

Iliotibial Band Tenodesis With a Tenodesis Screw for Augmentation of Anterior Cruciate Ligament Reconstruction



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Abstract: Anterior cruciate ligament reconstruction with lateral extra-articular tenodesis using a strip of the iliotibial band (ITB) has been shown to increase postoperative stability of the knee. This Technical Note describes a method of ITB tenodesis in which a central slip of the ITB is passed deep to the lateral collateral ligament and then rerouted anteriorly for fixation at a location anterior and proximal to the lateral femoral epicondyle. Five whipstitches are passed through the ITB, and a second distal suture is tied around the distal end. Of the 4 suture tails, 3 are passed through a tenodesis screwdriver, and the screw is placed in the previously reamed bone socket. A closed loop is formed around the tenodesis screw by tying off the suture tails. This technique creates a sling around the lateral collateral ligament, which serves as a checkrein to internal rotation in cases in which increased stability is warranted, such as revision anterior cruciate ligament reconstruction in an athlete.

Persistent laxity and anterolateral rotational instability (ALRI) have been associated with poor patient-reported outcomes and graft failure after anterior cruciate ligament reconstruction (ACLR).¹ Previous biomechanical studies have elucidated the stabilizing function of the lateral knee structures, including the iliotibial band (ITB).² At the time of ACLR, unaddressed injuries to such peripheral structures have been

suggested to contribute to failure to restore native knee kinematics.³ Recently, there has been a resurgence in interest in lateral extra-articular soft-tissue procedures to augment ACLR in attempts to address this residual laxity and subsequently improve surgical outcomes.⁴

Several techniques for lateral augmentation of ACLR have been described with variations in approach, soft-tissue source, and location for fixation.⁵ For lateral extra-articular tenodesis (LET), a strip of the ITB is often used as a soft-tissue source, such as in the well-described modified Lemaire technique.² In this technique, a central strip of the ITB is passed deep to the lateral collateral ligament (LCL) and fixated posterior to the lateral femoral epicondyle (LFEC).^{2,6} Augmentation of ACLR with this technique has previously shown the ability to restore the native knee kinematics when ACLR alone failed.⁶ However, for patients with baseline joint hyperlaxity or patients in whom primary ACLR failed in the absence of technical error, restoration of their native knee kinematics may not be sufficient. Furthermore, in the setting of revision ACLR in athletes, increased stability may be warranted because they have increased functional demands and rerupture can prove catastrophic.

This Technical Note describes a method of ITB tenodesis in which a central slip of the ITB is passed deep to the LCL and then rerouted anteriorly for fixation with a tenodesis screw at a location anterior and

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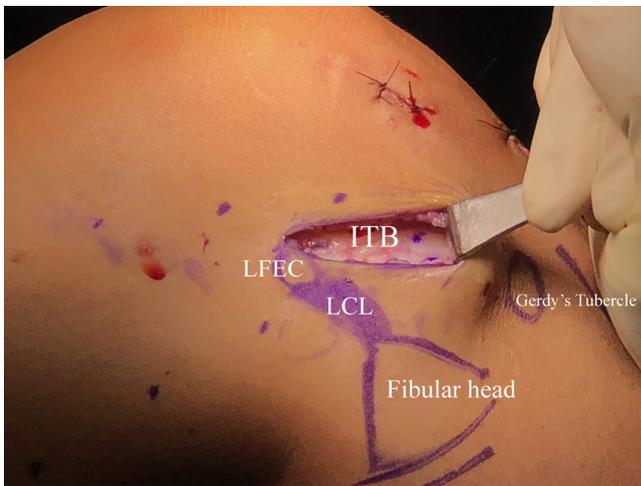


Fig 1. Right knee in flexion. Topographic marking of lateral collateral ligament (LCL), lateral femoral epicondyle (LFEC), fibular head, and Gerdy tubercle. The incision has also been made, exposing the iliotibial band (ITB).

proximal to the LFEC. This technique creates a sling that serves as a checkrein to knee internal rotation in cases in which increased stability is warranted.

Surgical Technique

Imaging and Indications

The indications for LET remain a topic of debate; some authors recommend an LET only for revision ACLR in the presence of a recurrent pivot shift,⁷ whereas some recommend an LET for any patient wishing to return to pivoting sports⁴ and others only indicate an LET when an anterolateral ligamentous injury or Segond fracture is detected on imaging.^{8,9} We indicate this method of LET in the setting of revision ACLR in patients who

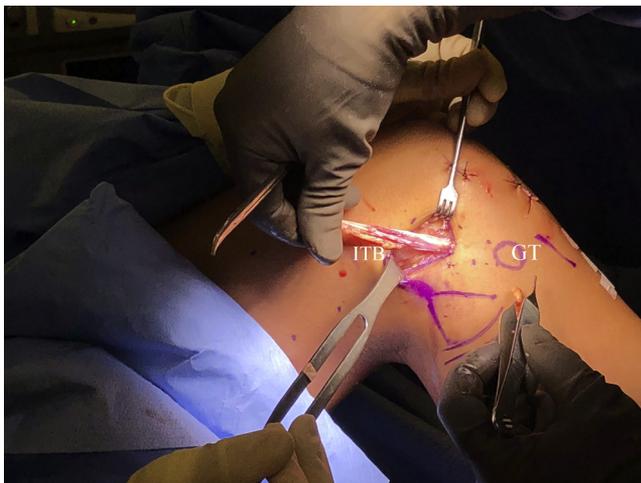


Fig 2. Right knee in flexion. The central one-third of the iliotibial band (ITB) has been harvested and freed, approximately 11 cm from its insertion at the Gerdy tubercle (GT). The distal insertion point is left intact.



Fig 3. Right knee in flexion. The lateral collateral ligament (LCL) has been dissected out, and deep tissue planes have been developed to facilitate passage of the iliotibial band slip deep to this ligament.

manifest ALRI with a grade III pivot-shift examination. In patients with residual laxity after revision ACLR with a pivot glide or grade I pivot shift, LET is also indicated intraoperatively. A lower threshold for LET is applied for athletes returning to pivoting or contact sports.

Leg Positioning

With the patient positioned supine, the knee is brought into 70° of flexion, and a bump is positioned along the lateral thigh to prevent the hip from externally rotating. The LCL can be best identified and palpated with the hip brought into flexion, abduction, and external rotation (FABER). The ITB tenodesis is tensioned with the leg in 30° of flexion and in neutral tibial rotation.

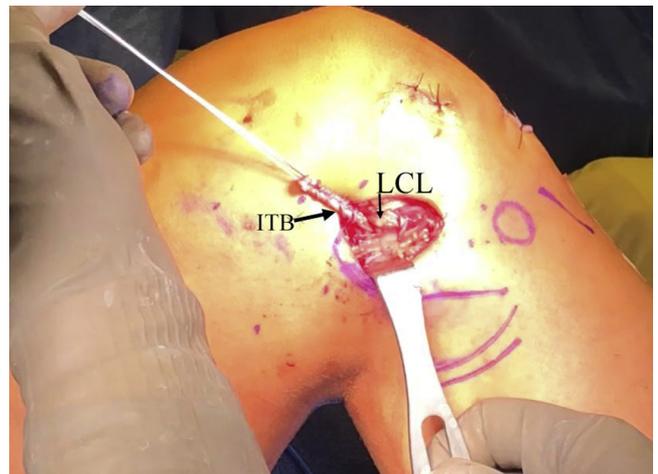


Fig 4. Right knee in flexion. The iliotibial band (ITB) has been passed deep to the lateral collateral ligament (LCL). The ITB is pulled anteriorly to show its course when it is anchored at a point proximal and anterior to the lateral femoral epicondyle.



Fig 5. Right knee in flexion. The iliotibial band (ITB) is shown after whipstitching with No. 2 FiberLoop and trimming of the proximal margin.

ITB Tenodesis “Sling” Technique

The lateral side of the knee is topographically marked including the fibular head, the distal ITB with its insertion at the Gerdy tubercle, the LCL, and the LFEC. A 6.0-cm incision is made along the central one-third of the ITB distal to the joint line. The sheath surrounding the ITB is incised (Fig 1). The central one-third of the ITB is clearly marked and harvested from the Gerdy tubercle, extending 11 cm proximally. Metzenbaum scissors are used to mobilize the strip of ITB from the underlying soft tissue. The insertion of the ITB on the Gerdy tubercle is left intact (Fig 2).

With the leg in flexion and varus stress applied, the LCL is palpated. Metzenbaum scissors are used to define tissue planes (Fig 3). A Kelly clamp facilitates passage of

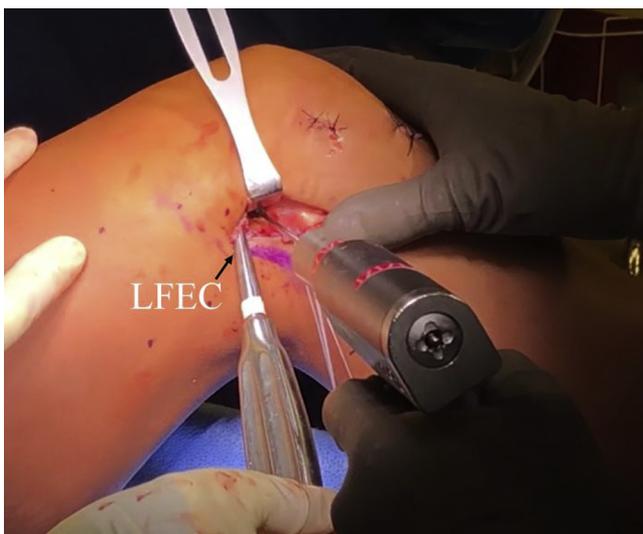


Fig 6. Right knee in flexion. A 2.4-mm guidewire is placed at the desired location for bone socket placement. This is a point located anterior and proximal to the lateral femoral epicondyle (LFEC).

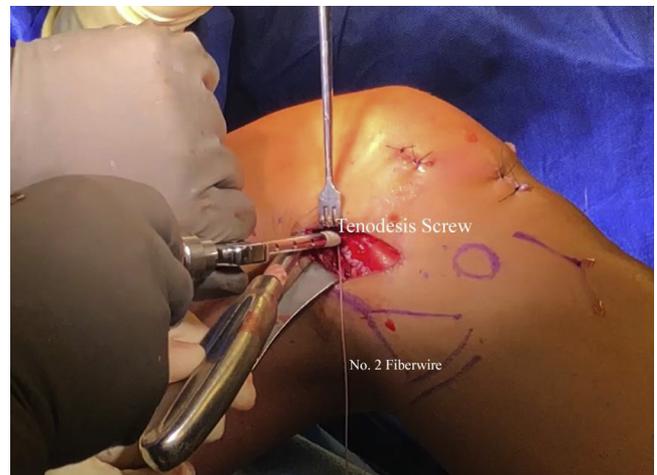


Fig 7. Right knee in 30° of flexion. The iliotibial band is shown, firmly fixed to the tip of a tenodesis screw, and is being screwed into the previously prepared bone socket. A single strand of No. 2 FiberWire is shown outside the tenodesis screw. Tying off this strand with the 3 strands placed through the tenodesis screw will create a closed loop around the construct. This helps to further reduce soft-tissue slippage.

the ITB strip deep to this ligament (Fig 4). A No. 2 Ethibond suture loop (Ethicon, Somerville, NJ) is used for shuttling ITB slip sutures.

Five Krackow whipstitches are placed in the slip with a No. 2 FiberLoop (Arthrex, Naples, FL), and the proximal margin is trimmed (Fig 5). A No. 2-0 FiberWire (Arthrex) is tied around the tendon, approximately 5 to 8 mm from the proximal tip. This ensures that ITB tissue is advanced into the bone socket for stable fixation. One strand of No. 2 FiberWire and both tails of the No. 2-0 FiberWire are then passed through a 6.25-mm PEEK (polyether ether ketone) vented tenodesis screw (Arthrex). The tip of the ITB slip is held firmly against the tip of the tenodesis driver. The socket location is then marked with a Bovie device (Bovie Medical, Clearwater, FL) at a point anterior and proximal to the LFEC to create a fulcrum around the LCL origin. The knee is flexed to 30° in neutral rotation, and care is taken to select a socket location that tensions the ITB slip without overconstraining the knee (Fig 6). A 2.4-mm guidewire is advanced, followed by a cannulated 7.0-mm reamer and 7-mm tap, completing socket preparation.

With the knee in 30° of flexion and neutral tibial rotation, the ITB slip is anchored with the tenodesis screw (Fig 7). Pressure is applied as the screw is advanced to prevent tendon displacement and wrapping around the screw. The No. 2 FiberLoop suture limbs are then tied to create a closed loop through the tenodesis screw, preventing tendon slippage past the screw. The suture ends are cut, and the incision is closed with absorbable No. 2-0 Vicryl (Ethicon), running No. 3-0 Monocryl (Ethicon), and Steri-Strips (3M, St Paul, MN).

Table 1. Advantages and Limitations of ITB Tenodesis Technique

Advantages	Limitations
Additional anterolateral stability in comparison to isolated ACL reconstruction	Large incision with notable postoperative scarring
Direct visualization of osseous and soft-tissue landmarks	Risk of knee overconstraint resulting in limited range of motion and pain
Minimal morbidity of harvesting ITB	Limited range of motion and risk of graft failure due to non-isometric placement of graft
Minimal additional equipment and operative time	Graft too thin or too short Risk of muscle hernia through graft harvest site

ACL, anterior cruciate ligament; ITB, iliotibial band.

Discussion

The described technique is an augmentation of ACLR that involves passing a central slip of the ITB deep to the LCL before rerouting the ITB anteriorly for fixation with a tenodesis screw at a site anterior and proximal to the LFEC (Video 1). The purpose of this technique is to address ALRI, which has been suggested as a contributing factor for persisting dissatisfaction and graft failure after isolated ACLR.^{6,10} Preventing graft failure after ACLR is paramount because the outcomes of subsequent reconstructions are increasingly bleak. Revision ACLR is associated with up to a 4 times higher failure rate, as well as worse subjective outcomes, compared with primary ACLR.¹¹ Given the physical and emotional challenges, as well as the daunting rehabilitation period associated with ACLR, we recommend consideration of this technique to augment revision ACLR in cases in which a patient is predisposed to surgical failure.

LET using the ITB is a well-described surgical method for restoring and reinforcing ALRI. Serial sectioning studies have clearly elucidated the ITB's effect of resisting tibial internal rotation, especially at increasing angles of knee flexion.^{4,12} A controlled laboratory study by Inderhaug et al.⁶ found that ACLR alone failed to restore native knee kinematics whereas ACLR plus the ITB using the deep Lemaire or Macintosh procedure with 20 N of tension restored rotational kinematics compared with an intact state. Care must be taken, however, because tensioning forces of 40 N may overconstrain the joint and cause abnormal forces to be dissipated across the cartilage.^{4,6} In addition, the

importance of tensioning the ITB near 30° of flexion must be highlighted because this allows for optimal tensioning and restriction of internal rotation.

Clinical outcome studies comparing combined extra- and intra-articular reconstructions have shown mixed results. A recent systematic review by Song et al.¹³ found a significant decrease in the prevalence of a positive pivot-shift examination in the combined intra- and extra-articular reconstruction group but found no difference in subjective outcomes compared with isolated ACLR. On the other hand, Noyes and Barber¹⁴ compared the same procedures but in patients who were competitive athletes. They found higher levels of sports participation, subjective outcomes, and objective outcomes in the combined intra- and extra-articular reconstruction group compared with the isolated ACLR group. This collective body of evidence suggests that only a specific patient population may benefit from a concomitant LET.⁴

We suggest a high selection threshold for implementation of the described ITB tenodesis technique. Because competitive athletes have increased demands for pivoting and revision ACLR has a significantly higher failure rate than a primary procedure,¹¹ we indicate this procedure in individuals receiving revision ACLR who wish to return to athletic activity. In addition, this procedure should be considered if an allograft anterior cruciate ligament (ACL) is being used, because the ACLR re-revision rate is up to 2.2 times higher for ACL allografts than ACL autografts.¹⁵ Finally, patients with joint hypermobility, a high-grade pivot-shift examination finding, or primary graft failure in the absence of technical error would warrant an

Table 2. Pearls and Pitfalls of ITB Tenodesis Technique

Pearls	Pitfalls
Use the central third of the ITB. Do not disrupt the knee capsule during graft preparation.	Disruption of the ITB insertion on the Gerdy tubercle may occur. Improper separation of tissue planes may result in difficulty passing the ITB graft below the LCL.
Tension the graft with the knee in 30° of flexion and neutral tibial rotation.	Inappropriate positioning of the knee during femoral screw fixation will result in improper tensioning of the ITB strip.
Anchor the ITB anterior and proximal to the lateral femoral epicondyle to create a fulcrum.	

ITB, iliotibial band; LCL, lateral collateral ligament.

indication for this technique because these patients may have an elevated risk of graft failure.

Our technique confers the advantage of additional anterolateral stability in comparison to isolated ACLR with minimal added morbidity. However, this technique is not without risks and limitations (Table 1). It uses a large incision that results in postoperative scarring. It is possible that the vastus lateralis can herniate through the graft harvest site; however, the senior author (B.F.) has encountered no such complication. Range of motion may be limited in cases of graft overconstraint or non-isometric placement of the graft on the lateral femoral condyle. The risk of graft failure may be heightened in the case that the harvested ITB graft is too thin or too short. Pearls and pitfalls of this technique are provided in Table 2.

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