Technical note

Pullout repair of a medial meniscus posterior root tear using a FasT-Fix® all-inside suture technique

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A B S T R A C T
A medial meniscus posterior root tear (MMPRT) may increase the tibiofemoral contact pressure by decreasing the tibiofemoral contact area. Meniscal dysfunction induced by posterior root injury may lead to the development of osteoarthritic knees. Repair of a MMPRT can restore medial meniscus (MM) function and prevent knee osteoarthritis progression. Several surgical procedures have been reported for treating a MMPRT. However, these procedures are associated with several technical difficulties. Here, we describe a technique to stabilize a torn MM posterior root using the FasT-Fix® all-inside meniscal suture device and a new aiming device. The uncut free-end of the FasT-Fix® suture can be used as a thread for transtibial pullout repair. Our procedure might help overcome the technical difficulties in arthroscopic treatment of a MMPRT.

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1. Introduction
The posterior root anchors the medial meniscus (MM) to the tibial plateau. Posterior root dysfunction is often caused by either acute injury or chronic degeneration [1], and it leads to abnormal biomechanics of the tibiofemoral joint and the inability to convert axial loads into transverse hoop stresses [2,3]. Although partial meniscectomy is used to manage a meniscal root tear, MM root disruption can affect the ability to withstand hoop strain, resulting in increased contact pressure and kinematic alteration of the affected compartment. Peak tibiofemoral contact pressures were previously found to be similar between a MM posterior root tear (MMPRT) and total meniscectomy of the MM [3]. The posterior root of the meniscus contains the perimeniscal capillary plexus and has radially arranged collagen fibrils [4]. A MMPRT is usually found in patients older than 50 years with degenerative changes of the knees [5]. However, the healing potential is lower in old patients than in young patients [6]; therefore, healing of the repaired meniscus might not be complete in older patients. Surgical indications of MMPRT repair in patients older than 50 years have been reported to include varus alignment < 5 °, mild cartilage lesion (Outerbridge low grade I or II), and Kellgren–Lawrence grade 0–II in radiographs [7].

Transtibial pullout repair and suture anchor-dependent repair have been developed for arthroscopic treatment of a MMPRT [7,8].

However, there are several technical difficulties, and conventional pullout repair requires complex arthroscopic techniques. These procedures may induce iatrogenic injuries of the articular cartilage and additional tears of the MM posterior root.

Here, we describe a technique to stabilize the torn MM posterior root using the FasT-Fix® all-inside meniscal suture device and a new aiming device (Smith & Nephew, Andover, MA, USA). Our technique aims to restore hoop tension and prevent cartilage damage, which can progress rapidly. The tear pattern was classified as previously described [9], and our technique is suitable for a MMPRT of type 2 (radial tear) or type 4 (oblique tear).

2. Operative technique
The patient is placed supine, with a tourniquet. A standard anterolateral portal for arthroscopic visualization of the MM posterior root and its anatomical attachment, using a 30° arthroscope (Smith & Nephew). An anteromedial portal is used for the instruments.

MMPRT repair is indicated in the absence of severe cartilage damage. The presence of a meniscal substance tear is evaluated via the anteromedial portal (Fig. 1A), and the type of meniscal root injury is defined.

To accommodate a new aiming device (Smith & Nephew) and the FasT-Fix all-inside meniscal suture device (Smith & Nephew), synovial tissues surrounding the posterior cruciate ligament are removed using a motorized shaver and radiofrequency device. Additionally, scar-like tissue behind the meniscus and between the

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Fig. 1. Medial meniscus posterior root tear (MMPRT) (right knee) in a 67-year-old woman. A. Radial type 2 tear of the MM posterior root. B. The tip of the aiming device is placed at the anatomical insertion of the MM posterior root from the anteromedial portal. The shiny white fiber is seen (black arrow). C. A cannulated drill (4.0 mm) is inserted along with the guide pin. D. Two FasT-Fix anchors are inserted into the MM posterior root in an oblique orientation. E. The uncut free-end of the FasT-Fix suture is pulled out from the tibial tunnel. F. Tibial fixation is performed with the knee flexed at 40°, using a double-spike plate, with an initial tension of 20 N. MFC: medial femoral condyle; MIT: medial intercondylar tubercle

Fig. 2. The aiming device. A. Image of the new aiming device (Smith & Nephew). B–D. The aiming device is matched to the structure of the tibial plateau surface.

tibial articular surface and meniscocapsular ligament is removed with rasping from the posterior segment to the mid segment of the MM. The posterior root is approximately 9.6 mm posterior and 0.7 mm lateral to the apex of the medial tibial eminence [10]. This area is present posterior to the shiny white fibers that are a distinct visual landmark on the distal aspect of the MM posterior horn [11]. The aiming device (Fig. 2) is placed at this anatomical insertion of the MM posterior root. The aiming device can be narrowed to create an accurate tibial bone tunnel at the anatomical attachment of the MM posterior root, without damaging the articular surface of the medial femoral condyle (Fig. 1B, Fig. 2B–D). A 2.4-mm guide pin is inserted, using the aiming device, at an angle of 55° to the articular surface, and a tibial tunnel is created with a 4.0-mm cannulated drill (Fig. 1C).

The torn posterior root of the MM is grasped using the FasT-Fix 360 meniscal repair system (Smith & Nephew) [12]. Our technique involves a single FasT-Fix suture. The needle is penetrated into the meniscal root using the oblique or horizontal mattress suture technique via the anteromedial portal, and the knot of the inserted FasT-Fix is fastened adequately. The free-end of the FasT-Fix suture is preserved (Fig. 1D). The uncut free-end of the FasT-Fix suture is used for transtibial pullout repair. The free-end is moved into the transtibial tunnel using a suture manipulator (Fig. 1E). The pull-out thread is pulled carefully with manual tension, while the knee
is flexed or extended under visualization of the medial compartment. Usually, the posterior horn is moved behind to increase the tension applied to the thread as the knee is flexed. To prevent suture breakage, the thread is fastened 5–10 mm from the hole in the anteromedial tibial cortex. Tibial fixation is performed using double-spike plate and screw (Meira, Aichi, Japan), with the knee flexed at 40° and with an initial tension of 20 N (Fig. 1F, Fig. 3; Video).

3. Results

MMPRT repair using FastT-Fix was performed in 6 cases. There were no intraoperative complications, such as iatrogenic cartilage injury and suture bar displacement in the joint.

4. Discussion

Kim et al. reported that radiographic and clinical outcomes were similar between pullout repair and suture anchor techniques for the treatment of a MMPRT [8,13]; however, this technique should not be indicated in case of varus deformity or severe cartilage lesion [7,14]. The suture anchor technique is a good treatment approach, but a posteromedial portal is needed [15]. Threading the MM posterior root using conventional all-inside suture devices in arthroscopic repair has technical disadvantages. Our FastT-Fix suture device technique is easy to perform. The aiming device is easy to manipulate in the narrow medial compartment (Fig. 2A–D). The FastT-Fix technique uses a tiny implant for suturing the peripheral attachment of the posterior horn of the MM via the standard anterior portal only, and it is therefore convenient.

The loads that can cause failure of vertical sutures using FastT-Fix and Ethibond 2-0 have been reported to be 115.2 ± 1.6 N and 82.6 ± 0.8 N, respectively [16]. Another study showed that a load of approximately 60 N could cause failure of meniscal sutures; however, there was no difference in clinical outcomes, and high thread strength was found to improve the degree of meniscal extrusion [17]. Considering the posterior translation of the MM posterior segment (Fig. 3), we set the fixation tension to 15–20 N in order to prevent it from exceeding 60 N.

Our repair technique is easier than traditional pullout techniques and the suture anchor technique, and the surgical device can be manipulated in a narrow working space, especially in the case of intact anterior cruciate ligament. Further studies with a large number of patients are needed to confirm the efficacy and safety of our technique.
Disclosure of interest

The authors declare that they have no competing interest.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.otsr.2016.06.013.

References