Technical Note

Combined Anterior Cruciate Ligament and Anterolateral Ligament Reconstruction Using a Rectus Femoris Graft With Anterior Cruciate Ligament–Adjustable Cortical Suspensory Fixation and Single Femoral Tunnel

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Abstract: Anterior cruciate ligament (ACL) and anterolateral ligament (ALL) injuries frequently coexist and contribute to residual rotational instability after isolated ACL reconstruction. Although several combined reconstruction techniques using hamstring or patellar tendons have been described, they often involve multiple tunnels and complex graft preparation. This Technical Note presents a reproducible technique for combined ACL and ALL reconstruction using a single rectus femoris tendon autograft prepared in GraftLink configuration. The graft is secured with ACL TightRope II suspensory fixation using a single femoral tunnel for both ligaments. This approach offers strong graft integrity, minimizes tunnel convergence, and is applicable in both primary and revision surgeries.

Anterior cruciate ligament (ACL) injuries are frequent and often lead to persistent instability. In patients with high-grade pivot-shift or high athletic demands, isolated ACL reconstruction may fail to restore full rotational control, increasing the risk of graft failure.[1]

To address this, combined ACL and anterolateral ligament (ALL) reconstruction has gained traction, enhancing rotational stability and improving outcomes in high-risk cases. However, conventional techniques, often using hamstring and/or patellar grafts and multiple femoral tunnels, can be technically demanding, risk tunnel convergence, and have complex graft preparation.[2,3]

Single-femoral tunnel techniques simplify the procedure, reduce hardware, and avoid tunnel conflict.[4-7] The rectus femoris tendon offers a viable alternative autograft, with suitable length, diameter, and strength. This Technical Note describes a reproducible technique for combined ACL and ALL reconstruction using a rectus femoris tendon in a GraftLink configuration, with ACL TightRope II fixation and a single femoral tunnel.

Surgical Technique

The complete technique is shown in Video 1, the pearls and pitfalls in Table 1, and advantages and disadvantages in Table 2.

Surgical Indications

The main surgical indications described for combined ACL reconstruction with ALL reconstruction are ACL revision surgery, physical examination with grade 2 or

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Table 1. Pearls and Pitfalls

Pearls	1. Accurate identification of candidates for combined anterior cruciate ligament (ACL) and anterolateral ligament (ALL) reconstruction is essential, especially in young athletes with rotational instability. 2. Imaging examination for surgical planning, especially in revisions. 3. Harvest the rectus femoris tendon with care to preserve the intermediate and deep QT layers. 4. Fold the graft in a triple configuration to allow quadrupling, with one strand separated for ALL. 5. Ensure precise femoral socket positioning to accommodate both ACL graft and ALL strand. 6. Caution during lateral femoral access: Identification of the lateral femoral epicondyle and the Gerdy tubercle is essential (when in doubt, use fluoroscopy). 7. Route the ALL strand subcutaneously beneath the iliotibial band before fixation. 8. Preferably, create the ALL tibial tunnel before the ACL tibial and femoral sockets. 9. Use the TightRope II system to allow independent tensioning and secure suspensory fixation. 10. Begin early postoperative mobilization to avoid stiffness and enhance recovery.
Pitfalls	1. Incorrect positioning of the femoral or tibial tunnels may compromise graft stability. 2. Inadequate dissection may damage underlying quadriceps layers or compromise graft integrity. 3. Failure to isolate a dedicated ALL strand may compromise extra-articular reconstruction. 4. Malpositioning may lead to tunnel conflict or graft impingement. 5. Excessive tension or superficial passage of ALL strand may cause lateral pain or skin irritation. 6. Incomplete seating of the button may lead to graft laxity or failure. 7. Delayed rehabilitation can result in quadriceps inhibition and limited range of motion.

Table 2. Advantages and Disadvantages

Advantages	1. Single femoral tunnel minimizes tunnel convergence and hardware use. 2. Rectus femoris tendon provides sufficient length and strength for a quadrupled graft. 3. Combined anterior cruciate ligament (ACL) and anterolateral ligament (ALL) reconstruction enhances rotational stability, reducing graft re-rupture rates in high-risk patients. 4. GraftLink configuration with TightRope II allows controlled, independent tensioning. 5. Avoids hamstring harvesting, preserving function in cases where hamstrings are weak or previously used.
Disadvantages	1. Technical demand may be higher in preparing and orienting a graft with a dedicated ALL strand. 2. Harvesting rectus femoris requires specific anatomical familiarity and careful dissection. 3. May be technically challenging for surgeons without adequate training in combined reconstruction. 4. Requires specific instrumentation (e.g., TightRope system, FlipCutter) not available in all centers. 5. Limited clinical evidence on long-term outcomes using rectus femoris graft in this specific technique.

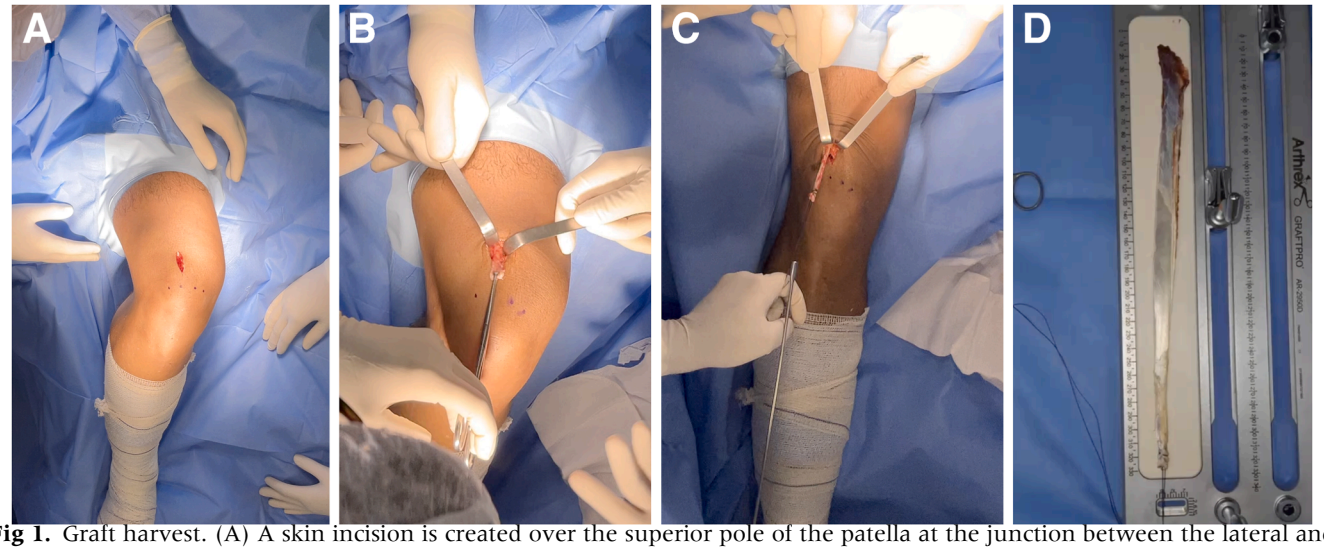

Fig 1. Graft harvest. (A) A skin incision is created over the superior pole of the patella at the junction between the lateral and middle thirds for rectus femoris tendon harvest. (B) A cleavage plane is developed approximately 3 cm proximal to the patella. A 10-mm-wide graft is outlined with 2 parallel incisions in the superficial layer and detached distally from the patella. The free end is whipstitched with nonabsorbable sutures. (C) The dissection is extended proximally for about 8 cm using scissors, preserving the intermediate and deep layers. With the knee flexed at 20°, the graft is harvested using a closed tendon stripper. (D) The harvested rectus femoris tendon is placed on the preparation table. Excess muscle fibers and irregularities are removed. The right knee is shown.

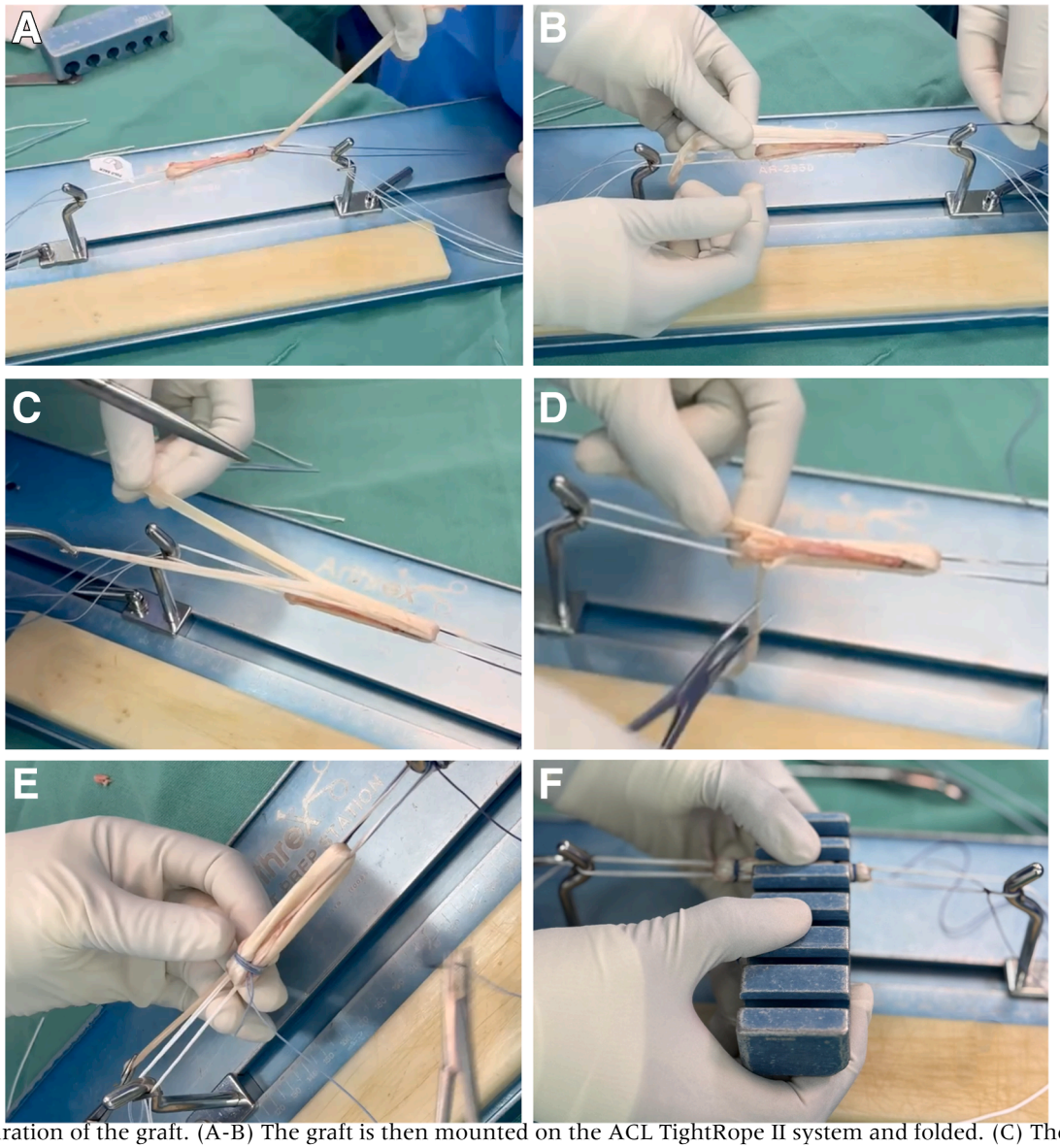

Fig 2. Preparation of the graft. (A-B) The graft is then mounted on the ACL TightRope II system and folded. (C) The outermost layer, formed by the final fold, is longitudinally split to create 2 separate strands. One of these strands will be used for anterolateral ligament (ALL) reconstruction. (D) The other strand is folded over, forming a quadruple graft. (E) The entire construct is reinforced with high-strength sutures to maintain stability and prevent loosening of the layers. (F) Finally, the diameter and length of the graft are measured.

3 pivot shift, participation in sports involving pivoting mechanisms and/or high-level activity, ligamentous laxity, and Segond fracture; secondary indications may also include chronic ACL injury, age younger than 25 years, and radiologic signs of lateral femoral condyle depression.[6]

Necessary Materials for the Procedure

The following materials are required for the procedure: ACL TightRope II (Arthrex, Naples, FL) adjustable suspensory fixation device; 7 × 20- to 25-mm interference screw or a SwiveLock Biocomposite Anchor (Arthrex), used for tibial fixation of the ALL; FlipCutter III (Arthrex), retrograde drilling system for femoral and tibial socket creation; Low-Profile Cannulated Reamer 4.5 mm (Arthrex), for cortical access if needed; RetroConstruction Drill Guide System (Arthrex), with adjustable angulation for accurate femoral socket targeting - femur guide to 92,5°; Arthrex ACL Tibial Guide, adjustable to 55°, for optimal tibial tunnel orientation; drill pins (2.0°mm), compatible with FlipCutter system; closed hamstring

Fig 3. Final appearance of the rectus femoris tendon graft prepared in GraftLink configuration. The graft is quadrupled, mounted on the ACL TightRope II, with the outermost strand isolated for anterolateral ligament (ALL) reconstruction. High-strength sutures are used to reinforce all layers and maintain construct integrity.

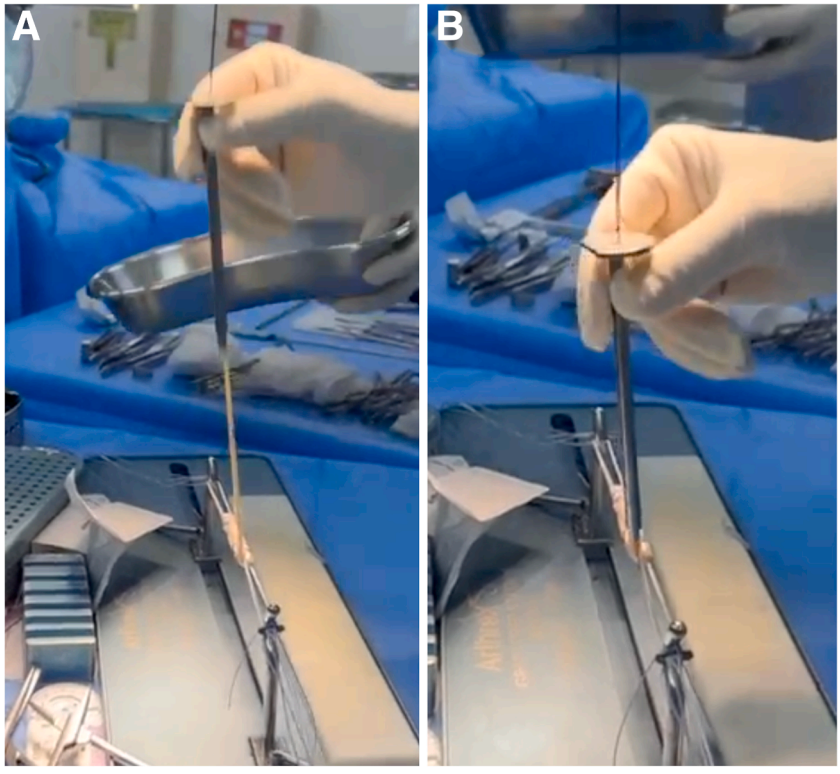

Fig 4. Technical tip. After graft preparation, ensure that the isolated strand for anterolateral ligament reconstruction has a diameter compatible with the FlipCutter guide path. In some cases, an oversized strand may catch at the femoral tunnel exit, impairing smooth passage and positioning.

tendon stripper, suitable for harvesting the rectus femoris tendon; and standard arthroscopy set, including scope, shaver, probe, curettes, cannulas, and grasper instruments.

Graft Harvest

With a padded tourniquet applied to the proximal thigh, a 3-cm longitudinal incision is made at the junction of the lateral and middle thirds of the superior patellar pole (Fig 1A). After dissection, the quadriceps tendon is exposed. The graft is harvested from the lateral portion of the rectus femoris tendon, corresponding to the superficial lamina of the quadriceps tendon.[8]

A cleavage plane is developed approximately 3 cm proximal to the patella. A 10-mm-wide graft is outlined with 2 parallel incisions in the superficial layer and detached distally from the patella (Fig 1B). The free end is whipstitched with nonabsorbable sutures.

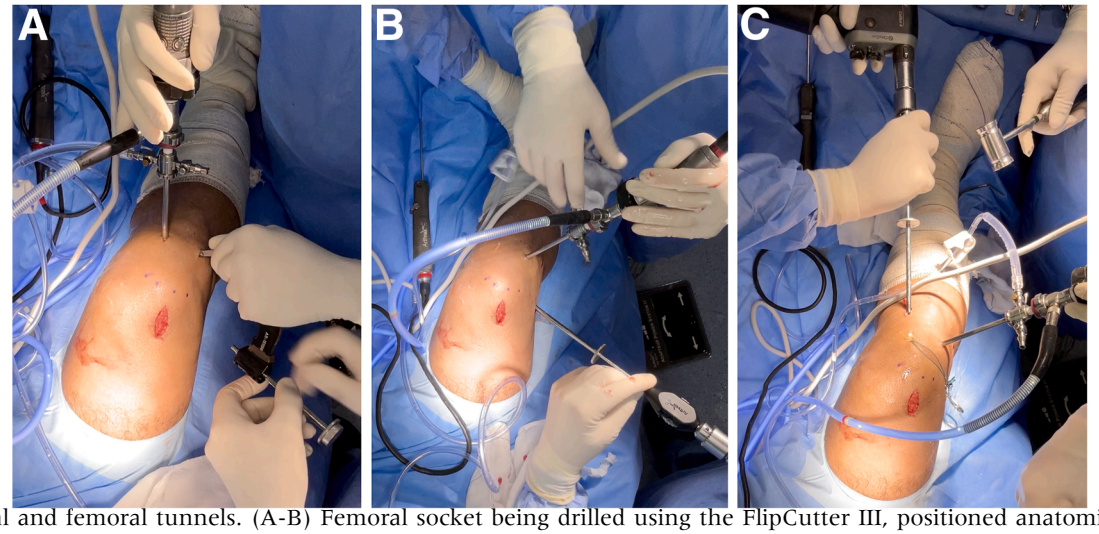

Fig 5. Tibial and femoral tunnels. (A-B) Femoral socket being drilled using the FlipCutter III, positioned anatomically at the native ACL footprint. (C) Tibial socket created with FlipCutter III at the center of the ACL tibial footprint using a 55° tibial guide. The right knee is shown.

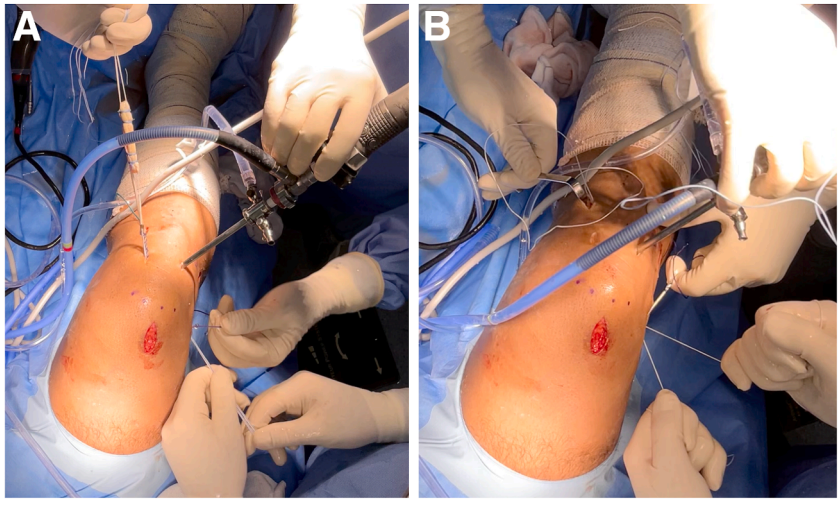

Fig 6. Passage of the rectus femoris graft. (A-B) The quadrupled rectus femoris graft is introduced into the joint through the anteromedial portal. The TightRope traction sutures, the strand designated for anterolateral ligament reconstruction, and the femoral end of the rectus femoris graft are first passed through the femoral socket using a shuttle suture. The TightRope button is flipped and secured over the lateral femoral cortex, without full tensioning at this stage. The right knee is shown.

The dissection is extended proximally for about 8 cm using scissors, preserving the intermediate and deep layers. With the knee flexed at 20°, the graft is harvested using a closed tendon stripper. The wound is closed in layers (Fig 1 C and D).

Preparation of the Graft

The harvested rectus femoris tendon is placed on a sterile preparation table. Any excess muscle fibers, synovial tissue, and irregular edges are carefully removed using Metzenbaum scissors or a scalpel to ensure smooth folding and reduce the risk of graft impingement.

The total usable length of the tendon is measured with a sterile ruler; ideally, it should exceed 24 cm to allow for proper quadrupling and reserve for fixation limbs. The cleaned graft is then mounted on the ACL TightRope II suspensory fixation system. Importantly, the loop of the TightRope is not placed at the midpoint of the tendon but rather at approximately one-quarter of its total length, creating a 1:3 ratio between the short and long limbs. The longer segment will later be folded 3 times to achieve a quadruple-strand configuration.

First, the long limb is folded back on itself twice, creating 3 parallel strands aligned side by side. Then, the shorter limb is folded once, positioned alongside the other strands, forming the final compact and uniformly tensioned bundle.

The outermost layer, formed by the final fold, is longitudinally split with a No. 11 blade or tenotomy

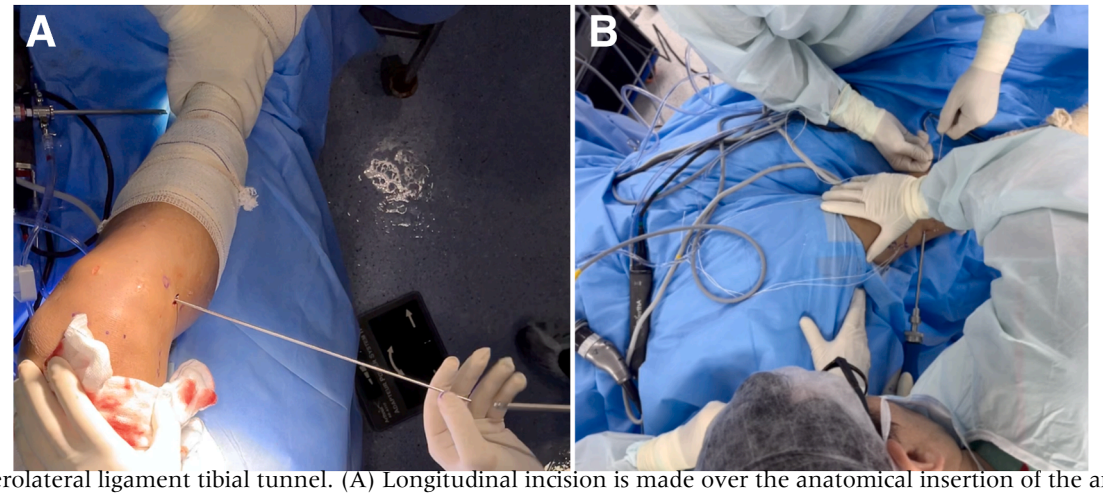

Fig 7. Anterolateral ligament tibial tunnel. (A) Longitudinal incision is made over the anatomical insertion of the anterolateral ligament (ALL), located between the fibular head and the Gerdy tubercle, approximately 5 to 10 mm distal to the lateral joint line. A guide pin is advanced through the tibial insertion of the ALL until the tip is visible near the medial access for graft harvest. A cannulated reamer is used to drill a tunnel over the guide pins. (B) The free strand allocated for the ALL exits through the lateral femoral cortex and is routed subcutaneously beneath the iliotibial tract toward the ALL tibial tunnel. The fixation of the ALL graft is performed with a 7 × 20- to 25-mm interference screw or a SwiveLock anchor for graft fixation.

scissors to create 2 separate strands. One of these strands is designated for ALL reconstruction and must remain isolated from the intra-articular ACL component.

Reinforcement is critical at this stage: the entire construct is sutured with high-strength FiberWire No. 2 (Arthrex). Multiple circumferential and figure-of-eight sutures are applied along the graft body to secure all layers firmly together and prevent elongation or unraveling during tensioning.

The free end of the ALL strand is also whipstitched with at least 4 to 5 locking throws using nonabsorbable suture to facilitate future passage and fixation. Finally, the diameter and length of the graft are measured (Figs 2 and 3).

After graft preparation, ensure that the isolated strand for ALL reconstruction has a diameter compatible with the FlipCutter guide path (Fig 4). In some cases, an oversized strand may catch at the femoral tunnel exit, impairing smooth passage and positioning.

ALL Tibial Tunnel

A 2-cm longitudinal incision is made over the anatomical insertion of the ALL, located between the fibular head and the Gerdy tubercle, approximately 5 to 10 mm distal to the lateral joint line (identified with a needle). This point can be confirmed using anatomical landmarks or fluoroscopic guidance. On imaging, it typically lies about 7 mm below the lateral tibial plateau in the frontal plane and at 50% of its anteroposterior length on the lateral view.[9-11]

A 2-mm guide pin is advanced through the tibial insertion of the ALL. A 4.5-mm cannulated reamer is used to drill a tunnel over the guide pins. After creating this tibial tunnel, we enlarge this tunnel with a 7-mm drill at the tibial origin of the ALL, inserting only 20 to 25 mm. This measurement is due to our smallest interference screw being 7 mm in diameter and 20 to 25 mm in length.

Tibial and Femoral Tunnels

The center of the femoral tunnel is at its native insertion, in the lateral femoral condyle, posterior to the "Resident's Ridge."[12] Extra-articularly, through the lateral femoral access at the topography of the lateral femoral epicondyle, the guide is adjusted so that the center of the tunnel is near the femoral origin of the ALL, posterior and proximal to the lateral femoral epicondyle, about 4 mm and 8 mm, respectively.[9-11]

With the knee flexed to 90°, the femoral socket is created. A 2.0-mm guide pin is inserted using the RetroConstruction Guide, angled at 92.5°, "outside-in." A 25-mm socket is then created using the FlipCutter III, matching the socket diameter (Fig 5).

Next, the tibial socket is created using the ACL tibial guide set at 55°, targeting the center of the native tibial ACL footprint.[12] A 2.0-mm guide pin is advanced, followed by retrograde reaming with the FlipCutter III to a depth of 25 mm (Fig 5). Both sockets are cleaned and calibrated to ensure accurate graft seating and tensioning.

Passage and Fixation of the Rectus Femoris Graft

The quadrupled rectus femoris graft is introduced into the joint through the anteromedial portal. The TightRope traction sutures, the strand designated for

ALL reconstruction, and the femoral end of the rectus femoris graft are first passed through the femoral socket using a shuttle suture. The TightRope button is flipped and secured over the lateral femoral cortex, with direct visualization, without full tensioning at this stage.

Next, the graft is introduced into the joint through the anteromedial portal and guided into the tibial socket under arthroscopic visualization. Progressive tension is applied to the TightRope system while cycling the knee to ensure optimal graft seating in both sockets (Fig 6).

The free strand allocated for the ALL exits through the lateral femoral cortex and is routed subcutaneously beneath the iliotibial tract toward the ALL tibial tunnel. The fixation of the ALL graft is performed with a 7 × 20- to 25-mm interference screw or a SwiveLock anchor for graft fixation (Fig 7). This sequence ensures secure femoral fixation and facilitates smooth intra-articular graft positioning, all while using a single femoral tunnel for both ACL and ALL reconstruction.

Postoperative Protocol

After reconstruction, closure is performed without the use of suction drains or immobilization braces. Unlike other extra-articular procedures, this technique does not require prolonged external support, allowing for immediate mobilization to reduce stiffness and facilitate recovery.

Patients are allowed weight-bearing as tolerated, using crutches for comfort during the initial days. Formal physiotherapy begins at the first postoperative visit (approximately 1 week), with emphasis on early range of motion and quadriceps activation to prevent atrophy. Progressive strength, proprioception, and neuromuscular control exercises are introduced in the following weeks to support functional recovery and return to sport.

Discussion

Combined reconstruction of the ACL and ALL has shown superior outcomes compared with isolated ACL reconstruction. Studies indicate a significant reduction in graft rerupture rates and residual pivot-shift phenomena, enhancing rotational stability and functional recovery, particularly in high-demand athletes.

Using a single femoral tunnel for both ACL and ALL grafts simplifies the surgical procedure, minimizes the risk of tunnel convergence, and reduces hardware usage. This approach maintains anatomical reconstruction while streamlining the technique.

The rectus femoris tendon serves as a viable autograft option, offering sufficient length and diameter for a quadruple-folded graft. Its use preserves hamstring integrity, which is beneficial in revision cases or when hamstring tendons are inadequate. Recent studies have highlighted the rectus femoris tendon as a reproducible and effective graft choice for ACL reconstruction. This technique, combining ACL and ALL reconstruction with a rectus femoris graft and a single femoral tunnel, presents a practical and efficient solution, potentially improving patient outcomes and reducing surgical complexity.

Disclosures

All authors (R.L.d.O., J.L.P.P., L.P.M.d.M.A.F., L.E.C., J.V.d.L.B.A., S.M.d.G.C., D.A.d.L.) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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