

All-Inside Double-Sided Suture Repair for Longitudinal Meniscal Tears



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Abstract: The current consensus in the literature is that the meniscus must be saved. Even though inside-out sutures are still considered as the gold standard, the need to alternate between intra- and extra-articular structures for every stitch makes it laborious. New generations of all-inside systems are now routinely used in operating rooms and enable easier, quicker, and safer techniques. However traditional all-inside repair with limited upper fixation does not provide uniform compression from top to down, essential precondition for satisfactory meniscal healing. This Technical Note describes a simple and accessible alternative technique that provides stable fixation and overall compression of vertical meniscal tears from top to down with standard all-inside instrumentation.

The place of meniscectomy has been questioned¹⁻⁴ in recent years, as it can result in joint pain, decreased joint function, and the onset of osteoarthritis. Consequently, there has been growing interest in meniscus repair.⁵ However, its results are still inadequate, with a reoperation rate of 10% to 20%.^{5,6} Preconditions for satisfactory meniscal healing include strong primary fixation and stable suturing technique combined with a biological healing process requiring effective abrasion and a large contact area.⁷ Some aspects of the technique are now validated, but others still need to be explored.

Even though simple inside-out sutures are still considered as the gold standard, new generations of hybrid systems combining an absorbable or PEEK (polyether ether ketone) anchor and a suture device are now routinely used in operating rooms. Indeed, these devices were designed to enable easier, quicker, and

safer techniques⁸ with biomechanical properties that are now validated.⁹ In longitudinal tears (Fig 1), the trend is now to use vertical sutures, placed every 5 to 7 mm, because horizontal sutures that are placed parallel to the collagen fibers can easily pull out by separating the fibers.^{10,11} The placement method and the surgical sequence for these vertical sutures has been poorly described. Traditional all-inside repair with limited upper fixation¹² does not seem to provide uniform compression (Fig 2). Saliman¹³ described circumferential compression sutures to allow compression of the superior, central, and inferior tear surfaces. Their technique is directed at red/white zone tears and does not seem to be suitable for very peripheral tears. This Technical Note describes a simple and accessible alternative technique that provides stable fixation and overall compression of vertical meniscal tears from top to down with standard all-inside instrumentation.

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The authors report the following potential conflicts of interest or sources of funding: M.T. reports other from Arthrex, outside the submitted work. J.-M.F. reports other from Arthrex, Newclip Technics, and Xnov, outside the submitted work. Full ICMJE author disclosure forms are available for this article online, as [supplementary material](#).

Received March 11, 2021; accepted May 11, 2021.

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2212-6287/21428

<https://doi.org/10.1016/j.eats.2021.05.006>

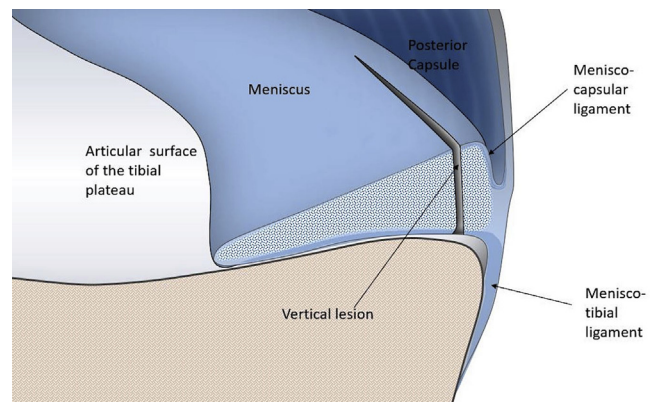


Fig 1. Longitudinal tear of the meniscus.

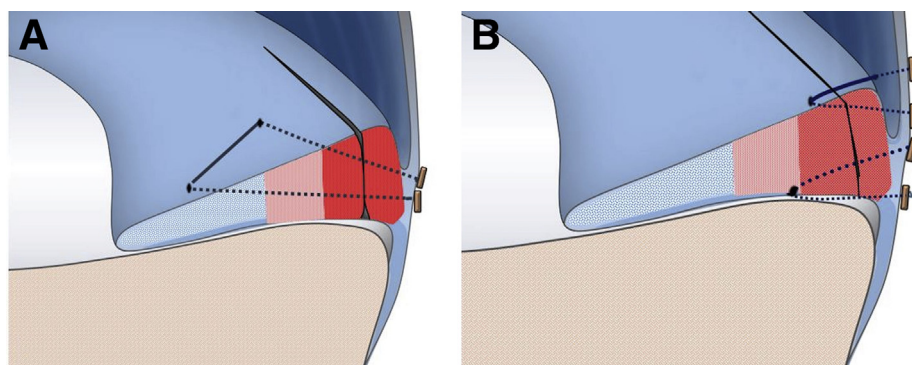


Fig 2. Longitudinal tear in red zone. (A) Standard vertical suture: suboptimal apposition of the lesion edges and placement of inferior anchor through the white zone. (B) Two-sided suture: optimal apposition of lesion edges. Anchor placement through the red/white zone or red/red zone.

Indications

Longitudinal tears, particularly those occurring closer to the red zone have always been considered as the best indication for repair.¹⁴ The most successful repairs are those associated with an anterior cruciate ligament reconstruction and those involving the lateral meniscus.⁵ Our indications are longitudinal tears involving the posterior horn and/or midportion of the medial and lateral menisci. Those lesions may be isolated or associated with anterior cruciate ligament tears.

Surgical Technique (With Video Illustration)

The surgical technique is presented in [Video 1](#); tips are summarized in [Table 1](#).¹⁵

Patient Setup

The surgery is performed under general or regional anesthesia after antibiotic prophylaxis. The patient is supine, with a tourniquet positioned high on the thigh. Lateral support is at the level of the tourniquet ([Fig 3](#)).

Portals

Standard arthroscopic high anterolateral and anteromedial portals are made as previously described by Sonnery—Cottet et al.¹⁶ to spare and not to be hindered by the infrapatellar fat pad ([Fig 4](#)). In case of medial meniscal tears, the knee is placed in valgus, close to extension ([Fig 5](#)). We recommend extending the anteromedial portal distally under arthroscopic control

Table 1. Technique Tips and Pitfalls

Technique Tips	Pitfalls
High portals to avoid the fat pad	Never use the anterolateral portal to place the stitches on the posterior horn of the lateral meniscus to prevent of vascular lesions ¹⁵
Medial compartment:	Place the suture as peripheral as possible to avoid the creation of holes in the white zone
<ul style="list-style-type: none"> • extend the medial portal distally to improve access to the posterior horn • pie-crusting of the superficial MCL in case of medial stiffness 	Limit the depth of the suture device at 16 mm to prevent the anchors from reaching out to the skin
Lateral compartment:	Check the posterior part of the knee after placing the anchors to prevent of a potential skin breach
<ul style="list-style-type: none"> • Make additional central midline portal to suture the posterior horn close to the posterior root • Second anchor of the suture can be placed into the popliteus tendon, this procedure is safe and associated with a low failure rate 	
Use of curved devices:	
<ul style="list-style-type: none"> • upward curve to repair the superior part of the meniscus • downward curve to suture the inferior part 	
Surgical sequence:	
<ul style="list-style-type: none"> • Effective abrading with a motorized shaver • Repair from the more unstable to the more stable, e.g., from posterior to anterior • Work on the top first (easily accessible) • Put superior stitches every 5 mm without tightening them • Tighten all superior stitches at the same time: the meniscus flips proximally which exposes its bottom part (usually difficult to access) • Put inferior stitches every 5 mm without tightening them • Tighten all inferior stitches at the same time: the meniscus flips distally to return to its conventional position 	



Fig 3. Patient setup (right knee): the patient is supine, with a tourniquet positioned high on the thigh. Lateral support is at the level of the tourniquet.

to provide easier access to the posterior horn and preserve the articular surface of the medial condyle. In case of medial stiffness, a pie-crust release is made in the superficial medial collateral ligament just above the hamstrings.

In case of lateral meniscal tears, the knee is placed in the figure-of-4 position (Fig 6). A high anteromedial portal provides safer access over the tibial spines to the posterior horn and midportion of the lateral meniscus. An additional transpatellar instrumental portal may be needed when the tear extends to the meniscal root.¹⁷

To handle the mid-part of the meniscus, portals can be switched to work in the axis and to perform perfectly vertical stitches: the suture device is passed through the anterolateral portal to repair the mid-body of the medial meniscus and conversely.

Anteromedial and transpatellar portals are preferred to the anterolateral portal to place the stitches on the posterior horn of the lateral meniscus to prevent of vascular lesions.¹⁵

Meniscus Repair

The first step consists in abrading both edges of the tear with a motorized shaver. Then, conventional all-inside meniscal repair devices are used (FAST-FIX; Smith & Nephew Endoscopy, Andover, MA). The depth stop is placed at 16 mm; this distance prevents from overpenetration of the capsular stitches and the risk of cutaneous breach. A metal-slotted cannula is always placed first to guide the device and preserve the cartilage.

The posterior horn, which is the more unstable portion of the meniscus, is fixed first. Then, sutures are performed from posterior to anterior.

The first anchor is placed through the meniscus and the capsule. The second anchor is placed through the capsule or in the popliteus tendon if the suture concerns the posterior part of the lateral meniscus. This procedure is associated with a very low failure rate with no specific complications.¹⁸ The aim is to obtain a final vertical stich, perpendicular to the collagen fibers. Thus, the curvature of the device helps to place the suture

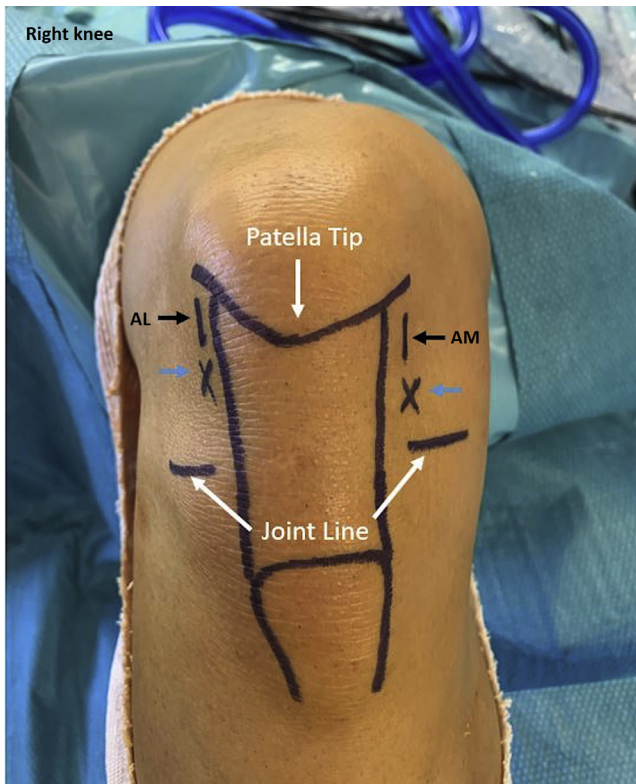


Fig 4. Portals (right knee): high anterolateral (AL) and anteromedial (AM) portals (black arrows) are made to spare and not to be hindered by the infrapatellar fat pad. Blue arrows represent the conventional portals in the soft points.

perfectly. The superior stitches are placed first with an upward curved device, 5 mm apart, to close the superior gap and to compress the upper part of the meniscus. First, all the superior stitches should be placed before being tightened to keep the superior part of the meniscus exposed. Then, they are tightened at the same time. By fixing the superior part of the tear, the meniscus flips proximally which exposes its inferior



Fig 5. In case of medial meniscal tears, the knee is placed in valgus, close to extension (right knee).

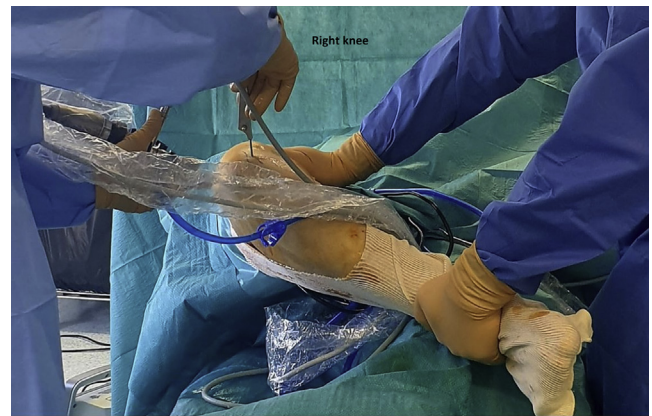


Fig 6. In case of lateral meniscal tears, the knee is placed in the figure-of-4 position (right knee).

side. This side of the meniscus is usually difficult to reach, a downward curved device can facilitate the access. The inferior stitches are then placed through the tear using the same sequence (first positioned, then tightened at the same time) to close the inferior gap and to compress the lower part of the lesion (Fig 7).

Rehabilitation

Active and passive range of motion is limited to 0° to 90° in the first 6 weeks. Full weight-bearing with brace and crutches is recommended for 1 month after the surgery in case of isolated meniscal repair. No brace is required in case of associated ACL reconstruction. Low-impact sport are permitted after 3 months, full activity is permitted after 6 months.

Discussion

Because longitudinal peripheral tears are associated with an increased risk of osteoarthritis but also have a high healing potential, meniscal preservation is now mandatory. Keys for successful meniscal repair are proper debridement and stable, circumferential fixation of the tear. New generations of thin and flexible all-inside devices provide easier access to the posterior horn and midportion of the meniscus with limited meniscal and cartilage damage. Adopting the “top first” technique provides easier access to the lower part of the meniscus. This double-sided suture technique produces overall compression of the tear. While the biomechanical properties of all-inside devices are now validated,^{9,19,20} the cost of these instruments compared with the inside-out technique has limited their uptake and dissemination (Table 2). At least, as every suture methods creating new holes in the meniscal tissue, this can be the departure of a newly formed lesion (Tachibana effect²¹), Nevertheless, thanks to this original technique more vertical stitches are realized allowing stronger primary fixation than “classical” vertical sutures.

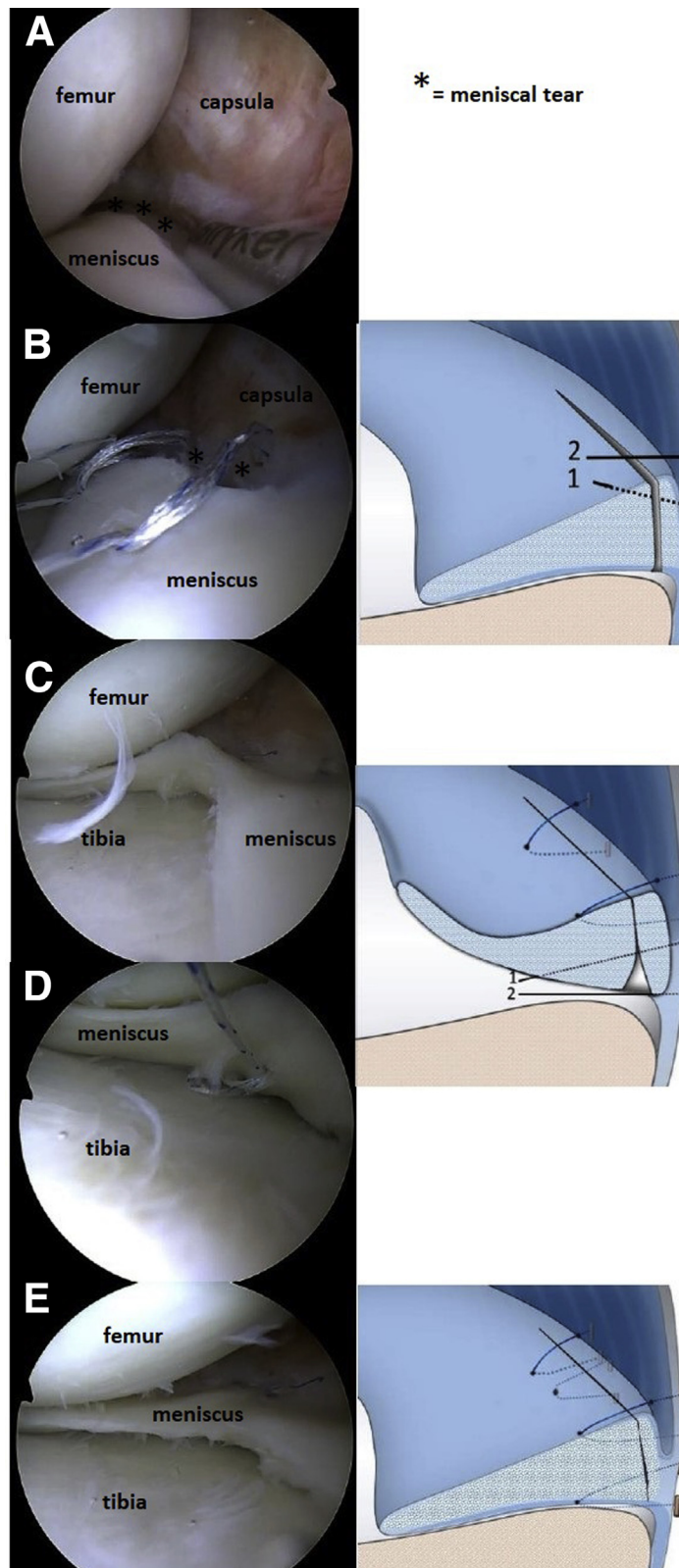


Fig 7. Surgical sequences (medial meniscus of a right knee). (A) Both edges of the lesion are abraded with a motorized shaver. (B) The superior stitches are placed first. (C) Tighten all superior stitches at the same time: the meniscus flips proximally which exposes its bottom part. (D) Put inferior stitches. (E) Tighten all inferior stitches at the same time: the meniscus flips distally to return to its conventional position.

Table 2. Advantages and Limitations

Advantages	Limitations
Safe: no additional incision	Cost
Quick	Need biomechanical assessment
Easy to perform: technique similar to classical stitches	The holes induced by the device can be the departure of newly formed lesion (Tachibana effect)
Conventional instrumentation	
Good exposure of the bottom side of meniscus	
Top to bottom compression: theoretically better healing	
Feasible for very peripheral tears	

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