



Description of a surgical technique of medial meniscus root repair: a fixation technique with two simple stiches under an expected initial tension

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Received: 6 September 2018 / Accepted: 25 November 2018 / Published online: 29 November 2018
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Abstract

The medial meniscus (MM) posterior root has an important role in the maintenance of knee kinematics and articular cartilage. Although transtibial pullout repair of the MM posterior root tear (MMPRT) has become the gold standard, it is associated with several suturing difficulties. The present technical note describes a simple fixation technique using two simple stiches under an expected initial tension. After the degree of knee flexion (20°) and an expected tension (30 N) are checked, tibial fixation is performed using a bioabsorbable interference screw with a spring tensioner. After that, a suture knot is made just below the screw in case the sutures are pulled toward the joint direction. Furthermore, a cancellous screw is inserted at a position 1-cm distal from the tibial tunnel for augmentation and is tightened. MMPRT usually occurs in middle-aged females who often have decreased bone quality. However, there is no risk of tibial fracture with our new technique because the bone does not need to be hit. Adopting the advances of fixation with a spring tensioner and Biosure RG instead of Double Spike Plate, we can determine an expected tension easily and safely. The present fixation technique allows reproducibility for many operators to determine an initial tension and might be a good candidate for arthroscopic repair of the MMPRT. Further follow-up studies including second-look arthroscopy and scoring will be necessary to show the clinical benefits of this technique.

Keywords Medial meniscus · Posterior root tear · Pullout repair · Simple fixation technique · Expected tension

Introduction

The posterior root attachments of the menisci have an important role in the maintenance of knee articular cartilage [1, 2]. Medial meniscus posterior root tear (MMPRT) was reported to be functionally equivalent to total meniscectomy of the medial meniscus (MM) [1]. Several techniques were recently developed for MMPRT repair [3–6]. Although transtibial pullout repair of the MMPRT has become the gold standard, it is associated with several suturing difficulties, such as poor visualization, narrow working space, mobility of the torn meniscus, and deciding an initial tension for fixation.

We previously reported a novel suture technique, a Fast-Fix (Smith & Nephew, Andover, MA, USA) combined with a modified Mason-Allen suture technique [6], which allows easy access to the torn site and strong grasping, especially in cases with a tight medial compartment [5]. The present technical note describes a new simple fixation technique involving two simple stiches (TSS) under an expected initial tension, using a Knee Scorpion suture passer (Arthrex, Naples, FL, USA) with No. 2 Ultrabraid (Smith & Nephew), Kocher, a spring tensioner, Biosure RG (a bioabsorbable interference screw, Smith & Nephew), and a cancellous screw (Meira, Aichi, Japan) as an anchor screw for pullout repair of the MMPRT.

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Surgical technique

Pullout repair of the MMPRT is performed in patients with a femorotibial angle < 180°, mild cartilage lesions (Outerbridge grade I or II), and Kellgren–Lawrence grade 0–II, which are confirmed by preoperative radiographs and

magnetic resonance images. A standard arthroscopic examination is performed using a 4-mm-diameter 30° arthroscope (Smith & Nephew). A probe is introduced through the anteromedial portal and used to evaluate the type of the MMPRT (Fig. 1a). In cases with a tight medial compartment, we use the outside-in pie-crusting technique of the medial collateral ligament by using a standard 18-gauge (1.2×40 mm) hypodermic needle (TERUMO, Tokyo, Japan) [7]. The torn area and synovium are debrided by rasping and shaving to facilitate the next procedure.

We used a Knee Scorpion suture passer to pass two No. 2 Ultrabraid sutures vertically through the meniscal tissue. To prevent suture cutout, the suture is placed with a safety margin (> 3 mm) from the edge of the tear as the first simple stitch (Fig. 1b). The first suture is inserted into the outer area of the MM posterior root, and the second suture is inserted into the inner area of the MM posterior horn, more than 10 mm from the torn area. It is important to keep the first Ultrabraid tensioning throughout an anterolateral portal during placement of the second suture for easy access. The second simple stitch is created using the Knee Scorpion suture passer (Fig. 1c). Two Ultrabraid sutures are retrieved through the anterolateral portal. The

MM posterior root attachment is then confirmed, and a custom-made posterior root-aiming device (PRT guide, Smith & Nephew) [8] is placed at the anterior area of the whole root attachment. A 2.4-mm guide pin is inserted, using the aiming device, at a 50° angle to the articular surface, and a 4.5-mm cannulated drill is used to overdrill. After removing the inner guide pin alone, two sutures are pulled out through the cannulated drill by using a suture retriever (Smith & Nephew) (Fig. 1d). Gentle tension is applied to the sutures. This step is visualized arthroscopically. After the degree of knee flexion (20°) and an expected tension (30 N) are checked, tibial fixation is performed using the Kocher clamp (Fig. 2a) and Biosure RG with a spring tensioner (Fig. 2b), by grasping all sutures (Figs. 2c, d, 3a). Screw size is selected depending on bone quality; a 5.0-mm screw is used for good bone quality, and a 6.0-mm screw for bad quality. After that, a suture knot is made just below the screw in case the sutures are pulled toward the joint direction (Fig. 3b). Furthermore, for augmentation, a cancellous screw is inserted about 1-cm distal from the first screw (Fig. 3c) and is tightened (Fig. 3d, e, f). The arthroscopic portals and anterior tibial incision are closed in a standard surgical fashion. Rehabilitation protocol was the same as previously described [6].

Fig. 1 Arthroscopic findings and schematic diagram. **a** A complete radial tear of the MM posterior root (PR). MFC, Medial femoral condyle; MTP, Medial tibial plateau. **b** The first simple stitch. **c** The second simple stitch is applied using the Knee Scorpion suture passer. **d** A TSS suture configuration. PCL, Posterior cruciate ligament

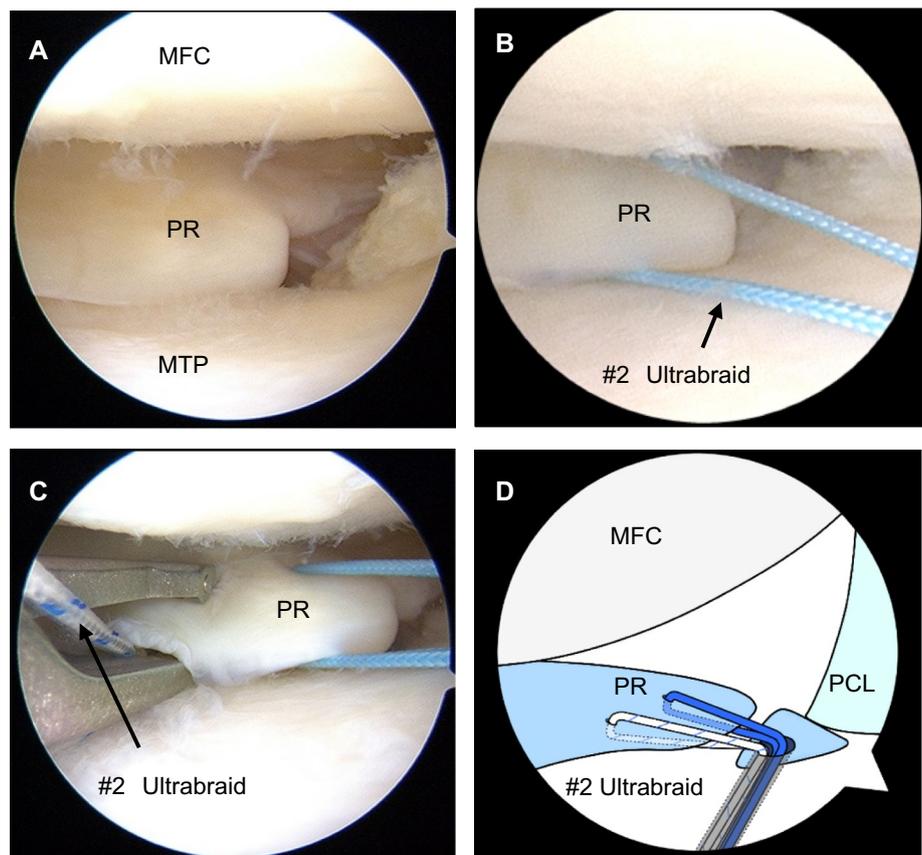
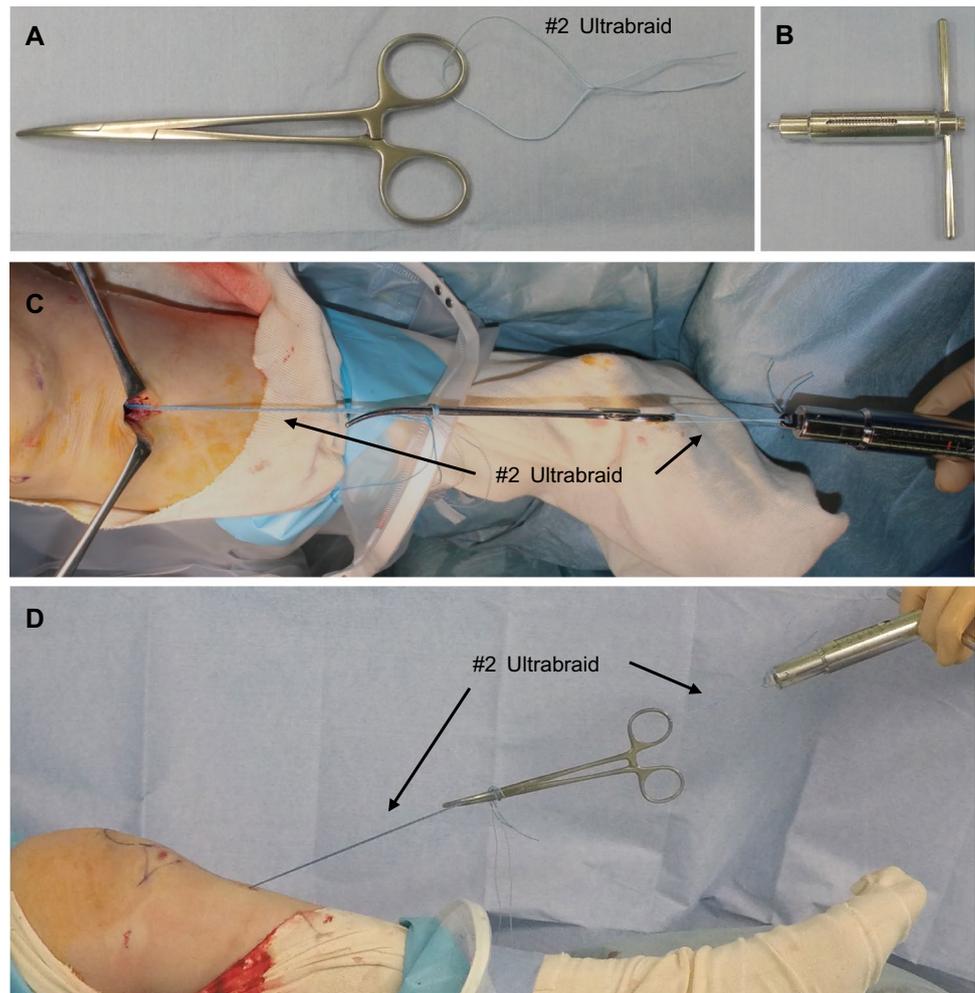


Fig. 2 Tibial fixation technique. All sutures are equally tensioned using the Kocher clamp (a) and a spring tensioner (b). An expected initial tension can be set using a spring tensioner at a favorable knee flexion angle (c and d)



Discussion

In the present study, we described a new simple fixation technique using TSS under an expected initial tension for pullout repair of MMPRT. Our new fixation technique could be performed easily by many operators.

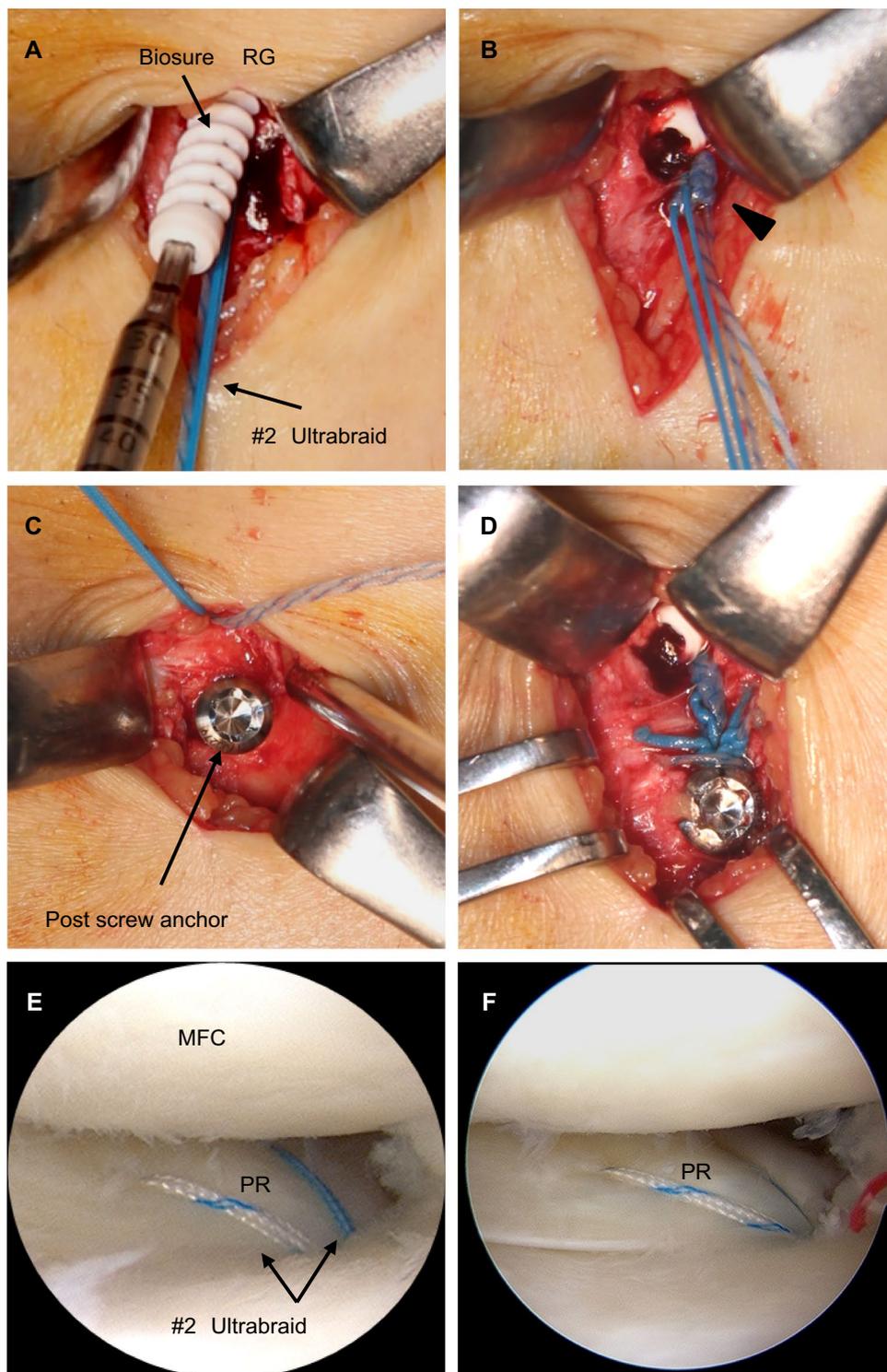
The pullout repair technique for meniscal root tear by using the tibial tunnel has been widely accepted. West et al. [9] developed the transosseous pullout repair technique by using a bone tunnel for lateral meniscal root tears. Several pullout repair techniques for meniscal root tears have been recently developed by numerous passing devices and suturing materials [5, 10–12].

Fortunately, we could perform second-look arthroscopy in almost all cases about 1 year after pullout repair and have decided on an initial tension with reference to their healing score, tension, and clinical outcome [13]. When we described the FasT-Fix combined with modified Mason-Allen suture, tibial fixation was performed with an initial 20-N tension in the 45° knee-flexed position referring to the biomechanical report concerning tension

at different flexion of the knee [14–16]. In second-look arthroscopy, no anterior-drawer sign of MM posterior segment was identified in the 20° knee-flexed position; however, the lifting sign of MM posterior segment was sometimes identified in the 20° or 60° knee-flexed position. As of now, tibial fixation has been performed with an initial 30-N tension in the 20° knee-flexed position for about 20 patients, and good clinical outcomes were achieved. Furthermore, we have not performed revision surgery for pullout repair yet. Therefore, this is a simple, safe, and reproducible fixation technique for many operators for performing tibial fixation in an expected tension by using Biosure RG and a spring tensioner.

The modified Mason-Allen suture technique recently showed superior cyclic loading and load-to-failure strength compared with other stitch configurations [14, 17, 18]. Although it is known that TSS is inferior to modified Mason-Allen suture in load-to-failure strength, favorable clinical outcomes by using two or three simple vertical sutures were described [19], which means TSS might be strong enough for the MM posterior root repair.

Fig. 3 Fixation of the sutures and arthroscopic images. A tibial fixation is performed using a bioabsorbable interference screw (a, Biosure RG) under an expected tension and knee flexion angle. Suture knots are made just below the screw in case the sutures are pulled toward the joint direction (b). A cancellous screw is inserted at a position 1-cm distal from the tibial tunnel for augmentation (c), and the sutures are tightened (d). Relaxed sutures (e) are adequately fixed under an expected initial tension (f)



A bioabsorbable interference screw has some advantages. MMPRT commonly occurs in middle-aged females [20], who often have decreased bone quality. There is no risk of tibial fracture in our new technique because we do not need to hit a fixation device on the bone. If the screw needs to be removed, the suture is cut, and the screw is removed only

from a stab incision, keeping the initial tension. Although it remains unclear, a suture knot below the bioabsorbable interference screw might be enough and a post-screw anchor might not always be necessary if the bone quality is good.

Adopting the advances of fixation with a spring tensioner and a bioabsorbable interference screw instead of Double

Spike Plate (Meira, Aichi, Japan), we can easily perform the fixation under an expected tension. The present fixation technique allows reproducibility in many operators to determine an initial tension, and this technique might be a good candidate for arthroscopic repair of the MMPRT although this may need fixation of an additional screw. Further follow-up studies, including second-look arthroscopy for the patients treated by this new technique and scoring with a large number of patients, will be necessary to show the clinical benefits of this technique.

Acknowledgements We thank Editage (www.editage.jp) for English language editing.

Compliance with ethical standards

Conflict of interest All authors declare that they have no conflict of interest.

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