

Anatomic Anterolateral Ligament Reconstruction with Iliotibial Band Graft and Concomitant Anterior Cruciate Ligament Reconstruction



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Abstract: Anterior cruciate ligament (ACL) reconstruction (ACLR) attempts to restore native ACL function. Persistent anterolateral instability is a common symptom after ACLR that can lead to worse patient outcomes. Additional surgeries, like anterolateral ligament reconstruction (ALLR), can augment the ACL graft and help increase anterolateral rotational stability. Certain indications for ACLR with ALLR include high-grade pivot shift, increased posterior tibial slope ($>12^\circ$), revision ACLR, and concomitant ligamentous or meniscal injuries. We describe an anatomic ALLR technique using an 8 cm long \times 1 cm wide strip of the inferior aspect of the iliotibial band fixed at the native attachment sites of the ALL.

Anterior cruciate ligament (ACL) tears are common, and ACL reconstructions (ACLR) attempt to restore the native function of the ACL to improve joint stability, delay osteoarthritis, and limit injury to other knee structures.¹ However, some patients have persistent anterolateral instability even after an ACLR.² Recent studies on the anterolateral knee complex structures and their role in anterolateral knee stability have increased interest in using lateral extra-articular tenodesis and anterolateral ligament (ALL) reconstructions (ALLR) with ACLR for patients with persistent anterolateral instability.^{3,4} There are various techniques for an ACLR with an ALLR that have reported positive outcomes compared to isolated ACLR³; all the proposed techniques have been developed to augment the anterolateral structures of the knee and increase the knee rotatory anterolateral

stability.⁵ The anterolateral ligament has been described as ligamentous fibers of the lateral capsule of the knee. The proximal femoral attachment is 4.7 mm posterior and proximal to the femoral attachment of the fibular collateral ligament, and the distal tibial attachment is midway between the center of Gerdy's tubercle and the anterior aspect of the fibular head and 9.5 mm distal to the lateral tibial joint line (Fig 1).⁶

For ACLR patients, persistent postsurgical anterolateral rotational instability, evident by residual pivot shift examinations, is associated with worse functional outcomes and graft failure.⁷ Various knee mechanisms and injuries can contribute to anterolateral rotational instability, including meniscal tears, meniscectomy, medial collateral ligament injuries, and injury to the posterolateral complex structures.^{8,9} In some cases, these mechanisms cannot be surgically repaired or reconstructed, or, despite treatment, the anterolateral rotational instability may persist because of other undetermined causes. In addition to mechanical risk factors, increased posterior tibial slope ($>12^\circ$), a high-grade pivot shift examination, and revision ACLR are all indicated to reduce anterolateral rotational stability.^{10,11} When these mechanisms responsible for anterolateral rotational stability cannot be addressed or one or more of the risk factors is present in an ACLR patient, it can be beneficial to perform an ALLR in conjunction with an ACLR to augment the anterolateral aspect of the knee.¹²⁻¹⁴ This article describes

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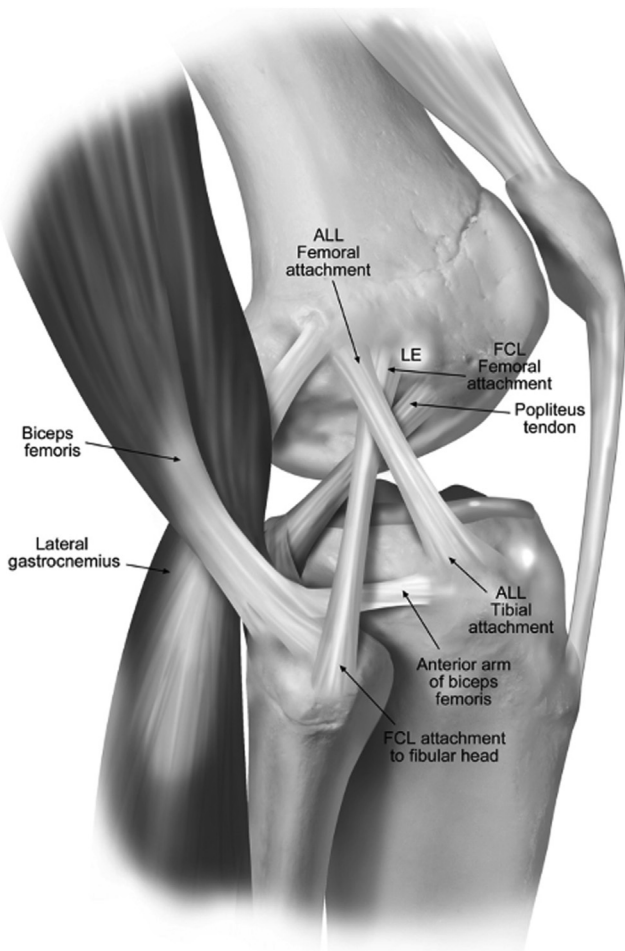


Fig 1. Image depicting the native anatomy of the anterolateral ligament (ALL). The ALL is a ligamentous structure of the lateral capsule located superior to the fibular collateral ligament (FCL). The tibial attachment of the ALL is midway between the center of Gerdy's tubercle and the anterior aspect of the fibular head and 9.5 mm distal to the joint line. The femoral attachment of the ALL is 4.7 mm posterior and proximal to the femoral attachment of the fibular collateral ligament. (Reprinted with permission from *Am J Sports Med* 2015;43:1606-1615.)

a technique for performing an anatomic ALLR with an iliotibial band autograft (Fig 2).

Technique

A detailed video of the ALLR technique is shown in [Video 1](#). The step-by-step guide and surgical pearls are in [Table 1](#). The anatomic ALLR technique is performed in conjunction with an ACLR. ACLR is performed in standard fashion as previously described.¹⁵ Additionally, this patient required a lateral meniscus repair and a medial meniscus root repair.

Anesthesia and Positioning

The patient is placed in a supine position on the operating table. After induction under general

anesthesia, a bilateral knee examination is performed, including the assessment of instability, flexion, and range of motion of the injured and contralateral uninjured knee. A well-padded thigh tourniquet is placed on the surgical leg. The surgical leg is placed into a leg holder (Mizho OSI, Union City, CA), and the nonsurgical leg is placed into an abduction stirrup (Birkova Product LLC, Gothenburg, NE). The surgical leg is then prepped and draped in a sterile manner. For prophylaxis against infection, the patient is given 2 mg of Ancef.

Graft Harvest and Preparation

In preparation for the ACLR, the bone-tendon-bone autograft is harvested first. Next, the ALLR graft is harvested. An incision is made from 10 cm proximal to Gerdy's tubercle distally down to Gerdy's tubercle. Careful dissection down to the iliotibial band is performed so the iliotibial band can be isolated out. The iliotibial band is first marked at 8 cm from the center of Gerdy's tubercle to determine the length of the graft. Next, parallel lines that are 1 cm apart are marked at

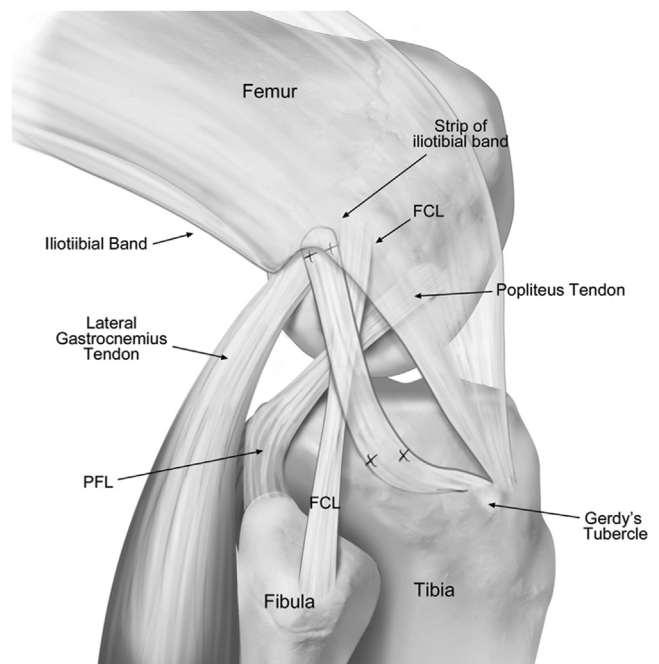


Fig 2. Image depicting the reconstruction graft of this new anterolateral ligament reconstruction (ALLR) technique surgery (lateral view, right knee). This technique uses an 8 cm long \times 1 cm wide graft of the inferior portion of the iliotibial band. The graft flares slightly at Gerdy's tubercle and is amputated proximally. The distal tibial attachment is 1 cm distal to the joint line and midway between the anterior head of the fibula and Gerdy's tubercle. The proximal femoral attachment of the graft is 5 mm posterior and proximal to the fibular collateral ligament (FCL) femoral attachment. The distal attachment is fixated first with 2 modified Mason-Allen stitches and proximally at 20° of flexion and neutral rotation using 2 modified Mason-Allen stitches.

Table 1. Step-by-Step Guide and Surgical Pearls**New ALLR Step-by-Step Guide**

- Lateral incision is made from 10 cm proximal to Gerdy's tubercle, distally down to Gerdy's tubercle.
- Dissection is carried down to isolate the iliotibial band.
- An 8 cm long \times 1 cm wide graft is marked on the inferior portion of the iliotibial band.
- The graft is cut along the marked lines and flares distally at Gerdy's tubercle. The graft is separated from the tissues underneath and then amputated proximally.
- The distal tibial attachment for the ALLR graft is identified and marked. This location is 1 cm distal to the joint line and midway between anterior aspect of the fibular head and Gerdy's tubercle.
- The proximal femoral attachment for the ALLR graft is identified and marked. This location is 5 mm posterior and proximal to the fibular collateral ligament femoral attachment.
- A Q-Fix Anchor (Smith & Nephew) is placed at the distal fixation location. The graft is fixated distally using 2 modified Mason-Allen stitches while holding the graft in tension in the final fixation position.
- The rest of the surgery is now performed, the final ALLR graft fixation will be performed after the ACLR graft is fully secured.
- A Q-Fix Anchor is now placed at the proximal femoral fixation location. The leg is held at 20° of flexion and the knee in neutral rotation. Two modified Mason-Allen stitches are placed.
- Cycle and rotate the knee to ensure the graft is fixated properly.

Pearls

- A long incision facilitates proper graft harvest.
- Proper dissection needs to be carried out to best visualize the inferior aspect of the iliotibial band for graft harvest.
- The graft length should be measured with a ruler from the center of Gerdy's tubercle to ensure the graft is the proper length, a longer graft can be trimmed or sewn back onto itself later.
- The flare at Gerdy's tubercle aids in properly fixating the graft at the distal location.
- A spinal needle can be placed at the joint line to ensure proper landmarks are identified.
- Isolating out the FCL and identifying its femoral attachment can aid in identifying the proper location for the proximal femoral attachment.
- Before securing the graft, the graft length should be verified to ensure it can be secured properly at both fixation locations.
- Waiting until after the ACLR graft is fully fixated helps ensure the ALLR graft is properly tensioned.
- Graft fixation at 20° of flexion and neutral rotation is critical to ensure the graft does not constrict the joint. After the first stitch is placed, the graft should be tested to determine where the second stitch should be positioned to best tension the graft.
- The graft should tighten with internal rotation and loosen with increasing flexion.

ACLR, anterior cruciate ligament reconstruction; ALLR, anterolateral ligament reconstruction; FCL, fibular collateral ligament.

Anatomic ALLR with an iliotibial band graft step-by-step guide. This procedure is typically performed in conjunction with an anterior cruciate ligament reconstruction (not included in the step-by-step guide). The key surgical pearls are listed with each step.

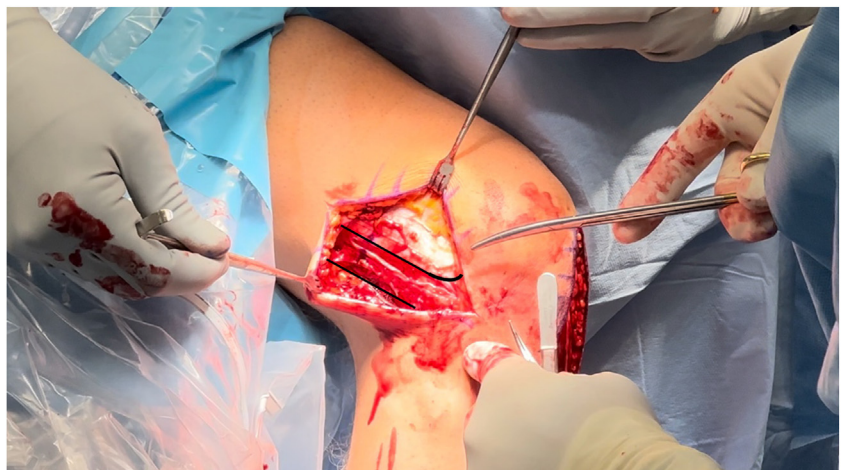
the inferior aspect of the iliotibial band. Parallel cuts are made starting proximally with the graft flaring at Gerdy's tubercle (Fig 3). By harvesting the graft from the inferior aspect of the iliotibial band, no closure of the iliotibial band is required at the end of the procedure. Initially the graft is left attached both proximally and distally to facilitate the detachment the underlying tissue adhesions from the graft. Once the graft is fully

detached, the proximal end of the graft is amputated, leaving the graft attached distally at Gerdy's tubercle.

Initial Graft Fixation

Next, the locations for the fixation point of the ALLR graft are located and marked. The distal tibial fixation location is identified first. Based on previous anatomical studies, the graft is fixated 1 cm distal to the joint line

Fig 3. Image showing the graft harvested (between black parallel lines) from the iliotibial band for the anterolateral ligament reconstruction (ALLR) (right knee, supine position). The graft is 8 cm long \times 1 cm wide and is harvested from the inferior aspect of the iliotibial band. The graft is slightly flared at Gerdy's tubercle (as depicted with black line). The graft is initially left attached at both the proximal and distal ends to remove any tissues adhered to posterior side of the graft. The graft is the amputated at the proximal end.



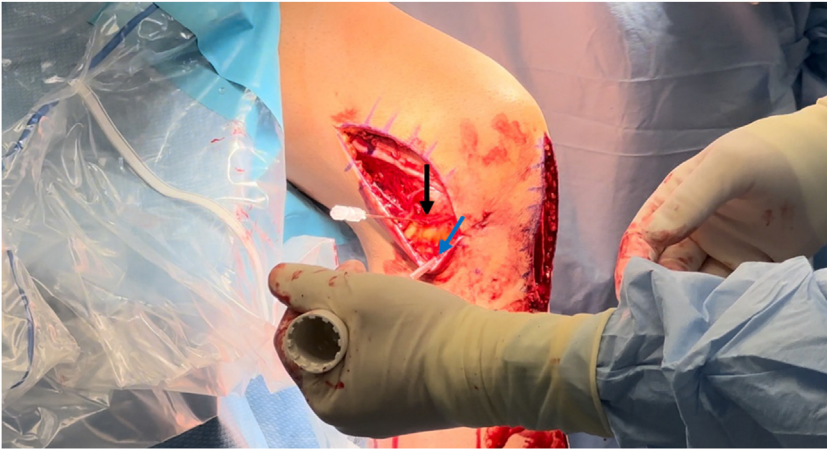


Fig 4. Image showing the distal attachment point of the anterolateral ligament reconstruction (ALLR) graft (right knee, supine position). The spinal needle is used to identify the joint line (black arrow). The landmark for the distal attachment is 1 cm distal to the joint line (black arrow) and midway between the anterior aspect of the fibular head and Gerdy's tubercle. The guide (blue arrow) depicts where the Q-Fix Anchor (Smith & Nephew) will be inserted to fixate the distal portion of the graft.

and midway between the anterior margin of the fibular head and the center of Gerdy's tubercle (Fig 4).⁶ A spinal needle is used to mark the lateral joint line to aid in identifying the proper landmark. After marking the distal fixation location, a Q-Fix anchor (Smith & Nephew, Andover, MA) is placed. The position is marked with a Q-Fix guide, the pilot hole is drilled, and the Q-Fix device is inserted. Care should be taken to ensure the Q-Fix anchor device is fully inserted into the guide before fixation of the anchor. The distal portion of the ALLR graft is then fixed with the sutures from the Q-Fix anchor. Before fixation, the graft should be positioned over the distal fixation location and held over the general proximal fixation locations to ensure the graft is sufficiently long enough (Fig 5). The graft is fixed using 2 modified Mason-Allen stitch techniques (Fig 6). Holding the graft over the proximal fixation location during the entire distal fixation helps ensure the graft is properly oriented and positioned. After the distal fixation, the proximal femoral fixation location of the ALLR graft is located and marked. The proximal landmark is 5 mm posterior and proximal to the

femoral attachment of the fibular collateral ligament (FCL) (Fig 7). Once the proper location has been marked, another Q-fix anchor is placed using the same technique as the distal Q-Fix anchor. The final fixation using this anchor will be performed at the end of the surgery.

Final Graft Fixation

Before final proximal femoral fixation of the ALLR graft, other portions of the procedure should be completed first. Arthroscopy is initiated to drill the tunnels for the ACL graft, assess other tissues and structures in the knee, and perform meniscus repair if indicated. The ACL graft is fixated in its reconstruction tunnels before the ALLR graft is fixated in its final position.

Finally, the ALLR graft is fixated at the proximal femoral attachment site. It is secured using the previously placed Q-Fix anchor using the same modified Mason-Allen stitch technique as the distal graft fixation. The graft is fixated with the knee at 20° of flexion and neutral rotation (Fig 8). Ensuring the graft is fixated

Fig 5. Before distal fixation of the anterolateral ligament reconstruction (ALLR) graft, the final graft fixation location should be verified to ensure there is enough graft length (right knee, supine position). The distal portion should be held over the distal attachment site (black arrow) that has a Q-Fix Anchor (Smith & Nephew) already placed. The proximal portion of the graft should be held over the fixation site (blue arrow), which is 5 mm posterior and proximal to the femoral attachment of the fibular collateral ligament (FCL).

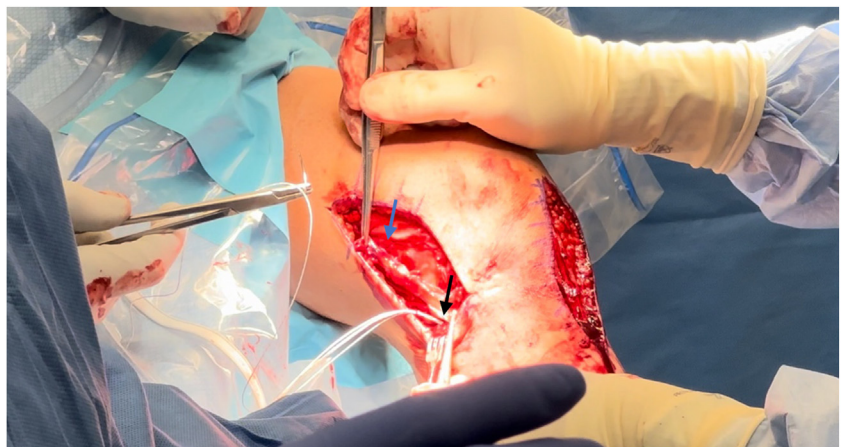
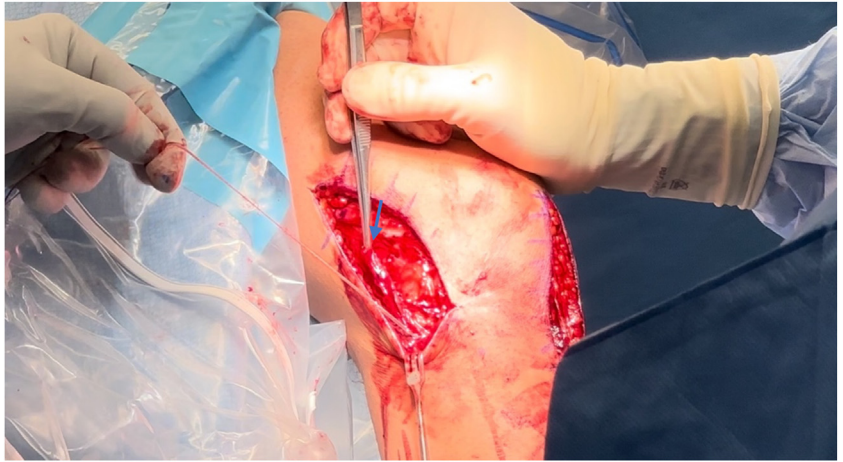


Fig 6. The distal tibial end of the anterolateral ligament reconstruction (ALLR) graft should be fixated first (right knee, supine position). After the first suture is passed and tightened using a modified Mason-Allen stitch technique, the graft should be tensioned and draped over the general area of the proximal attachment site (blue arrow), which is 5 mm posterior and proximal to the femoral attachment of the fibular collateral ligament (FCL). Then, the second modified Mason-Allen stitch can be placed and tightened in a similar location.



with the knee in the proper flexion and rotation help to ensure the graft does not restrict the knee but properly unloads the ACL graft. After the first stitch is placed, the tension of the graft is tested by flexing and rotating the knee. The graft should tighten with internal rotation of the knee and loosen with increasing amounts of knee flexion. If the graft is too loose, the second stitch can help tighten the graft. After final fixation, the end of the graft can be trimmed or sewn back on itself if extra is leftover. The knee should again be cycled to ensure the graft tightens with internal rotation and loosens with increasing flexion.

After final graft fixation, all deep and superficial tissues are closed. Closure of the iliotibial band is not required because of harvesting the graft at the inferior portion of the iliotibial band.

Postoperative Protocol

The patient begins physical therapy the following morning and will be nonweightbearing on the right knee for 6 weeks because of the meniscus root repair.

Flexion will be limited to 90° for the first 2 weeks, and then the patient may advance as tolerated. At 6 weeks, the patient may begin partial protected weightbearing in a functional hinge brace (CTi; Ossur Americas, Foothill Ranch, CA). Baseline AP and lateral x-ray films will be obtained after physical therapy, which will be repeated in 4 months to evaluate tibiofemoral position.

Discussion

Current indications suggest performing an ACLR with a ALLR augmentation when patients have meniscal deficiency, posterolateral injury or instability, high-grade pivot shift examination without concomitant injury to other knee structures, high posterior tibial slope (>12°), or revision ACLR. ACLR with concomitant ALLR helps to reduce persistent anterolateral rotational instability and reduce ACL graft failure. Certain concerns over performing an ALLR have been proposed that may deter some surgeons from performing an ALLR even when indicated. These techniques attempt to avoid some of the major concerns,

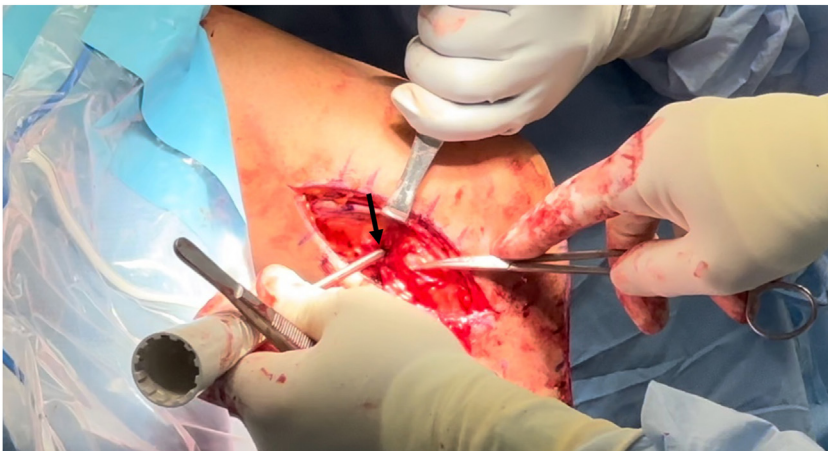


Fig 7. The proximal femoral attachment site for the anterolateral ligament reconstruction (ALLR) graft should then be identified (right knee, supine position). This position is about 5 mm posterior and proximal to the femoral attachment of the fibular collateral ligament (FCL). At this position, a second Q-Fix Anchor (Smith & Nephew) is placed (black arrow). The graft will be fixated at this location after the completion of the anterior cruciate ligament reconstruction.



Fig 8. The proximal femoral end of the anterolateral ligament reconstruction (ALLR) graft is fixated after the anterior cruciate ligament reconstruction graft is fully fixated (right knee, supine position). The knee should be placed in 20° of flexion and in neutral rotation, and the graft should be pulled into tension before the first suture is placed. After the first suture is passed and tightened using a modified Mason-Allen stitch technique, the knee should be examined to determine where the second suture should be placed for proper tensioning. Then, the second modified Mason-Allen stitch can be placed and tightened. The knee should be examined for proper knee and graft function. The path of the graft is marked with the black lines.

like overconstraint of the knee, altered knee kinematics, and a nonanatomic reconstruction. ACLR with an anatomic ALLR with an iliotibial band can improve surgical outcomes by helping to augment the ACL and reduce knee instability. Advantages and disadvantages of this technique are listed in Table 2.

Various biomechanical studies have demonstrated that performing an ALLR reduces residual laxity after ACLR and can help in controlling anterolateral rotational stability and anterior translation. In addition, because of load sharing between the ACL and the ALLR, the forces experienced by the ACL can be

offloaded to help prevent graft failure.⁵ Furthermore, clinical studies have reported that ACL reconstruction with ALLR improves clinical outcomes for indicated patients by reducing graft failure rates, reducing persistent anterolateral rotational laxity, and reducing high-grade postoperative pivot shift examinations.^{3,7} Based on the biomechanical and clinical data, an anatomic ALLR augmentation with an iliotibial band graft in conjunction with ACLR may help reduce anterolateral rotational instability and improve outcomes for indicated patients undergoing ACLR patients. Overall, the poor patient outcomes and failure of the ACL graft when anterolateral instability is present makes performing the ALLR with an ACLR an important surgical technique. This can help to restore normal knee rotational stability and reduce poor patient outcomes associated with residual and persistent anterolateral rotational instability after ACL reconstruction.

Table 2. Advantages and Disadvantages of New ALLR

Advantages

- Cheaper cost, utilizes autograft instead of allograft
- Shorter iliotibial band graft vs other methods, 8 cm vs 10 cm
- No closure of the iliotibial band required
- Can help augment the ACL graft by reducing tension forces on the graft
- Can be performed in conjunction with an ACL reconstruction
- Graft stays attached to Gerdy's tubercle
- Less likely for over constriction by not going under the FCL
- Graft attempts to mimic the native anatomy of the anterolateral ligament which is superior to the FCL

Disadvantages

- Possible morbidity and large incision over the ALLR augmentation site
- Increases operative time
- Increases risk of iatrogenic tissue damage
- The graft can be over tensioned causing constriction of the knee
- Graft can be too short for proper fixation
- Loose graft fixation can make ALLR augmentation ineffective

ACL, anterior cruciate ligament reconstruction; ALLR, anterolateral ligament reconstruction; FCL, fibular collateral ligament.

The advantages and disadvantages of this described anatomic ALLR with an iliotibial band technique.

Disclosures

The authors declare the following financial interests/ personal relationships which may be considered as potential competing interests: N.I.K. reports speaking and lecture fees from Smith & Nephew and Foundation Medical; and travel reimbursement from Medical Education. R.F.L. reports Board member/owner/officer/committee appointments with ISAKOS, AOSSM, and AANA; royalties from Ossur, Smith & Nephew, Elsevier, and Arthrex; research or institutional support from AANA, AOSSM, Ossur, and Smith & Nephew; and is a paid consultant or employee for Ossur, Smith & Nephew, Linvatec, and Responsive Arthroscopy. All other authors (M.I.K., L.V.T.) 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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