then placed in 70° of flexion and neutral rotation without varus or valgus stress. The sutures from the previously whipstitched tendon are loaded into the 4.75-mm SwiveLock anchor and placed into the previously tapped hole while being tensioned appropriately (Fig 10). The sutures from the G4 Mitek anchor are then passed in a horizontal mattress configuration through the tendon and subsequently tied. The accessory stitch from the SwiveLock anchor is also passed through the tendon in a horizontal mattress fashion and tied (Fig 11). Postoperative range of motion, as well as appropriate tendon isometry, is assessed (Fig 12). The wound is copiously irrigated and closed in a layered fashion, beginning with the capsule (Fig 13). Finally,

platelet-rich plasma is injected into the knee joint to potentially aid in healing.

Postoperative Protocol

Postoperatively, the patient is placed in a knee brace locked in extension with physical therapy beginning on postoperative day 1. Range of motion is limited to 0° to 90° for 2 weeks and then advanced as tolerated. The patient is restricted to toe-touch weight bearing for 3 weeks before progression to full weight bearing. Knee strengthening is started at 6 weeks, with a return to activities at approximately 4 to 6 months postoperatively, pending progress with therapy.

Discussion

The described surgical technique is a reproducible and consistent approach for popliteal tendon repair based on the anatomy and principles of the posterolateral corner. The advantages of surgical intervention in an isolated popliteal tendon tear are that it restores the anatomy, thereby protecting the surrounding structures from future injury. Popliteal integrity decreases the external rotation laxity seen in full-thickness popliteal tendon tears. However, there is also a role for conservative management in these injuries,^{10,11} and future prospective studies are needed to determine the relative outcomes of surgical intervention as opposed to conservative management. In this case, a full-thickness popliteal injury was diagnosed preoperatively based on both clinical examination and imaging findings, and the surgical approach was already necessary to treat the meniscal pathology. Therefore, completing the popliteal tendon repair through the same approach in the same setting added little to the risk of complications or morbidity. Furthermore, the cause of popliteal injury must be evaluated closely because these injuries in



Fig 4. The knee capsule is incised longitudinally.

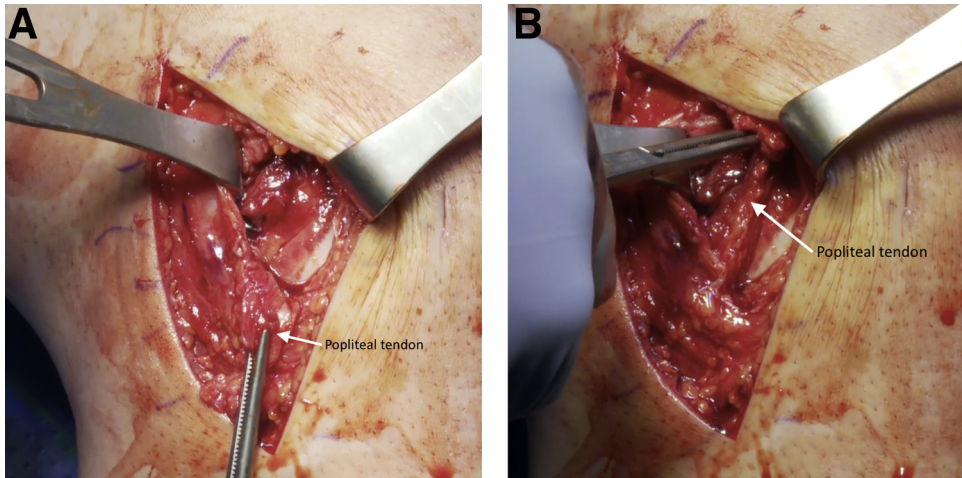


Fig 5. (A) The popliteus is identified and grasped. (B) Adhesions to the capsule and other surrounding structures are released. Tendon excursion is tested.

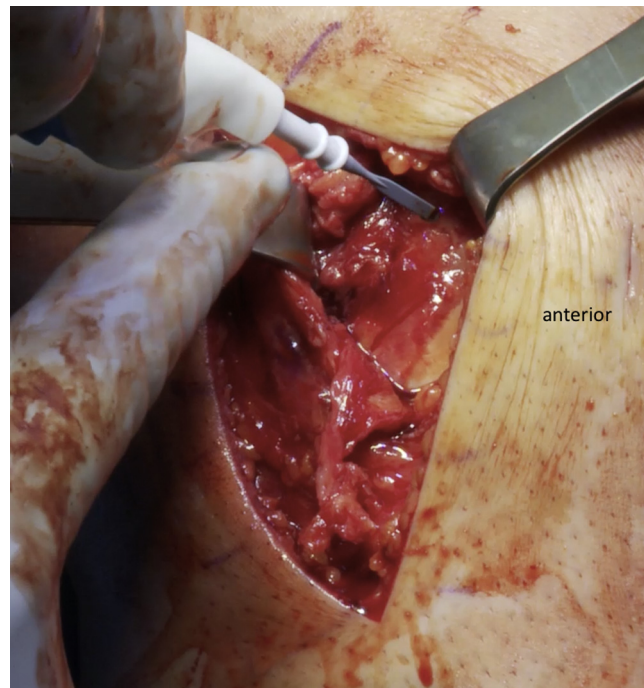


Fig 6. The footprint of the popliteus is exposed and prepared to maximize healing.

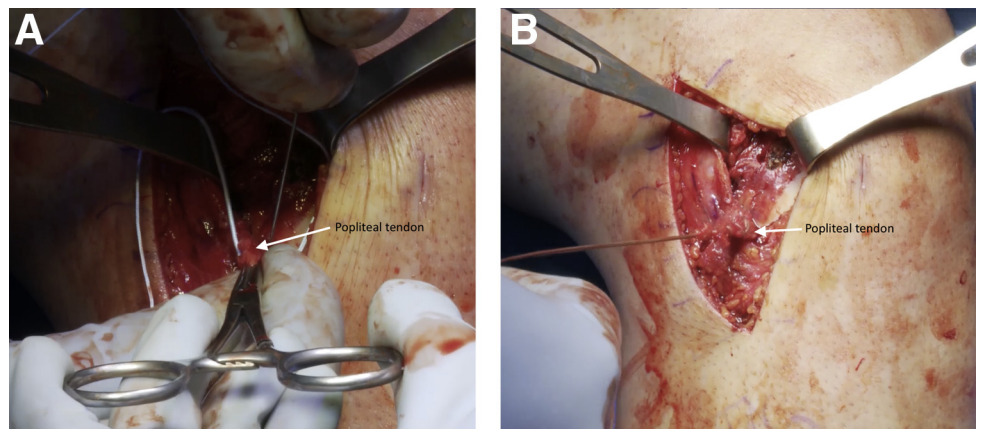


Fig 7. (A) The tendon is whip-stitched with a No. 2 suture, 2 cm in length, along the tendon. (B) Final construct.

Fig 8. The 4.75-mm SwiveLock anchor is drilled (A) and tapped (B).

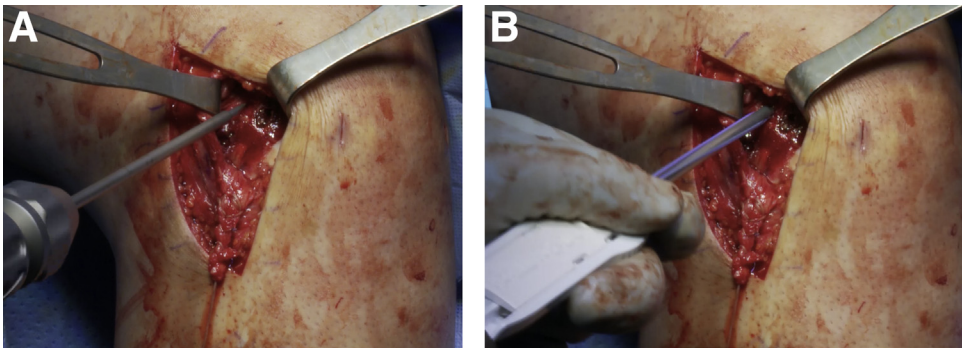
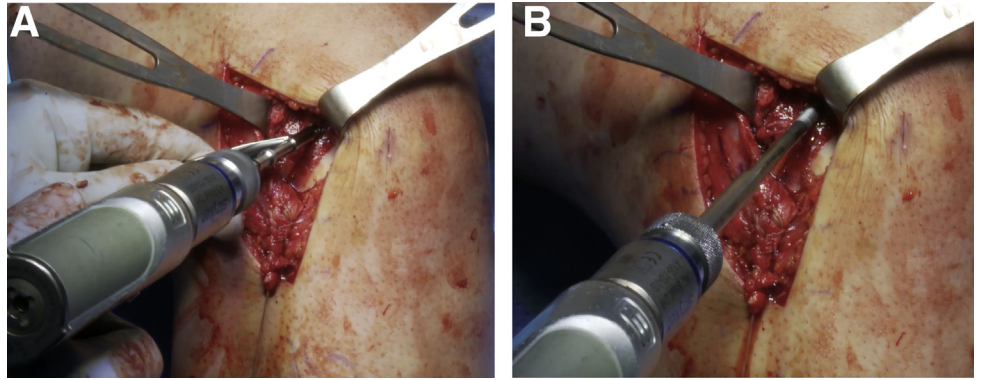


Fig 9. The 2 G4 Mitek anchors are drilled (A) and placed 8 mm posteriorly and slightly inferior to the previously marked anterior extent of the popliteal footprint (B).

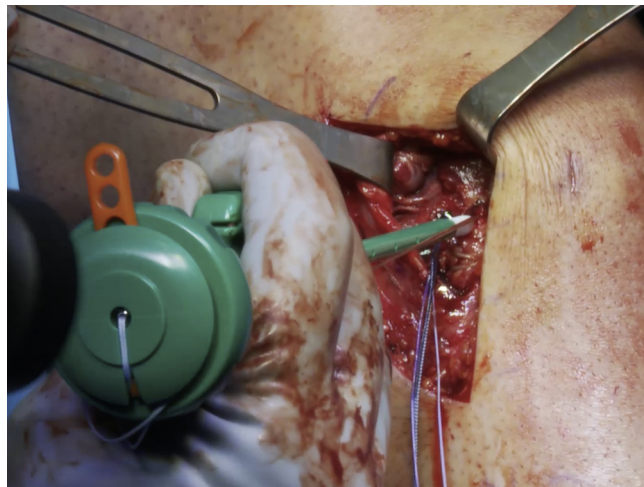


Fig 10. The sutures from the previously whipstitched tendon are loaded into the 4.75-mm SwiveLock anchor and placed into the previously tapped hole while being tensioned appropriately. The knee is then placed in 70° of flexion and neutral rotation without varus or valgus stress during fixation.

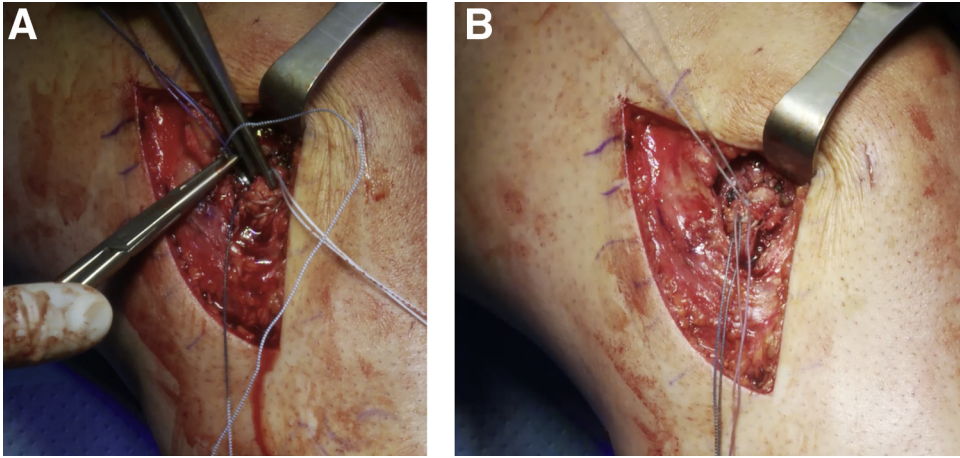


Fig 11. The sutures from the G4 Mitek anchors are passed in a horizontal mattress configuration through the tendon (A) and subsequently tied (B). The accessory stitch from the SwiveLock anchor is also passed through the tendon in a horizontal mattress fashion and tied.

isolation are rare. In this case, gout may have weakened the tendon, leading to its isolated injury, given that monosodium urate crystals have been shown to collect in the popliteal hiatus and groove.^{8,9}

It is critically important to evaluate the integrity of all posterolateral corner structures prior to determining a surgical treatment plan. FCL injuries are frequently seen in posterolateral corner injuries, but up to 77% of posterolateral corner injuries can occur without a full-thickness FCL tear.¹³ Furthermore, other predisposing factors, such as gout, should be considered in patients with isolated tears.^{8,9} Preoperatively, a careful history and physical examination that includes the dial test, posterolateral external rotation test, reverse pivot-shift test, and varus stress test must be performed, in addition to magnetic resonance imaging to confirm an isolated popliteal tendon tear. Intraoperatively, the “lateral

gutter drive-through sign,” as described by Feng et al.,¹² may be used to confirm the diagnosis. In this technique, the lateral gutter is noted to be open and devoid of the popliteal tendon, with an increased interval between the lateral femoral condyle and lateral joint capsule.¹² In combination, this comprehensive approach should provide a reliable method to diagnose isolated popliteal tendon tears, and the described surgical technique provides a consistent and reproducible method of tendon repair when deemed necessary based on concomitant pathology and patient factors.

In conclusion, this report presents a reliable surgical technique for repair of an isolated popliteal tendon tear. This technique may be used in isolation when indicated or for the treatment of injury to the popliteus at the time of open meniscal, capsular, or other ligament surgery through the same surgical approach and interval.

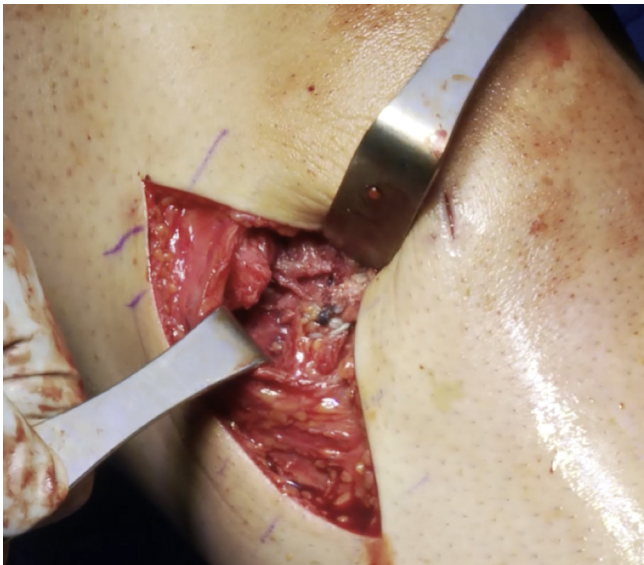


Fig 12. The final construct is shown, with the popliteal tendon being repaired to its footprint with 2 anchors. Post-operative range of motion, as well as appropriate tendon isometry, is assessed.

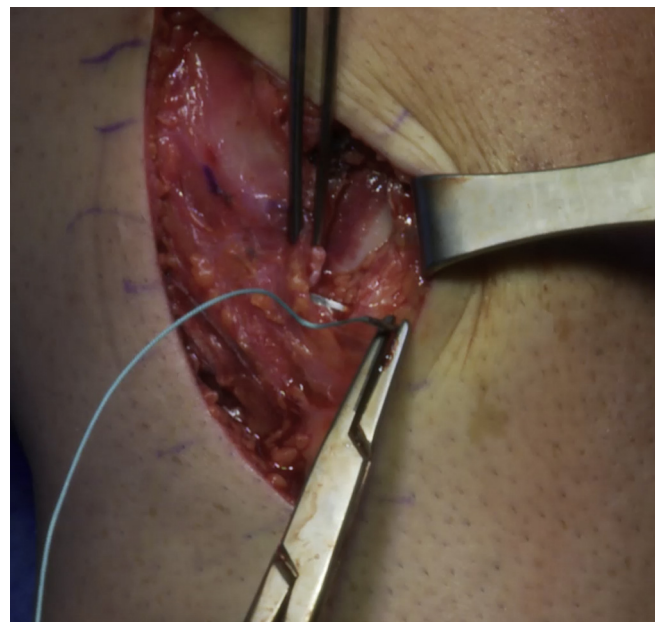


Fig 13. The capsule is closed with an absorbable suture.

References

1. LaPrade RF, Wozniczka JK, Stellmaker MP, Wijdicks CA. Analysis of the static function of the popliteus tendon and evaluation of an anatomic reconstruction: The "fifth ligament" of the knee. *Am J Sports Med* 2010;38:543-549.
2. Takeda S, Tajima G, Fujino K, et al. Morphology of the femoral insertion of the lateral collateral ligament and popliteus tendon. *Knee Surg Sports Traumatol Arthrosc* 2015;23:3049-3054.
3. Chahla J, Moatshe G, Dean CS, LaPrade RF. Posterolateral corner of the knee: Current concepts. *Arch Bone Joint Surg* 2016;4:97-103.
4. LaPrade RF, Ly TV, Wentorf FA, Engebretsen L. The posterolateral attachments of the knee: A qualitative and quantitative morphologic analysis of the fibular collateral ligament, popliteus tendon, popliteofibular ligament, and lateral gastrocnemius tendon. *Am J Sports Med* 2003;31:854-860.
5. Jadhav SP, More SR, Riascos RF, Lemos DF, Swischuk LE. Comprehensive review of the anatomy, function, and imaging of the popliteus and associated pathologic conditions. *Radiographics* 2014;34:496-513.
6. LaPrade RF, Tso A, Wentorf FA. Force measurements on the fibular collateral ligament, popliteofibular ligament, and popliteus tendon to applied loads. *Am J Sports Med* 2004;32:1695-1701.
7. Nakhostine M, Perko M, Cross M. Isolated avulsion of the popliteus tendon. *J Bone Joint Surg Br* 1995;77:242-244.
8. Di Matteo A, Filippucci E, Cipolletta E, et al. The popliteal groove region: A new target for the detection of monosodium urate crystal deposits in patients with gout. An ultrasound study. *Joint Bone Spine* 2019;86:89-94.
9. Girish G, Melville DM, Kaeley GS, et al. Imaging appearances in gout. *Arthritis* 2013;2013:673401.
10. McKay SD, Holt A, Stout T, Hysa VQ. Successful nonoperative treatment of isolated popliteus tendon avulsion fractures in two adolescents. *Case Rep Orthop* 2014;2014:759419.
11. Koong DP, An VVG, Lorentzos P, Moussa P, Sivakumar BS. Non-operative rehabilitation of isolated popliteus tendon rupture in a rugby player. *Knee Surg Relat Res* 2018;30:269-272.
12. Feng H, Zhang H, Hong L, Wang XS, Zhang J. The "lateral gutter drive-through" sign: An arthroscopic indicator of acute femoral avulsion of the popliteus tendon in knee joints. *Arthroscopy* 2009;25:1496-1499.
13. LaPrade RF, Terry GC. Injuries to the posterolateral aspect of the knee. Association of anatomic injury patterns with clinical instability. *Am J Sports Med* 1997;25:433-438.