# Popliteomeniscal Fascicle Tear: Diagnosis and Operative Technique

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**Abstract:** The occurrence and the consistency of the popliteomeniscal fascicle between the popliteus tendon and the lateral meniscus have been the subject of debate. It is difficult to diagnose and treat popliteomeniscal fascicle tears. Furthermore, popliteomeniscal fascicle tears are difficult to identify with arthroscopy. This article describes the diagnostic factors for popliteomeniscal fascicle tears and the safe, effective operative techniques that can be used for their treatment. We suggest that popliteomeniscal fascicle tears are diagnosed when the following 3 conditions are confirmed: (1) existence of mechanical symptoms such as pain, locking, and giving way in the lateral compartment of the knee; (2) identification of hypermobility of the lateral meniscus through arthroscopic probing; and (3) occurrence of an osteochondral lesion in the posterior area of the lateral femoral condyle. In the case of popliteomeniscal fascicle tears, the tear area can be repaired with a suture hook and polydioxanone with an all-inside technique. If the joint space is narrowing because of soft-tissue tightness, it can be repaired with a zone-specific cannula through an inside-out technique.

The occurrence and the consistency of the popliteomeniscal fascicle association between the popliteus tendon and the lateral meniscus have been the subject of debate. It has been assumed that the disruption of the fasciculus between the popliteus tendon and the lateral meniscus would result in increased meniscal instability.[1-3] Meanwhile, ways to accurately diagnose this condition, predict clinical symptoms, and determine an effective treatment are still not available.[4-6]

Suganuma et al.[6] recently reported on the use of magnetic resonance imaging (MRI) in the diagnosis of popliteomeniscal fascicle tears. However, MRI only reflects the conditions in the static position and might not be able to accurately diagnose the instability of the lateral meniscus that occurs while the patient is moving. Therefore it is necessary to use arthroscopy for direct observation and evaluation of the instability and pain in the lateral meniscus. The purpose of this article is to describe the arthroscopic findings of symptomatic, isolated injuries to the popliteomeniscal fascicles of the lateral meniscus and to introduce a safe and effective operative technique for the treatment of this condition, by use of an all-inside or inside-out technique.

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## TECHNIQUE

### Diagnostic Arthroscopy

A popliteomeniscal fascicle tear from the meniscus can produce mechanical symptoms, but it is typically difficult to confirm the diagnosis with MRI scans. Furthermore, in a study by Simonian et al.,[5] 3 patients who were found to have unstable popliteomeniscal fascicle tears at the time of surgery had shown normal MRI scan results initially.

We postulated that popliteomeniscal fascicle tears would entail pain, locking, and giving way in the lateral compartment of the knee. In particular, when the popliteomeniscal fascicle tear puts the lateral meniscus in an unstable condition, arthroscopic observation and probing into the popliteomeniscal fascicle area would be helpful (Fig 1, Video 1). Probing is essential for the identification of the damaged fascicle. The lateral meniscus may be pulled forward until more than half of it excurses without visually seeming actually torn, which may manifest a popliteomeniscal fascicle tear if it is accompanied by mechanical symptoms. Without accompanying mechanical symptoms, its manifestation may be ruled out during the diagnosis even if the fascicle seems loose to some degree. In addition, if the tear area is wide and severe, direct visualization is possible with arthroscopy through the anterolateral portal (Fig 2A). In practice, we occasionally found an osteochondral lesion in the posterior area of the lateral femoral condyle adjacent to the popliteomeniscal fascicle tear area by using a 70° arthroscope through an anterolateral portal.

We concluded that popliteomeniscal fascicle tears can be diagnosed from (1) mechanical symptoms such as pain, locking, and giving way in the lateral compartment of the knee; (2) hypermobility of the lateral meniscus (which can be observed through arthroscopic probing where more than half of the lateral meniscus excurses); and (3) as a relative indication, an osteochondral lesion in the posterior area of the lateral femoral condyle (which is the manifestation suggesting subluxation of the chronic lateral meniscus) (Fig 3, Table 1).

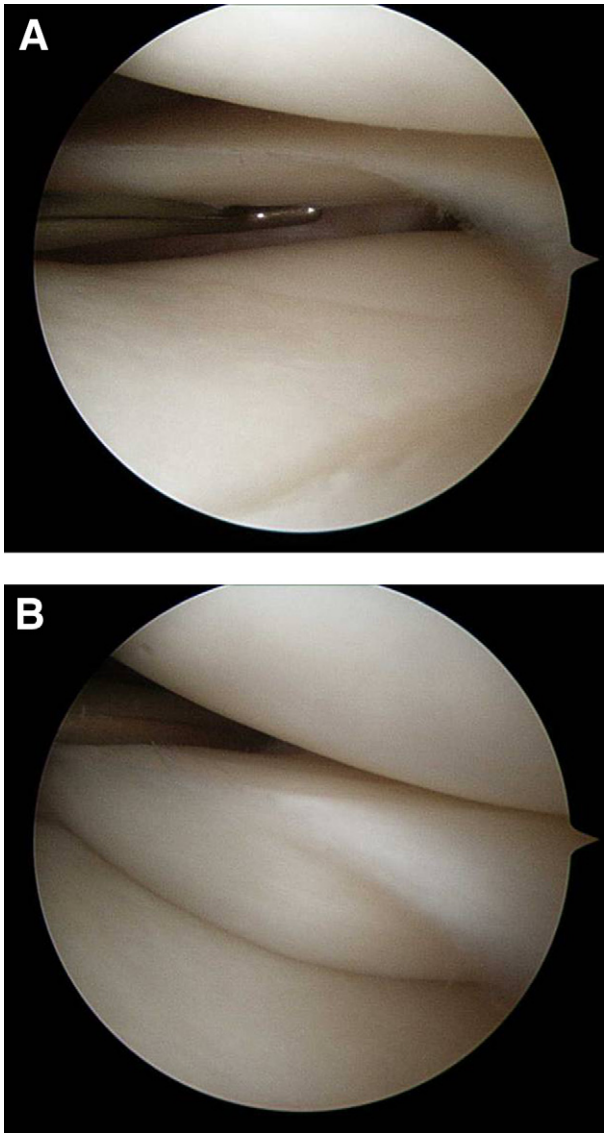


**Figure 1.** Hypermobility of lateral meniscus. (A) The arthroscopic view (30°) through the anterolateral portal without probing seems normal. (B) However, it can be observed through arthroscopic probing that more than half of the lateral meniscus excursed.

## Arthroscopic Repair

The patient was positioned so that the knee could be flexed at 90° and supported by a lateral post. This enabled full support of the knee while the knee was flexed at 90° during the repair. This setup also allowed full access to the posterior aspect of the knee. Standard diagnostic arthroscopy was performed by use of 2 anterior portals (anteromedial and anterolateral). In addition, a posterolateral portal was placed. The position of the posterolateral portal needs to be high and posterior in reference to the lateral condyle to facilitate easy visualization of the popliteomeniscal fascicle tear. With the arthroscope (70°) routed through the anteromedial portal and visualizing the popliteomeniscal fascicle tear (Fig 2B), we maneuvered a curved suture hook (Linvatec, Largo, FL) with No. 0 polydioxanone (PDS) (Ethicon, Somerville, NJ). Identifying a popliteomeniscal fascicle tear by probing, we used a rasp (Arthrex, Naples, FL) to stimulate the tissue in the area as well as the meniscal rim adjacent to it in the area of the popliteomeniscal fascicle. A small right-angle curved suture hook was then placed into the tear area through a posterolateral portal. If the sutures need to be placed more peripherally, the suture hook may be maneuvered past the lateral meniscus. The No. 0 PDS was then passed up through the tear area from below, after which a suture retriever could be used to retrieve the upper leg of the suture through

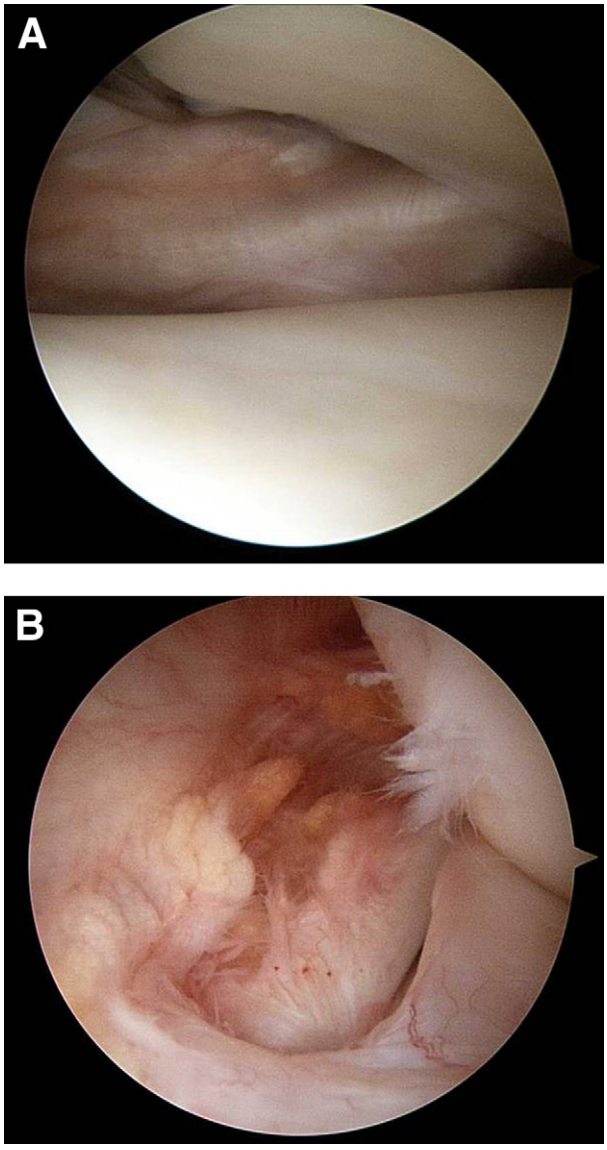


**Figure 2.** Observations with the arthroscope routed through the portal and visualizing the popliteomeniscal fascicle tear. (A) Arthroscopic view (30°) through the anterolateral portal. (B) Arthroscopic view (70°) through the anteromedial portal of the knee posterior joint space.

the posterolateral portal. After the suture hook was removed, both ends of the PDS were held together and retrieved at the same time through the posterolateral portal with a suture retriever (Fig 4A). The No. 0 PDS was tied using a sliding knot and additional 2 or 3 half-stitch knots (Fig 4B). The approximation of the previous tear site was controlled by a probe. This step was repeated until 2 or 3 sutures were placed according to the tear shape and approximation (Fig 5). To ensure easy repair, we did not use a zone-specific cannula. However, if the joint space was narrowing because of soft-tissue tightness, the tear was then repaired with an inside-out technique using a cannula. Table 2 shows more detailed considerations for the operation.

### Postoperative Rehabilitation

The patient's extremity was placed with a long leg splint with the knee at 30° flexion, and non–weight-bearing range-of-motion exercises were started on postoperative day 1 with a flexion limit of 90° for 3 weeks. We only allowed weight-bearing ambulation using crutches during the first 6 weeks after surgery to prevent retears of the suture area. At 6 weeks postoperatively, short-arc closed-chain kinetic exercise began (e.g., mini-squats and use of an exercise bicycle). Straight-line jogging started at 10 to 14 weeks. Full return to sports was allowed at 14 to 16 weeks.

## DISCUSSION

After examining 10 gross anatomic dissections of fresh-frozen knee specimens (none of which had any evidence of previous surgery), in 1979 Cohn and Mains[7] reported that the superior border of the popliteal hiatus defined the superior popliteomeniscal fascicle and the inferior border defined the inferior popliteomeniscal fascicle. Later, Stäubli and Birrer[8] described the popliteus tendon and its fasciculi at the

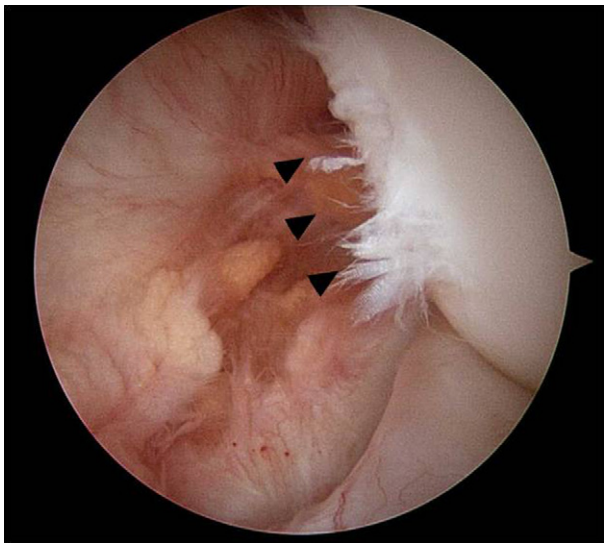

**Figure 3.** An osteochondral lesion (arrowheads) in the posterior area of the lateral femoral condyle adjacent to the popliteomeniscal fascicle tear area observed through an anteromedial portal with a 70° arthroscope.

**Table 1.** *Diagnosis of Popliteomeniscal Fascicle Tear*

| |
|---|
| Absolute* |
| Mechanical symptoms such as pain, locking, and giving way in the lateral compartment of the knee |
| Hypermobility of the lateral meniscus (which can be observed by arthroscopic probing where more than half of the lateral meniscus excurses) |
| Relative* |
| An osteochondral lesion in the posterior area of the lateral femoral condyle (suggesting a chronic lesion) |

*Both of the absolute indications are required for a definite diagnosis of a popliteomeniscal fascicular tear. The relative indication may strongly suggest a popliteomeniscal fascicular tear, but it is not a criterion for definite diagnosis.

popliteal hiatus and suggested that the superior and inferior popliteal fasciculi influenced the motion of the lateral meniscus. Yet, the clinical correlation between these structures and their injuries has not been clearly elucidated.

The popliteomeniscal fasciculus consists of the anteroinferior, posterosuperior, and posteroinferior fascicles, and 3 popliteomeniscal fascicles are combined with the popliteus tendon and attached to the lateral meniscus at the popliteal hiatus of the knee.[6,8] The superior fascicle arises from the medial fibers of the aponeurosis of the popliteus tendon, whereas the inferior fascicle is a coronary ligament that extends from the meniscus to the edge of the tibia.[1] In particular, Sussmann et al.[9] reported that the anteroinferior fascicle had a greater degree of control over lateral meniscal motion compared with the posterosuperior fascicle. In addition, they suggested that, during embryologic development, the fascicle appeared to have provided a vascular supply to the lateral meniscus adjacent to the popliteal

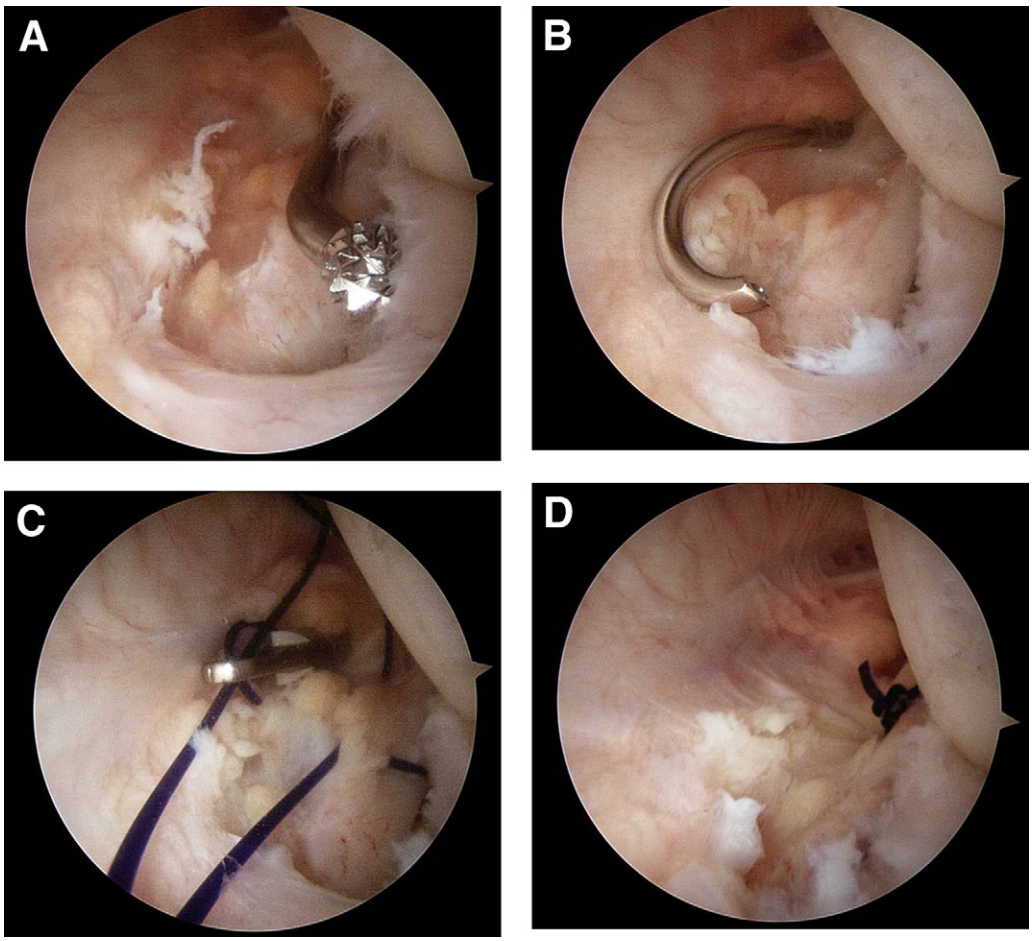


**Figure 4.** All-inside suture technique. (A) A rasp is used to stimulate the tissue in the tear area. (B) A suture hook is maneuvered past the popliteomeniscal fascicle tear area. (C) A sliding knot is used to tie the No. 0 PDS. (D) The first knot has been completed.

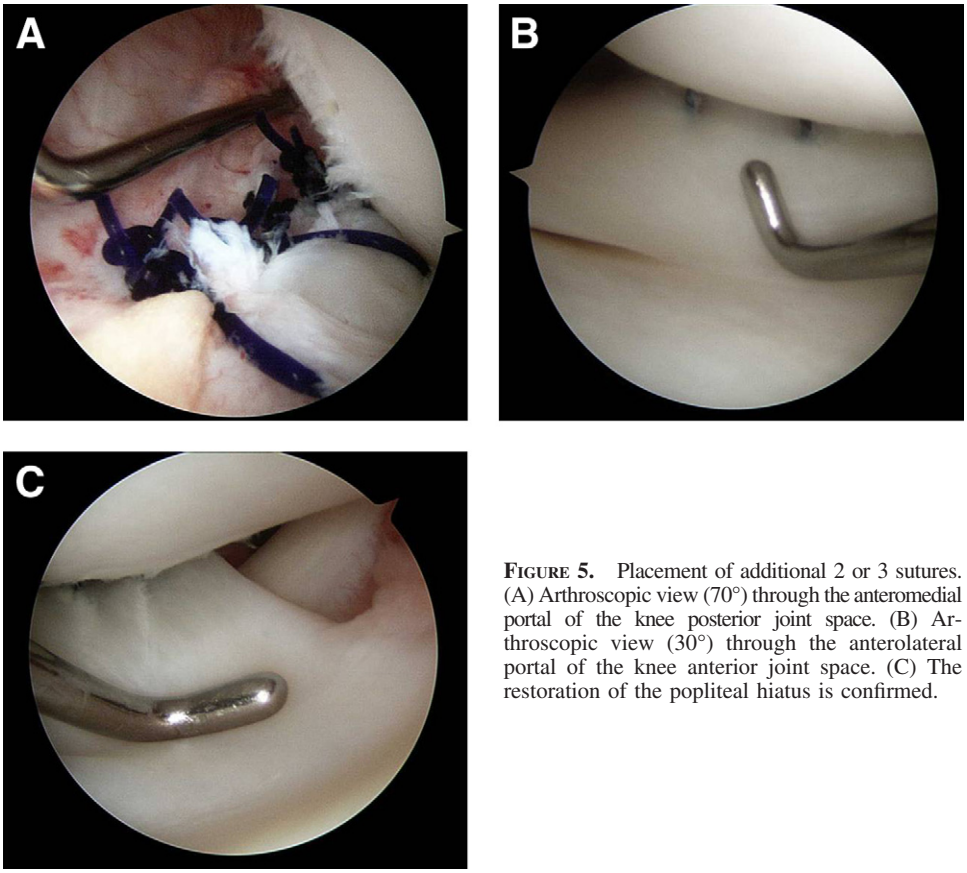


**FIGURE 5.** Placement of additional 2 or 3 sutures. (A) Arthroscopic view (70°) through the anteromedial portal of the knee posterior joint space. (B) Arthroscopic view (30°) through the anterolateral portal of the knee anterior joint space. (C) The restoration of the popliteal hiatus is confirmed.

hiatus where the meniscus was devoid of capsular attachment.

Stäubli and Birrer[8] reported their clinical observations that increased lateral meniscal motions, as well as the loss of lateral retraction of the lateral meniscus with a varus stress applied to the knee, occurred when these fascicles were torn. If the popliteomeniscal fascicles are disrupted, the normal peripheral hoop tension on the lateral meniscus is lost, a circumstance that can result in the lateral meniscus displacing medially into the joint.[3]

The main complaints associated with this condition were pain in the lateral compartment of the knee and mechanical symptoms such as locking and giving way with the knee in full flexion. Because the lateral meniscus could potentially become trapped in the joint, we concluded that the knee pain and the mechanical symptoms such as locking and giving way resulted from popliteomeniscal fascicle tears. In addition, popliteomeniscal fascicle tears may result in the displacement of the separated bucket-handle meniscus.[5,6]

**TABLE 2.** *Items to Consider When Diagnosing and Operating on Popliteomeniscal Fascicle Tear*

| | Pearls and Pitfalls |
|---|---|
| Diagnosis | During arthroscopy, be sure to hook and pull the popliteal hiatus with the probe. Even if no fascicle tear exists, hypermobility of the popliteal fascicle may occur because of its elongation or loosening, in which case repair is required. Because the existence of an osteochondral lesion strongly suggests a popliteomeniscal fascicle tear, careful observation is required to determine hypermobility. |
| Operative technique | It is easier to place sutures when the location of the posterolateral portal is a little higher than the height of the meniscus. Perform suturing from the point nearest to the popliteal hiatus. Be cautious not to suture the popliteal tendon during repair. Place 2 to 3 sutures depending on the length of the tear with 5- to 10-mm intervals. Place knots on the posterior capsule side to avoid impingement. |

It is also important to verify the concurrent lateral meniscal hypermobility using arthroscopic probing to confirm the need for a surgical repair of a popliteomeniscal fascicle tear. Simonian et al.[4] emphasized that the stability of the lateral meniscus should be evaluated with a probe from an anterior portal applied with an anterior-to-posterior force while the knee is in a flexed position to allow access to this region. The force applied to the meniscus was designed to mimic the force applied at arthroscopic examination, similar to probing the lateral meniscus at the zone of fascicular injury near the popliteal hiatus and displacing the meniscus anteriorly. Because less than half of the intact lateral meniscus showed excursion when there was no popliteomeniscal fascicle injury,[10] we postulated that, when more than half of the lateral meniscus shows excursion, a popliteomeniscal fascicle tear should be suspected. To prevent mechanical symptoms and posterolateral knee pain from occurring in patients, we agree with Simonian et al.[5] that isolated, unstable popliteomeniscal fascicle injuries should be surgically repaired.

Furthermore, we found an osteochondral lesion in the posterior area of the lateral femoral condyle through an anteromedial portal with a 70° arthroscope during arthroscopic evaluation. We hypothesized that the cause of the osteochondral lesion was the repetitive entrapment of the lateral meniscus caused by posterolateral translation in a situation where a popliteomeniscal fascicle tear occurs. When osteochondral lesions develop in the posterior area of the lateral condyle, a popliteomeniscal fascicle tear can be strongly suspected, although it cannot be confirmed in all cases.

Despite their assessment of the results of the open repairs, LaPrade and Konowalchuk[11] postulated that arthroscopic or arthroscopically assisted lateral meniscal repair that restores the integrity of the popliteomeniscal fascicles and the capsular attachment to the lateral meniscus would also be successful. In our study arthroscopic surgical repair with a curved suture hook or a zone-specific cannula was performed when the arthroscopic evaluations confirmed that the lateral meniscus was unstable.

The limitations of this study are that objective postoperative functional evaluation was not performed and that the lack of long-term follow-up did not allow us to cover the potential postoperative complications or operation failures. Furthermore, because arthroscopy is, to some degree, an invasive procedure and cannot represent the severity of lateral meniscus hypermobility in objective values, the result of diagnosis may differ depending on the experience of the surgeon. Another limitation is that this study did not look into the correlation with MRI, which is widely used in the diagnosis of intra-articular conditions. However, the static nature of MRI may not be expected to reflect all conditions, and more endeavors and studies will be necessary for the development of more objective methods of diagnosis.

In conclusion, we recommend other surgeons who encounter cases of a hypermobile lateral meniscus and mechanical symptoms of the lateral knee compartment to consider the described technique for the treatment of this injury pattern.

## REFERENCES


1. Johnson RL, De Smet AA. MR visualization of the popliteomeniscal fascicles. *Skeletal Radiol* 1999;28:561-566.
2. Kimura M, Shirakura K, Hasegawa A, Kobayashi Y, Udagawa E. Anatomy and pathophysiology of the popliteal tendon area in the lateral meniscus: 1. Arthroscopic and anatomical investigation. *Arthroscopy* 1992;8:419-423.
3. Kimura M, Shirakura K, Hasegawa A, Kobayashi Y, Udagawa E. Anatomy and pathophysiology of the popliteal tendon area in the lateral meniscus: 2. Clinical investigation. *Arthroscopy* 1992;8:424-427.
4. Simonian PT, Sussmann PS, van Trommel M, Wickiewicz TL, Warren RF. Popliteomeniscal fasciculi and lateral meniscal stability. *Am J Sports Med* 1997;25:849-853.
5. Simonian PT, Sussmann PS, Wickiewicz TL, et al. Popliteomeniscal fasciculi and the unstable lateral meniscus: Clinical correlation and magnetic resonance diagnosis. *Arthroscopy* 1997;13:590-596.
6. Suganuma J, Mochizuki R, Inoue Y, Yamabe E, Ueda Y, Kanauchi T. Magnetic resonance imaging and arthroscopic findings of the popliteomeniscal fascicles with and without recurrent subluxation of the lateral meniscus. *Arthroscopy* 2012;28:507-516.
7. Cohn AK, Mains DB. Popliteal hiatus of the lateral meniscus. Anatomy and measurement at dissection of 10 specimens. *Am J Sports Med* 1979;7:221-226.
8. Stäubli HU, Birrer S. The popliteus tendon and its fascicles at the popliteal hiatus: Gross anatomy and functional arthroscopic evaluation with and without anterior cruciate ligament deficiency. *Arthroscopy* 1990;6:209-220.
9. Sussmann PS, Simonian PT, Wickiewicz TL, Warren RF. Development of the popliteomeniscal fasciculi in the fetal human knee joint. *Arthroscopy* 2001;17:14-18.
10. Thompson WO, Theaete FL, Fu FH. Tibial meniscal dynamics using three-dimensional reconstruction of magnetic resonance images. *Am J Sports Med* 1991;19:210-216.
11. LaPrade RF, Konowalchuk BK. Popliteomeniscal fascicle tears causing symptomatic lateral compartment knee pain: Diagnosis by the figure-4 test and treatment by open repair. *Am J Sports Med* 2005;33:1231-1236.