Technical Note

Suture Anchor Refixation of Meniscal Root Tears Without an Additional Portal

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Abstract: The biomechanical consequences of a tear of the posterior root of the medial meniscus are comparable to that of a complete meniscectomy. The integrity of the meniscal roots is crucial to enable the important function of load sharing and shock absorption. An untreated root tear leads to extrusion and loss of function of the meniscus causing early degenerative arthritis of the respective knee compartment. Meniscal root repair can be achieved by 2 main techniques: indirect fixation using pullout sutures through a transtibial tunnel with extracortical fixation and direct fixation using suture anchors. Pullout sutures are prone to elongation or abrasion of the suture material due to the length of the bone tunnel. Current suture anchor techniques are challenging as they require an additional posterior portal with higher risk of damage to neurovascular structures. Even with the use of specially designed curved passing devices, secure insertion of the anchor is difficult. We present a technique for suture anchor refixation of the posterior root of the medial meniscus without the need for an additional posterior portal.

With about 10% to 20% of all arthroscopic meniscectomies or meniscal repairs, the incidence of root tears is higher than previously thought.[1] Root tears occur in the acute as well as chronic setting. Due to its low mobility, the posterior root of the medial meniscus is most frequently affected.

The biomechanical consequences of a tear of the posterior root of the medial meniscus are comparable to those of a complete meniscectomy.[2] The integrity of the meniscus roots is crucial to enable the important function of load sharing and shock absorption. An untreated root tear will lead to extrusion and loss of function of the meniscus, causing early degenerative arthritis of the respective knee compartment.[3] By repairing the meniscus root, contact pressure can be returned to normal, which was shown by Harner et al.[2] in 2009 in a biomechanical study.

Refixation of the posterior root of the meniscus can be achieved by 2 main repair techniques: indirect fixation using pullout sutures through a transtibial tunnel with extracortical fixation or direct fixation using suture anchors. Pullout sutures are prone to elongation or abrasion of the suture material due to the length of the bone tunnel. Current suture anchor techniques are challenging as they require an additional posterior portal with higher risk of damage to neurovascular structures. Even with the use of specially designed curved passing devices, secure insertion of the anchor is difficult.[4,5]

We present a technique for suture anchor refixation of the posterior root of the medial meniscus without the need for an additional posterior portal. An all-suture anchor typically used for shoulder stabilization is modified and pulled into the bone instead of tapped in.

Surgical Technique

Indications

Meniscal root refixation is indicated in all patients with complete root avulsions and sufficient tissue quality.

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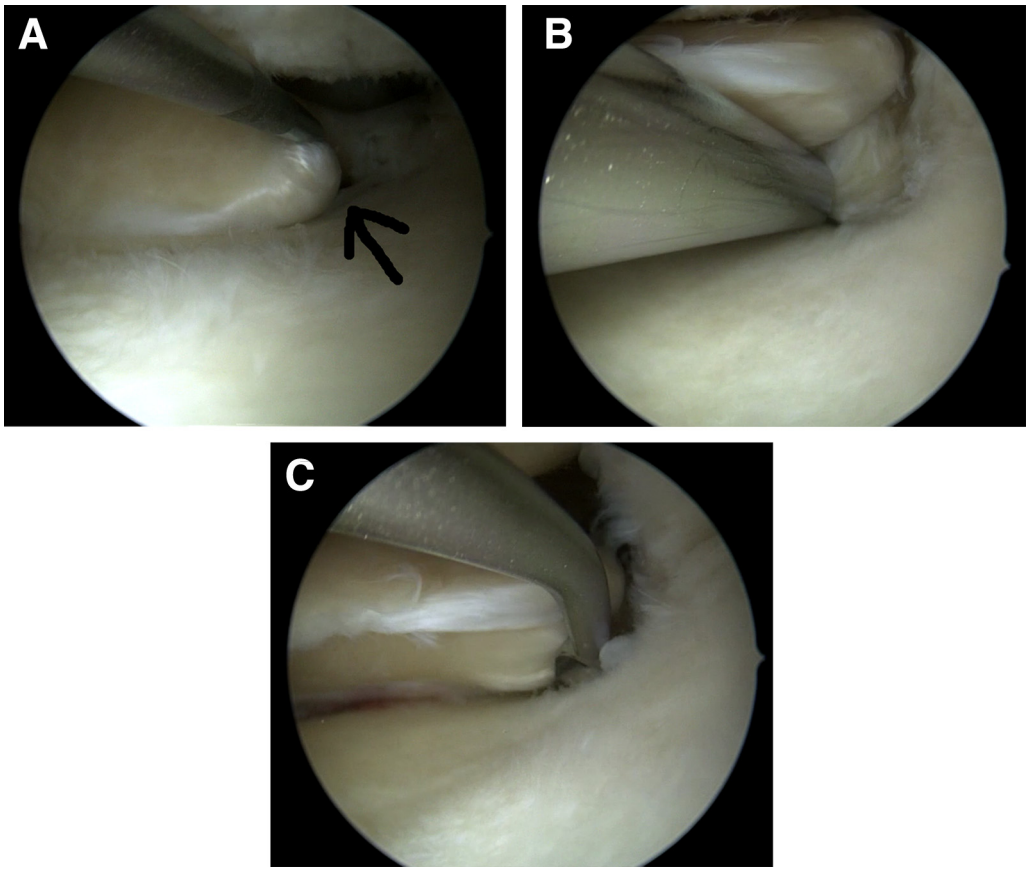

Fig 1. Posterior root tear of medial meniscus in a left knee. Knee extended, applying valgus stress. Arthroscope in anterolateral, and instruments in anteromedial portal. Probe examination of medial meniscal root (arrow) showing instability (A), debridement of footprint with shaver (B), and bended curette (C) to enable bony ingrowth.

Patient Positioning and Portal Placement

The patient is positioned supine with the operative extremity placed in a leg holder and the leg hanging free. Prepping and draping is done as usual, and a standard arthroscopy is performed beginning with an anterolateral portal close to the patella tendon. After completion of the diagnostic arthroscopy, an anteromedial portal is established after ensuring the right direction with the use of a spinal needle. In most cases the anteromedial portal is localized at the upper border of the anterior horn of the medial meniscus. This portal is gently spread using scissors. The attachment of the meniscus root is than examined using a probe (Video 1, Fig 1A). During the whole procedure the knee is positioned near extension while gently applying valgus stress. To facilitate passage of instruments to the posterior horn and to decrease the risk of cartilage damage, we often perform a fenestration of the tibial insertion site of the medial collateral ligament using a spinal needle. Then the root insertion is debrided using a shaver and a bended curette in order to create a bone bed enabling ingrowth of the meniscus root (Video 1, Fig 1 B and C).

Additional Instruments

In addition to the basic arthroscopy setup, the following instruments are necessary (Fig 2): a drill guide for the transtibial drilling (most suitable is a tip aimer enabling posterior positioning of the drill hole), a spinal needle loaded with a PDS no. 0 suture, a knot pusher, an arthroscopic suture cutter, a Y-Knot Flex 1.8-mm disposable drill bit (Conmed, Utica, NY), a Y-Knot Flex 1.8-mm all-suture anchor with 2 Hi-Fi sutures (Conmed), and a FiberWire no. 2 (Arthrex, Naples, FL) or any other comparably strong suture.

Preparation of the Anchor

A Y-Knot Flex 1.8-mm all-suture anchor with 2 Hi-Fi sutures is originally designed for shoulder stabilization (Fig 2, Video 1). For the present technique this anchor is modified, enabling the surgeon to pull it into the bone instead of tapping it in. Therefore, the suture limbs are marked with a skin marker indicating the approximate depth to which it is usually tapped in (Video 1). The anchor is removed from its seating instrument. A pulling suture (e.g., FiberWire no. 2) is placed in the kink point of the suture anchor (Fig 3,

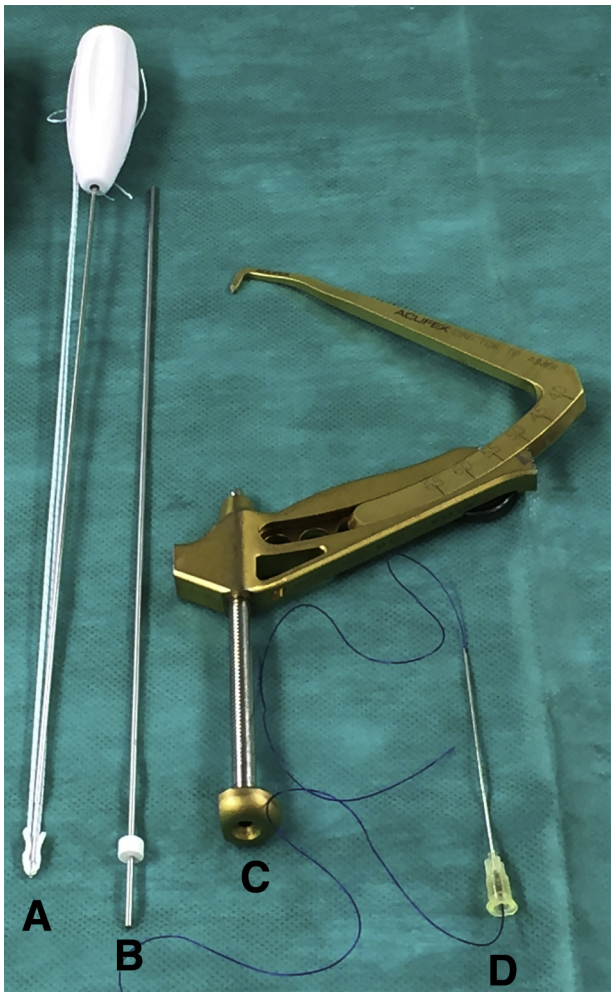

Fig 2. Necessary instruments in addition to standard arthroscopy equipment. From left to right: Y-Knot Flex 1.8-mm all-suture anchor with 2 Hi-Fi sutures (A), Y-Knot Flex 1.8-mm disposable drill bit (B), drill guide for the transtibial drilling (most suitable is a tip aimer enabling posterior positioning of the drill hole) (C), spinal needle loaded with a PDS no. 0 suture for passing (D). On the photograph, knot pusher, arthroscopic suture cutter, and pulling suture are missing.

Video 1) and is later used to pull the anchor into the bone.

Insertion of the Anchor

The camera is placed into the anterolateral portal, and the drill guide is introduced through the anteromedial portal. Switching portals or establishing an additional portal is necessary in some cases, depending on the anatomy and the shape of the drill guide. The tip of the drill guide is placed into the footprint of the meniscal root, which typically lies far posterior. A skin incision is made on the anteromedial or anterolateral tibia (depending on the shape of the drill guide), and the guiding sleeve is pushed forward until contact with the bone. The Y-Knot Flex 1.8-mm disposable drill bit is drilled forward into the posterior cortex of the tibia (Video 1). In order to prevent drilling into the popliteal fossa and potentially damaging neurovascular structures, we recommend stopping drilling as soon as the wire reaches the posterior cortex. The drill bit is than advanced by gentle hammer blows.

The drill bit and the drill guide are removed. A spinal needle loaded with a PDS no. 0 suture is introduced into the tunnel and advanced until it can be identified at the footprint (Fig 4, Video 1). The suture is pulled out over the anteromedial portal using a suture grasper, and the needle is removed. A loop is tied at the end of the suture, and the pulling suture placed in the kink of the anchor is shuttled back through the bone (Video 1).

By pulling on this suture the anchor is pulled into the joint until it reaches the drill hole at the root footprint. Now the anchor reaches the bone tunnel almost perpendicular, which makes it difficult to pull in. Therefore, a knot pusher is introduced over all 4 limbs of the anchor sutures and advanced forward to the anchor. The knot pusher is than used to erect the anchor, which enables pulling it in up to the depth marks made earlier using the skin marker (Video 1). Wrapping the pulling sutures around a compress facilitates pulling (Video 1). The knot pusher is now used to pull the anchor back, which provokes the mechanism of blocking the anchor right underneath the cortical bone. The marks on the sutures are visible again and will help to certify the correct depth (Fig 5, Video 1). The pulling suture can be removed.

Passage of Sutures

The 4 suture limbs can now be shuttled through the meniscus as desired. We prefer using a spinal needle loaded with a PDS no. 0 suture loop and pass the sutures in an outside-in fashion (Video 1). In the present case we performed a simple stitch with one suture pair in the anterior part of the meniscus root and a lasso-loop stitch[6] with the other suture pair penetrating the posterior part

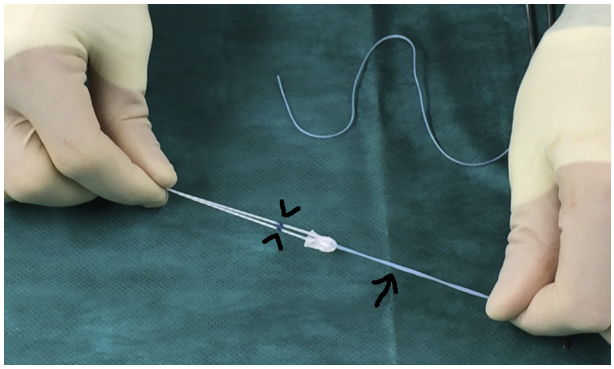

Fig 3. Modified Y-Knot Flex 1.8-mm all-suture anchor removed from insertion instrument with pulling suture (arrow) placed in the kink point. Note the blue depth marks drawn with a skin marker (arrow heads).

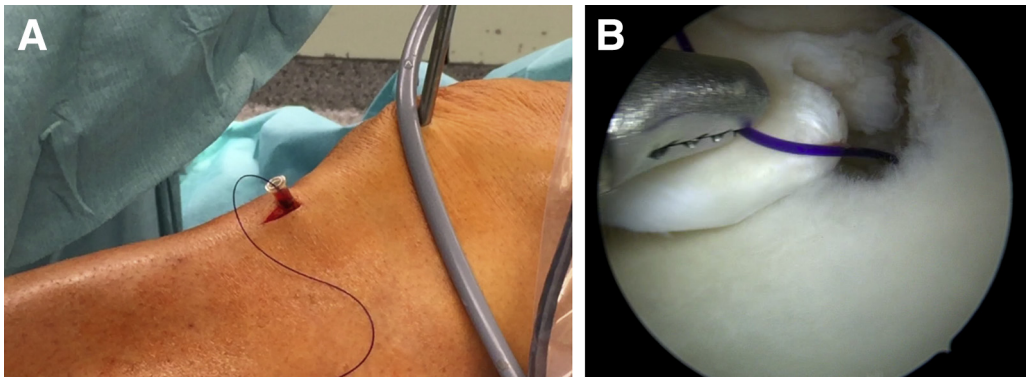

Fig 4. PDS no. 0 suture introduced through a spinal needle in the tibial tunnel. Left knee in extension applying valgus stress. (A) Exterior view and (B) intra-articular view with suture grasper holding passage suture (arthroscope in anterolateral, and instrument in anteromedial portal).

of the root (Video 1). The knots are tied using the knot pusher and cut using a suture cutter. This enables a strong refixation of the posterior root of the meniscus (Fig 6, Video 1). Other suture configurations, for example, mattress sutures or simple stitches, are also possible.[3,8] Depending on the surgeons' preferences other passing devices could also be used.

Rehabilitation

Weight bearing is restricted to 20 kg for the first 6 weeks after surgery. Range of motion is limited to 90° of flexion using a brace. After 6 weeks, full weight bearing and full range of motion are allowed, but knee loading in deep flexion is limited for 3 months postoperatively.

Table 1 summarizes the pearls and pitfalls, and Table 2 the advantages and limitations of the presented technique.

Discussion

Complete meniscal root tears lead to a functional loss of the meniscus comparable to a complete meniscectomy.[2,7] It has been shown that the meniscus function and thus peak contact pressures can be restored to normal by a surgical reattachment of the root.[8] These promising biomechanical results have been proven in clinical studies. Chung et al.[9] followed 20 patients after partial meniscectomy and 37 patients after pullout repair of a medial meniscus root tear for a minimum of 5 years. Clinical and radiographic assessments were evaluated preoperatively and compared to the final results postoperatively. The repair group showed less

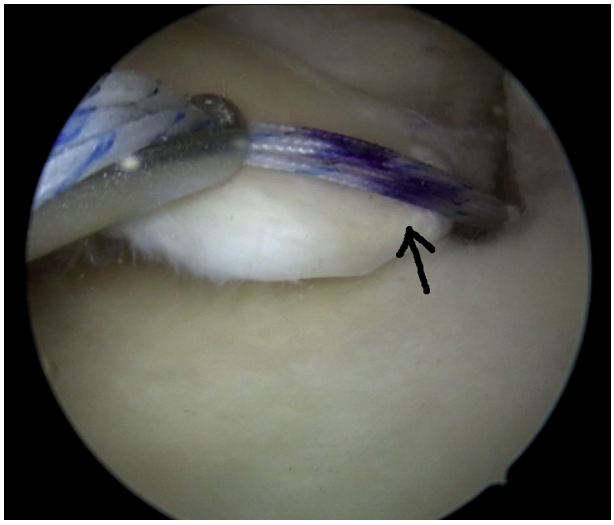

Fig 5. Sutures of inserted anchor after blocking underneath the cortex. Left knee in extension applying valgus stress. Arthroscope in anterolateral, and instrument in anteromedial portal. The knot pusher, needed to pull back and block the anchor, is still in place. Note the blue depth marks (arrow), which are clearly visible again.

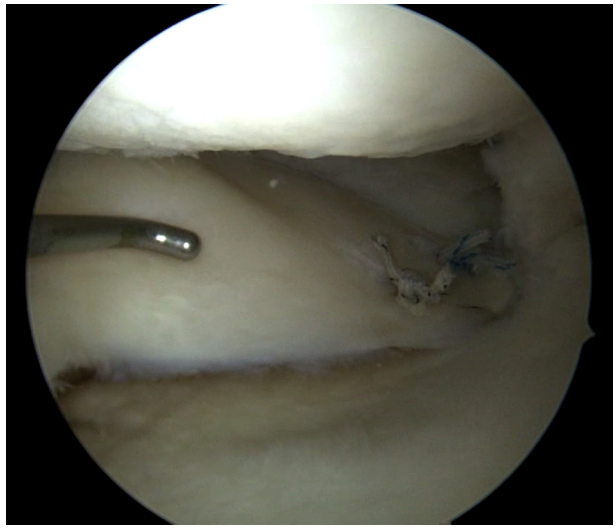

Fig 6. Final result after refixation of medial meniscal root. Left knee in extension applying valgus stress. Arthroscope in anterolateral, and instrument in anteromedial portal. Strong refixation of the medial meniscal root in anatomic position.

Table 1. Pearls and Pitfalls

Pearls	Pitfalls
Consider needling of medial collateral ligament	Remaining soft tissue might prevent anchor from entering bone
Aim for correct posterior positioning of drill guide	Anchor may not fully block if not pulled back underneath cortical bone
Draw depth mark on sutures of the anchor	Finding transtibial canal with spinal needle might be difficult
Make use of knot pusher to erect and pull back anchor	Patient needs to understand reasons for cautious rehabilitation
Wrap pulling suture around the compress to facilitate pulling in of the anchor	

progression of degenerative changes and significantly better clinical scores (International Knee Documentation Committee and Lysholm). Thirty-five percent of meniscectomies were converted to total knee arthroplasties, as opposed to 0% in the repair group.

Several techniques have been described for transosseus suture repair.[10] Typically the sutures are passed through the meniscus, pulled out through a transtibial tunnel, and tied over a bone bridge, a suture button, or a screw at the anterior tibial cortex. Due to the long distance of the tibial tunnel and the possibility of soft-tissue entrapment between button and bone, these techniques pose the risk of suture elongation or abrasion. The tibial bone tunnel could also interfere with concomitant ligament reconstruction.[11]

These drawbacks can be avoided by the use of suture anchors. Engelsohn et al.[12] originally described arthroscopic meniscal root repair with a suture anchor using an accessory high posteromedial portal to accomplish anchor placement. A comparable technique was later published by Jung et al.[13] Current suture anchor techniques are challenging and pose the risk of neurovascular injuries due to the accessory posterior portal.

The presented procedure combines the advantages of both techniques. The transtibial drilling and pulling in of the anchor facilitate anchor insertion and avoid the use of an additional posterior portal. Potential elongation of the sutures can be avoided, and the anchor will not interfere with potential concomitant ligament reconstructions. The whole procedure can be performed using the standard anterior portals, and the suture configuration can be achieved as desired.

Potential limitations are summarized in Table 2. The knots on the meniscal surface might irritate articulating cartilage, and the fixation might loosen if the anchor is not fully blocked.

Table 2. Advantages and Limitations

Advantages	Limitations
Stable refixation of meniscal root at footprint	Potential cartilage irritation due to knots compared with extracortical fixation
No additional posterior portal needed	Fixation might loosen if anchor is not fully blocked
No potential suture elongation	Additional costs of suture anchor
No potential interference of tibial tunnel with concomitant procedures	Only possible with Y-Knot Flex 1.8-mm anchor
If anchor fails for any reason, conversion to pullout repair possible	
Several suture configurations possible	

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