

Combined Revision Anterior Cruciate Ligament and Anterolateral Ligament Reconstruction



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Abstract: There has been a substantial increase in the number of revision anterior cruciate ligament (ACL) reconstructions performed in the past decade. This Technical Note describes combined revision ACL and anterolateral ligament reconstruction using outside-in drilling, which avoids the need for 2-stage revision ACL reconstruction because it allows unconstrained anatomic placement.

There has been a substantial increase in the number of primary anterior cruciate ligament (ACL) reconstructions (ACLRs) performed in the United States in the last decade.¹ As a result, the quantity of revision surgical procedures has increased, and there is an accumulative body of literature on revision ACLR (RACLR). Nonetheless, most of the literature has focused on tunnel-related complications such as malposition, containment, widening, or interference, in addition to 2-stage procedures.²

The clinical outcomes of single- and 2-stage RACLRs are comparable; therefore, avoiding the increased morbidity of 2 surgical procedures is beneficial. Outside-in drilling avoids the need for 2-stage RACLR because it allows unconstrained anatomic placement.^{3,4} Conversely, trans-tibial or anteromedial portal techniques are limited and therefore more likely to require 2-stage RACLR.

Additionally, the rates of ACLR combined with a lateral extra-articular procedure (LEAP) have increased as a result of the increasing body of literature on the anterolateral ligament (ALL) and its role in rotational control of the knee.⁵ Indeed, a recent systematic review showed good mid-term results with combined RACLRs and LEAPs.⁶ Furthermore, the addition of an LEAP to an RACLR has been shown to reduce graft failure rates, reduce rotational laxity, and lead to a higher rate of return to the same level of sporting activity when compared with isolated RACLR.^{7,8}

This Technical Note presents combined revision ACL and ALL reconstruction as a single-stage procedure after primary bone–patellar tendon–bone or quadriceps tendon ACLR (Video 1). Pearls and pitfalls of this procedure are described in Table 1, and advantages and disadvantages are presented in Table 2.

Surgical Technique

Patient Positioning

The patient is placed in the supine position on the operating table with a lateral support at the level of a padded tourniquet and a foot roll positioned to maintain 90° of knee flexion. The injured leg is prepared and draped with the surgeon's preferred method, similar to any arthroscopic procedure around the knee. Previous scars and appropriate landmarks are palpated and marked, including the joint line, Gerdy tubercle, head of the fibula, and lateral epicondyle (Fig 1).

Preparation for ALL Reconstruction

Three stab incisions are made in preparation for the ALL reconstruction. The first incision is made at the

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Table 1. Pearls and Pitfalls**Pearls**

- A needle can be used to mark the joint line to ensure accuracy.
- Guidewires can be used prior to reaming the ALL tunnels to ensure correct positioning.
- Use of a circular motion during drilling of the ALL tunnels increases the aperture to facilitate graft passage.
- Beginners should make a large femoral incision to ensure correct positioning and avoidance of the lateral collateral ligament.
- Preoperative planning is necessary to ensure awareness of the previous tunnel position.

Pitfalls

- If an insufficient length of graft is harvested, it may not be enough to ensure an adequate ACL and ALL graft diameter.
- Iatrogenic injury to the lateral collateral ligament is possible.

ACL, anterior cruciate ligament; ALL, anterolateral ligament.

posterior aspect of the Gerdy tubercle, perpendicular and 1 cm distal to the joint line. The second incision is made 2 cm posterior to this, anterior to the head of the fibula. The third incision is made proximal and posterior to the lateral epicondyle (Fig 2).

Two 15-mm sockets are created in the tibial incisions using a 4.5-mm drill. These sockets are connected using an ALL tibial jig (Arthrex, Naples, FL). A suture loop is then passed through the tunnel using a No. 2 suture (Mersilene; Ethicon, Somerville, NJ), which is used to facilitate ALL graft passage later in the procedure (Fig 3).

Graft Harvest and Diagnostic Arthroscopy

The semitendinosus and gracilis tendons are harvested with an open-ended tendon stripper using the surgeon's preferred method. The free end of the gracilis tendon is whipstitched using a No. 0 suture (Mersilene). The tibial insertion is preserved to improve fixation and vascularity.⁹ The tendons are then wrapped in vancomycin-soaked swabs to reduce the risk of septic arthritis.¹⁰

High anterolateral and anteromedial portals are established. A diagnostic arthroscopy is performed, and the previous femoral and tibial tunnels are identified. Meniscal and cartilage lesions are then addressed before the RACLR.

Table 2. Advantages and Disadvantages**Advantages**

- Initially using a 6-mm reamer for the ACL tunnels allows adjustments when using the larger reamer.
- Outside-in drilling is anatomically unconstrained.
- Two-stage RACLR can be avoided.
- The technique is cost-effective.

Disadvantages

- Incorrect placement of the femoral tunnel can potentially result in overconstraint of the knee.
- There is a learning curve because few orthopaedic surgeons perform outside-in drilling.

ACL, anterior cruciate ligament; RACLR, revision anterior cruciate ligament reconstruction.

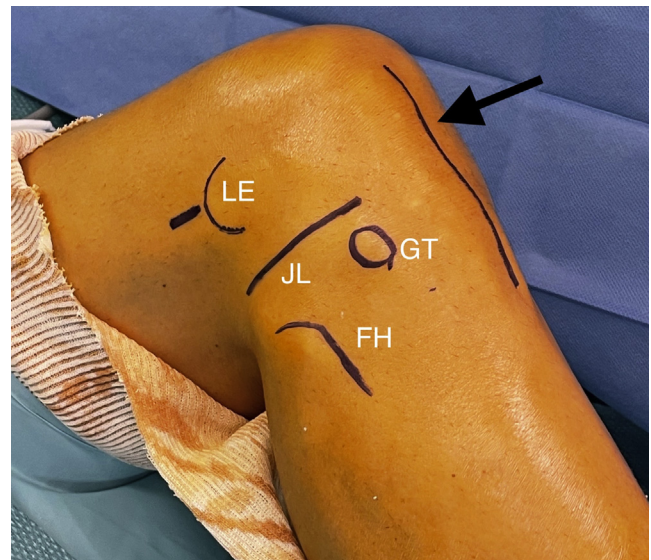


Fig 1. Patient positioning and landmarks. Lateral view of right knee positioned in 90° of knee flexion. The previous scar (black arrow) and landmarks are marked. (FH, head of fibula; GT, Gerdy tubercle; JL, joint line; LE, lateral epicondyle.)

Femoral Tunnel

A femoral outside-in ACL guide (Arthrex) is inserted into the knee via the anteromedial portal. It is positioned at the femoral origin of the ACL in a mid-ant anteromedial bundle position. The bullet of the guide is placed in the previously made incision, proximal and posterior to the lateral epicondyle. A guidewire is introduced, followed by a 6-mm reamer, to allow any adjustments when the appropriately sized

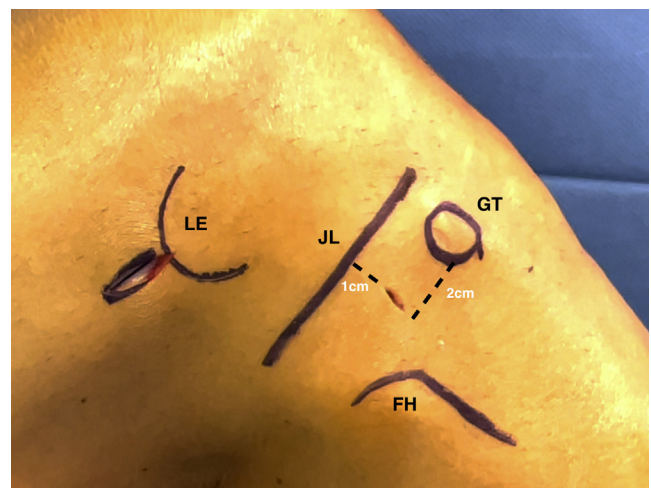
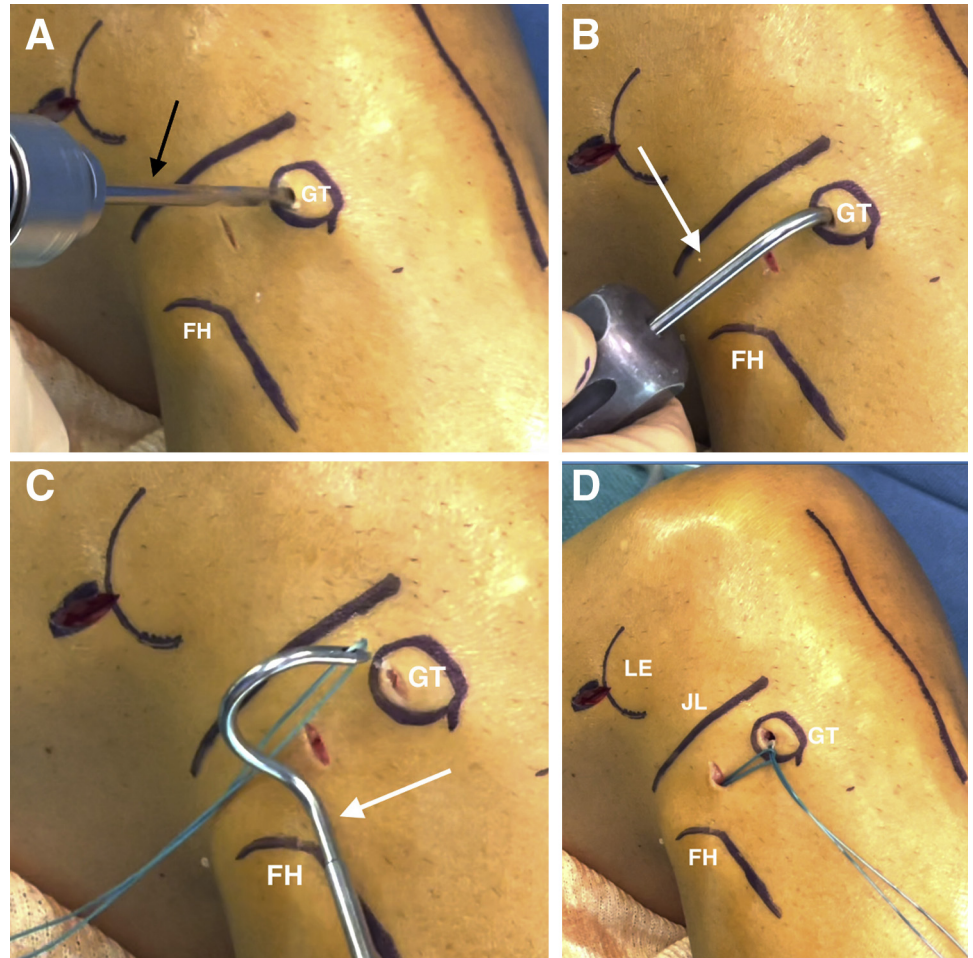


Fig 2. Stab incisions for anterolateral ligament reconstruction. Lateral view of right knee. The first incision is made at the posterior aspect of the Gerdy tubercle (GT), perpendicular and 1 cm distal to the joint line (JL). The second incision is made 2 cm posterior to the first incision. The third incision is made proximal and posterior to the lateral epicondyle (LE). (FH, head of fibula.)

Fig 3. Preparation for antero-lateral ligament reconstruction. Lateral view of right knee. (A) Two 15-mm sockets are created using a 4.5-mm drill (black arrow). (B) The anterolateral ligament (ALL) jig (white arrow) connects the socket. (C) The opposite end of the ALL jig (white arrow) is used to pass a suture loop through the tunnel. (D) Suture loop for ALL graft passage later in procedure. (FH, head of fibula; GT, Gerdy tubercle; JL, joint line; LE, lateral epicondyle.)



reamer (based on graft size) is used. When one is revising a primary ACLR that has been performed through a transtibial or anteromedial portal technique,

the tunnels will be almost perpendicular. A shaver is then inserted to remove any graft remnant or suture material from the primary procedure (Fig 4).

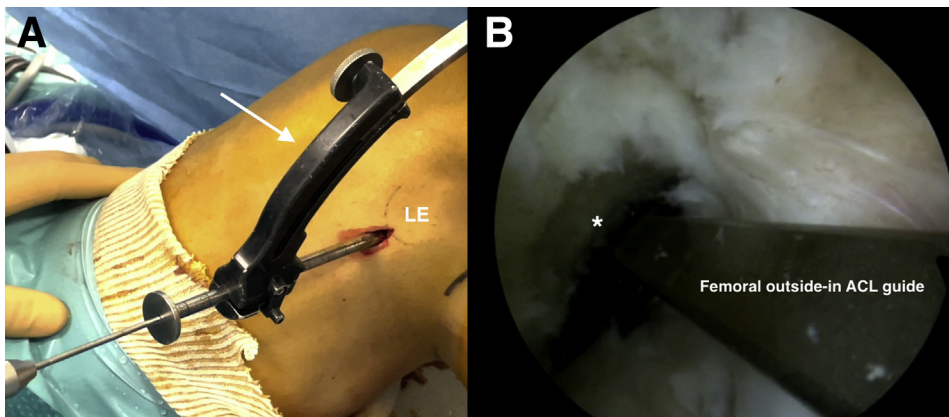


Fig 4. Femoral tunnel. (A) Lateral view of right knee. The bullet of the femoral outside-in anterior cruciate ligament (ACL) guide (white arrow) is positioned proximal and posterior to the lateral epicondyle (LE). (B) Arthroscopic view of right knee. The jig is positioned at the femoral origin (asterisk) of the ACL.

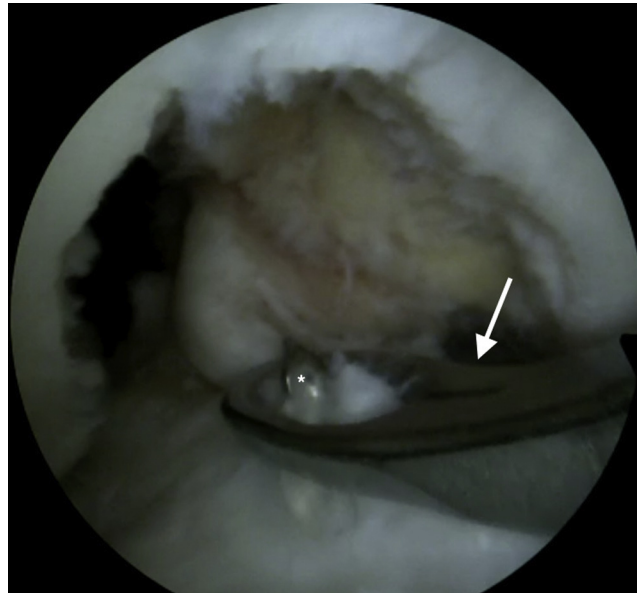


Fig 5. Tibial tunnel. Arthroscopic view of right knee. The tibial jig (white arrow) is positioned over the anterior cruciate ligament footprint, and a guidewire is inserted (asterisk).

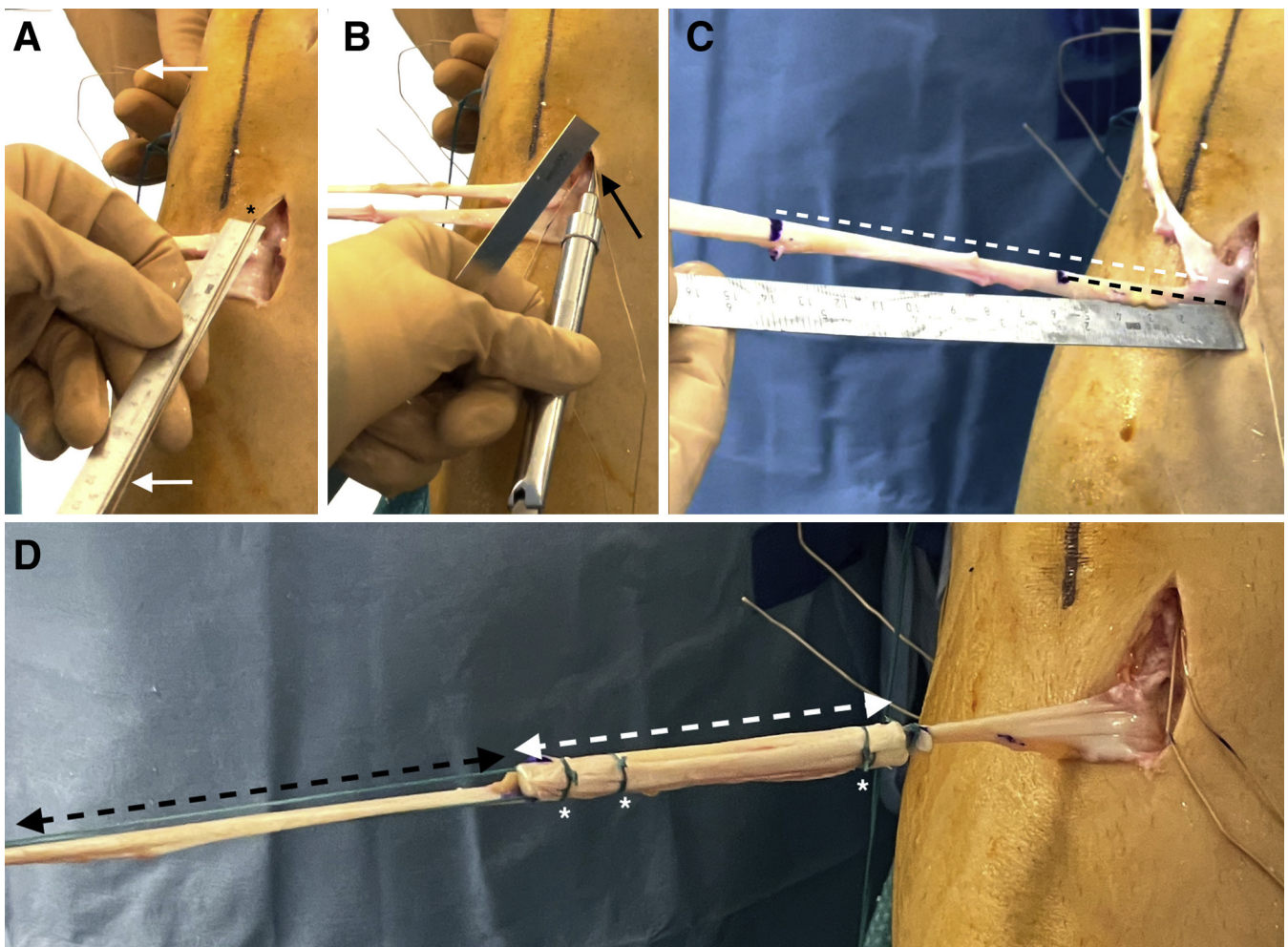


Fig 6. Graft preparation. Medial view of right knee. (A) A passing suture (white arrows) is delivered from the femoral tunnel through the tibial tunnel; then, the tunnel length is measured and marked with a pen (black asterisk). (B) The distance from the hamstring insertion to the tibial aperture is measured with a depth gauge (black arrow). (C) The aforementioned measurements are marked on the semitendinosus tendon (black and white dashed lines). (D) The final anterior cruciate ligament graft consists of 3 parts semitendinosus and 1 part gracilis (white dashed arrow), with an additional length of gracilis for the anterolateral ligament graft (black dashed arrow). White asterisks indicate triple graft sutures.

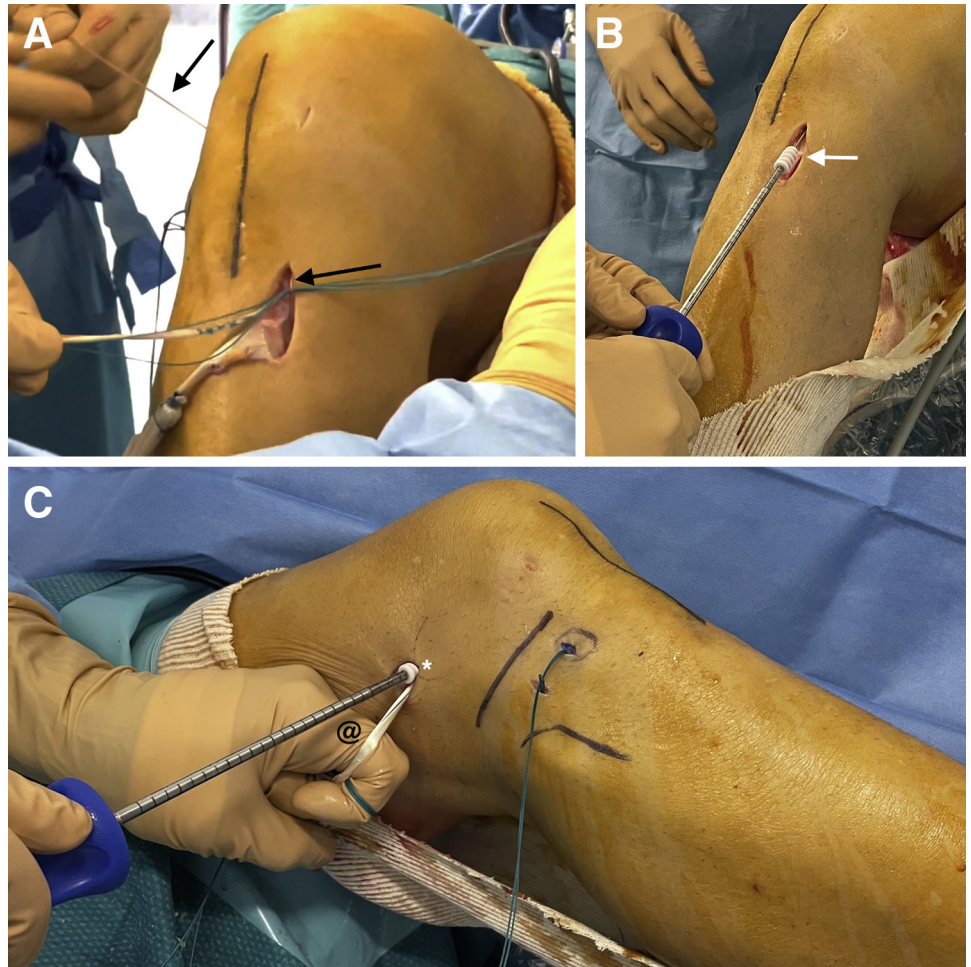


Fig 7. Anterior cruciate ligament graft passage and fixation. (A) Medial view of right knee. A passing suture (black arrows) delivers the graft from the tibial tunnel through the femoral tunnel. (B) Medial view of right knee. An interference screw is inserted into the tibial tunnel (white arrow). (C) Lateral view of right knee. An interference screw is inserted into the femoral tunnel (asterisk) while tension is applied to the graft (@).

Tibial Tunnel

The tibial ACL guide (Arthrex) is set at 65° to be placed just above the hamstring insertion and then introduced into the knee via the anteromedial portal. It is positioned over the ACL footprint, and a guidewire is inserted. A 6-mm reamer is initially used to allow any adjustments with the appropriately sized reamer based on graft size. A shaver is then inserted to remove any graft remnant or suture material (Fig 5). It is important, particularly during revision surgery, to assess for impingement at this stage because a notchplasty may be required.

Graft Preparation

A No. 2 passing suture (Polysorb; Covidien, Mansfield, MA) is delivered from the femoral tunnel through the tibial tunnel. The tunnel length is identified by measuring the distance from the hamstring insertion to the lateral cortex of the femur and marking it with a pen. The distance from the hamstring insertion to the tibial aperture is then measured using a depth gauge. The semitendinosus tendon is marked at these distances, allowing for 2 cm of the graft within the tibial

tunnel. The gracilis is then detached from its tibial insertion and sutured to the semitendinosus at the markings with a No. 0 suture (Mersilene). A No. 2 suture (Mersilene) is then positioned at the distal mark, and the semitendinosus is folded back on itself and sutured with a further No. 0 suture. Finally, the semitendinosus is tripled, and several No. 0 sutures are used to tubularize the graft. As a result, this creates an ACL graft that is 3 parts semitendinosus and 1 part gracilis, with an additional continuation of the gracilis for the ALL graft (Fig 6).

ACL Graft Passage and Fixation

The graft is shuttled from the tibial tunnel through the femoral tunnel using the passing suture. A nitinol guidewire is inserted into the tibial tunnel; then, with tension applied to the graft where it exits the femoral tunnel, an interference screw (Biocomposite; Arthrex) is inserted into the tibial tunnel. A nitinol guidewire is inserted into the femoral tunnel and an interference screw is inserted with the knee at 30° of flexion while tension is applied to the graft (Fig 7).

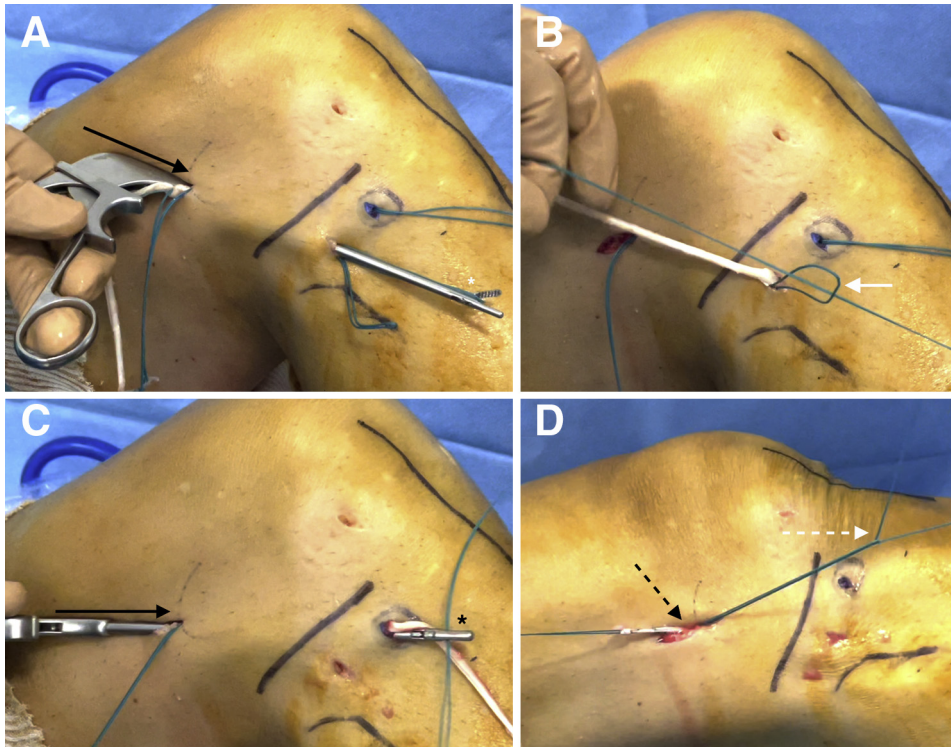


Fig 8. Anterolateral ligament (ALL) graft passage and fixation. Lateral view of right knee. (A) The suture grasper is placed under the iliotibial band (black arrow) and delivers the ALL graft using the whipstitched end (white asterisk). (B) The previously prepared suture loop (white arrow) is used to shuttle the graft from the posterior to anterior tibial incisions. (C) The suture grasper is placed under the iliotibial band (black arrow) to deliver the graft (black asterisk) back to the femoral incision. (D) The suture ends of the anterior cruciate ligament graft are tied (white dashed arrow) around the ALL graft (black dashed arrow).

ALL Graft Passage and Fixation

A suture grasper is used to deliver the whipstitched gracilis under the iliotibial band to the posterior tibial stab incision. The previously prepared suture loop then allows passage of the graft to the anterior incision. The suture grasper is reinserted under the iliotibial band and delivers the graft back to the femoral incision. With tension applied to the ALL graft, the suture ends of the ACL graft are tied around the ALL graft in extension and neutral rotation (Fig 8).

Postoperative Rehabilitation

Postoperative rehabilitation consists of brace-free, immediate full weight bearing and progressive range-of-motion exercises, with restriction of range of motion to 0° to 90° for 6 weeks for patients who undergo meniscal repair. Early rehabilitation focuses on maintaining full extension and performing quadriceps activation exercises. Return to sports is allowed at 4 months for non-pivoting sports, 6 months for pivoting non-contact sports, and 8 to 9 months for pivoting contact sports.

Discussion

Historically, RACLR has been performed as a 2-stage procedure. The extended time interval between procedures has several drawbacks, including increased patient morbidity, meniscal or chondral pathology between stages, an extended duration of rehabilitation, a longer time to return to sports for athletes, and the

economic burden of 2 operations.^{11,12} As a result, there is increased interest in single-stage procedures. Indeed, Mitchell et al.¹³ compared 1-stage versus 2-stage ACLR and found significantly improved objective outcomes and patient subjective outcomes in both groups, without notable differences in failure rates. In addition, White et al.¹⁴ found that in most patients, single-stage ACLR can be reliably performed with good clinical outcomes, low rerupture rates, and high return-to-play rates. Moreover, Pioger et al.³ reported excellent clinical results with a single-stage approach to RACLR using outside-in drilling as we have described in this Technical Note.

Furthermore, the addition of an LEAP to an RACLR reduces graft failure rates, reduces rotational laxity, and results in higher return-to-sport rates than isolated RACLR.^{7,8} Additionally, a recent matched-pair study has shown that combined RACLR and ALL reconstruction is equivalent to the more commonly performed modified Lemaire procedure in terms of clinical outcomes.¹⁵

In summary, the described combined revision ACL and ALL reconstruction technique is safe and reliable and avoids the need for 2-stage RACLR through the use of outside-in drilling.

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