Technical Note

Graft Reorientation and Lateral Extra-articular Tenodesis in Revision Surgery for Persistent Rotational Instability of a Verticalized Anterior Cruciate Ligament Graft

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Abstract: Persistent rotational instability after anterior cruciate ligament reconstruction is a relatively common postoperative complication, typically associated with graft verticalization due to improper femoral tunnel placement, especially with classic transtibial femoral tunnel techniques. This article describes a technique designed to reorient a verticalized anterior cruciate ligament graft at its femoral insertion to a more anatomic position in the coronal and sagittal planes, aiming to restore knee stability without the need for a complete revision operation. Additionally, a lateral extra-articular tenodesis with fascia lata is added to reinforce rotational stability.

The location of tunnels to accommodate the graft is a crucial factor during anterior cruciate ligament (ACL) reconstruction. This location will determine the graft orientation in both the coronal and sagittal planes and thus may influence stability control.[1]

Occasionally, patients may continue to experience subjective instability after ACL reconstruction, which can manifest as joint laxity on physical examination, especially during the pivot-shift maneuver.[1,2] In many of these cases, magnetic resonance imaging may reveal ACL graft integrity, but a misalignment of the graft may be observed due to improper tunnel placement of the tibial insertion, femoral insertion, or both insertions. Frequently, this misplacement can result in a verticalization of the graft in both the coronal plane (typically due to improper femoral tunnel placement) and the sagittal plane (more commonly caused by a posteriorly positioned tibial tunnel, although femoral tunnel placement can also contribute).

Treatment options for symptomatic postoperative instability in these cases range from a conservative approach with physical therapy and rehabilitation for low-demand patients to various surgical options, including revision ACL reconstruction[3] or isolated anterolateral extra-articular reinforcement.[4] On the other hand, reinsertion of proximal tears of the ACL has shown good outcomes,[5-7] so this could be helpful during reorientation of the graft.

The purpose of this article is to describe a technique designed to reorient a verticalized ACL graft at its femoral insertion to a more anatomic position in the coronal and sagittal planes, aiming to restore knee stability without the need for a complete revision operation. Additionally, a lateral extra-articular tenodesis (LET) with fascia lata is added to reinforce rotational stability.

Surgical Technique

Patient Positioning

The patient is placed in a supine position under regional anesthesia. A pneumatic tourniquet is applied,

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Received August 1, 2023; accepted October 30, 2023.

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2212-6287/231097
https://doi.org/10.1016/j.eats.2023.10.014

and the affected limb is positioned on a leg holder with the knee flexed at 90°.

Arthroscopic Exploration

A central transtendinous portal is used for visualization, and an anteromedial portal is used for instrumentation. An anterolateral portal may also be used if necessary. The diagnosis of graft verticalization is confirmed through direct visualization, and graft laxity is assessed through palpation (Fig 1). Once all knee compartments have been explored and associated injuries have been assessed, the proximal insertion of the ACL graft is partially released using radiofrequency.

Lemaire Extra-articular Tenodesis Preparation

A 3- to 4-cm incision is made over the lateral femoral condyle, and a strip of fascia lata measuring 10 mm in width with a length that exceeds the lateral epicondyle proximally by 3 cm is harvested, leaving it distally inserted at the Gerdy tubercle. A traction suture is applied using the Krackow technique, and the graft is passed under the lateral collateral ligament (Fig 2).

Tunnel Placement

The center of the anatomic femoral footprint of the native ACL is located. By use of an ACL tibial guide (Stryker Endoscopy, Kalamazoo, MI) through the transtendinous central portal with visualization from the anteromedial portal, a guide pin is inserted at the lateral femoral condyle and exits at the center of the anatomic ACL footprint (Fig 3). An opening angle of 70° to 75° is required for the guide. Once the correct position of the guide pin is confirmed from a central view through the transtendinous portal, a complete femoral tunnel with a diameter of 7 mm is drilled using an outside-in technique.

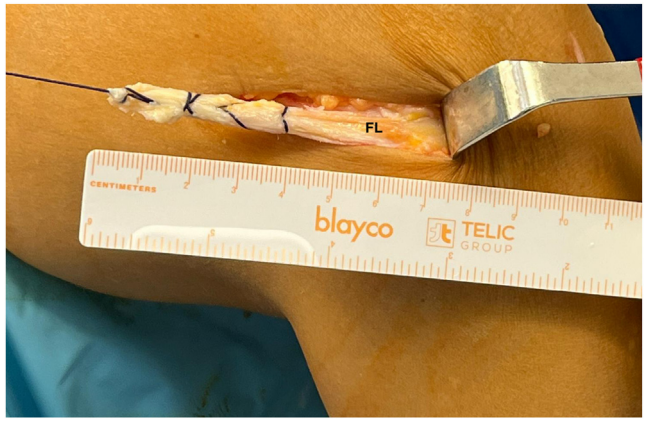

Fig 2. Lateral extra-articular view of right knee. A strip of fascia lata (FL) for anterolateral tenodesis is prepared and measured.

ACL Reorientation

By use of a knee suture passer (Scorpion, 3.2 mm; Arthrex, Naples, FL), 2 stitches of ultra-resistant material (Force Fiber, size 2; Stryker Endoscopy) are placed at the most proximal area of the ACL graft (Fig 4). A loop is created at each stitch for increased fixation (Fig 5), and both sutures are passed through the femoral tunnel in a cranial direction. Traction is applied to the sutures to verify the reorientation of the ACL to its anatomic position (Fig 6).

Femoral Graft Fixation

The traction threads of the LET are passed caudally through the femoral tunnel, retrieved within the joint with the aid of a fingertip pincer, and brought out of the joint through the anterolateral portal. With the knee at 30° of flexion, traction is applied to both sets of sutures (Fig 7)—the ACL threads in a cranial direction through

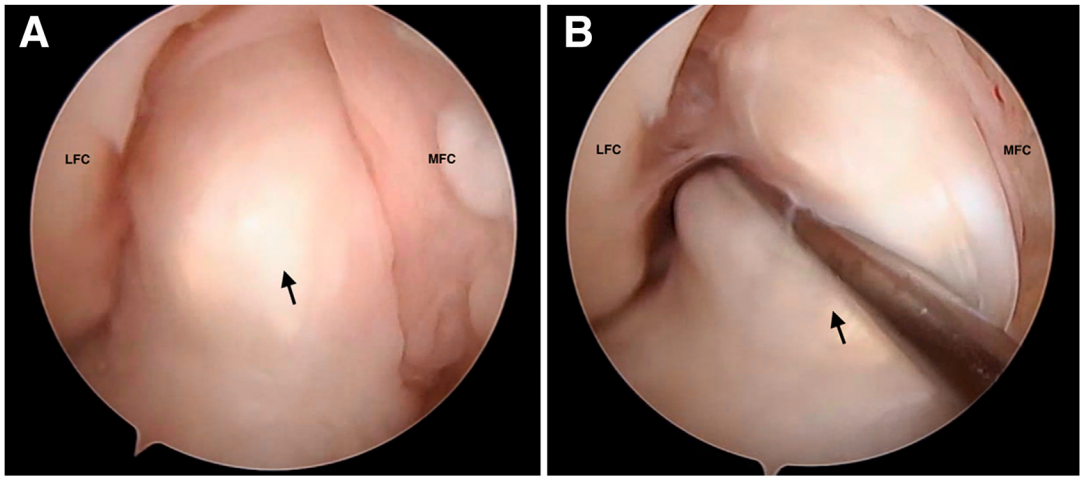

Fig 1. Arthroscopic view of right knee from central portal. (A) The anterior cruciate ligament graft is verticalized (arrow). (B) A probe is used to confirm anterior cruciate ligament graft laxity by palpation. (LFC, lateral femoral condyle; MFC, medial femoral condyle.)

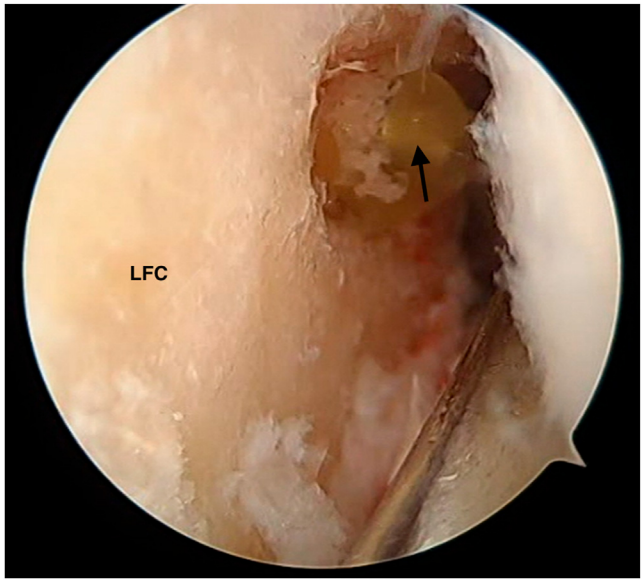

Fig 3. Arthroscopic view of right knee from central portal. Placement of guide pin (arrow) for femoral tunnel drilling. (LFC, lateral femoral condyle.)

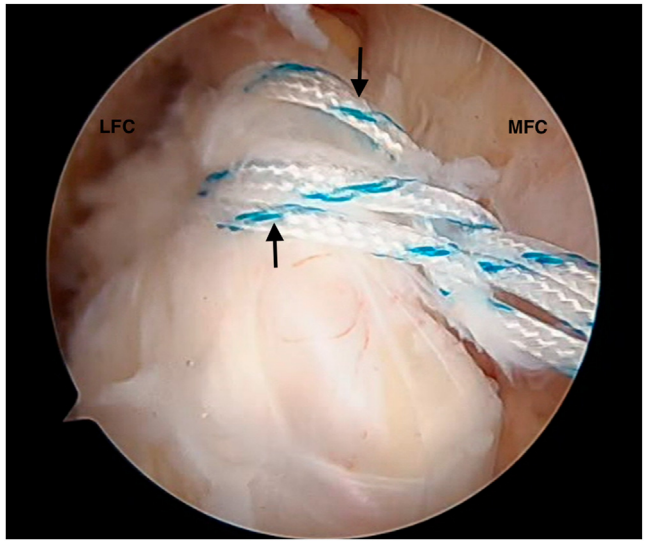

Fig 5. Arthroscopic view of right knee from central portal. Two traction sutures are placed at the proximal part of the graft, forming a loop (arrows). (LFC, lateral femoral condyle; MFC, medial femoral condyle.)

the lateral exit of the femoral tunnel and the anterolateral reinforcement sutures in a caudal direction through the anterolateral portal—and they are fixed together within the femoral tunnel using an 8-mm interference screw (Biosteon; Stryker Endoscopy) (Fig 8). The traction sutures of the ACL are additionally secured with a knotless anchor (ReelX, 4.5 mm; Stryker Endoscopy) inserted 5 mm proximal to the femoral tunnel entry at the lateral condyle (Fig 9). This anchor allows for additional tensioning of the sutures before they are cut.

Finally, the proper tension of the reoriented ACL graft is assessed using a probe, ensuring the absence of impingement. The aforementioned technique is demonstrated in Video 1.

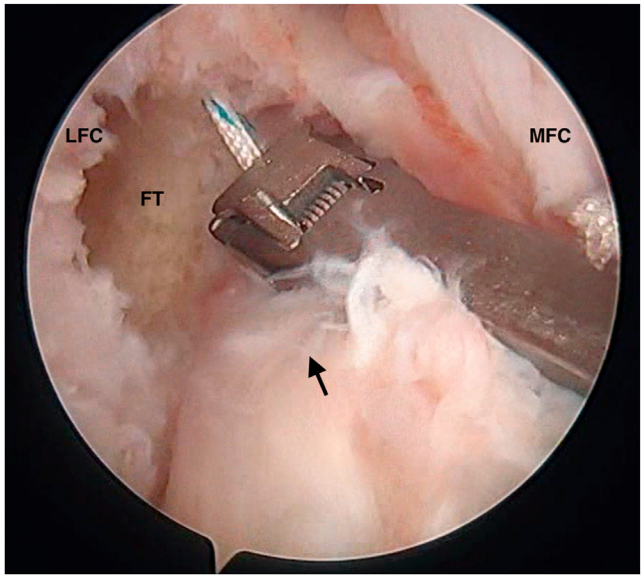

Fig 4. Arthroscopic view of right knee from central portal. Placement of traction sutures at proximal part of anterior cruciate ligament graft (arrow) using knee suture passer (Scorpion, 3.2 mm), introduced through anteromedial portal. (FT, femoral tunnel; LFC, lateral femoral condyle; MFC, medial femoral condyle.)

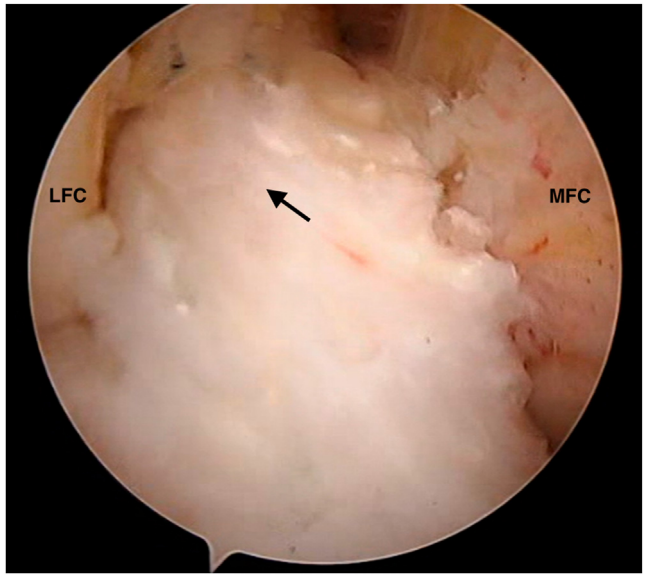

Fig 6. Arthroscopic view of right knee from central portal. Confirmation of graft reorientation (arrow) after traction is applied to sutures. (LFC, lateral femoral condyle; MFC, medial femoral condyle.)

Fig 7. Anterolateral outside view of right knee. The fascia lata traction suture is passed through the femoral tunnel, exiting through the anteromedial portal (arrows).

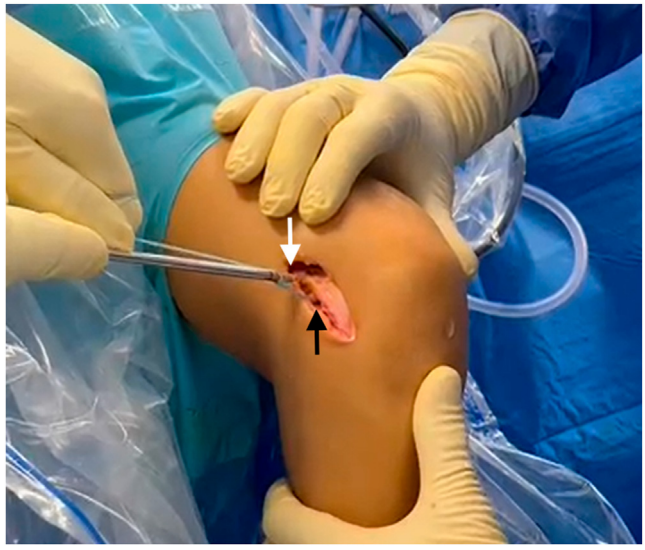

Fig 9. Anterolateral extra-articular view of right knee. Additional fixation of anterior cruciate ligament graft traction sutures with knotless anchor (white arrow), 1 cm proximal to femoral tunnel (black arrow).

Discussion

The described surgical technique shows the possibility of reorienting an intact ACL graft that is malpositioned at the femoral site and partially lax, avoiding the need for complete revision surgery while achieving restoration of both anteroposterior and rotational stability, with the addition of an LET. Persistent rotational instability after ACL reconstruction is a relatively common postoperative complication, typically associated with graft verticalization due to improper femoral tunnel placement, especially with classic transtibial femoral tunnel techniques.[1] Additionally, the anterolateral reinforcement has been shown to play an important role in restoring rotational stability of the knee after ACL reconstruction and ACL repair.[5,6]

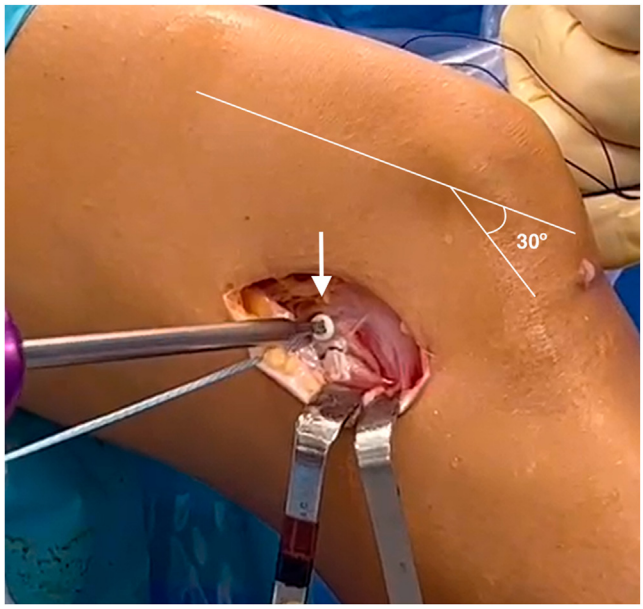

Fig 8. Anterolateral extra-articular view of right knee. Femoral fixation using interference screw (arrow) with knee at 30° of flexion.

Various surgical options have been described to address rotational instability after ACL reconstruction, with the most common being revision ACL reconstruction surgery to properly position the femoral tunnel.[3] However, in many cases, only a femoral misplacement of the ACL graft is found, so complete revision ACL reconstruction surgery would be too aggressive. Our technique provides a less invasive approach to these cases, by placing only 1 tunnel in the femur in which both the LET and the reoriented ACL graft are fixed, avoiding the need for new grafts (Table 1).

In low-demand patients, an isolated extra-articular reinforcement has been proposed to restore rotational stability with a much less invasive surgical procedure than a graft revision.[4] We fully agree with such an approach but believe that reorienting the graft would add further stability to the joint.

The reorientation of the proximal end of the ACL graft in its anatomic position is carried out by reinserting the proximal end of the ACL, which significantly resembles the technique used for repairing an acutely avulsed proximal ACL tear. Recent literature has shown excellent clinical and functional outcomes after ACL repair, provided that patient selection is appropriate.[7-9] Factors that positively influence the outcomes of ACL repair include the duration of the injury (acute tears

Table 1. Tips, Pearls, and Pitfalls

Tips and pearls
The central or transtendinous portal allows for improved visualization of the ACL and its femoral insertion.
Partially releasing the femoral graft insertion and the adhesions allows correct graft reorientation.
The graft sutures should be placed as proximally as possible to have the ability to reorient the graft.
The knotless anchor can provide additional final tensioning for graft reorientation.
Pitfalls
Extreme caution must be exercised during the placement of the femoral tunnel to avoid graft damage.
Accurate localization of the anatomic center of the femoral insertion of the ACL is essential.

ACL, anterior cruciate ligament.

Table 2. Advantages and Disadvantages

Advantages
The technique requires less surgical aggression than complete revision ACL reconstruction.
Morbidity from autograft extraction is avoided.
The use of allograft is avoided.
A single, smaller-caliber bone tunnel is required.
The surgical time is shorter.
Greater rotational stability is achieved than with isolated anterolateral reinforcement.
The technique is technically simple and reproducible.
Disadvantages
The technique is possibly insufficient as an isolated technique in cases of very high functional demand.
Good vascularization, synovialization, and graft size are essential to trust the reorientation. If not, a reinforcement should be added or a different technique should be chosen.

ACL, anterior cruciate ligament.

yield better results),[7,9] the location of the lesion (favorable outcomes are observed in proximal ACL avulsions),[7,9] the vascularization of the ACL (preservation of good synovialization of the avulsed ligament has a positive impact),[10] and the biological environment at the insertion site (better outcomes are achieved when repair is performed in a biologically suitable environment, including bone tunnels, microfractures at the footprint, or the use of platelet-rich plasma or other biological enhancements).[11] Taking into consideration these favorable prognostic factors for ACL repair, it can be inferred that the prognosis for reorientation or reinsertion of a verticalized ACL graft will also be favorable. This is because the ligament retains its complete synovial tissue (thus being well vascularized) and is proximally inserted into a suitable biological environment, in this case, a 7-mm femoral tunnel.

Although our technique is straightforward and reproducible, it is not without the risk of pitfalls (Table 1) and limitations (Table 2). One of the drawbacks of this technique may be that reinsertion of the proximal end of the ACL has been related to higher failure rates in high-demand patients; techniques such as suture augmentation or internal bracing of the ACL, both statically and dynamically, have also shown better clinical outcomes and lower short-term failure rates in some studies,[9,12,13] so adding these procedures could have a positive impact.

Disclosure

The authors report the following potential conflicts of interest or sources of funding: A.E-R. reports that financial support was provided by Stryker Ibérica. A.E-B. reports that financial support was provided by Stryker Ibérica. All other authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

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