

Suprameniscal Portal for Repairing Meniscal Root Tears



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Abstract: Several techniques and portals have been described for meniscal root repairs. Some authors describe using anterior portals for suture passing and manipulation of meniscal tissue, with some risk of iatrogenic chondral injuries reported. Other authors describe using posterior portals to avoid this risk. In this technique, we used a suprameniscal portal, which allowed a good trajectory for passing sutures in the meniscal tissue with minimal risk of iatrogenic chondral damage without the need to use posterior portals. The meniscal bed is first prepared. The suprameniscal portal is created in 15° of knee flexion and used to pass 2 sutures through the meniscus by a Lasso. The sutures are tied in a cinch configuration, shuttled through the tibial tunnel, and tied over a Dog Bone button.

Meniscal root injuries are documented to have a deleterious effect on knee biomechanics.¹⁻³ Repair of the root tear can restore the biomechanics of the knee and decrease the peak stresses to normal,^{2,3} with a resulting decrease in the risk of progression of osteoarthritis and better clinical outcomes.^{4,5} This led to an increased interest in meniscal root repair and the development of several surgical techniques. Some techniques use the anterior arthroscopic portal,⁶⁻⁸ which requires great caution to avoid iatrogenic chondral damage. Other techniques require the use of posterior portals⁹⁻¹⁴ and can be technically demanding. In this manuscript, we present a suprameniscal portal that can be strategically located to provide good access to the root with minimal risk of chondral injury without the need of using additional posterior portals.

Surgical Technique (With Video Illustration)

Indications

Our indications for root repair include traumatic tears and symptomatic degenerative tears in young patients

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with signs of medial compartment overload (subchondral marrow edema of the medial compartment on magnetic resonance imaging). The following were not found to be good candidates for the procedure: chondral degeneration (grade 3 and more or established osteoarthritis), degenerative root tears in patients with obesity, and varus malalignment unless high tibial osteotomy is done simultaneously.

Patient Positioning

All surgeries are performed with the patient in the supine position under spinal or general anesthesia with their leg hanging down the operation table. A pneumatic thigh tourniquet and a side post are applied.

Diagnostic Arthroscopy

The standard anterolateral and anteromedial portals are developed to confirm the posterior medial meniscal root injury (Fig 1A) and reducibility and to assess meniscal centralization and medial compartment chondral degeneration. The anterolateral portal is used for visualization throughout the whole procedure.

Preparation of the Meniscal Root Bed

Medial collateral ligament pie-crusting using a spinal needle is almost always done to provide adequate room for the posterior work and to prevent iatrogenic chondral injury (Fig 1B). The meniscal root bed is prepared by abrading the tibial articular cartilage (using a curette and a motorized shaver) down to subchondral bone to promote healing (Fig 2).

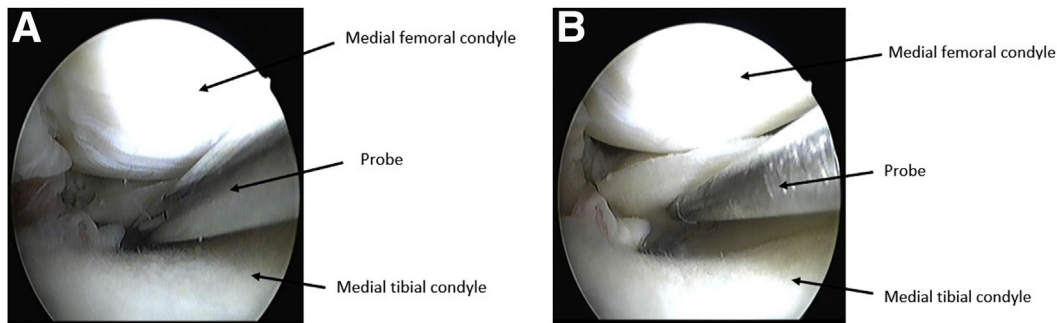


Fig 1. Arthroscopic view of the medial compartment of the right knee. The scope is introduced from the anterolateral portal, and a probe is introduced from the anteromedial portal and used for assessment of medial meniscus posterior root tear. (A) Before medial release. (B) After medial release.

Development of a Suprameniscal Portal

While the knee is held in valgus in 15° of flexion, the suprameniscal portal is now established. A spinal needle is used to make sure there is a good trajectory to the posterior medial meniscal root. The portal is established in an outside-in manner just above the body of the meniscus at tangent to the most anterior part of medial femoral condyle (Fig 3 A and B). The portal is developed by the nick-and-spread technique.

Passage of Sutures Through the Meniscus

For medial meniscal root tears, a SutureLasso SD 25° tight curve (Arthrex, Naples, FL) curved to the left for a right knee (and vice versa) is inserted through the suprameniscal portal (Fig 4A) and twisted to penetrate a healthy part of the posterior root about 5 to 7 mm from the edge to ensure biting good tissue (Fig 4 B and C). At this point, a probe can be inserted through the standard medial portal to raise the root while the Lasso is twisted through the tissue to see its tip exiting the under surface of the meniscus. The shuttling suture is then grabbed and retrieved through the medial portal. A looped number 2 heavy braided suture (FiberWire; Arthrex) is shuttled such that the loop end exits the

upper surface of the meniscus. A suture grasper is introduced through the suprameniscal portal then into the loop to grab the 2 free suture tails and a cinch configuration is formed.

The lasso is reintroduced through the suprameniscal portal to take a second bite of meniscal root tissue (3-4 mm posterior and central to the first one), and a looped number 2 heavy braided suture of different color (MaxBraid; Zimmer Biomet, Warsaw, IN) is shuttled and cinched in a similar fashion. Careful suture management is important at this point to avoid suture entanglement.

Creating Tibial Tunnels

A regular tibial anterior cruciate ligament guide can be used if a flat low-profile guide is not available. A 2- to 3-cm tibial skin incision is established to introduce the tibial beath pin (Fig 5A). The 2.4-mm guidewire should exit the tibial articular surface as central as possible and slightly anterior to the meniscal root bed (Fig 5B) such that when the meniscal repair sutures are pulled into the tunnel, the root will be pulled centrally and anteriorly and rest anatomically in its bed without kinking of the meniscal body. A cannulated 4.5-mm drill bit is passed over the wire, and the tunnel is drilled. A Number 1 PDS (PDS II [polydioxanone] Suture; Ethicon, Somerville, NJ) is passed through the tunnel and retrieved through the medial portal for later shuttling.

Shuttling of the Sutures and Suture-Tying

A suture grasper is used to retrieve the 4 free tails of heavy braided sutures (FiberWire and MaxBraid) together with the PDS (PDS II (polydioxanone) Suture; Ethicon) out of the medial portal (Fig 6). The PDS shuttles the suture tails into the tibial tunnel while viewing the root reduction and compression.

The sutures are then tied (several half hitches) over a Dog Bone button (Arthrex) (Fig 7A). While one pair of sutures is being tied over the Dog Bone button (Arthrex), the other pair is pulled and held in tension to

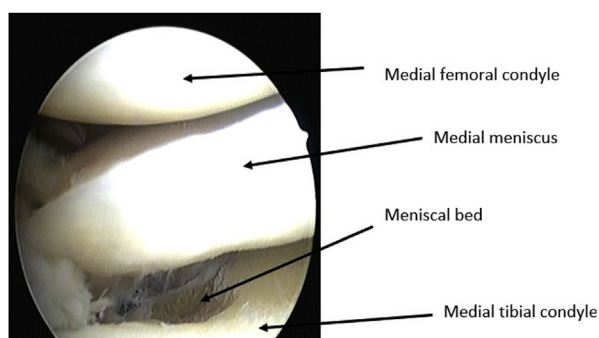


Fig 2. Arthroscopic view of the medial compartment of the right knee. The scope is introduced from the anterolateral portal. The meniscal bed is shown prepared down to subchondral bone.

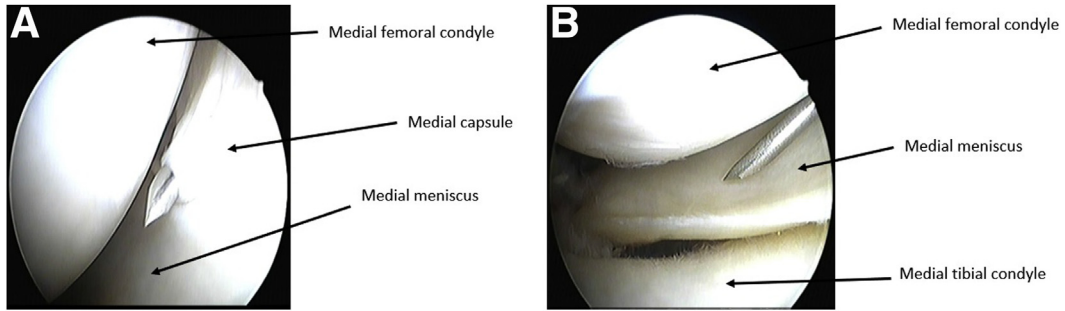


Fig 3. Arthroscopic view of the medial compartment of the right knee. The scope is introduced from the anterolateral portal. Placement of the suprameniscal portal (A), ensuring good trajectory to posterior root (B).

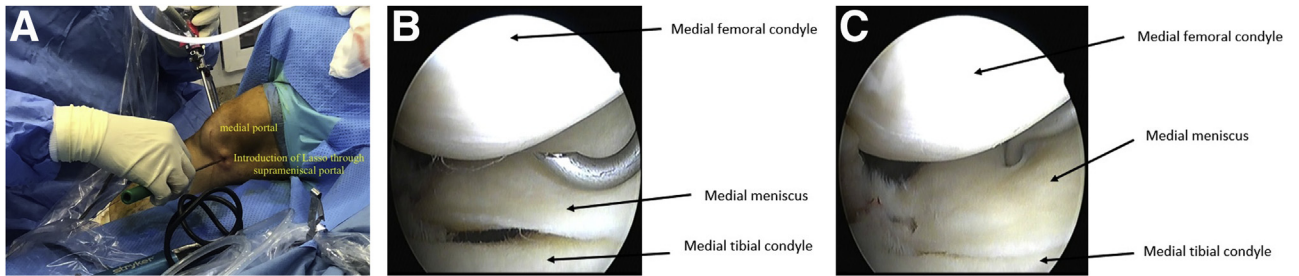


Fig 4. (A) Clinical photograph of a patient with right medial meniscus posterior root tear showing introduction of the lasso through the suprameniscal portal. Arthroscopic view of the medial compartment of the right knee. The scope is introduced from the anterolateral portal. (B) The lasso at the posterior horn of the medial meniscus after introduction through the suprameniscal portal. (C) The lasso is shown penetrating the meniscus.

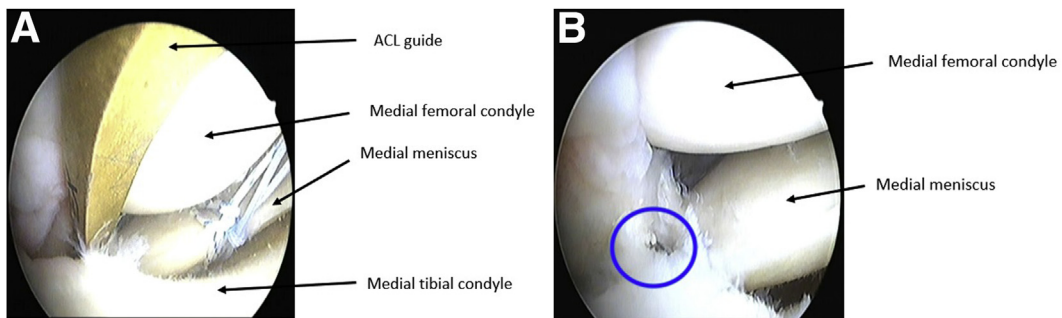


Fig 5. Arthroscopic view of the medial compartment of the right knee, the scope is introduced from the anterolateral portal. (A) Introduction of ACL guide through the anteromedial portal. (B) pin seen exiting the tibial plateau at the anatomical site of root attachment (blue circle). (ACL, anterior cruciate ligament.)

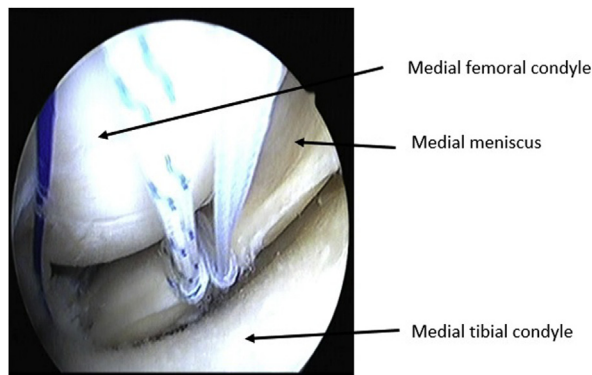


Fig 6. Arthroscopic view of the medial compartment of the right knee, the scope is introduced from the anterolateral portal. Two cinch stitches, just before the PDS shuttles them into the tibial tunnel.

keep the meniscal root reduced and compressed against its bed. The medial meniscus root should appear reduced and compressed against the prepared footprint at the end of the procedure (Fig 7 B and C).

Suprameniscal Portal for Lateral Meniscal Root Tears

A suprameniscal portal can be used for repairing lateral meniscal root tears. The portal is established just above the body of the lateral meniscus and anterior to the popliteus tendon. A SutureLasso SD 25° tight curve (Arthrex) curved to the right is used for a right knee. All other steps are similar to those described for the medial meniscus root repair. The steps of the procedure are shown in Video 1. Pearls and pitfalls are shown in Table 1.

Rehabilitation

An extension brace is applied for 2 weeks. Early isometric quadriceps exercises and achieving full knee extension are strongly encouraged. Patients are not allowed to bear weight for 6 weeks. Flexion range is permitted to 90° for the first 6 weeks and gradually increased to 120° by the eighth week. Deep squats are not allowed before 3 to 4 months.

Discussion

In this technique for meniscal root repair, we used the suprameniscal portal to obtain a good trajectory to the meniscal root. The proposed advantages of the technique are shown in Table 2. Several techniques have been described for repairing root tears, which employed a variety of portals. Kim et al.⁸ used an anteromedial portal for introducing the ACL guide for the pull-out technique they described. Similarly, Kodama et al.⁷ and Okazaki et al.⁶ used the anteromedial portal for passing the instruments. Chahla et al.¹⁵ recommended using far anterolateral and anteromedial portals for insertion of a grasper to hold the meniscal tissue during passage of the suture passing device. The advantages of these techniques are that no posterior portal was needed. However, instrumentation through the anterior portals may be associated with chondral injuries.

Ahn and Ha¹⁶ described the posterior trans-septal portal and stated that they used this portal to give access to the posterior compartment of the knee in more than 150 patients with no complications. Ahn et al.⁹ described repair of root tears of the medial meniscus using pull-out suture using the transseptal portal. They used the trans-septal portal to place the arthroscopic probe, anterior cruciate ligament guide, and suture-passing device with minimal iatrogenic cartilage injury. Choi et al.¹⁰ used a high posteromedial portal (3 cm above the joint line) to insert a suture anchor in the root attachment site for root tears of the medial meniscus and used the anteromedial portal for suture hook insertion. Several authors described using posterior portals for their root repair techniques.¹¹⁻¹³ The posterior portals allowed insertion of instruments with minimal risk of iatrogenic chondral damage.^{9,10}

In our technique, we used a suprameniscal portal to allow access of the suture-passing device to the posterior root but used the standard anteromedial portal for creating the tunnels for the pullout sutures. On the medial side of the knee, surgical incision may carry a risk of injury to the infrapatellar branch of the saphenous nerve. Cadaveric studies have reported variability in the course of nerve and its branches.^{17,18} To

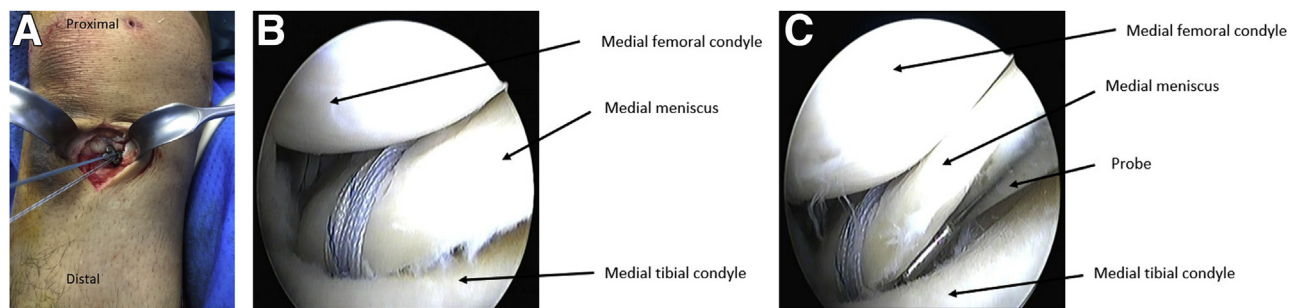


Fig 7. (A) Clinical photograph of a patient with right medial meniscus posterior root tear showing tying sutures over Dog Bone button. (B) and (C) Arthroscopic views of the medial compartment of the right knee. The scope is introduced from the anterolateral portal, showing final visualization.

Table 1. Pearls and Pitfalls of the Technique

Pearls	Pitfalls
Use a spinal needle to locate the portal site and establish your portal when you are satisfied with the trajectory.	Working in tight knees can cause inadequate visualization and iatrogenic chondral injury.
Park your sutures in the suprameniscal portal to avoid overcrowding and entanglement.	Always consider medial release by pie-crusting.
Using 2-cinch stitches gives you the advantage of maintaining reduction and compression with a pair of sutures while tying the other pair. If reduction or compression are not satisfactory after tying the first pair, the second pair can then be tied with more tension.	Suture entanglement can occur. To be avoided, pass and shuttle one set of sutures at a time.
The suprameniscal portal can be used for repairing posterior root tears of the lateral meniscus (far anterolateral portal). It is established above the mid-portion of the body of the lateral meniscus just anterior to the popliteus tendon while the knee is held in figure-4 position. Suture passing, shuttling and tying are done as previously described.	Soft tissues could be caught between sutures with development of bridges. A suture grasper should be always used to grasp the shuttle together with the sutures to be shuttled
A suture grasper is preferably inserted through the loop end of the suture and grasp the 2 free tails to form a cinch stitch. This reduces the risk of soft-tissue bridge formation.	

minimize injury to the medial cutaneous nerves, we recommend creating the suprameniscal portal by the nick-and-spread technique. When the suprameniscal portal is created laterally for root repair of the lateral meniscus, it will be anterior to the popliteus tendon. We believe that this portal provides an excellent trajectory to the meniscal tissue where the sutures used for repair will be put (5-7 mm medial to the root for medial meniscus root repairs or 5-7 mm lateral to the root for lateral meniscus root repair). Introduction of instruments to capture or pass sutures through the meniscal tissue through anterior portals may be associated with chondral damage, which can be avoided by using this portal as the suture passing device runs parallel to the femoral condyle till it reaches the meniscal root. We believe that this portal is a utility portal that can be also be used in repairing radial tears in the

posterior horn of the meniscus and bucket handle tears, where the tear is located a few millimeters from the menisco-capsular junction so that the surgeon would like to fix the bucket handle portion back the meniscal remnant not to the posterior capsule.

We passed 2 sutures through the meniscal tissue and used them to for our repair. We believe that using 2 pairs of sutures will give us more secure fixation and allow better reduction of the meniscal root to its bed. One pair of sutures was held by an assistant to reduce the meniscal root to its bed while the second pair was tied after the position of the meniscal tissue position was found to be satisfactory. This was followed by tying of the first pair of sutures. The use of 2 sutures decreases the stresses at the meniscus–suture interface, which was shown to be a site of failure of the repair and resulted in displacement of the meniscal root in a biomechanical study by Cerminara et al.¹⁹

In conclusion, the suprameniscal portal creates an excellent trajectory to the meniscal tissue with minimal risk of iatrogenic chondral injury. The technique is simple and reproducible and can be used for root repairs of the medial or lateral meniscus.

Table 2. Advantages of the Technique

Proposed advantages
<ul style="list-style-type: none"> • The suprameniscal portal gives good trajectory to the posterior horn of the meniscus and the root with minimal risk of iatrogenic chondral damage. • The lasso has a lower profile than the antegrade passing device, which is sometimes difficult to introduce in tight knees. • Antegrade passing devices may be not readily available in all OR settings. • The lasso allows penetration of the meniscus in the area of best tissue quality where you can feel the resistance as you twist it through. • Using the accessory portal frees your medial portal where you can use a probe or soft tissue grasper to manipulate the meniscus. It also serves for parking sutures to avoid entanglement. • The cinch stitch configuration produces less stress on meniscal tissue and is less likely to cut through.
Disadvantages
<ul style="list-style-type: none"> • Medial sided knee pain due to MCL pie-crusting can sometimes last for 6-8 weeks after surgery. Patients should be informed preoperatively.

MCL, medial collateral ligament; OR, operating room.

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