

# Percutaneous Medial Ligament Reconstruction for Valgus Knee Instability



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**Abstract:** Injuries to stabilizing elements on the medial side of the knee are one of the most common knee ailments. Because of the good healing capacity of these structures, acute injuries are typically treated conservatively. However, valgus laxity near full extension can persist in some patients. This laxity may be the source of instability due to medial joint space opening, which then requires surgical treatment. Various procedures have been described that aim to reproduce the anatomy of the medial collateral ligament (MCL) and the posterior oblique ligament (POL), which work together to stabilize the medial aspect of the knee. However, these are complex open surgical procedures, technically demanding to achieve the favorable isometry, which prevent joint contracture or recurrence of laxity. The purpose of this study was to describe a short construct that minimizes the risk of secondary loss of tension and complies with the principle of favorable anisometry. The graft is positioned in the joint opening axis, between the deep bundle of the MCL and the POL.

Chronic injuries to the knee's medial ligament structures can cause valgus laxity and increased tibial rotation.<sup>1</sup> To the patient, this instability feels like excessive tibiofemoral separation in the frontal plane when the knee is near full extension during weight-bearing activities (walking, running). This laxity can also contribute to cartilage degeneration in the medial compartment over the long term.<sup>2</sup> When these injuries negatively impact function, or there is more than a 10-mm medial joint opening compared with the opposite knee on radiographs with valgus stress testing at 20° knee flexion (grade III injury), surgical treatment is indicated.<sup>3</sup> In 75% of these cases, the anterior cruciate ligament (ACL) is also torn.<sup>4</sup>

The anatomical structures involved are the superficial and deep portions of the medial collateral ligament

(MCL), the posterior oblique ligament (POL), and the posteromedial capsule.<sup>1</sup> The injury mechanism consists of valgus stress, which damages different structures, depending on the amount of knee flexion at the time.<sup>5</sup> To correct valgus laxity near full extension, a graft must reproduce the action of the deep portion of the MCL and POL, which are both oriented along the separation axis.

Various surgical techniques have been described to accomplish this. Single-bundle techniques replicate the MCL only, while 2-bundle techniques have either the same femoral attachment for the MCL and POL or 2 separate bundles to mimic the different attachment sites for the MCL and POL.<sup>6,7</sup>

While these reconstruction techniques provide good control over laxity, they are invasive and increase the risk of flexion or extension contracture.<sup>4</sup> This led us to develop a simple, minimally invasive percutaneous technique in which a short construct with appropriate isometry is used to counter valgus laxity near full extension ([Video 1](#)). Our technique is not indicated to correct laxity caused by excessive external tibial rotation, as the superficial portion of the MCL controls this.

## Surgical Technique

### Patient Set-Up

The patient must be positioned so the knee can be flexed 90°, the medial side of the knee is easily

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**Fig 1.** The patient must be positioned for easy access to the medial side of the knee. The contralateral leg is placed in gynecological stirrups.

accessible, and the knee can be mobilized fully. The patient's leg can be left hanging, with stirrups at the thigh or with the foot resting on the table with a lateral support at the thigh (Fig 1)

### Graft Harvesting and Preparation

The graft is harvested from the gracilis tendon using the standard method with a tendon stripper through an anteromedial tibial incision. It is folded in half to make a 2-bundle construct that is 9 to 11 cm long, depending on the patient's size. The 2 ends of its entire length are weaved using nonabsorbable Ethibond no. 1 (Ethicon, Somerville, NJ). The graft diameter is typically 5 to 7 mm (Fig 2). Other autografts can be used such as the semitendinosus tendon, fascia lata slip, partial quadriceps tendon, or even an allograft.

### Skin Landmarks

It is vital to palpate the bone landmarks: on the tibial side, the joint line and anterior and posterior edges of the medial tibial plateau; and on the femur side, the medial epicondyle (Fig 3).

### Positioning and Drilling of the Femoral Tunnel

The femoral tunnel will be located 1 cm proximal and posterior to the most prominent aspect of the medial epicondyle (Fig 1). The guide wire can be positioned free hand (Fig 4A) or using a drill guide (Orthomed, Saint-Jeannet, France; Fig 4B). It takes an anterior and proximal path and emerges over the lateral condyle, at an angle of approximately 45° between the frontal and sagittal planes. The tunnel is drilled at the diameter of 6 mm to a depth of 25 mm.

### Insertion and Fixation of the Graft in the Femoral Tunnel

Once the graft is inserted in the femoral tunnel, its fixation is performed with an absorbable interference screw (Arthrex, Naples, FL) of 6 × 25 mm (Fig 5).



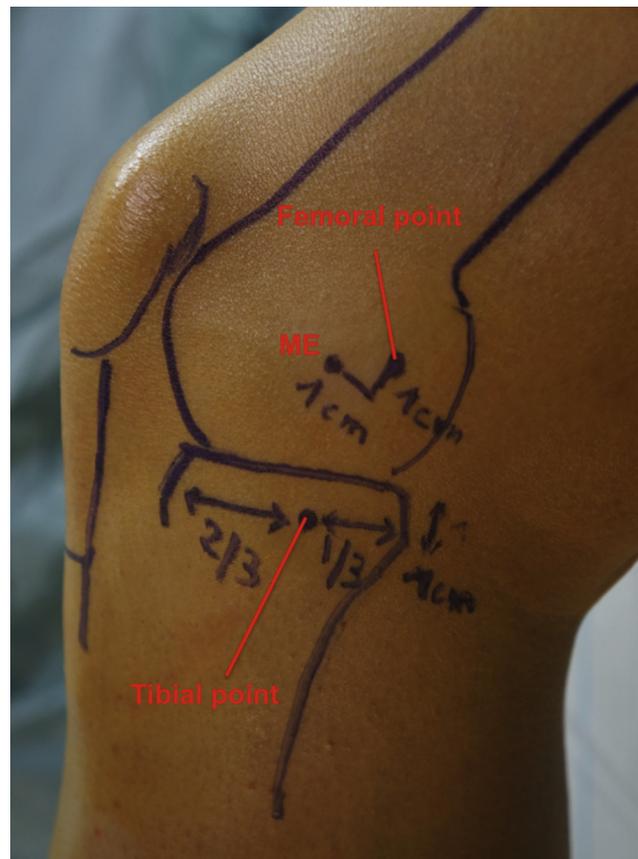
**Fig 2.** The tendon, harvested from the gracilis muscle, is folded in half to make a 9 cm long graft. It is braided over its entire length using 2 nonabsorbable sutures (Ethibond no. 1).

### Positioning and Drilling of the Tibial Tunnel

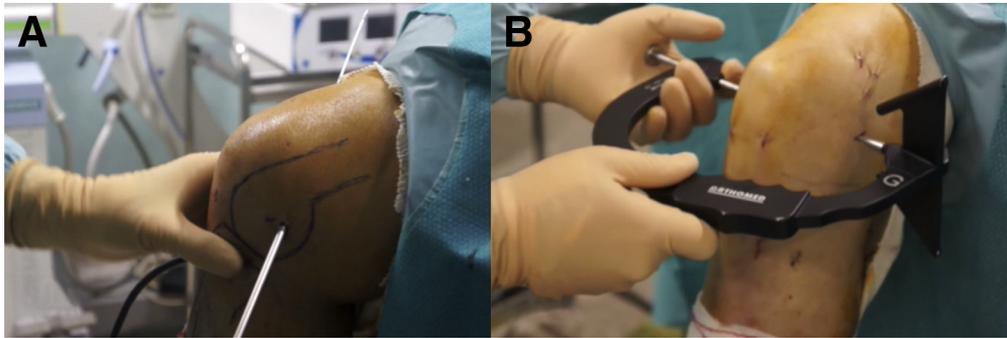
The K-wire is placed 1 cm below the joint line, at a point 1/3 posterior and 2/3 anterior from the medial tibial plateau (Fig 1). It is oriented downward and forward and emerges in front of the fibular head, away from the common fibular nerve (Fig 6). The tunnel is drilled at the diameter of 6 mm, until the drill bit contacts the opposite cortex, to ensure the tunnel is long enough.

### Passing of Graft

The graft is retrieved from the tibial incision through the femoral incision using an alligator grasper and then



**Fig 3.** Drawing the bone landmarks with a skin marker pinpoints the medial epicondyle (ME) and the point 1/3 posterior and 2/3 anterior on the medial tibial margin.



**Fig 4.** Patient right knee, supine position, knee positioned at 90°. The femoral tunnel is made through a small skin incision over the selected point, 1 cm posterior and 1 cm proximal to the medial epicondyle (A). The guide wire is angled proximally 45° to the frontal plane and forward 45° to the sagittal plane. The K-wire can also be inserted using a drill guide (Orthomed) resting on the epicondyles (B).

passed between the ligament layer and the subcutaneous layer (Fig 7).

#### Control of Isometry

The graft isometry is verified by pulling on the braided sutures while moving the knee through its full range of motion (Fig 8).

#### Insertion and Fixation of the Graft in the Tibial Tunnel

The graft is then introduced in the tibial tunnel. Pulling on the braided sutures while moving the knee

through its full range of motion helps to ensure valgus laxity has been neutralized when traction is placed on the graft near full extension (Fig 9). Fixation is performed with an absorbable interference screw (Arthrex, Naples, FL) of 7 × 30 mm, with the knee flexed 10° and in neutral rotation (Fig 10).

#### Postoperative Care

Immediately postoperative, passive mobilization through the full range of motion with the aid of a physical therapist and isometric quadriceps contractions are allowed. A 20° flexion splint is used day and night for the first 3 weeks, with touch-down weight bearing for 2 weeks and gradual return to full weight bearing within 1 month. Between postoperative weeks 4 and 6, the emphasis is on muscle strengthening while avoiding placing valgus stress on the knee. From week 7 to week



**Fig 5.** Patient right knee, supine position, knee positioned at 90°. Once a 25 mm long, blind femoral tunnel has been drilled using a drill bit of 6 mm, the traction sutures on the construct are inserted in the tunnel, the K-wire is set into place, and the graft itself is inserted. It is secured with a 20-mm long absorbable interference screw (Arthrex) of 6 mm or the same diameter as the tunnel.



**Fig 6.** Patient right knee, supine position, knee positioned at 90°, front view. After making a small skin incision, the guide wire is inserted horizontally in the frontal plane and angled 30° downward.



**Fig 7.** Patient right knee, supine position, knee positioned at 90°. The graft is retrieved through the tibial insertion using an alligator grasper inserted between the superficial MCL layer and the deep subcutaneous layer.

12, in-line sports are allowed. Participation in pivot sports is allowed at 4 months postoperative.

### Discussion

Current medial knee reconstruction procedures aim to copy its anatomy in order to reproduce its function.<sup>6</sup> This goal is difficult to achieve because this part of the knee has complex flat structures with wide attachment points, while the grafts typically used are tubular in shape with narrow attachments.

The technique described here is inspired by anatomy but driven by isometry. The aim is to correct the valgus laxity without altering flexion-extension or rotation, which is more significant in flexion than extension.<sup>8</sup> To accomplish this, the graft must be taut during extension but slack during flexion. This can be achieved only by placing the femoral attachment above and behind the medial epicondyle<sup>9</sup> (Fig 11).



**Fig 8.** Patient right knee, supine position, knee positioned in extension. The isometry can be verified by checking the position of the graft relative to the K-wire when the knee is flexed and extended fully.



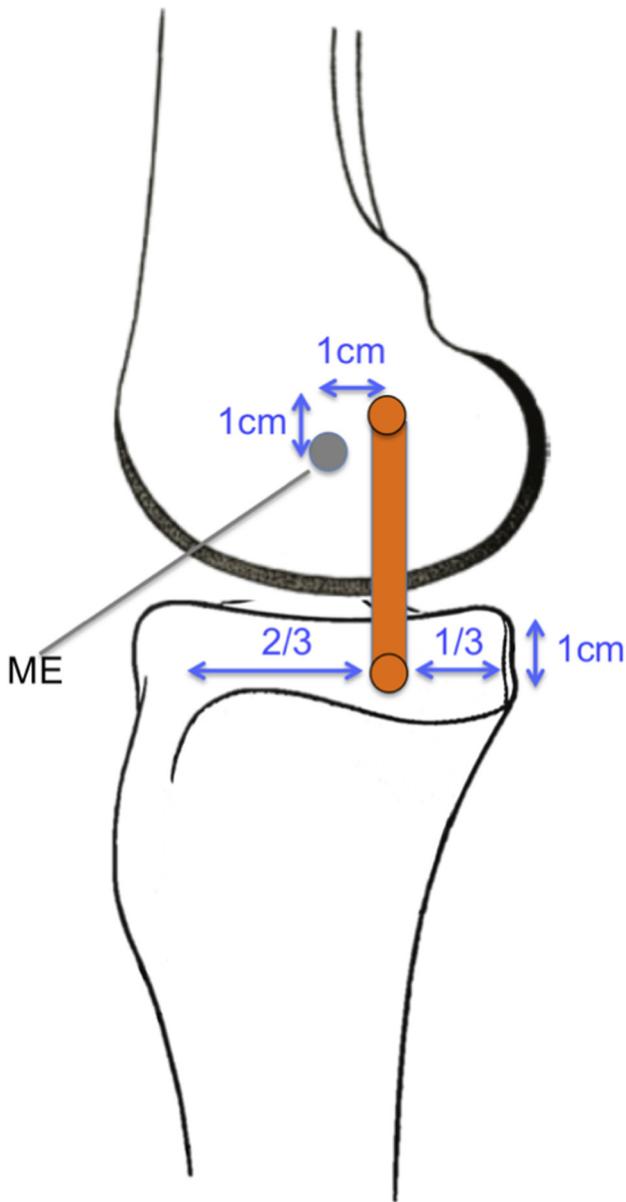
**Fig 9.** Patient right knee, supine position, knee positioned in extension. Once the traction sutures, K-wire and graft have been successively introduced into the tibial tunnel using small forceps, we can confirm isometry and ensure that no valgus laxity remains by pulling the traction sutures taut.

The fixation point on the tibia is placed 1 cm from the edge of the tibial plateau at a point 1/3 posterior and 2/3 anterior of the medial edge of this plateau (Fig 11). This “high” fixation provides better isometry by being closer to the knee’s center of rotation.<sup>10</sup> This short construct also reduces the risk of secondary loss of tension due to the Bengy effect. In the anteroposterior direction, the graft is positioned in the axis controlling the valgus separation. As a result, the graft is positioned between the deep MCL and the POL (Fig 12).

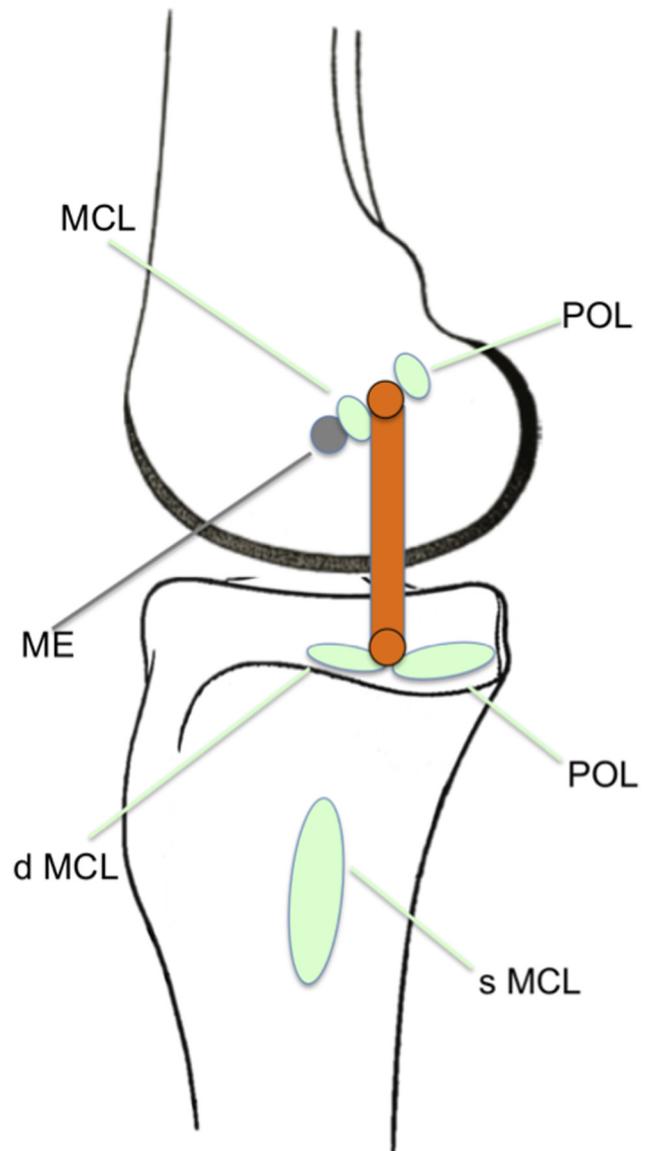
This percutaneous reconstruction procedure is easy to carry out and minimally invasive since the subcutaneous layers are not dissected. The short nature of the graft means that a folded gracilis tendon can be used. Consequently, the semitendinosus can be preserved or used for simultaneous ACL reconstruction. Other advantages as well as disadvantages of the technique can be found in Table 1.



**Fig 10.** Patient right knee, supine position, knee positioned in slight flexion. Tibial fixation is carried out using a 30 mm long absorbable interference screw (Arthrex) that is 7 mm or 1 mm larger than the tunnel’s diameter. The knee is nearly fully extended (10° flexion), with neutral rotation.



**Fig 11.** Positioning of the entry points for the femoral and tibial tunnels (graft in orange). At the femur, the entry point is 1 cm proximal and posterior to the medial epicondyle (ME). At the tibia, the entry point is 1 cm below the joint line at the 1/3 posterior and 2/3 anterior junction of the medial tibial plateau.



**Fig 12.** Position of the graft relative to other anatomical structures on the medial side of the knee. This ligament graft (orange) does not reproduce a specific anatomical structure but is located between the deep MCL and the POL. d MCL, tibial attachment of the deep MCL bundle; MCL, medial collateral ligament; ME, medial epicondyle; POL, posterior oblique ligament; s MCL, tibial attachment of the superficial MCL bundle.

**Table 1.** Advantages and Disadvantages of Percutaneous Medial Ligament Reconstruction

Advantages	Disadvantages
Minimally invasive, preserves soft tissues	Locating the femoral tunnel on large knees is challenging.
Favorable anisometry	Cost of interference screws
Fast and easy to perform, reproducible	Tunnels alter the bone stock.
Short construct with low risk of loss of tension	Not indicated when anteromedial rotational instability is also present.

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