

# Outside-in Continuous Meniscal Suture Technique of the Knee



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**Abstract:** The meniscus is largely responsible for the health and longevity of the knee. It has diverse functions, being fundamental in load absorption and distribution and even in joint stability. To preserve meniscal functions and prevent the occurrence of osteoarthritis after meniscectomy, several meniscal repair techniques have been developed. To perform meniscal repair in anterior horn, the outside-in technique is the most used. There are few devices for performing them, with most of the surgical techniques described using needles. Our group uses a device capable of performing meniscal repair in different ways. Our objective is to describe a continuous outside-in meniscal repair technique, especially indicated for anterior horn and meniscus body tears, with the “Meniscus 4-All suture device.” The continuous outside-in meniscal suture technique using this device is easy to perform, inexpensive, fast, and reproducible, minimizing the risk of soft-tissue entrapment. In addition, it allows the surgeon to perform meniscal repair in the posterior horn in extensive injuries with the same repair device, just switching to inside-out technique.

The meniscus is largely responsible for the health and longevity of the knee. It has diverse functions, being fundamental in load absorption and distribution and even in joint stability.<sup>1</sup> Recent studies have shown a decrease in the number of the meniscectomies performed in the United States.<sup>2,3</sup> Meniscectomy was the treatment that prevailed for decades. Despite providing good clinical results in the short term, it showed an

intimate relationship with the development of osteoarthritis in the medium and long term.<sup>4</sup> To preserve meniscal functions and prevent the occurrence of osteoarthritis after meniscectomy, several meniscal repair techniques have been developed.<sup>5</sup>

Many publications have brought innovative techniques for meniscal repair, mainly with the new generations of all-inside and inside-out suture devices, very useful to repair posterior horn and meniscus body tears, but with limited use for anterior horn tears.<sup>6</sup> To perform meniscal repair in anterior horn, the outside-in technique is the most used. There are few devices for performing them, with most of the surgical techniques described using needles.<sup>1,6-8</sup>

Our group uses a device capable of performing meniscal repairs in different ways, such as inside-out (horizontal and vertical), meniscal root repair, and meniscal repair outside-in. The device is called “Meniscus 4-AII.”<sup>9-11</sup> Our objective is to describe a continuous outside-in meniscal repair technique, especially indicated for anterior horn and meniscus body tears.

## Surgical Technique (With Video Illustration)

A detailed demonstration of the surgical procedure is presented in [Video 1](#). The patient is anesthetized with spinal anesthesia and positioned in the prone position. The pneumatic cuff is attached to the thigh root of the

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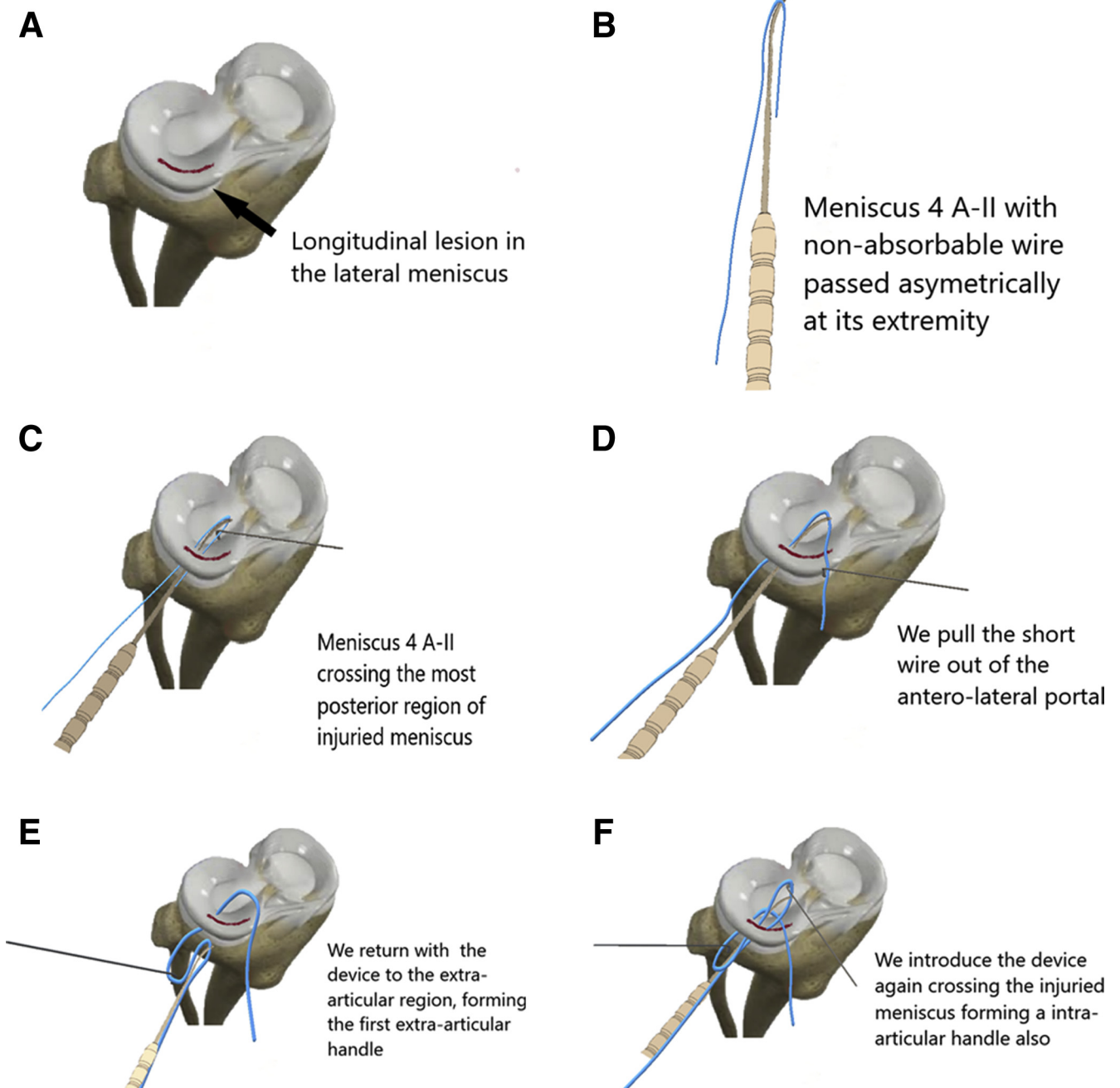
affected limb. The leg holder is positioned on the operating table. Asepsis and antisepsis is performed and surgical drapes are positioned.

We then perform a time-out, checking the patient's name, laterality, medications to be infused (such as venous antibiotics), surgical material to be used, and whether the video material is working correctly so that we can begin the surgical procedure. We perform the anterolateral, anteromedial arthroscopic portals, and the longitudinal transpatellar portal. We then perform joint inventory, identifying the longitudinal lesion in

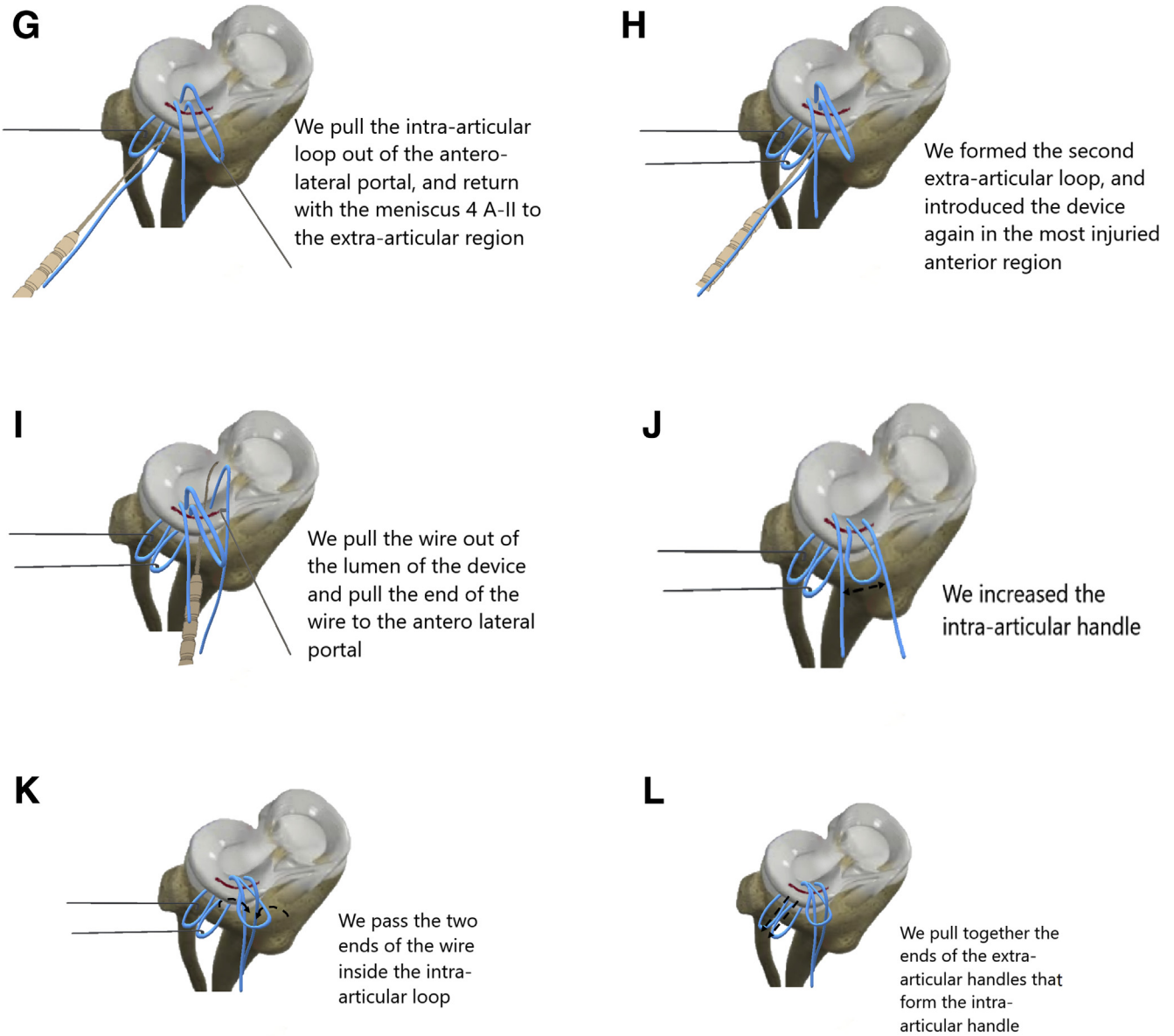
the lateral meniscus in topography of the body and anterior horn (Fig 1A).

We prepared the Meniscus 4 A-II device by passing a 2-0 nonabsorbable suture thread over the end of it, in general using FiberWire (Arthrex, Naples, FL) or ETHIBOND (Ethicon, Somerville, NJ). We leave the suture thread passed asymmetrically so that its smallest end is toward the anterior region of the device (concava region) (Fig 1B).

A surgical approach is performed according to the size of the lesion to be treated. Surgical access is performed



**Fig 1.** (A-P). Anterior horn, lateral meniscus repair, right knee.



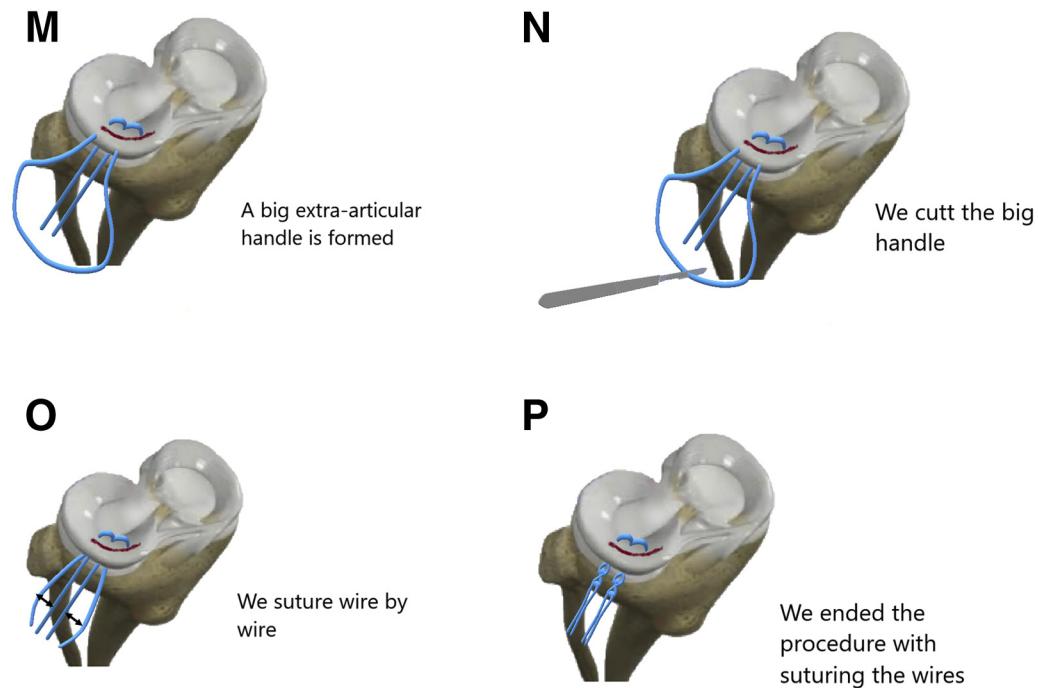
**Fig 1. (continued).**

from proximal to distal, crossing the joint interline in an oblique way. We use the lateral epicondyle as a proximal parameter and the gerdy tubercle as a distal parameter. After making the skin incision, we identify and section the iliotibial tract in the direction of its fibers.

We introduce the arthroscopic camera together with the optics through the anteromedial portal. With the help of transillumination of the optics and palpation of the joint line, we identify the region in which the suture device will pierce the injured meniscus. We position the device in the desired location and introduce it slowly and gradually, crossing the meniscus, reaching the intra-articular region, and crossing the proximal face of the affected lateral meniscus (Fig 1C).

We recommend starting to repair the most posterior region by moving to the anterior. Therefore, the first region through which the Meniscus 4 A-II crosses the meniscus is the region of the meniscal body.

After identifying the device inside the joint, we pull the smallest end of the suture into the joint and pull it out of the anterolateral portal (Fig 1D). With the Meniscus 4 A-II, we move back to the extra-articular region, taking care to hold the end of the thread that is crossing the meniscus with a finger forming a loop with the thread (Fig 1E). We identify the new region through which the device should cross the meniscus, about 5 to 7 mm anterior to the first pass. We introduce the Meniscus 4 A-II and, with the help of 2-finger tweezers (wire puller), we hold a handle inside the joint and pull it out



**Fig 1. (continued).**

of the anterolateral portal (Fig 1F). We return with the meniscal suture device out of the joint again; when returning, we hold with another finger the thread that is passing through the meniscus, this second time forming a new extra-articular loop (Fig 1G). With 2 handles formed outside the joint, we then select the new location for the device to be introduced in the joint, always more anterior than the previously inserted location (Fig 1H). We introduce the device and pull the end of the thread into the joint, removing it from inside the lumen of the suture device (Fig 1I). After this step, we also pull this end of the wire to the anterolateral portal. To prevent soft parts from adhering during the last steps of the

procedure, we pull both ends of the wire and the loop (all previously passed to the anterolateral portal) simultaneously to the transpatellar portal with the 2-finger arthroscopic tweezers.

Therefore, we are left with 2 extra-articular loops located in the lateral surgical approach, and 2 ends of the wire and an intra-articular loop exiting through the transpatellar portal. We introduce the 2 ends of the wire into the intra-articular loop (Fig 1, J and K). We then identify the ends of the 2 extra-articular loops that form the intra-articular loop. After correctly identified, we pull them by transporting the region of the lateral approach to the intra-articular loop bringing with it the

**Table 1.** Advantages, Disadvantages, Risks, and Limitations

Advantages	Disadvantages	Risks	Limitations
Better control of where the device crosses the injured meniscus	Need an anterolateral approach for neurovascular protection	Chondral injury with the tip of the device	A long, nonabsorbable thread is necessary
Lower risk of neurovascular injury	Need to repair each loop of suture stitch	Injury of the lateral collateral ligament during the surgical approach	The device can be deformed at its extremity if it is pressed in an erroneous way. For example, if it is pressed against the tibial plateau or femoral condyle
Two sutures in several planes continuously			Can only be performed with the device Meniscus 4 A-II
Greater agility to the meniscal repair process			
Low cost—a single device allows suturing of the entire meniscus			

2 ends of the wire (Fig 1, L and M). Remaining in the lateral approach region with a large peripheral loop and 2 ends of the wires, we section the large loop in its central (Fig 1N) region and suture it thread by thread (Fig 1O), completing the continuous meniscal suture from outside to inside (Fig 1P).

### Discussion

According to a review article by Dave et al.,<sup>12</sup> the healing rate of the meniscus in most studies found in the literature reporting on the outside-in technique is around 50% to 91%. These variations are correlated with the method used to evaluate the healing, with some studies performing a second arthroscopic look and other studies using clinical scores.<sup>13-15</sup>

In the pioneering study by Morgan and Casscells,<sup>16</sup> the authors found 98% good results in 70 patients who underwent this surgical technique used in the posterior horn of the meniscus. Recently, Joshi et al.<sup>17</sup> described a new surgical technique for outside-in meniscal suture for the treatment of longitudinal lesions of the posterior horn of the medial meniscus. The authors cite as advantages the use of small surgical approach, the good reproducibility of the technique, as well as its low cost with the use of materials commonly found in operating rooms.<sup>17</sup>

However, in the study by van Trommel et al.,<sup>15</sup> the authors found a lower healing rate when the outside-in meniscal suture was performed on the posterior horn, observing in the same study greater healing rates when this type of suture was performed on the body and anterior horn of the meniscus. Other studies also suggest that the best indication for performing the meniscal suture from the outside-in is mainly in the anterior horn and meniscus body.<sup>1,4,18-20</sup>

The performance of meniscal repair in conjunction with the reconstruction of the anterior cruciate ligament proved to be superior in several studies.<sup>14,21</sup> However, some studies show high healing rates of isolated meniscal repair, such as study conducted by Morgan and Casscells.<sup>16</sup> However, we suggest associating microperforations in the intercondyle to stimulate intra-articular intraosseous bleeding, increasing the possibility of meniscal healing, if the meniscus repair is performed isolated.<sup>22,23</sup> The techniques for meniscal injuries repair at the level of the anterior horn basically boil down to the use of preloaded needles with double-loop suture, varying only the way the suture is passed through the needle and how the threads are pulled through the arthroscopic portal.<sup>5</sup>

A limitation of the use of preloaded needles is that the suture is often stuck in soft parts in the arthroscopic portal. The use of continuous suture with the same thread has the advantage of preventing this build-up from occurring, eliminating the use of accessory arthroscopic cannulas. In addition, it is an inexpensive technique because it requires a single suture device, which can even be used from the inside out on the

posterior horn in extensive lesions of the entire meniscus. As with other outside-in repair techniques, there is a risk of iatrogenic chondral and meniscal injury due to penetration of the suture device.<sup>24</sup>

This outside-in surgical technique is limited to injuries to the body and anterior horn of the meniscus, and we recommend not to perform this technique in injuries at the posterior horn due to the risk of neurovascular injury. In this case, it is possible to repair the lesion with the same device, but with an inside-out technique.<sup>9,11</sup>

The advantages, disadvantages, risks, and limitations of the outside-in continuous meniscal suture of the knee are described in Table 1. The continuous outside-in meniscal suture technique using the Meniscus 4 A-II repair device is easy to perform, inexpensive, fast, and reproducible, minimizing the risk of soft-tissue entrapment. In addition, it allows the surgeon to perform meniscal repair in the posterior horn in extensive injuries with the same repair device, just switching to inside-out technique.

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