Technical Note

Pullout Repair Associated With a Bridging Suture Using FiberLink for the Medial Meniscus Posterior Horn/Root Tear

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Abstract: Transtibial pullout repair for the medial meniscus (MM) posterior root tear has become the gold standard. However, an optimal repair technique has not yet been established for MM posterior horn (MMPH) tear with a sufficient root remnant. We describe a pullout repair technique associated with a bridging suture using FiberLink (Arthrex, Naples, FL) for the MMPH tear. In this bridging suture technique, the simple cinch stitch is applied to the root remnant and MMPH. The loop end of the FiberLink is inserted into the MMPH, and its free-end is inserted into the root remnant. Next, the suture is tensioned and tied on the superior surface of the MMPH. The bridging suture and the additional simple stitch applied to the MMPH are pulled out through the tibial tunnel and fixed to the tibia on an expected tension. This technique might lead to better meniscal healing of the tear site, because it involves bridging of the MMPH and root remnant, and lower risk of suture cut-out owing to the biomechanical strength.

The posterior root of the medial meniscus (MM) can be an anchor for regulating the meniscal shift during knee movement and load bearing.[1] Pathologically, a medial meniscus posterior root tear (MMPRT) can accelerate the degeneration of the articular cartilage in the knee joint by disrupting meniscal functions.[2] Recently, several techniques have been developed for MMPRT repair, and pullout repair of the MMPRT has become the gold standard. In the past, favorable clinical outcomes were reported when MMPRT was treated with transtibial pullout repair.[3]

MMPRT has commonly been categorized according to the 5 classifications reported by LaPrade et al.[4] Type 2 injures, which involve a complete radial tear within 9 mm of the root attachment, and lesions of 5 distinct types, have been observed most often. Pullout repair using 2 simple stitches or additional all-inside sutures has been performed for these types of MMPRTs.[5] However, we sometimes encounter the situation in which a radial tear is observed over 10 mm apart from the root attachment, and the root remnant is sufficiently remaining. This is called a medial meniscus posterior horn (MMPH) tear. Although the ideal location of the tibial tunnel aperture is within the

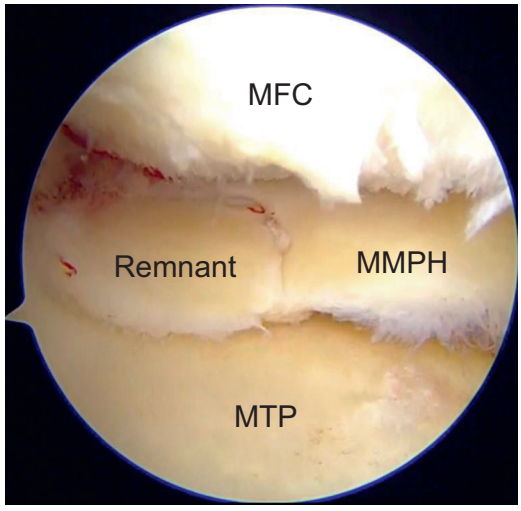

Fig 1. Arthroscopic view of the medial meniscus before repairing (right knee, spine position, anterolateral portal view). Radial tear of the MMPH is observed with a sufficient root remnant. (MFC, medial femoral condyle; MMPH, medial meniscus posterior horn; MTP, medial tibial plateau.)

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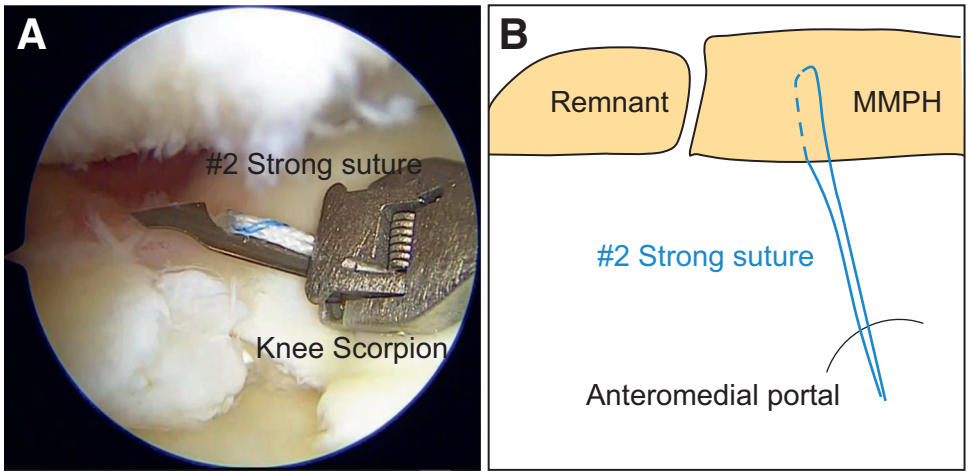

Fig 2. Arthroscopic view showing a simple stitch being applied to the medial meniscus (right knee, spine position, anterolateral portal). (A) A #2 strong suture is inserted into the outer area of the MMPH using the Knee Scorpion suture passer. (B) The schema of the simple stitch. The suture is inserted into the outer area of the MMPH through the anteromedial portal. (MMPH, medial meniscus posterior horn.)

anatomical attachment, the distance between the tibial tunnel and suture site becomes longer in the knee with MMPH tear (MMPHT).[6] If the conventional pullout repair such as 2 simple stitches is applied to the MMPHT knees, the tension applied to the repaired MMPH increases, and there may be risk of suture cut-out during or after repair.

However, an optimal root repair technique has not yet been established for MMPHT knees. We describe a pullout repair associated with a bridging suture using FiberLink (Arthrex, Naples, FL) for the MMPHT. In this suture technique, the bridging suture using the simple cinch stitch is applied to the root remnant and the MMPH and is pulled out.

Surgical Technique

Indications

A radial tear 10 mm from the root attachment with a sufficient root remnant is defined as an MMPHT. Patients with MMPHT and a femorotibial angle <180°, radiographic Kellgren–Lawrence grade 0 to II, body mass index <35, and high compliance are regarded as having indications for this transtibial pullout repair technique.

Diagnostic Arthroscopy

The patient is placed in the supine position with a tourniquet. Standard anterolateral and anteromedial portals are created in the knee for arthroscopic visualization of the MM posterior root and its anatomical attachment using a 30° arthroscope. The outside-in piecrusting technique using a standard 18-gauge (1.2 × 40 mm) hypodermic needle (TERUMO, Tokyo, Japan) is used to widen the tight medial compartment. Synovial tissues are gently debrided using a shaver to create a good visualization. The MMPHT is observed as having a sufficient root remnant for the suture to pass through (Fig 1).

A Simple Stitch

A simple stitch is performed by using a Knee Scorpion suture passer (Arthrex) to pass a No. 2 strong suture vertically through the meniscal tissue (Fig 2 A and B). The suture is inserted into the MMPH's outer area through the anteromedial portal (Fig 2B).

Bridging Suture

The suture using a Knee Scorpion suture passer is inserted into the middle area of the MMPH to pass through the loop side of the FiberLink (Fig 3 A and B). It is passed through about 5 mm from the tear site, to avoid suture cut-out. Next, the suture is inserted into the remnant to pass through the free-end side of the FiberLink about 5 mm away from the tear site (Fig 3 C and D). Following, the free-end of the FiberLink is passed through the loop and tensioned to the meniscal surface; thus, the bridging suture is applied (Video 1, Fig 2 E and F).

Tibial Tunnel Creation and Suture Pullout

After MM posterior root attachment is confirmed, a custom-made posterior root-aiming device (Arthrex) is placed at the center of the attachment area (Fig 4A). A 2.4-mm guide pin is inserted, using the aiming device at a 45° angle to the articular surface, and a 4-mm cannulated drill is used to overdrill. After removing only the inner guide pin, 2 sutures are pulled out through the cannulated drill using the suture relay technique (Figs 4B and 5). Tibial fixation of the pullout sutures is performed using a bioabsorbable screw with an initial tension of 10 N at an angle of 30° knee flexion.

Postoperative Protocol

Patients are initially kept non–weight-bearing in a knee immobilizer for 2 weeks. Between 2 and 4 weeks

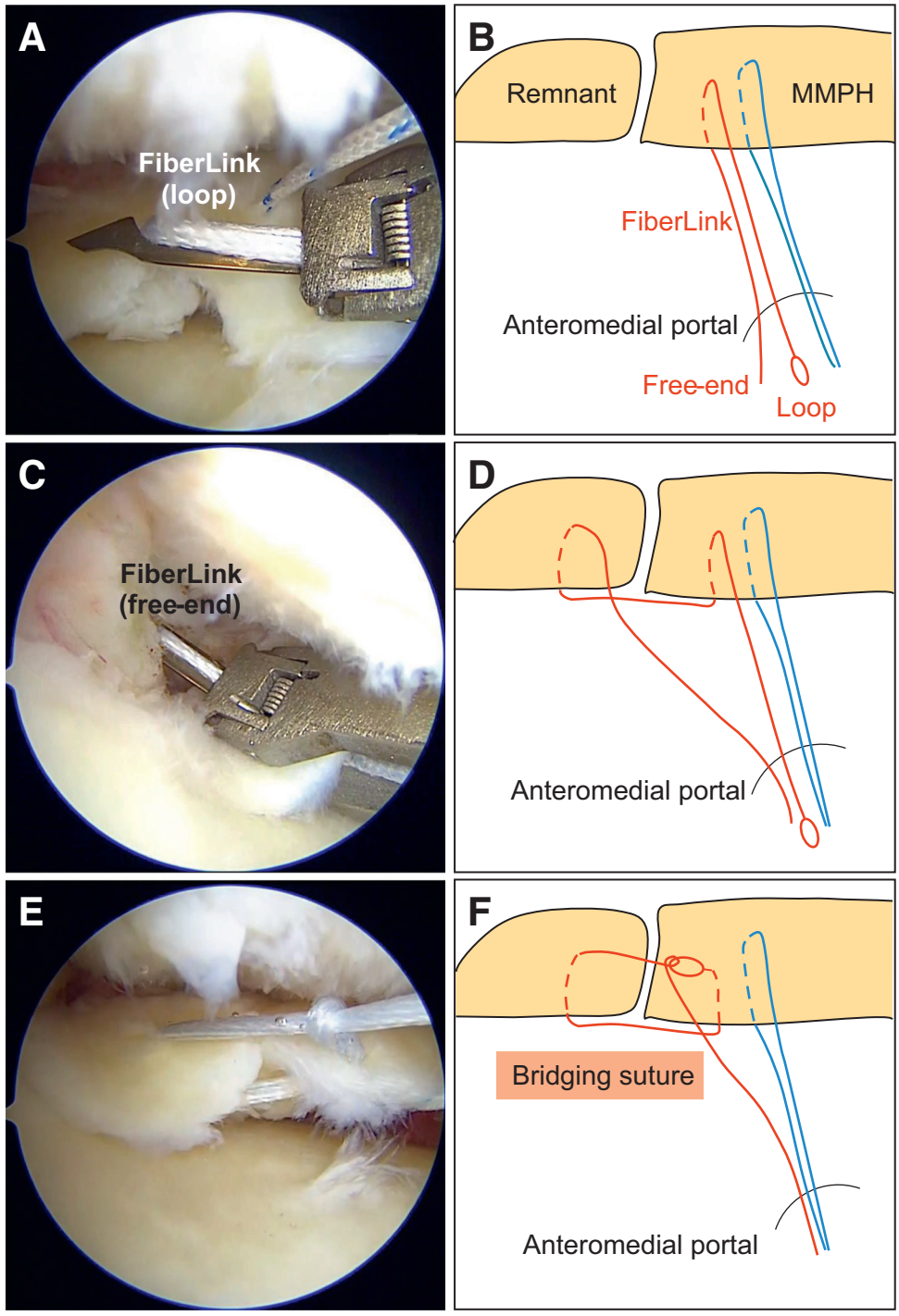

Fig 3. Arthroscopic views of applying the bridging suture to the medial meniscus (right knee, spine position, anterolateral portal). (A) The loop side of the FiberLink is inserted into middle area of the MMPH with adequate margins (approximately 5 mm) from the torn site. (B) The schema of (A). The loop side of the FiberLink is inserted into the middle area of the MMPH through the anteromedial portal. (C) The free-end side of the FiberLink is inserted into the remnant with an adequate margin (approximately 5 mm) from the torn site. (D) The schema of (C). The free-end side of the FiberLink is inserted into the remnant through the anteromedial portal. (E) After passing the free-end of the FiberLink through the loop, the suture is tensioned to the meniscal surface; that is the bridging suture. (F) The schema of (E). The bridging suture and a simple stitch are applied. (MMPH, medial meniscus posterior horn.)

following surgery, knee flexion exercises are gradually increased up to 90° with partial weight-bearing on the affected knee. At 6 weeks postoperatively, patients are allowed full weight-bearing and 120° of knee flexion.

Discussion

Transtibial pullout repairs have been developed for arthroscopic treatments of MMPRT, and favorable clinical outcomes have been reported. However, a standard repair technique for the MMPHT has not yet been established. We describe a pullout repair associated with a bridging suture using FiberLink for the MMPHT. A FiberLink suture with a closed loop on one end is designed to facilitate the application of a cinch stitch by simply passing the suture through tissue and feeding the free-end through the loop, then tensioning

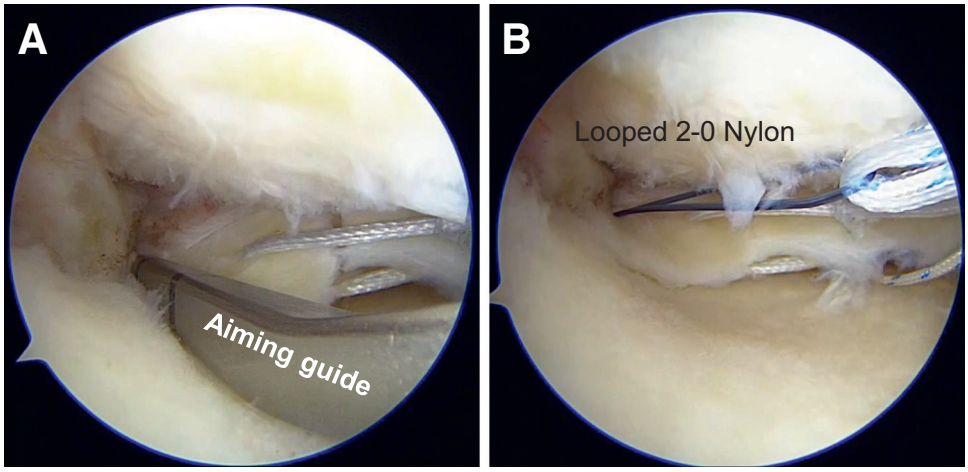

Fig 4. Arthroscopic view of the tibial tunnel creation and suture pullout (right knee, spine position, anterolateral portal). (A) The tibial tunnel is created to the anatomical attachment of the medial meniscus posterior root using the Unicorn Meniscal Root (UMR) guide (Arthrex). (B) The sutures are pulled out via the suture relay technique by using a looped 2-0 Nylon.

it. The cinch suture has stronger biomechanical strength compared with other suture techniques and has the distinct advantage of fewer penetrations into meniscus using all-inside suture devices.[7,8] Anz et al.[7] have used a cinch stitch with a double locking loop suture and demonstrated that it had the greatest failure loads than other simple suture constructs. Furthermore, Krych et al.[8] showed that the simple cinch suture had less cyclic displacement and similar ultimate failure load compared with the locking loop configuration. The simple cinch suture has the advantage of one perforation in the meniscus, which could reduce surgery time and risk of iatrogenic chondral damages.

In this technique, the simple cinch stitch is modified. The bridging suture, using the simple cinch stitch, is used to link the root remnant and the MMPH and made only one perforation in the root remnant and one in the MMPH. In using the bridging suture with a simple cinch stitch, meniscal repair between the MMPH and root remnant is expected to be achieved. In addition, regaining meniscal function for the hoop could be obtained by using a pullout repair technique. In this technique, the additional simple stitch is also applied to the MMPH, to ensure pullout of the MMPH. In terms of the biomechanical strength, better meniscal healing and less suture cut-out may be expected when using this technique over other types of suture configurations. In this technique, surgeons can access the MMPH easily in the wide medial compartment using the outside-in pie crusting technique. The Scorpion needle may be easily inserted into the meniscus in the wide medial compartment, and there may be a reduced risk of iatrogenic cartilage injury by the needle or needle breakage. In addition, this technique might be applied to the lateral meniscus posterior horn tear, which often accompanies with the anterior cruciate ligament or type 4 MMPRT with a sufficient root remnant (Tables 1 and 2). Further clinical and biomechanical studies are needed to evaluate the long-term efficacy of our surgical technique compared with that of previously described techniques.

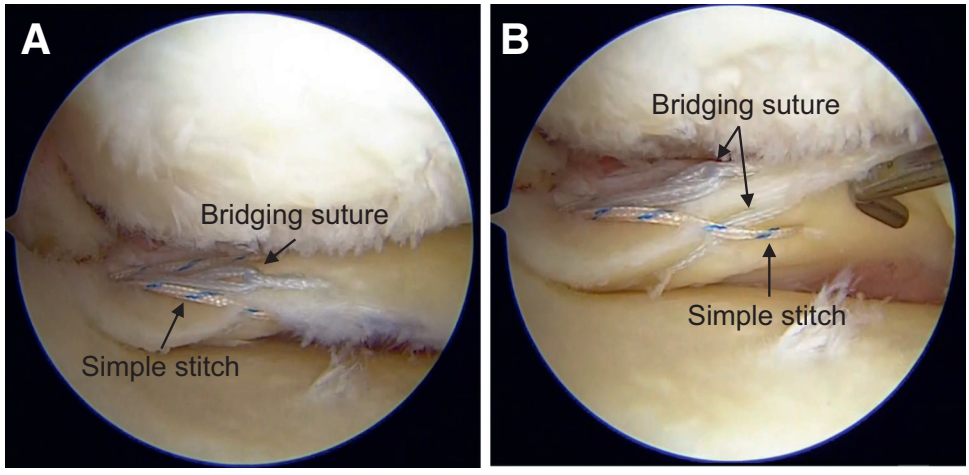

Fig 5. Arthroscopic view after repair (right knee, spine position, anterolateral portal). (A) Superior surface of the repaired MM. The bridging suture and a simple stitch are applied to the MM and pulled out successfully. (B) Inferior surface of the repaired MM. (MM, medial meniscus.)

Table 1. Pearls/Pitfalls of This Technique

Pearls	Pitfalls
The outside-in pie-crusting technique is useful to access easily the tight medial compartment.	The Scorpion needle may break on inserting it upward in the tight medial compartment.
The sutures are applied approximately 5 mm from the tear site to reduce the risk of suture cut-out.	Suture cut-out may occur when the root remnant is not retained sufficiently.
A high anterolateral portal should be used to obtain good visualization and prevent iatrogenic injury of the transverse ligament.	Sutures should be passed through the same path as the anteromedial portal to be pulled out successfully.

Table 2. Advantages/Disadvantages of This Technique

Advantages
A FiberLink suture can make a simple cinch stitch easily.
Meniscal repair between the MMPH and root remnant is expected.
Greater biomechanical strength is expected.
Fewer perforations in the meniscus lead reduce surgery time and the risk of iatrogenic chondral damage.
Can also be applied to the lateral meniscus posterior horn tear.
Disadvantages
Need to release part of medial collateral ligament in the tight medial joint compartment.
Requires a new suture and device.

MMPH, medial meniscus posterior horn.

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