Technical Note

Outside-In Single—Lasso Loop Technique for Meniscal Repair: Fast, Economic, and Reproducible

Jose Maria Silberberg Muiño, M.D., Ph.D., Alessandro Nilo Fulvi, M.D., Martin Gimenez, M.D., and Jose Ramon Muina Rullan, M.D.

Abstract: The current understanding of the biomechanical role of the meniscus, in conjunction with the increasing efforts to achieve its preservation within the orthopaedic community during treatment of meniscal lesions, has prompted the development of different meniscal repair techniques. The outside-in technique is recommended for anterior horn and middle-segment meniscal tears and has been recognized as a low-cost procedure with a low incidence of complications. Diverse modifications of this technique have been published over the past decade. On the basis of these previous outside-in technique modifications and aiming to simplify and reduce the number of surgical steps, as well as simplify suture and/or instrument manipulation, during this technique, we describe the single—lasso loop outside-in technique for meniscal repair. We believe this modified technique represents a simplified, economic, and highly reproducible procedure option whenever an outside-in technique for meniscal repair is considered.

Meniscal repair techniques have been evolving over recent decades as meniscal preservation efforts continue to increase within the orthopaedic community. Although reoperation rates are higher when the meniscus is repaired, improved long-term outcomes, higher activity levels, and slower progression to osteoarthritis have also been reported with meniscal preservation.[1] Therefore, meniscal repair is indicated whenever possible.

Most commercial surgical implants for meniscal repair represent a high-cost impact to health care systems. We present an economic, fast, and reproducible technique for meniscal repair that does not require specific arthroscopic instrumentation and that reduces the number of surgical steps and avoids suture manipulation through arthroscopic portals.

Surgical Technique

For each meniscal repair suture, 3 basic materials are required: a 14-gauge × 2-inch needle preloaded with nonabsorbable No. 1 polydioxanone (PDS) as a loop placed in the needle tip, a 16-gauge × 2-inch needle

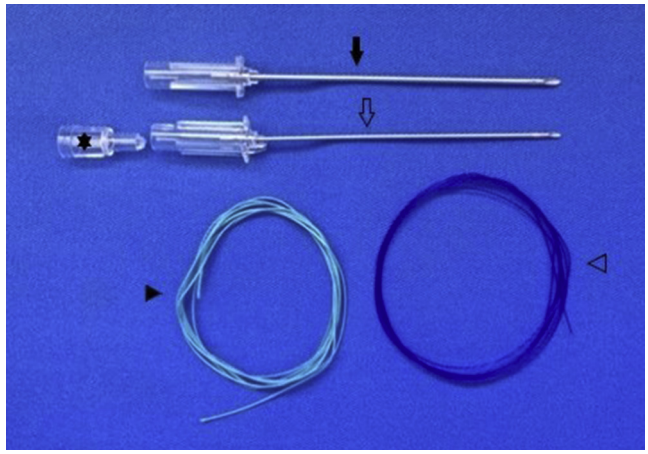

Fig 1. Required material: 14-gauge × 2-inch needle (black arrow) preloaded with nonabsorbable No. 1 polydioxanone (PDS) (open arrowhead) as loop placed in needle tip, 16-gauge × 2-inch needle (open arrow) preloaded with nonabsorbable No. 1 PDS, absorbable No. 1 threaded suture (black arrowhead) (Vicryl), and needle plug (asterisk).

From Clinica Universidad de Navarra, Hospital Clinica Universitaria de Navarra (J.M.S.M.), Madrid, Spain; Centro Articular Mano Codo Hombro, Doctors Hospital No. 923 (A.N.F.), Monterrey, Mexico; Hospital Delicia Concepción Masvernat (M.G.), Concordia, Argentina; and Hospital Universitario de Torrejón (J.R.M.R.), Torrejón de Ardoz, Spain.

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Address correspondence to Alessandro Nilo Fulvi, M.D., Centro Articular Mano Codo Hombro, Doctors Hospital No. 923, Ecuador No. 2331, Col Balcones de Galerías, Monterrey, Nuevo Leon, Mexico, PC 64620. E-mail: a.nilofulvi@gmail.com

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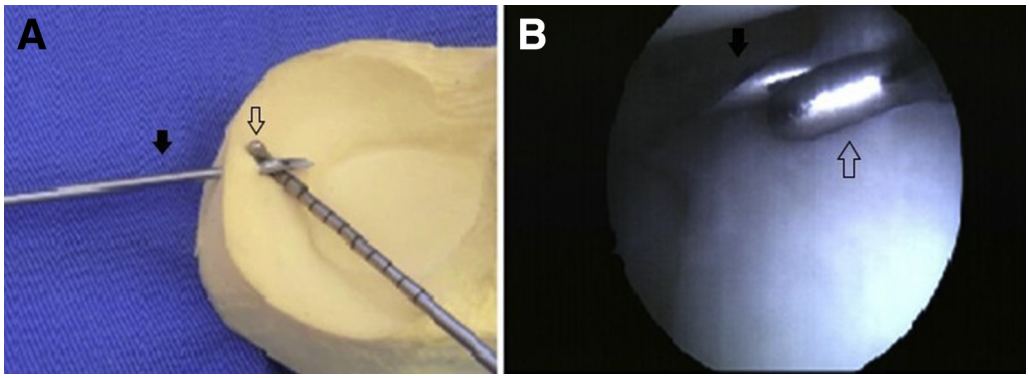

Fig 2. (A) Anatomic model. (B) Arthroscopic view of middle segment of medial meniscus from anterolateral portal in left knee. The first preloaded needle (14-gauge × 2-inch needle) (black arrows) with the lasso loop is passed through the peripheral border of the meniscal tear. The arthroscopic hook is used for tear reduction and/or manipulation of the meniscus during its penetration (open arrows).

preloaded with nonabsorbable No. 1 PDS, and an absorbable No. 1 threaded suture (Vicryl; Ethicon, Somerville, NJ) (Fig 1). Standard knee arthroscopy portals are established, and complete articular inspection and meniscal tear evaluation are performed. The first preloaded needle (14-gauge × 2-inch needle) with the "lasso" loop is passed through the peripheral border of the meniscal tear (Fig 2). During this step, attention must be paid to the placement of the lasso loop just before the needle tip and fixation of the needle plug to prevent the suture from folding and sliding during capsulomeniscal penetration. Once satisfactory peripheral meniscal placement of the first preloaded needle with the loop is obtained, the second needle can be placed. The second preloaded needle, a 16-gauge × 2-inch needle, with simple suture is passed through the other meniscal tear fragment (longitudinal horizontal tear) or through both sides of the fragment (longitudinal vertical tear) (Fig 3).

Once both needles are satisfactorily placed, the preloaded lasso loop suture is unloaded inside the joint (Fig 4). Then, the needles are oriented toward each other to insert the needle preloaded with the single suture into the loop (Fig 5). Once this step is achieved—unloading the single suture into the lasso loop, followed by pulling the loop—the single suture will be retrieved on the outside of the joint (Figs 6-8).

At this point, the No. 1 PDS suture will serve as a transporting suture through the meniscal tear (Fig 9). The No. 1 threaded absorbable suture can be transported by a simple knot, followed by pulling the transporting suture. We recommend arthroscopic visualization and manipulation of the suture with an arthroscopic hook during this maneuver to avoid additional damage to the meniscal tissue as the final suture passes through (Figs 10 and 11).

Finally, a 5-mm incision between both ends of the suture is performed in the skin. The sutures are retrieved with blunt and blind dissection using mosquito forceps to avoid capsular damage or subcutaneous nerve entrapment. A sliding or nonsliding knot is tied against the capsule, and the stability of the suture is addressed with the arthroscopic hook. More sutures can be placed as needed (Fig 12). Further technical details

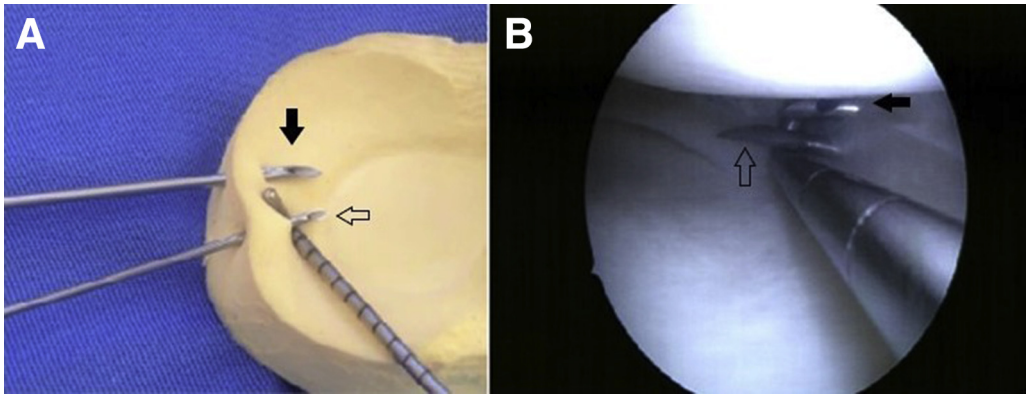

Fig 3. (A) Anatomic model. (B) Arthroscopic view of middle segment of medial meniscus from anterolateral portal in left knee. The second preloaded needle (16-gauge × 2-inch needle) with the simple suture is passed through the meniscal tear fragment (open arrows). The lasso loop preloaded needle (black arrows) has not been unloaded.

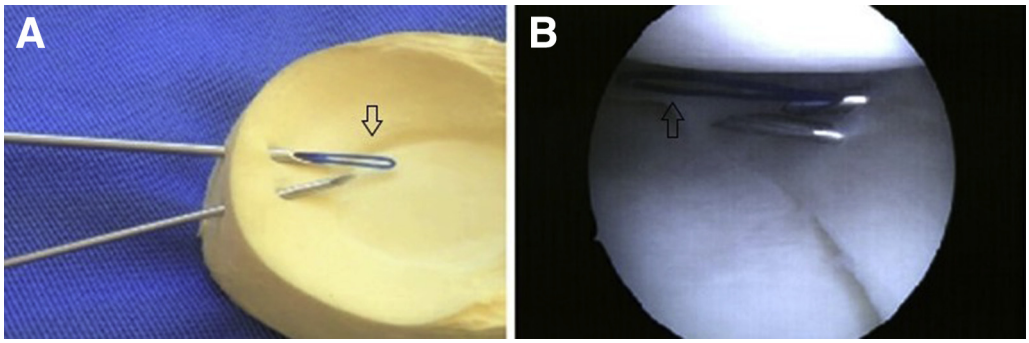

Fig 4. (A) Anatomic model. (B) Arthroscopic view of medial meniscus from anterolateral portal in left knee. Once both needles have been satisfactorily placed, the preloaded lasso loop suture is unloaded inside the joint (arrows).

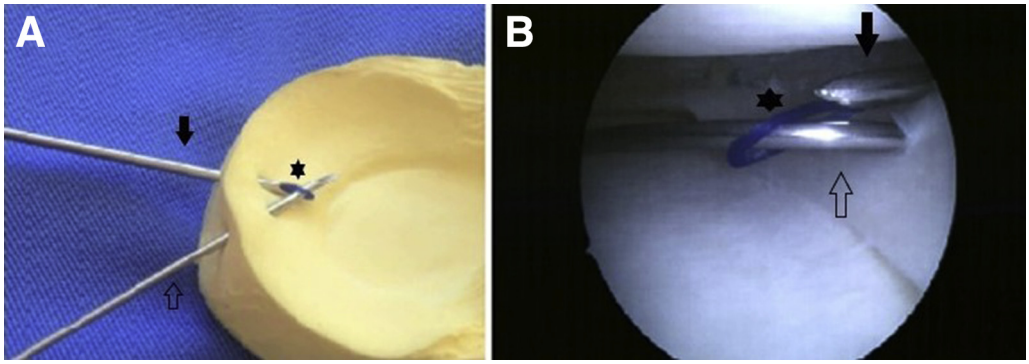

Fig 5. (A) Anatomic model. (B) Arthroscopic view of medial meniscus from anterolateral portal view in left knee. The needles are oriented toward each other to insert the single preloaded suture needle into the loop (asterisks). The open arrows indicate the single-suture preloaded needle, and the black arrows indicate the lasso loop suture preloaded needle.

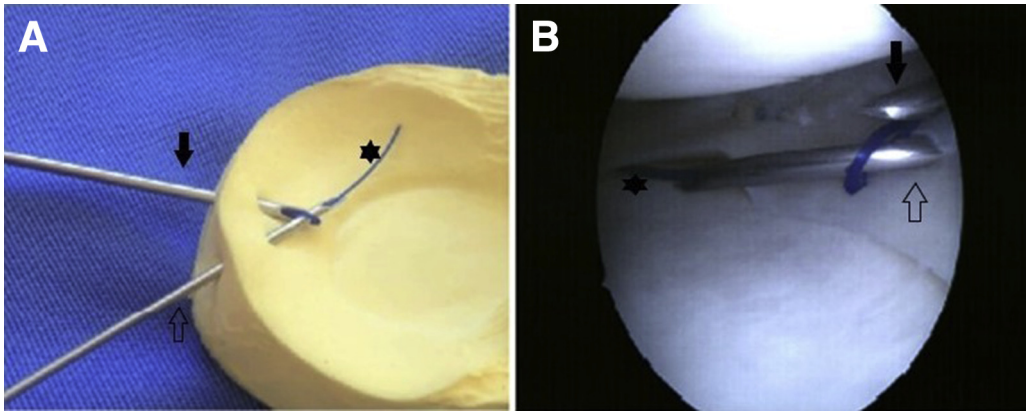

Fig 6. (A) Anatomic model. (B) Arthroscopic view of medial meniscus from anterolateral portal view in left knee. Unloading of the preloaded single-suture needle (asterisks) is performed once it has been introduced into the lasso loop. The black arrows indicate the lasso loop preloaded needle, and the open arrows indicate the simple suture preloaded needle.

are presented in Video 1. Table 1 shows advantages, disadvantages, and limitations; Table 2 presents pearls; and Table 3 shows pitfalls and risks.

Discussion

The described technique is a modification of previously published outside-in techniques. Bender et al.[2] in 2002 developed an outside-in double-loop technique for meniscal repair using 2 preloaded needles with double-loop suture. Later, in 2014, Thompson et al.[3] described a similar outside-in double-loop technique for repair of anterior horn tears, modifying the configuration of the suture passage in the needles and suture retrieval through portals. In addition, Cho[4] in the same year published a similar outside-in technique using 2 single-suture preloaded needles for repairs of

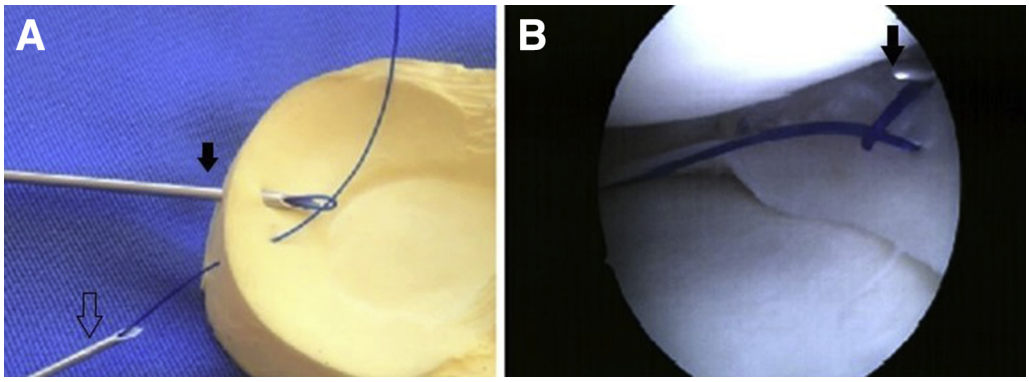

Fig 7. (A) Anatomic model. (B) Arthroscopic view of medial meniscus from anterolateral portal view in left knee. The single-suture preloaded needle (open arrow) is pulled out while the suture remains inside the lasso loop. The black arrows indicate the lasso loop preloaded needle.

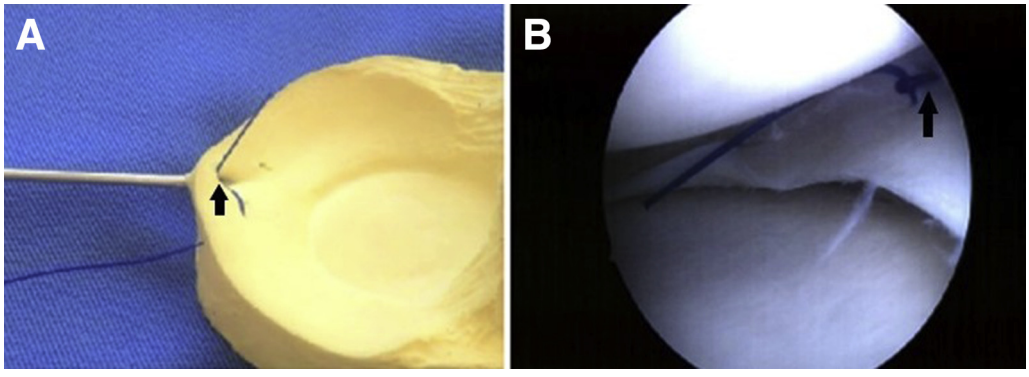

Fig 8. (A) Anatomic model. (B) Arthroscopic view of medial meniscus from anterolateral portal in left knee. Pulling the preloaded needle with the loop (arrows) will retrieve the single suture out of the joint.

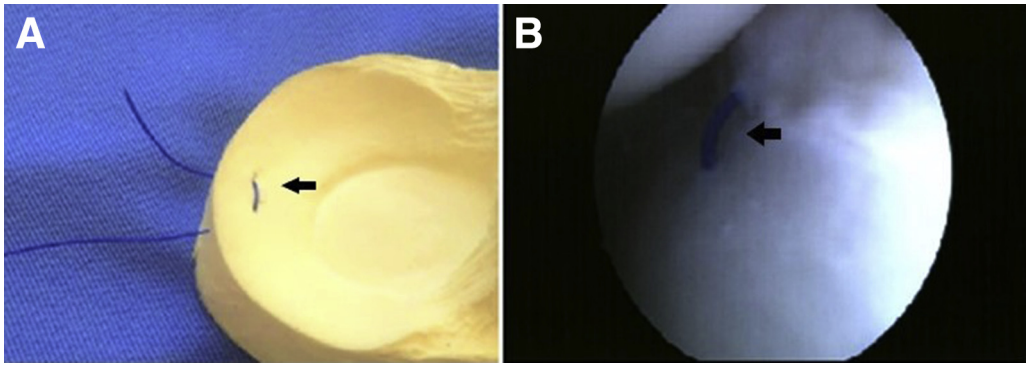

Fig 9. (A) Anatomic model. (B) Arthroscopic view of medial meniscus from anterolateral portal in left knee. Final view of nonabsorbable No. 1 polydioxanone suture through meniscal tear (arrows). This suture will serve as a transporting suture through the meniscal tear.

middle-segment, posteromedial or posterolateral meniscal corner injuries. More recently, another outside-in repair technique for anterior horn tears, using an anterior incision for joint capsular exposure and a special spinal needle outside-in repair kit, was published by Menge et al.[5]

We believe our modified outside-in technique represents a simpler and faster procedure than techniques previously published for the treatment of tears located in the anterior two-thirds of the meniscus. The first valuable advantage of this outside-in technique is that it can be performed in the absence of specific meniscal repair implants and devices; all necessary material can be found in conventional operating rooms.

To our knowledge, all previously published outside-in techniques involved extra-articular suture manipulation and/or introduction of arthroscopic devices through portals.[1-6] During suture retrieval through portals,

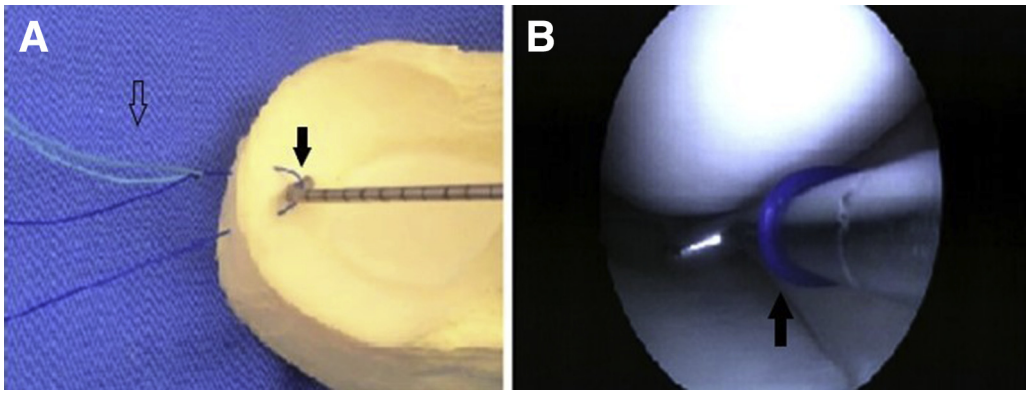

Fig 10. (A) Anatomic model. (B) Arthroscopic view of medial meniscus from anterolateral portal in left knee. Traction of the transporting suture away from the meniscus (black arrows) during suture replacement will protect against meniscal tearing. No. 1 threaded absorbable suture can be transported by a simple knot (open arrow).

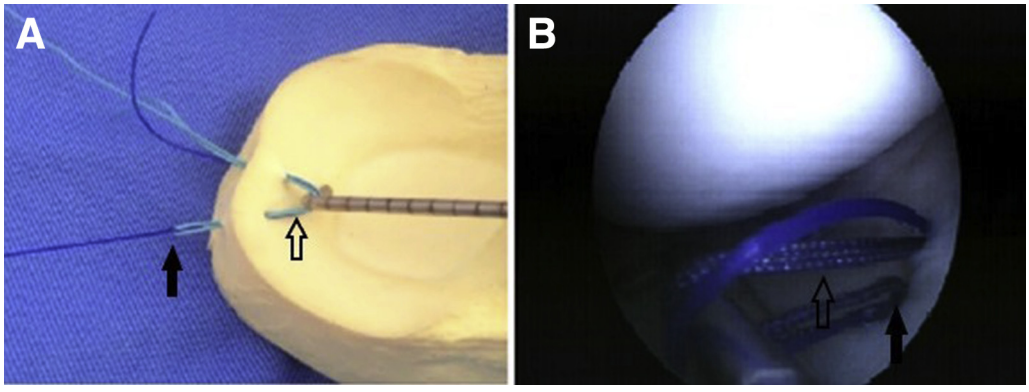

Fig 11. (A) Anatomic model. (B) Arthroscopic view of medial meniscus from anterolateral portal in left knee. Pulling the transporting suture (black arrows) will finally replace the definitive repair with the nonabsorbable suture (open arrows).

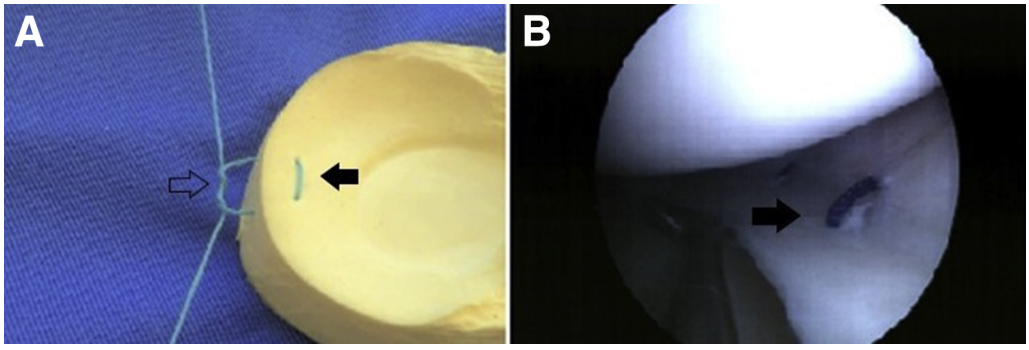

Fig 12. Final meniscal suture repair. (A) A sliding or nonsliding knot is tightened against the capsule (arrows). (B) Arthroscopic visualization during final tensioning and knot tightening of middle segment of medial meniscus (arrow) from anterolateral portal view in left knee.

entrapment in the Hoffa fat pad is frequently seen, which makes placement of arthroscopic cannulas necessary. Furthermore, the use of arthroscopic instrumentation during suture retrieval increases the risk of chondral damage. The single—lasso loop technique avoids extra-articular suture retrieval through arthroscopic portals, resulting in fewer surgical steps and a decreased risk of chondral lesions by arthroscopic instrumentation, and renders the use of cannulas unnecessary.

Regarding repair configuration, both vertical and horizontal sutures can be achieved with this technique. We recommend the vertical configuration whenever possible because of the greater pullout strength properties compared with the horizontal suture configuration.[7]

Table 1. Advantages and Disadvantages and/or Limitations

Advantages
The procedure is a very low-cost procedure: No especial instrumentation devices or specific arthroscopic implants are required.
No suture retrieval through arthroscopic portals is required; therefore, the use of cannulas is unnecessary.
There is less risk of chondral iatrogenic damage from using retrieving instrumentation in the femorotibial compartment.
Fewer steps are required: Extra-articular suture retrieval and manipulation are not necessary, reducing the surgical time for each meniscal suture repair.
Vertical and horizontal configurations are possible.
The procedure involves a highly reproducible technique: Technical demand is low, and a short learning curve is required to perform this technique.
Disadvantages and/or limitations
Repairing posterior horn meniscal tears by this method is not recommended because of an increased risk of neurovascular injury.
Additional medial or lateral incisions are required, and local tenderness at the suture knot is possible.

Currently, it is well known that to avoid vascular and nervous structure damage, an outside-in technique is not recommended for posterior horn tears.[4] However, outside-in techniques for repair at other meniscal locations represent a low-cost procedure, with a low incidence of complications and faster execution time.[8]

Some disadvantages and risks should be considered while performing this technique to avoid complications. Multiple needle penetrations of the meniscus when deciding where to place the sutures can lead to iatrogenic meniscal injury, which will compromise the repair site or require meniscectomy. Moreover, chondral lesions can occur with manipulation of the needles during the maneuver in which the single preloaded suture is introduced into the lasso loop. We advocate performing this step at the level of the intercondylar notch if possible. Furthermore, adequate tension during knot tightening over the capsule is crucial for maintaining the stability of the meniscus during the healing process; therefore, care must be taken to perform adequate dissection and knot tightening over the joint capsule. Finally, our technique is not recommended for posterior horn tear repairs because of the increased risk of neurovascular structure injury. Further biomechanical and clinical studies are needed to investigate the comparative benefit between this outside-in technique and other previously published techniques, as well as the long-term outcomes of this technique.

Table 2. Pearls

When loading the single suture and lasso loop, the surgeon should place the suture just before the tip and fix the needle plug to avoid suture sliding during meniscal penetration.
Placing the arthroscopic hook against the meniscus during its penetration is crucial for adequate needle orientation through the meniscus and tear reduction.
Introduction of the needle into the lasso loop becomes simpler and safer if it is performed at the level of the intercondylar notch. This step is fundamental to avoid chondral damage with the needle tip.
Traction of the transporting nonabsorbable suture away from the meniscus during absorbable suture replacement will prevent meniscal tearing.
Arthroscopic visualization during knot tightening will allow assessment of the proper tension of the suture repair.

Table 3. Pitfalls and Risks

Multiple needle penetrations can lead to extended meniscal tissue injury and suture instability or loosening.
The surgeon should avoid a deep incision for suture end retrieval: The incision must involve only the skin during suture retrieval before knot tightening. Sectioning of the sutures is commonly seen when attention is not paid during this step.
The surgeon should make sure dissection has reached the joint capsule to obtain proper knot tightening over the capsule; otherwise, the risk of suture loosening and consequent nonhealing of the meniscus will increase.
Superficial closure of the skin over the knot incision results in local tenderness. The surgeon should ensure that closure of the subcutaneous cellular tissue and closure of the skin are performed separately.

In conclusion, we propose the single—lasso loop outside-in technique as a simplified procedure option whenever outside-in meniscal repair is considered. This modified technique results in fewer surgical steps, uses no cannulas, and avoids suture retrieval or use of devices through arthroscopic portals, which makes it an economic and highly reproducible procedure.

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