Technical Note

Reinsertion of Posterior Meniscal Root for Management of Hypermobile Lateral Meniscus: Description of a Surgical Technique

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Abstract: Lateral meniscus hypermobility is a special condition in which the posterior horn of the lateral meniscus exhibits excessive mobility. This condition can cause pain and locking in the knee, especially during kneeling, deep flexion, or squatting. In this article, we present a surgical technique for the reinsertion of the posterior root of the external meniscus in cases of hypermobility without detachment. The objective is to increase the tension of the meniscotibial and meniscal popliteal ligaments to achieve meniscal stability. The procedure involves suturing the meniscal root and fixation using a knotless implant through a transosseous tunnel. This technique has proven to be effective in stabilizing the lateral meniscus in patients with hypermobility.

Lateral meniscus hypermobility, found in both the adult and pediatric population, is defined as a rare condition in which the posterior horn of the lateral meniscus (PHLM) exhibits excessive mobility.[1] This hypermobility is characterized by knee pain, which may or may not be accompanied by locking symptoms, especially during kneeling or squatting.[1,2] Its cause has been linked to the absence of posterior meniscocapsular attachments, such as the meniscotibial ligaments and/or meniscopopliteal fascicles, either congenitally, as seen in cases of Wrisberg-type variant discoid meniscus, or due to a traumatic injury.[1,3-5] In some cases, it has been observed to be associated with chronic injuries to the anterior cruciate ligament and the posterolateral corner.[6]

During the clinical examination, the figure-of-4 test, as described by LaPrade et al.,[7] involving flexion, varus, and external rotation, can reproduce pain and locking in the lateral compartment at the level of the popliteal hiatus. Radiologic studies typically do not show signs of meniscal pathology.[1,2,6-8] Occasionally, Wrisberg-type discoid meniscus or secondary signs, such as bone contusions of the tibial plateau suggestive of traumatic injury at the popliteal hiatus, may be found.

During arthroscopy, the diagnosis is established through a systematic exploration, as described by Jacquet et al.,[6] to evaluate the popliteal hiatus and visualize the popliteal tendon, meniscotibial ligaments, and popliteomeniscal fascicles. The "aspiration test" is made at the time of the exploration of the lateral tibiofemoral compartment with the knee in the figure-of-4 position. The arthroscope is placed in the anterolateral portal and directed toward the lateral compartment. The test is performed by activating the aspiration. In the absence of instability, no anterior translation is observed. Conversely, the test is positive if there is an excessive translation of the posterior portion of the lateral meniscus more than 50% of the external tibial plateau area.[6] Palpation and traction through the anteromedial portal can reveal subluxation of the posterior horn of the lateral meniscus, exceeding 50% of the tibial plateau.[6] The "crescent moon" sign has also been

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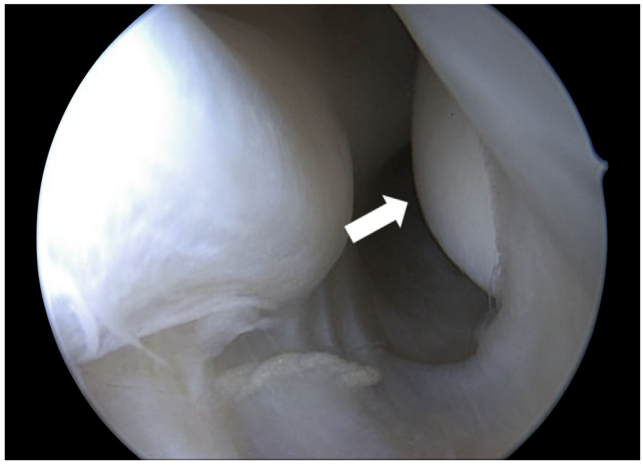

Fig 1. Crescent moon sign, showing the cartilaginous edge of the lateral tibial plateau while examining the popliteal hiatus during diagnostic arthroscopy (image from Goto et al.[9]).

described, which is observed when evaluating the popliteal hiatus, and shows part of the cartilage of the external tibial plateau, indicating a lesion of the meniscotibial ligaments (Fig 1).[9]

Various surgical techniques have been described for the treatment of lateral meniscus hypermobility, such as using radiofrequency for collagen thermoretraction of the meniscotibial ligaments,[10] repair of the popliteomeniscal and meniscotibial ligaments,[7] all-inside sutures with implants,[1] or inside-out sutures.[3]

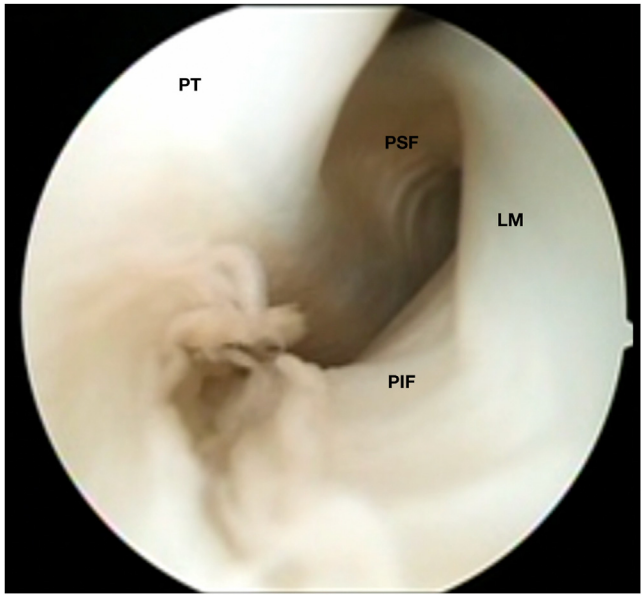

Fig 2. Popliteal hiatus examination during arthroscopy. Introduction of the arthroscope in to the popliteal hiatus is made through the anterolateral portal in semi-flexion of the knee. No pathology is found in the structures of the popliteal hiatus. (LM, lateral meniscus; PIF, posteroinferior fascicle; PSF, posterosuperior fascicle; PT, popliteal tendon.)

Fig 3. Figure-of-4 position during arthroscopy to access the lateral compartment. Only the anterolateral portal is done for diagnostic arthroscopy.

However, to date, reinsertion of the posterior root of the lateral meniscus has not been described as a treatment option for cases of laxity without detachment. Therefore, in this article, we describe our surgical technique used for managing lateral meniscus hypermobility, based on the reinsertion of the posterior root of the lateral meniscus and tensioning with medialization of the meniscotibial ligaments, a technique described by LaPrade et al.[11] and Bhatia et al.[12] and used for the treatment of acute posterior root injury. Our objective is to increase tension in the insertions of the meniscotibial and popliteomeniscal ligaments, thus achieving stability of the posterior horn and the

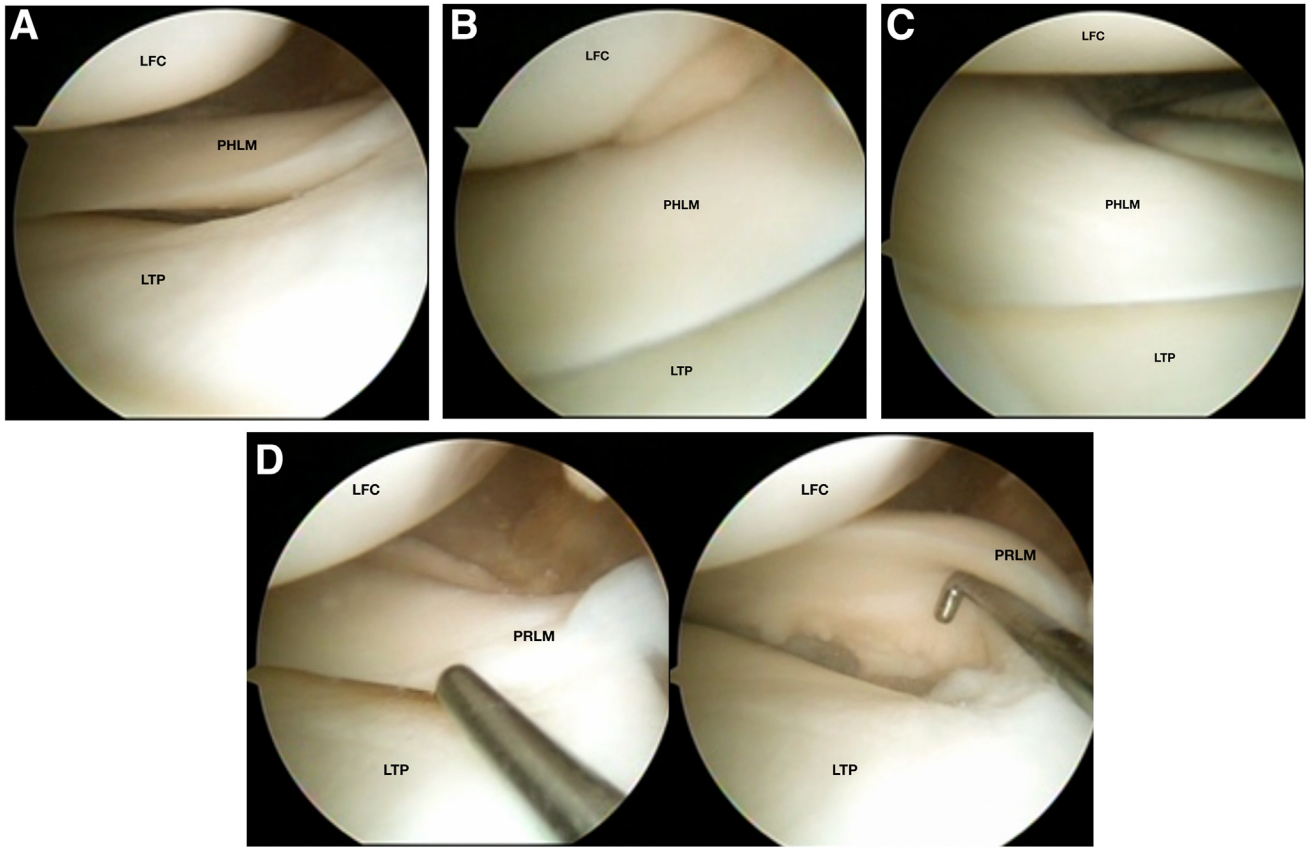

Fig 4. Lateral compartment is examined with the figure-of-4 position using the anterolateral portal for vision. (A) Lateral compartment view. First view during arthroscopy before performing arthroscopy tests for lateral hypermobile meniscus. (B) Positive aspiration test is performed by activating aspiration and when subluxation of the PHLM is greater than 50% of the tibial surface. (C) After making the anteromedial portal for arthroscopic instruments, positive traction test is done with the arthroscopic probe through the anteromedial portal. Palpating and anteromedial traction of the PHLM can reveal subluxation that exceeds 50% of the tibial plateau. (D) The laxity of the posterior root of the lateral meniscus is verified by introducing the arthroscopic probe through the anteromedial portal, under the meniscal root, and by generating cephalic stress. Posterior root tears are ruled out during this step. (LFC, lateral femoral condyle; LTP, lateral tibial plateau; PHLM, posterior horn of the lateral meniscus; PRLM, posterior root of the lateral meniscus.)

posterior third of the meniscal body. We confirmed the effectiveness of our technique by observing negative results in diagnostic arthroscopic tests, such as aspiration, anterior traction of the posterior meniscus horn, and root laxity, along with normal translation during evaluation of full knee flexion-extension.

Technique

Preoperative Evaluation and Surgical Decision

Patients with lateral meniscus hypermobility can have intermittent and unspecific posterolateral knee pain. Sometimes they can have locking while kneeling of squatting. During physical examination, pain can be reproduced during the figure-of-4 (Moragas) test,[7] with complete knee flexion and varus stress on the joint while palpating the lateral meniscus wall. There can be a catching sensation in the meniscus during extension from this position.

Even though there are no specific radiologic signs to diagnose this pathology, in magnetic resonance imaging, a contusion at the posterior edge of the tibia can be seen in the sagittal plane, with an increase of the space between the posterior wall of the lateral meniscus and the popliteal tendon at the popliteal hiatus on axial and sagittal views. Additionally, a hypertrophic Wrisberg meniscofemoral ligament (Wrisberg variant or type C discoid meniscus) can be seen in coronal view and the lack of meniscotibial ligaments in the sagittal view.

Physical therapy is the initial treatment. But in many cases, patients do not improve and continue having knee pain. Therefore, arthroscopic surgical management is an option.

Patient Position and Surgical Technique

The patient is in the supine position under spinal anesthesia, and a diagnostic arthroscopy is performed

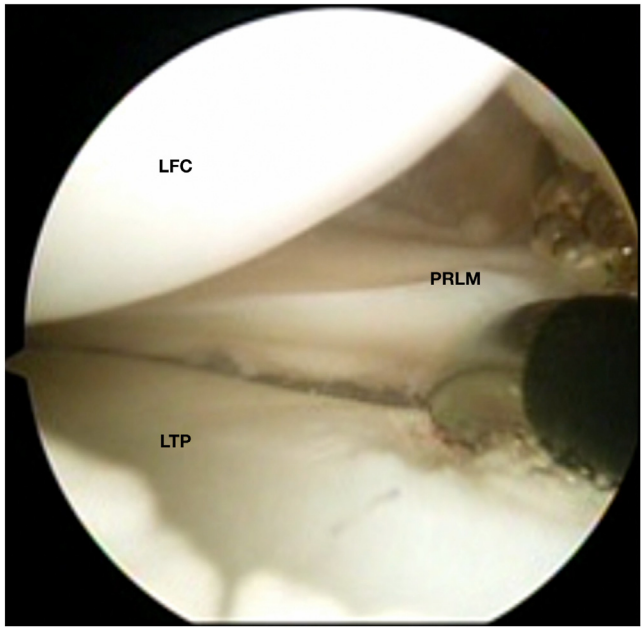

Fig 5. Preparation of the footprint of the posterior root of the lateral meniscal using radiofrequency. Anterolateral portal for vision and anteromedial portal for instrumentation in figure-of-4 position (LFC, lateral femoral condyle; LTP, lateral tibial plateau; PRLM, posterior root of the lateral meniscus.)

to rule out associated pathologies in other compartments. Extended exploration of the popliteal hiatus is made to assess the popliteal tendon; the outer edge of the lateral meniscal body; the posterosuperior, posteroinferior, and anterosuperior popliteomeniscal fascicles; and the meniscotibial ligaments, as shown in Video 1 (Fig 2).[6]

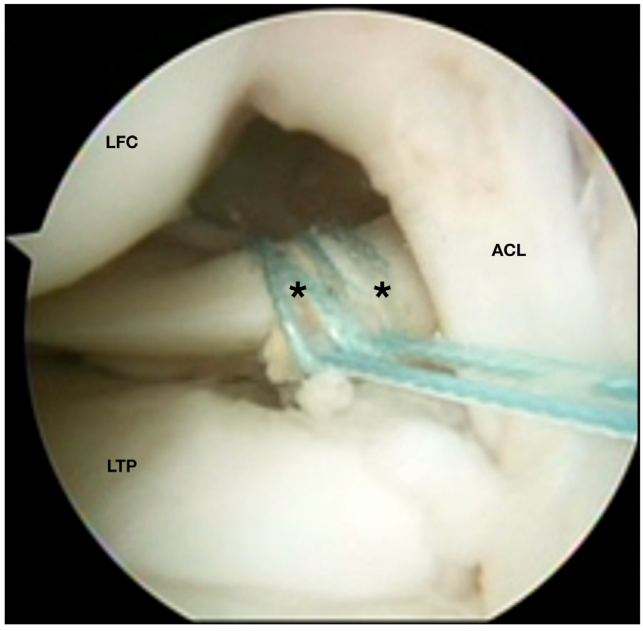

Fig 6. Double cinch-type suture in the posterior root of the lateral meniscus (asterisks) by using a Scorpion clamp. Anterolateral portal for vision and anteromedial portal for instrumentation in figure-of-4 position (ACL, anterior cruciate ligament; LFC, lateral femoral condyle; LTP, lateral tibial plateau.)

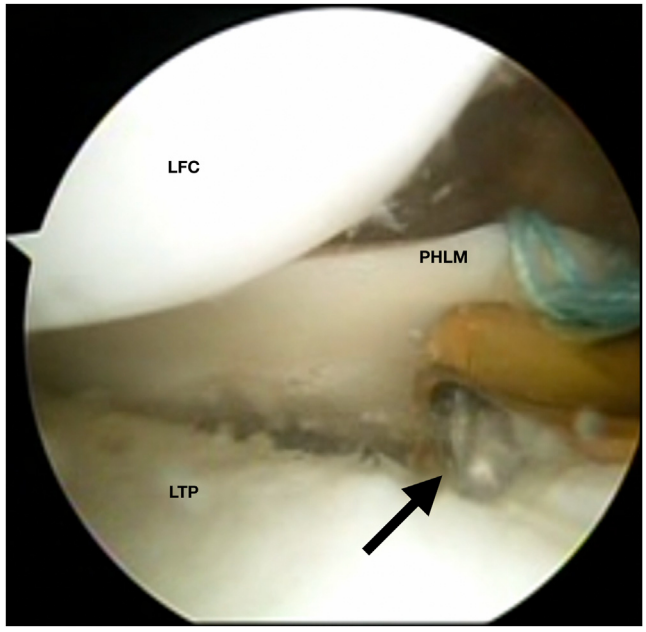

Fig 7. Tibial tunnel drilling with a posterior meniscal root guide at a 50-degree angle. First, a 2.4-mm guide pin is positioned, after a 4.5-mm drill is used (arrow) under arthroscopic visualization. Anterolateral portal for vision and anteromedial portal for instrumentation in figure-of-4 position (LFC, lateral femoral condyle; LTP, lateral tibial plateau; PRLM, posterior root of the lateral meniscus.)

Access to the lateral compartment with the figure-of-4 position (Fig 3) and tests to diagnose lateral meniscus hypermobility are performed (Fig 4). For the aspiration test,[6] water flow is closed and aspiration is connected to the trocar, observing the luxation of the PHLM (Fig 4A). Then, the anteromedial portal is done, and with an arthroscopic probe, traction on the posterior horn is made to reproduce anterior subluxation of the PHLM (Fig 4B). Then, the laxity of the meniscal root is verified and lesions are ruled out using the probe through the same portal, placing it underneath the root and generating cephalic stress, as shown Video 1. Occasionally, integrity and laxity of the meniscotibial ligaments can be observed (Fig 4C).

Debridement of the meniscal root footprint on the tibial plateau is done by using a curette, shaver, and radiofrequency (Fig 5). The meniscal root is sutured with 2 mattress sutures using FiberWire No. 2 (Arthrex) and the Scorpion-type suture passer (Arthrex) (Fig 6). We use cinch-type knots to achieve secure suturing.

With the meniscal root guide at a 50-degree vertical angle, a 2.4-mm guide pin is positioned under arthroscopic visualization. Subsequently, tibial tunnel is created using a 4.5-mm diameter cannulated drill (Fig

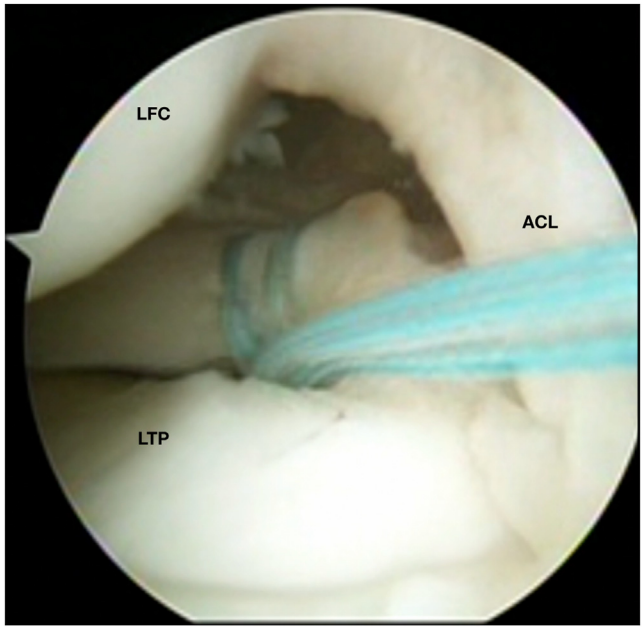

Fig 8. Retrieval of double meniscal root sutures through the tibial tunnel. Anterolateral portal for vision in figure-of-4 position (ACL, anterior cruciate ligament; LFC, lateral femoral condyle; LTP, lateral tibial plateau.)

7). The meniscal sutures are retrieved through the tibial tunnel using a suture retriever (Fig 8).

Before final fixation, meniscal stability is confirmed by pulling on the sutures and ensuring that the aspiration test, posterior horn traction, and posterior root laxity are negative, as shown in Video 1 (Fig 9A, B).

Final fixation is made at 40 degrees of flexion, using direct visualization to observe the tension of the lateral meniscus. For fixation, the Swivelock system with a knotless titanium tip (Arthrex) is used to secure the meniscal root sutures to the anteromedial tibial cortex. Prior to placing the device, adequate exposure of the cortical area is ensured to prevent postsurgical local pain associated with irritation of the hamstring tendons. The stability of the posterior horn is reevaluated, and the aspiration test is performed again. Radiologic imaging is used postoperatively to confirm the position of the implant and the bone tunnel (Fig 10).

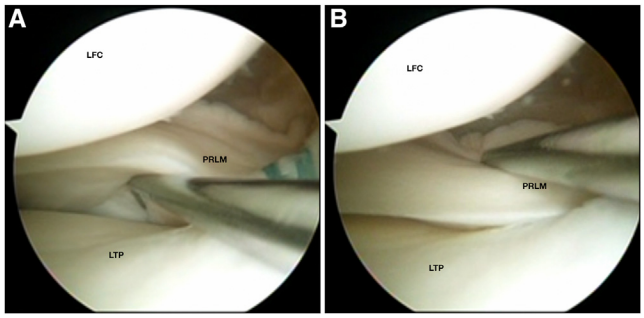

Fig 9. Arthroscopic tests after suture traction of the meniscal root. (A) Negative test for cephalic laxity of the meniscal root. (B) Negative traction test of the posterior horn of the lateral meniscus. Anterolateral portal for vision and anteromedial portal for instrumentation in figure-of-4 position (LFC, lateral femoral condyle; LTP, lateral tibial plateau; PRLM, posterior root of the lateral meniscus.)

Rehabilitation

After surgery, the patient uses soft dressings for 5 days, along with ice therapy 3 times a day and complete range of motion. The physical therapy starts the day after surgery, with a sedative protocol. Weightbearing is not allowed for at least 4 weeks to protect the suture but active range of motion is encouraged. Pivot movements are not allowed for 2 months and hyperflexion for 4 months.

Discussion

Lateral meniscus hypermobility is a rare condition, and despite being described by various authors, the literature on this condition is limited, which has made it challenging to understand its epidemiology and develop effective treatment strategies. Similarly, there is controversy regarding its management, with some reports advocating conservative management or even partial or total meniscectomy. However, different surgical techniques have been described in the medical literature, showing a diversity of approaches to address this condition. These techniques range from simple procedures such as using radiofrequency to induce collagen changes and provide stability, as described by Higuchi et al.,[10] to more complex and invasive techniques for anatomic reconstructions, as described by LaPrade et al.[7]

In the study by Steinbacher et al.,[1] meniscal fixation using all-inside sutures was demonstrated as a successful treatment for lateral meniscus hypermobility in soccer players. This study highlighted the effectiveness of meniscal fixation in improving symptoms, allowing for a return to sports activities and achieving a low rate of reinterventions in this specific patient group. Furthermore, the study emphasizes that this technique is easily reproducible and can be considered a viable therapeutic option.

Another relevant study is that by Kamiya et al.,[3] who evaluated midterm results, with an average follow-up of 37 months, of the inside-out technique for fixation of the popliteomeniscal fascicles in patients with an average age of 37 years. This study reported significant improvement in the Lysholm scale without complications, pain, or recurrent locking. These findings support the notion that surgical intervention can play a crucial role in the management of this pathology.

It is essential to highlight that each surgical technique has its advantages and limitations, and the choice of the best therapeutic option should be based on the individual patient evaluation and the surgeon's experience.

Fig 10. Postoperative radiograph to assess the position of the titanium implant and tibial tunnel.

However, all techniques aim to restore stability to the posterior horn by managing the popliteomeniscal ligaments rather than the meniscotibial ligaments, which we consider the main stabilizers of the posterior horn of the lateral meniscus in this condition.

The ease of reproducibility of a surgical technique is a crucial aspect to consider. For this reason, we described our technique as we have found that anchoring the meniscal root provides adequate stability. Despite being a known and reproducible technique, the effect on these elements and its efficacy for managing pathologic mobility in the posterior horn of the lateral meniscus has not been taken into account. Pearls and pitfalls are presented in Table 1. However, further studies are needed to evaluate the effectiveness and long-term outcomes of this technique on a larger scale, as well as its applicability in different patient groups.

In summary, although lateral meniscus hypermobility remains a relatively unknown condition with limited literature, surgical fixation has shown favorable results in resolving excessive meniscal movement and alleviating symptoms. In our experience, reinsertion of the lax meniscal root, even without obvious detachment, is a promising and easily reproducible surgical option to achieve stability in hypermobile lateral meniscus cases.

Table 1. Pearls and Pitfalls

Pearls
• Ensuring the stability of the lateral meniscus by comparing intraoperative arthroscopic tests before and after performing the fixation of the posterior root of the lateral meniscus
• Surgical technique for posterior meniscal root reinsertion, which is well known and reproducible
• No additional surgical approaches required
• Avoids the use of all-inside meniscal fixation intra-articular implants
• For anterior cruciate ligament (ACL) injury, the anchoring of the meniscal root can be performed through the tibial tunnel created for ACL reconstruction, as described by Forkel and Petersen.[8]
Pitfalls
• Without a meniscal root detachment, there may be difficulty in correctly placing the meniscal sutures, potentially resulting in a more lateral placement, which can cause translation and/or central subluxation of the meniscal body.
• Anteromedial pain in the proximal tibia, in the area of the fixation implant, may occur due to irritation of the hamstring tendons. Therefore, it is essential to perform a proper exposure and deperioste of the site where the tibial tunnel will be created and the implant will be placed. This careful approach helps minimize the risk of postsurgical pain and discomfort associated with the hamstring tendons, ensuring better patient outcomes.

Disclosure

The authors report no conflicts of interest in the authorship and publication of this article. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

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