Technical Note

Lateral Extra-articular Tenodesis with Iliotibial Band Using Knotless All-Suture Anchor Femoral Fixation

Joseph Temperato, D.O., Michael Ewing, M.D., and Clayton W. Nuelle, M.D.

Abstract: Common injuries, such as anterior cruciate ligament (ACL) tears, can result in both anterior and rotational instability of the knee. An arthroscopic anterior cruciate ligament reconstruction (ACLR) method has been shown to be effective in restoring anterior translational stability, but this could be followed by persistent rotational instability by means of residual pivot shifts or repeat instability episodes. Alternative techniques, such as a lateral extraarticular tenodesis (LET), has been proposed as a technique for preventing persistent rotational instability following ACLR. This article presents a case of a LET using an autologous central slip of iliotibial (IT) band with fixation to the femur using a 1.8-mm knotless all-suture anchor.

Introduction

Anterior cruciate ligament (ACL) tears are common injuries and can result in both anterior and rotational instability of the knee.[1−3] Arthroscopic anterior cruciate ligament reconstruction (ACLR) has been shown to be effective in restoring anterior translational stability, but persistent rotational instability, as demonstrated by residual pivot shift or a repeat instability episode, may persist in up to 20% of patients following ACLR.[4] Retear rates following ACLR remain as high as 18% in younger, high-demand populations.[5] As such, alternative techniques have been described, which aim to further address rotational instability in the ACL-injured patient and reduce the risk of ACLR graft rupture, particularly in high-risk patients.

Lateral extraarticular tenodesis (LET) is one proposed technique for preventing persistent rotational instability following ACLR. Prior to the development of intra-articular ACLR, LET was used in an attempt to restore normal knee kinematics following ACL injury.[6] There has been a recent resurgence of LET proposed as an adjunct to intra-articular ACLR to improve post-operative rotational instability.[2,7,8] Biomechanically, LET has been shown to transfer loads from the ACL graft and to decrease anterior tibial translation in response to pivoting stresses.[9,10] Historically, controversy exists regarding the clinical effects of an LET procedure because of potential concern of increased pain and morbidity from the procedure, as well as lateral compartment overconstraint with resulting osteoarthritis.[9,11]

More recent literature has demonstrated strong clinical outcomes for arthroscopic ACLR with concomitant LET.[12] Multiple reviews have exhibited similar patient-reported outcomes between isolated ACLR versus ACLR combined with LET, with the added benefit of less rotational instability with the addition of a LET.[2,8,12] In a multicenter randomized control trial, Getgood et al.[7] showed a significant decrease in graft rupture rate when ACLR with hamstring autograft combined with LET was compared to ACLR with hamstring autograft alone. Given these clinical results, there has been an increased interest in performing LET with ACLR, and as such, multiple techniques for LET

Department of Orthopaedic Surgery, University of Missouri, Columbia, Missouri, U.S.A. (J.T., M.E., C.W.N.); and Thompson Laboratory for Regenerative Orthopaedics, University of Missouri, Columbia, Missouri, U.S.A. (C.W.N.).

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Address correspondence to Clayton W. Nuelle, M.D., Department of Orthopaedic Surgery, Missouri Orthopaedic Institute, Thompson Laboratory for Regenerative Orthopaedics, University of Missouri, 1100 Virginia Ave., Columbia, MO 65212, U.S.A. E-mail: nuellec@health.missouri.edu

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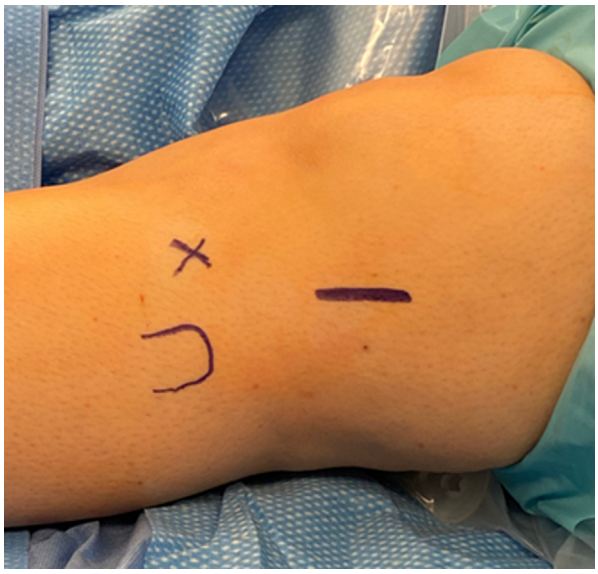

Fig 1. Intraoperative image of a left knee (left of image is distal, right is proximal) demonstrating the location of the skin incision over the distal femur (beginning over the lateral epicondyle), as well as Gerdy's tubercle (Marked with an "X") and the fibular head (marked posterior to the "X"), which are the anatomic landmarks that dictate the proximal and distal extent of the incision, respectively.

Fig 2. Intraoperative image of the lateral aspect of a left knee demonstrating superficial soft tissue dissection down to the level of the iliotibial (IT) band. The "X" marks the location of Gerdy's tubercle.

have been described.[12–16] The following Technical Note presents an LET using an autologous central slip of the iliotibial (IT) band with fixation to the femur using a 1.8-mm knotless all-suture anchor (Fibertak, Arthrex, Naples, FL).

Surgical Technique

The patient is positioned supine on the operating table, and an examination under anesthesia is performed. LET is typically performed in conjunction with ACLR and, therefore, careful ligamentous exam is important to note both before the procedure begins and at its conclusion. A nonsterile tourniquet is placed on the operative thigh but not inflated. The patient's extremity is then prepped and draped using a basic knee arthroscopy set up as per surgeon preference. Standard anterolateral and anteromedial arthroscopic portals are made using a #11 blade, and a thorough diagnostic arthroscopy is performed to evaluate and address any concomitant pathology. As mentioned above, this procedure is usually performed at the time of ACLR. ACLR is performed first, with specific graft and technique per surgeon preference.

Attention is then turned to the LET. The lateral epicondyle and Gerdy's tubercle are palpated and marked using a marking pen (Fig 1). Using a #15 blade scalpel, a longitudinal incision is made beginning just proximal to the lateral epicondyle and extending approximately 4 cm distally over the midline of the lateral thigh (Fig 2). Using Bovie electrocautery, the subcutaneous tissue is divided in line with the incision, and dissection is carried out to the level of the IT band. Any remaining soft tissue is bluntly dissected from the IT band to expose the anterior and posterior aspects of the IT band itself. Once adequate exposure is achieved, Gerdy's tubercle is palpated, and a mark is made on the IT band ~8 cm proximal to Gerdy's tubercle using a marking pen. A 1-cm, double-edged blade (Arthrex, Naples, FL) is used to incise a 1-cm wide strip of the IT band at its central-most aspect from the previously marked location extending distally to the level of Gerdy's tubercle without releasing it from its insertion, similar to the well-described modified Lemaire technique (Fig 3).[13] Care is taken to stay central in the IT band and to not drift posteriorly, as doing so could disrupt the Kaplan's fibers distally or the entirety of the IT band itself. The proximal end is then incised completely, and the undersurface of the IT band is debrided of remaining soft tissue attachments at the level of and just distal to the joint line using a #15 blade scalpel (Fig 4). The proximal free end is whip-stitched using a 0-Vicryl suture.

The lateral collateral ligament (LCL) is then identified and carefully dissected out using Metzenbaum scissors.

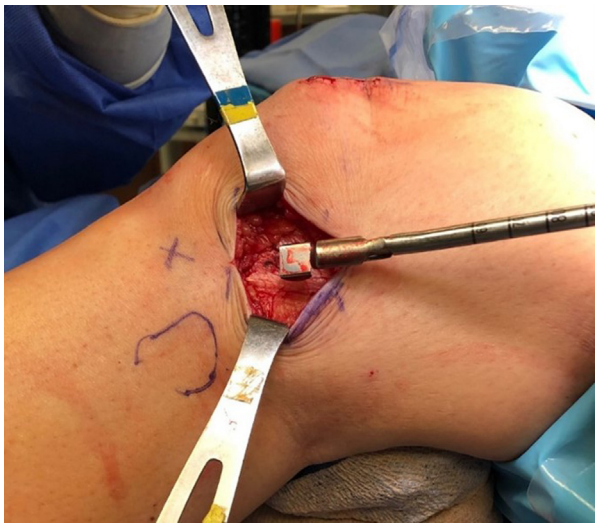

Fig 3. Intraoperative image the lateral aspect of a left knee demonstrating the appropriate orientation of a 1-cm double-edged blade (Arthrex, Naples, FL) used to incise a 1-cm-wide strip of the iliotibial (IT) band at its central most aspect ~8 cm proximal to Gerdy's tubercle (marked with an "X").

A varus stress may be placed on the knee to place tension on the LCL and aid in appropriate identification. A hemostat is passed underneath the LCL, and the whipstitched ends of the IT band from the proximal IT band is pulled through, passing the IT band beneath the LCL (Fig 5). The lateral epicondyle is palpated, and the surrounding soft tissue is dissected away, exposing the femoral cortex. Extreme care is taken to avoid the lateral cortical button of the ACLR, if suspensory fixation has been used. A drill guide sleeve is placed slightly proximal and posterior to the lateral epicondyle. Using a 1.8-mm drill, the surgeon creates a pilot hole (Fig 6A), and a 1.8-mm knotless all-suture anchor (Arthrex, Naples, FL) is placed (Fig 6B). All three suture tails are pulled to seat the anchor into place. The knee is placed in 30° of flexion and neutral rotation. With the IT band pulled taut, the repair suture from the anchor is looped around the proximal aspect of the IT band twice. The repair suture is then placed through the looped end of the passing suture. The nonlooped end of the passing suture is then pulled, which passes the repair suture through the anchor in a knotless fashion (Fig 7A). Once the repair suture has been passed through the anchor, it is tensioned, so that the IT band is secured firmly against the femoral cortex (Fig 7B). Once appropriately tensioned, the repair suture tail is cut flush with the anchor. The remaining IT band that is proximal to the anchor is pulled back over top of itself distally, and a 0-Vicryl suture is used to suture the tendon onto itself in a pant-over-vest fashion.

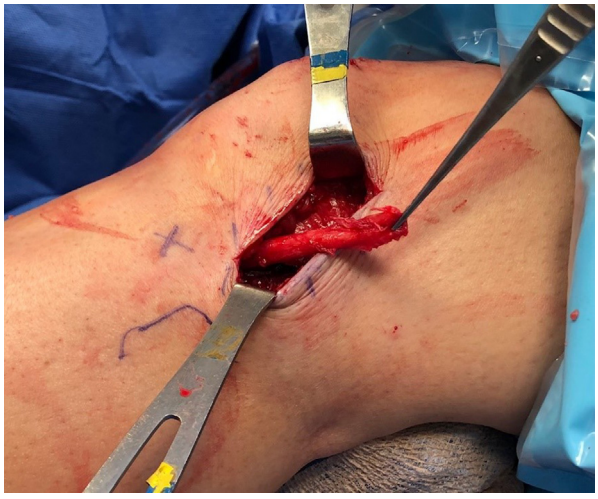

Fig 4. Intraoperative image of the lateral aspect of a left knee demonstrating the central portion of the iliotibial (IT) band, which has been debrided of surrounding soft tissue, but still remains attached distally at Gerdy's tubercle (marked with an "X").

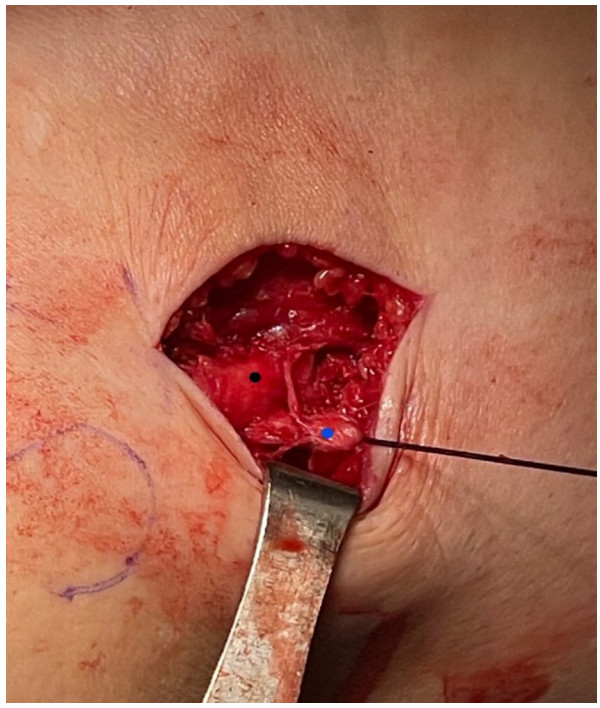

Fig 5. Intraoperative image of the lateral aspect of a left knee demonstrating the correct orientation of the LET, as the IT band (blue dot) is pulled underneath the lateral collateral ligament (black dot).

The defect created in the IT band is reapproximated using a running 0-Vicryl suture. The wound is irrigated and closed in a layered fashion. A soft, sterile dressing is applied followed by a hinged knee brace, which is locked in full extension. The above-mentioned technique is demonstrated in Video 1.

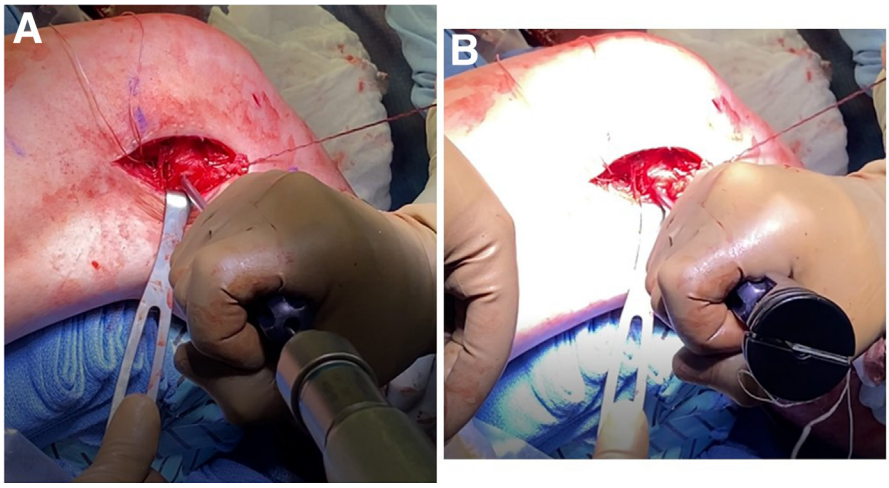

Fig 6. Intraoperative images of the lateral aspect of a right knee demonstrating drilling of 1.8 mm pilot hole (A) just proximal and posterior to the lateral epicondyle followed by placement of a knotless suture anchor (Arthrex, Naples, FL) (B).

Rehabilitation

The patient is placed in a hinged knee brace at the conclusion of the procedure, which is locked in extension. The patient unlocks the hinged knee brace while in bed for range of motion exercises and during physical therapy sessions. The patient is allowed to weight bear, as tolerated, with crutch assistance; however, the hinged knee brace is locked in extension when ambulating until the patient has regained adequate quadriceps control. Formal physical therapy typically begins within the first week after surgery. Initially, therapy consists of range-of-motion exercises but quickly progresses to strengthening, as able.

Discussion

ACL tears are common injuries and, thus, there are a wide variety of ACLR techniques described in the literature. While many of these techniques achieve good clinical outcomes and restore anterior translational stability, the high incidence of retears has led to concerns about persistent rotational instability, particularly in high-risk patients. This residual instability places ACLR graft under undue stress, which can result in continued patient-perceived instability and even ACLR failure. Although not all patients with an ACL tear require a procedure in addition to ACLR to address rotational instability, there are some patient factors to consider, which may put them at risk for continued instability or ACLR failure. Younger patient age, plan to return to cutting/pivoting sport postoperatively, high-grade pivot shift on exam, generalized ligamentous laxity, and knee hyperextension greater than 10° are all factors that may lead to increased retear risk.[16] Patients with one or more may be considered for a LET procedure in addition to ACLR.

There are several advantages to this technique (Table 1). First, when used in conjunction with ACLR,

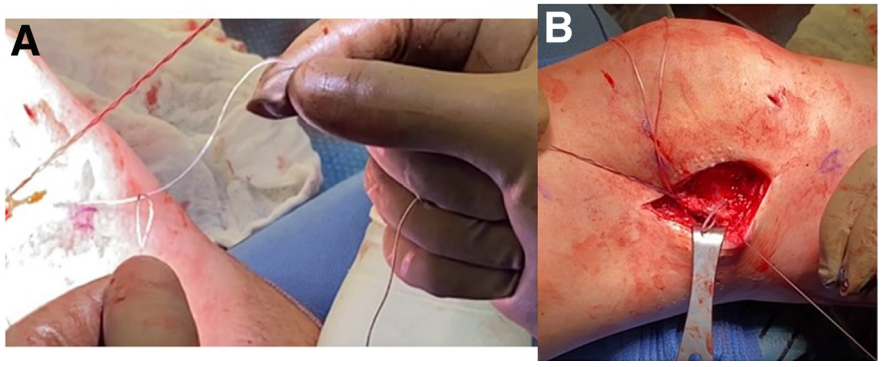

Fig 7. Intraoperative images of the lateral aspect of a right knee demonstrating passing the repair suture through the looped end of the passing suture to bring it through the knotless mechanism of an all-suture anchor (A), followed by pulling the repair suture to secure the autograft iliotibial (IT) band down to the lateral aspect of the distal femur (B).

Table 1. Advantages and Disadvantages of Lateral Extra-Articular Tenodesis With Iliotibial Band Using Knotless All-Suture Anchor Femoral Fixation

Advantages	Disadvantages
LET augments knee stability and can reduce the pivot shift when performed with ACLR in the ACL injured knee.	The procedure requires additional operative time and soft tissue dissection when compared to ACLR alone.
No allograft is necessary, as autograft IT band is used.	There is associated donor site morbidity with IT band autograft harvest.
LET may be performed at the time of ACLR and does not need to be staged.	There is a possibility to iatrogenic injury to ACLR femoral fixation when dissecting about the lateral epicondyle.
Use of a knotless anchor for femoral fixation is low profile and results in minimal surrounding soft tissue irritation	The graft may be excessively tensioned if the knee is externally rotated during tensioning.
LET with IT band may be useful in revision ACLR, where concern for residual rotational instability after index procedure is a concern for primary ACLR failure.	The IT band may have scarring from primary ACLR graft passage or fixation in the revision setting, making it difficult to mobilize.

ACLR, anterior cruciate ligament reconstruction; IT, iliotibial; LET, lateral extraarticular tenodesis.

LET can provide additional stability and help eliminate the pivot shift. Since it can be performed at the time of ACLR, it also reduces the need for staged procedures. Additionally, this technique utilizes autograft IT band tissue, which eliminates the need for any allograft tissue. Another advantage of this technique is that the knotless anchor mechanism used for femoral fixation is minimally invasive and, typically, does not cause soft tissue irritation or require later removal, as can occur with more prominent fixation devices. Lastly, in the setting of revision ACLR, LET is able to provide additional stability and lower stress placed on ACLR graft postoperatively.

There are a few disadvantages or limitations to this technique (Table 1). As this procedure is performed in addition to ACLR, it requires additional soft tissue dissection and utilization of IT band autograft, both of which come with associated incisional and graft site harvest morbidity. This also requires more operative time when compared to ACLR alone. During the soft tissue dissection, there is also a possibility of iatrogenic damage to femoral ACLR graft fixation if care is not utilized. Slow, meticulous dissection about ACLR graft fixation when performing the LET approach will help minimize risk to graft fixation. When using knotless mechanisms that allow for retensioning, it is important to consider the potential risk that the graft may be overtensioned, and care should be taken during this step of the procedure. To mitigate this risk, ensure the knee is placed in $\sim 30^{\circ}$ of flexion and neutral rotation during tensioning. Lastly, although this technique may be useful in the revision ACLR setting as well, autograft IT band harvest may be difficult, secondary to IT band scarring from the index ACLR.

Table 2. Pearls and Pitfalls of a Lateral Extra-Articular Tenodesis With Iliotibial Band Using Knotless All-Suture Anchor Femoral Fixation

Pearls	Pitfalls
Careful exam under anesthesia should be performed prior to the procedure to identify translational/rotational instability as well as range of motion, including native hyperextension.	LET may not need to be performed in every patient with ACL tear undergoing ACLR.
Careful dissection of the IT band and removal of surrounding adhesions allows for easier graft harvest and passage under the LCL.	In the setting of revision ACLR, the IT band may have scarring present making it difficult to harvest and mobilize the tissue.
Carefully identify the fixation point of the ACL on the lateral femoral condyle to avoid tunnel convergence or ACL fixation disruption.	Failure to identify femoral fixation for ACLR may result in iatrogenic damage to the fixation and possible ACLR failure.
When setting the knotless anchor, apply a slow and steady force in line with the anchor.	Fast or aggressive pulling that is not in line with the anchor may result in improperly setting the anchor or anchor failure.
The knee should be placed in approximately 30 degrees of flexion and neutral rotation when tensioning the LET.	Incorrect positioning of the knee may result in residual laxity or over-tensioning of the graft.
The resultant defect in the IT band from graft harvest should be closed at the conclusion of the procedure.	Failure to close the IT band defect may result in muscle herniation, persistent pain and cosmetic deformity.

ACL, anterior cruciate ligament; ACLR, anterior cruciate ligament reconstruction; IT, iliotibial; LCL, lateral collateral ligament; LET, lateral extraarticular tenodesis.

Additional pearls and pitfalls to consider when performing this technique are described in Table 2.

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