Transosseous Posterior Meniscal Root Reinsertion Using Knotless Anchor for Tibial Fixation

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Abstract: A technique for posterior meniscal root reinsertion is presented. With the arthroscope in the central transtendinous portal for a better view, a 5-mm transtibial tunnel is created with the aid of an anterior cruciate ligament guide open to 45°. A suture device, which consists of a long needle with an eyelet on its tip, is introduced through the tunnel with a suture thread inserted through the eyelet, while the meniscus is stabilized with a grasper inserted through the anterior portal. The meniscus is pierced with the device, and the suture thread is recovered with said grasper. A finger-tip pincer is inserted through the tunnel to recover the thread. The same procedure is followed to perform a second stitch. A lasso loop is made for both stitches, and the resultant tails are knotted to a knotless suture anchor, which is inserted in the anterior cortex of the tibia, 1 cm distal to the extra-articular end of the tibial tunnel.

Meniscal root tears are a hot spot in knee surgery, and in recent years, a considerable number of articles have focused on them. Some biomechanical studies have reported the increase of peak pressure on both tibial plateaus when a meniscal root tear occurs,[1-3] as well as the presence of altered joint kinematics,[4] and the subsequent need to repair it.

Different techniques have been described for meniscal root tear repair, which can be divided into 2 groups: transosseous repair, using ultraresistant sutures and fixing the suture to a button, which seems to be the more frequently used technique,[5,6] and in situ repair, using shoulder arthroscopy anchors.[7,8] Transosseous repair is a reproducible technique; nevertheless, the fixation technique has been suggested to be a weak point.[9] In situ repair with suture anchors has shown good biomechanical properties[10]; however, this technique is more demanding and may be difficult to reproduce. None of the techniques for transtibial fixation reach the load to failure of the native meniscus.[9,10] The aim of our technique is to facilitate meniscal root repair, improving at the same time the fixation of the construct.

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Technique

Patient Positioning, Portals and Arthroscopic Exploration

The patient is positioned supine, and regional or general anesthesia is used (Video 1). The limb is placed in a leg holder with an ischemia cuff and the knee at 90° of flexion (Table 1). A diagnostic arthroscopy is performed through a central transtendinous and anteromedial portal to assess every lesion inside the knee. When the medial meniscus is treated, the anterolateral portal can be used to facilitate the stabilization of the meniscus.

The location of the injury is usually easy to identify in most lateral meniscal root lesions because of its frequent association with anterior cruciate ligament (ACL) tears[11] and the need for ACL remnant removal (Fig 1). However, sometimes it is more difficult to identify medial meniscal root lesions because of the higher stiffness of the medial compartment and the presence of the medial condyle, which obstructs the view. For this reason, it is occasionally necessary to

Table 1. Pearls and Pitfalls

Pearls
The use of a leg holder allows the knee to be kept in a comfortable position for both the patient and the surgeon, avoiding the need for stressed positions. With the knee at 90° of flexion, its posterior structures become relaxed and the posterior compartment increases, decreasing the possibility of damage.
Use of the central transtendinous portal is recommended because it provides a direct view of the lesion, especially in the lateral meniscus.
It is recommended to remove the ACL remnants and perform the reinsertion of the meniscal root first if there is an associated ACL injury that has to be addressed at the same time (which occurs commonly in lateral meniscus root tears) because doing so considerably improves the visibility and the working field.
An arthroscopic grasper is useful to stabilize the posterior root of the meniscus at the moment of piercing it with the suture device, making it more feasible.
Before insertion of the anchor on the anterior cortex of the tibia, it is recommended to create a hole with the aid of an awl to help the penetration of the device.
It is recommended to always have a suture passer ready when performing an ACL reconstruction, given its frequent association with meniscal root tears (especially tears of the lateral meniscus), although such tears have not been previously diagnosed because they were not observed on physical examination or magnetic resonance imaging.
Pitfalls
Sometimes it is necessary to lengthen the medial collateral ligament by performing fenestration with a spinal needle while applying valgus force to the knee (pie crusting), especially when operating on the medial meniscus. In addition, a reverse notchplasty may be performed by removing a small amount of bone from the posterior aspect of the notch to obtain a correct view of the meniscal root and to improve the working field.
It is mandatory to keep the tip of the needle of the suture device under control when piercing the meniscus to avoid pricking the posterior capsule with the consequent risk of damage to the posterior neurovascular structures.
The ReelX suture anchor might break if a hole is not created in the anterior cortex of the tibia, as previously stated, because the cortex is very hard.

ACL, anterior cruciate ligament.

lengthen the medial collateral ligament by performing fenestration with a spinal needle while applying valgus force to the knee ("pie crusting") (Table 1). In addition, a "reverse" notchplasty may be performed by removing a small amount of bone from the posterior aspect of the notch, which will aid in visualization of the meniscal root attachment.

Meniscus Suturing and Tunnel Performance

Once all intra-articular injuries have been addressed and the meniscal root tear is found, the insertion site of the posterior root is marked with a motorized burr. With the aid of an ACL reconstruction guide open to 45° and set through the contralateral portal, a guide pin is inserted in an outside-in manner after a vertical 2-cm skin incision is made on the anteromedial aspect of the tibia (the same incision used for hamstring tendon harvesting can be used when the meniscal root repair is performed together with an ACL reconstruction) (Fig 2). An anterolateral incision may be used when reinserting the medial meniscus to apply the traction in the same direction as the medial meniscus insertion.

After the correct location of the guide pin is confirmed arthroscopically, a 5-mm tunnel is reamed while a

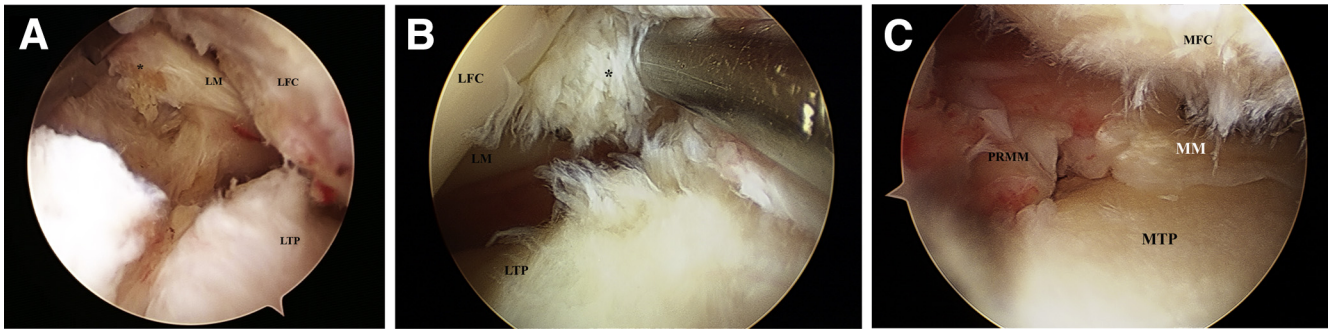

Fig 1. Different types of posterior meniscal root tears. (A) View of a bony avulsion of the posterior root of the lateral meniscus (LM) in a left knee, with the arthroscope introduced through a transtendinous portal. The asterisk indicates the bony fragment. (LFC, lateral femoral condyle; LTP, lateral tibial plateau.) (B) View of an avulsion of the posterior root of the lateral meniscus (LM) in a right knee, without any bony fragment involved, with the arthroscope set through the anterolateral portal. The asterisk indicates the avulsed meniscal root. (LFC, lateral femoral condyle; LTP, lateral tibial plateau.) (C) View of a complete radial tear on the posterior root of the medial meniscus (PRMM) in a right knee, with the arthroscope introduced through an anterolateral portal. (MFC, medial femoral condyle; MM, medial meniscus; MTP, medial tibial plateau.)

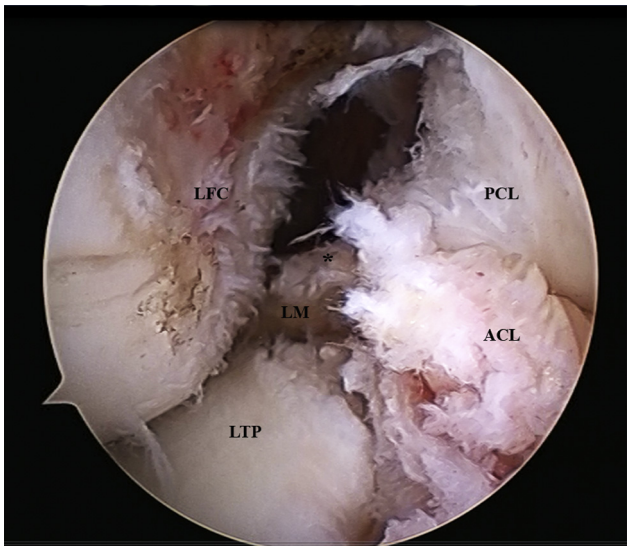

Fig 2. View of a posterior root tear of the lateral meniscus in a right knee after removal of anterior cruciate ligament (ACL) tear remnants, with the arthroscope set through the central transtendinous portal. The asterisk indicates an avulsed posterior root tear of the lateral meniscus (LM). (LFC, lateral femoral condyle; LTP, lateral tibial plateau; PCL, posterior cruciate ligament.)

curette is placed over the guide pin to prevent its advancement. With the arthroscope set through the central portal, a custom-made device called the "Sutureasy" (Fig 3)[12] is introduced in an outside-in manner through the tibial tunnel (Fig 4) with an ultraresistant No. 2 suture thread (Force Fiber; Stryker, Kalamazoo, CA) inserted through the eyelet on its tip; at the same time, a grasper is inserted through the contralateral portal of the treated meniscus to hold it in place while the Sutureasy is inserted through the posterior root of said meniscus (Fig 5). The grasper is now used to retrieve the thread from the Sutureasy, which is drawn out of the tunnel (Fig 6). Once the thread is passed through the meniscus, the resultant loop is retrieved through the 5-mm tunnel with the aid of a finger-tip pincer and a lasso loop is created, resulting in a loop embracing the meniscus (Fig 7). The same procedure is carried out with a second ultraresistant No. 2 suture thread; the 4 resultant tails are marked with 2 mosquito clamps by pairs.

Fixation

An awl is used to perforate the anterior cortex of the tibia in a position 5 mm distal to the tunnel (Table 1). Each pair of tails is passed through a different pull tab of a 4.5-mm ReelX STT knotless anchor (Stryker), and gentle tension on the tails is applied until the implant is inserted in the hole created with the awl, with the aid of a mallet (Fig 8). Once it is inserted, a tether suture is released from the inserter handle, and the knob is rotated clockwise a minimum of 1 spin and a maximum of 3 spins to spool excess suture into the anchor and to increase the tension of the posterior root repair. The process is checked arthroscopically, and once the procedure is finished, the final tension of the construct is checked with the aid of a probe (Fig 9).

Discussion

The main feature of the described technique is that it can be performed easily with conventional instrumentation and the aid of a meniscal suturing device.

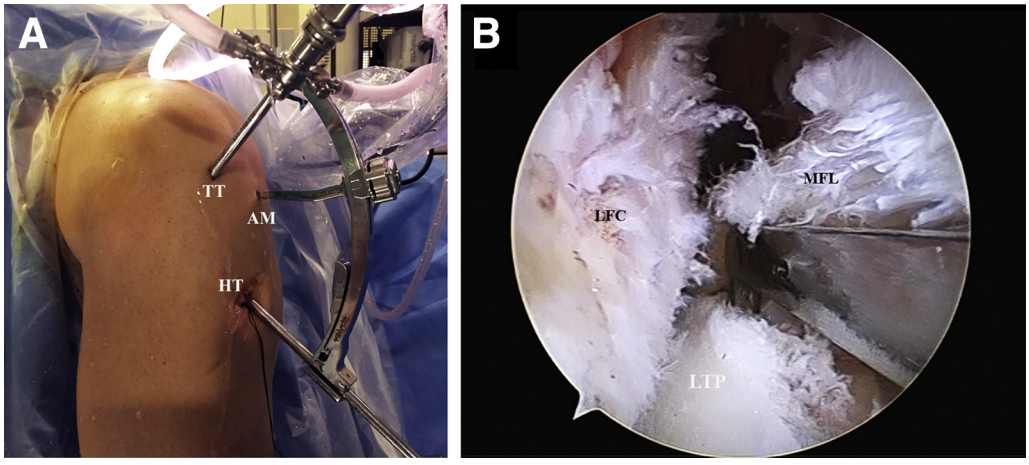

Fig 3. Placement of the anterior cruciate ligament (ACL) guide to create the tibial tunnel. (A) External view of the right knee, with the arthroscope introduced through the transtendinous portal (TT) and the ACL guide inserted through the anteromedial portal (AM). In this case, in which a concomitant ACL tear was present, the guide pin for reinsertion of the posterior root of the lateral meniscus was inserted through the anteromedial approach made for hamstring tendon harvesting for ACL reconstruction. (HT, incision made to harvest hamstring tendons.) (B) Intra-articular view of the guide used to create the tibial tunnel introduced through the anteromedial portal, with the arthroscope set through the transtendinous portal, to perform a lateral meniscus posterior root reinsertion. (LFC, lateral femoral condyle; LTP, lateral tibial plateau; MFL, meniscofemoral ligament.)

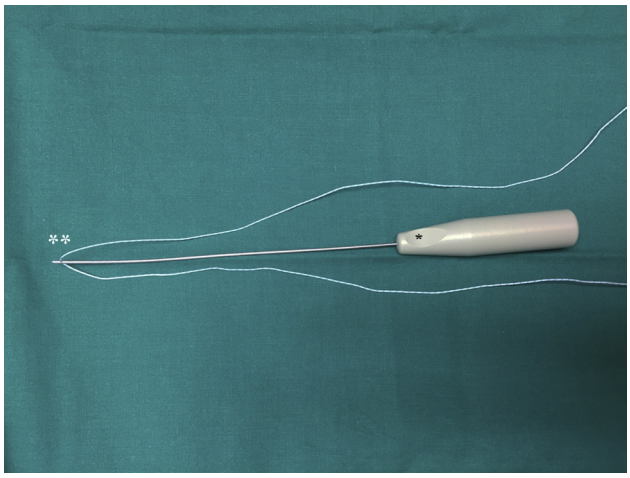

Fig 4. The device used for posterior meniscal root reinsertion consists of a curved needle with an eyelet on its tip (white asterisks); a No. 2 ultraresistant suture thread is inserted through this eyelet to perform the reinsertion. The handle of the device has a small indentation (black asterisk) to accommodate the thumb, which indicates the direction of the curved needle.

Fig 5. Diagram of the technique showing the suture device inserted through the tibial tunnel. The tip of the device is piercing the posterior root of the lateral meniscus in a right knee.

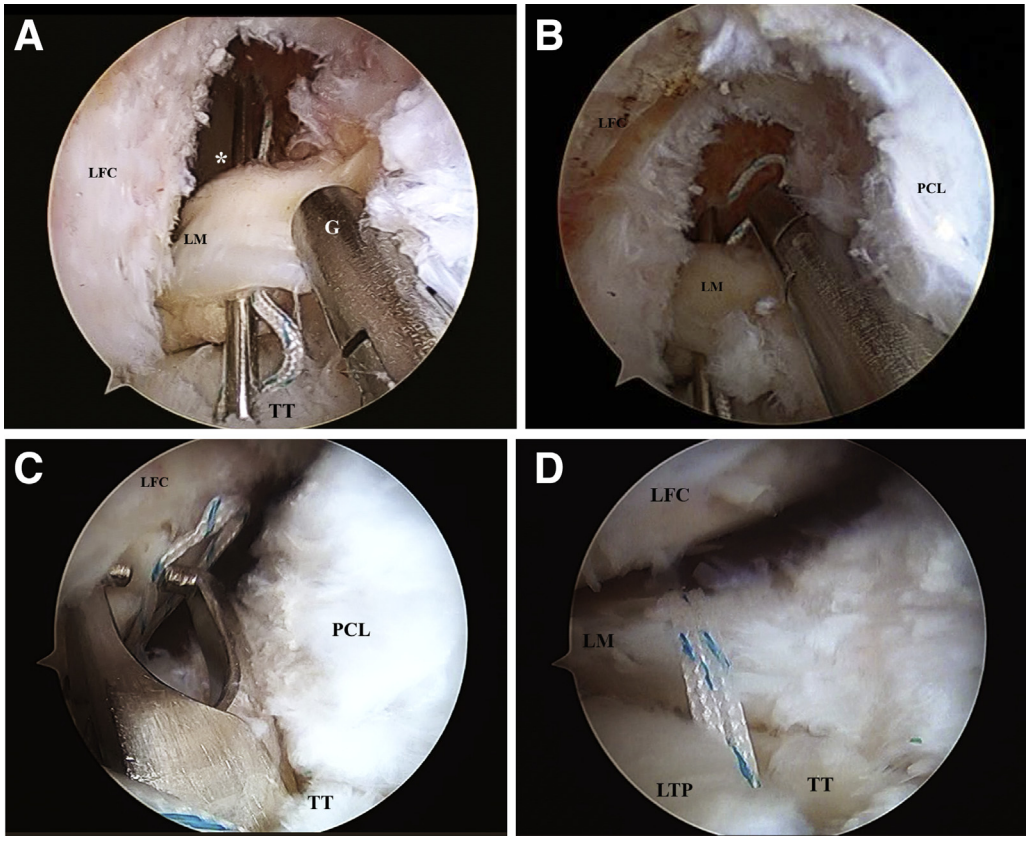

Fig 6. Arthroscopic view of the posterior root of the lateral meniscus in a right knee through the central transtendinous portal. (A) The Sutureasy (previously inserted through the tibial tunnel [TT]) carrying the suture thread (asterisk) pierces the posterior root of the lateral meniscus (LM) while an arthroscopic grasper (G) inserted through the anteromedial portal helps stabilize the lesion. (LFC, lateral femoral condyle.) (B) Once the meniscus (LM) is pierced, the suture thread is retrieved with the aid of the pincer previously used for stabilizing the meniscal lesion (inserted through the anteromedial portal). (LFC, lateral femoral condyle; PCL, posterior cruciate ligament.) (C) The resultant loop is retrieved through the 5-mm tunnel with the aid of the finger-tip pincer, inserted through the tibial tunnel (TT). (LFC, lateral femoral condyle; PCL, posterior cruciate ligament.) (D) Final image of the suture thread embracing the meniscus. (LFC, lateral femoral condyle; LM, lateral meniscus; LTP, lateral tibial plateau; TT, tibial tunnel.)

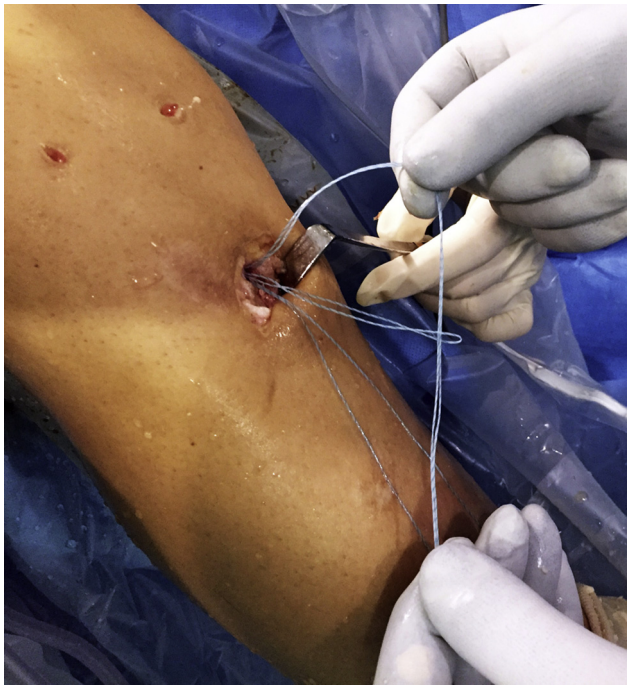

Fig 7. Extra-articular view of the creation of a lasso loop in a right knee, which will be carried to the intra-articular part of the joint afterward to fix the suture.

Furthermore, the method of fixation provides stability to the construct.

Different techniques have been developed for meniscal root repair. They can be divided into 2 different groups according to the fixation method: transosseous and anchor fixation. Despite having shown adequate biomechanical properties,[10] anchor reinsertion is a more demanding technique, given that posterior portals are needed,[7,8] making the technique more difficult to perform. For this reason, transosseous techniques are usually preferred by most surgeons. There are 2 steps to focus on: the passing of the suture threads through the tunnel after piercing the meniscus and the fixation of said suture.

In some techniques, suture passers are used to pierce the meniscus. They are usually introduced into the joint through the posterolateral or posteromedial portal[7,8,13] or through the anterior portal by use of cannulas to avoid soft-tissue bridges and aid in suture management.[14] These features make the suture difficult to perform. In our technique the suture is directly passed through the meniscus through the tibial tunnel, avoiding the need for posterior portals and the use of cannulas.

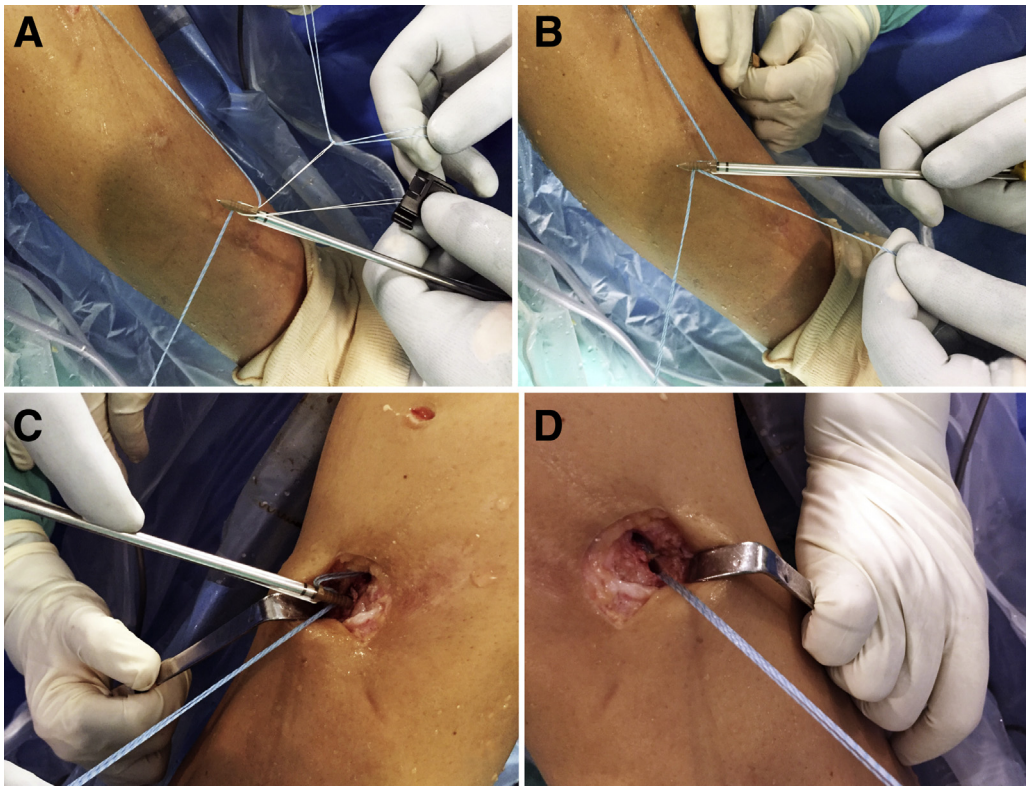

Fig 8. Threading of both pairs of tails into the 4.5-mm ReelX STT knotless anchor (Stryker). (A) Extra-articular view of the fixation preparation, in which the first pair of tails has been passed and the second pair is ready to be passed. (B) Both pairs of tails have been threaded into the suture anchor. (C) The tip of the anchor is attached to the hole created on the anterior tibial cortex through the anteromedial approach made to harvest the hamstring tendons and is introduced with the aid of a mallet, while the threads are pulled to maintain tension; the hole has previously been created 1 cm distal to the extra-articular end of the tibial tunnel, with the aid of an awl. (D) The anchor has been inserted and the inserter handle removed. Both remaining pairs of tails can be seen and will be removed afterward.

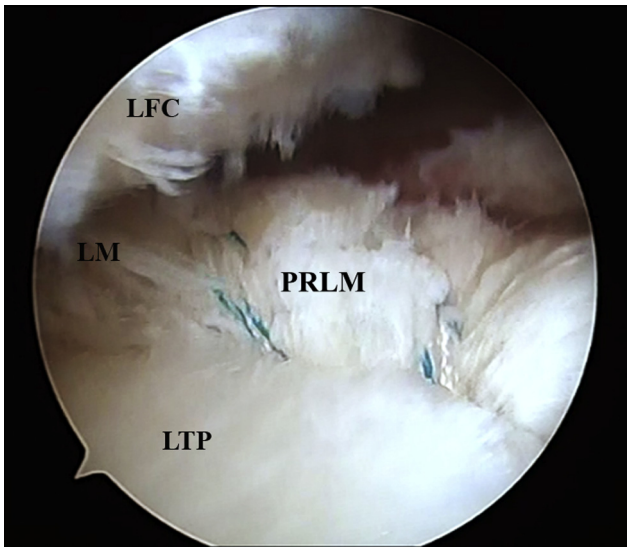

Fig 9. Arthroscopic view of the final appearance of the reinsertion of the posterior root of the lateral meniscus (PRLM) in a right knee, performed with 2 transosseous stitches and seen with the arthroscope introduced through the central transtendinous portal. (LFC, lateral femoral condyle; LM, lateral meniscus; LTP, lateral tibial plateau.)

Table 2. Advantages and Disadvantages

Advantages
The use of a central portal provides an excellent view of the posterior meniscal root, especially that of the lateral meniscus.
The use of posterior portals is not necessary, simplifying the surgical procedure.
There is no need to use cannulas to avoid soft-tissue bridges.
Disadvantages
The use of a knotless suture anchor for fixation can increase the cost of the surgical procedure.

The most common bony fixation used is knotting of the ends of the threads to a button on the anterior cortex of the tibia. Anchor fixation has been described for all-inside techniques. This technique combines the easiness of a transosseous technique and the strength of anchors for fixation; its main disadvantage is the need for a fixation device, which makes the technique a bit more expensive (Table 2).

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