Technical Note

Fixation of Lateral Extra-articular Tenodesis With a Biointegrative Compression Staple

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Abstract: Anterior cruciate ligament (ACL) tears are a common knee injury, particularly among cutting and pivoting athletes. Despite advancements, retear rates and outcomes remain unsatisfactory in certain populations. Lateral extra-articular iliotibial band tenodesis (LET) has gained traction as an adjunct to ACL reconstruction to decrease retear rates and enhance knee stability by reducing the pivot shift. We present a technique for LET fixation using the OSSIOfiber Compression Staple, a biointegrative implant that promotes osseointegration. The technique involves standard ACL reconstruction followed by LET fixation with the OSSIOfiber staple, offering potential advantages such as reduced radiographic artifacts and enhanced integration.

Anterior cruciate ligament (ACL) tears are one of the most common knee injuries for cutting and pivoting athletes.[1,2] Despite advancements in anterior cruciate ligament reconstruction (ACLR) techniques, retear rates and outcomes remain unsatisfactory in certain populations.[3-5] Recent investigations into the persistence of anterolateral rotational laxity in patients have led to an increased focus on the role of the anterolateral complex for knee stability.[6] Specifically, lateral extra-articular iliotibial band tenodesis (LET) has grown in popularity in the setting of ACLR. Previous studies have demonstrated that the addition of LET may reduce retear rates and improve clinical outcomes when performed in conjunction with an ACLR.[7,8] There are multiple described methods of fixation for the iliotibial band (ITB), including, but not limited to, tenodesis screws, knotless anchors, and metal staples.

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Received September 13, 2024; accepted November 21, 2024.

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2212-6287/241532

https://doi.org/10.1016/j.eats.2024.103399

The use of osseointegrative implants is gaining popularity in orthopaedic surgery.[9,10] OSSIOfiber (OSSIO) is a biointegrative material that draws benefits from its continuous, mineral fiber matrix composition. This material demonstrates bony attachment in as little as 2 weeks via bone-in growth and achieves complete osteointegration within 2 years of being implanted. Implants composed of this material upon initial fixation at the time of surgery are 150% tougher than cortical bone and can be up to 200% and 500% tougher than PEEK (polyether ether ketone) screws and conventional polymer bioresorbables, respectively.[11] In this article, we describe a technique for LET fixation using an OSSIOfiber Compression Staple (OSSIO).

Indications

Indications for ACLR with LET are higher-risk patients for ACL graft retear. Such patients may include but are not limited to (1) female patients, (2) soccer athletes, (3) elite athletes, (4) inherent ligamentous laxity, (5) increased posterior tibial slope, (6) high-grade pivot shift, (7) revision ACL surgery, (8) meniscal root tears and subtotal meniscectomies, and (9) chronic ACL tears.[12]

Surgical Technique

The patient is positioned in a standard fashion for an ACLR. The skin is marked out laterally for the LET (Video 1). Standards portals are made for ACLR. Any meniscal or cartilage pathologies are also addressed at this time.

Fig 1. Patient is in a supine position with the left operative knee flexed over the side of the table. A 6-cm incision line is marked on the lateral aspect of the knee that runs longitudinally 2 cm proximal to Gerdy's tubercle.

Attention is then turned to the LET. A 6-cm incision that runs longitudinally with a No. 15 blade is made on the lateral aspect of the knee that starts 2 cm proximal to Gerdy's tubercle (Fig 1). Soft tissue is cleared away off the ITB with a Cobb elevator, and the ITB is identified. A 1-cm × 8-cm strip of the ITB is marked with a surgical marker on the middle third of the ITB. Two parallel incisions using a No. 15 blade are made along the long edges of the marked strip of the ITB (Fig 2). The graft is released proximally using the No. 15 blade to incise the proximal short edge of the ITB strip. The strip of the ITB is released from the vastus lateralis while maintaining its connection to Gerdy's tubercle using blunt dissection. The lateral collateral ligament (LCL) is then identified through the created ITB window as the cord-like structure traveling from the lateral femoral epicondyle to the anterolateral fibular head. A stab incision is made with a No. 15 blade just proximal and distal to the LCL, and a hemostat is then passed under the LCL to widen the space. This pathway is then further expanded by flossing under the LCL with a No. 2 FiberWire (Arthrex) suture. A curette and rongeur forceps are used to clear away soft tissue just proximal and posterior to the lateral epicondyle to create a bony footprint for the staple. The bony footprint should measure approximately 2 cm anterior to posterior and 1 cm distal to proximal.

Fig 2. Items included in a disposable, single-use kit are the 15-mm × 15-mm OSSIOfiber Compression Staple (OSSIO), two 1.4-mm K-wires, a 2.5-mm drill bit, 2 locating pins, a drill guide, an inserter, and a tamp. Multiple sizes of the staple are available—this technique utilizes the 15-mm × 15-mm staple.

Figure 3 demonstrates the instruments used for the use OSSIOfiber Compression Staple kit: 15-mm × 15-mm staple, a 2.5-mm drill bit, 2 locating pins, a drill guide, an inserter, and a tamp. The drill guide is placed perpendicular to the femur at the bony footprint, and tunnels are drilled using the provided 2.5-mm drill bit. One should aim to be as perpendicular as possible in this area given the curvature of the femur in the metadiaphyseal area. Locating pins are malleted into the tunnels to maintain position after drilling each tunnel. The drill guide is removed, and then the locating pins are removed. The staple is placed on its inserter and inserted halfway using a mallet against the back of the inserter. Enough space is maintained between the footprint and staple while malleting such that the harvested graft can later pass underneath the staple (Fig 4). This portion of the LET is performed first to avoid any tunnel convergence with the ACLR femoral tunnel.

Femoral and tibial tunnels are drilled in the standard fashion. One should be cautious not to create the

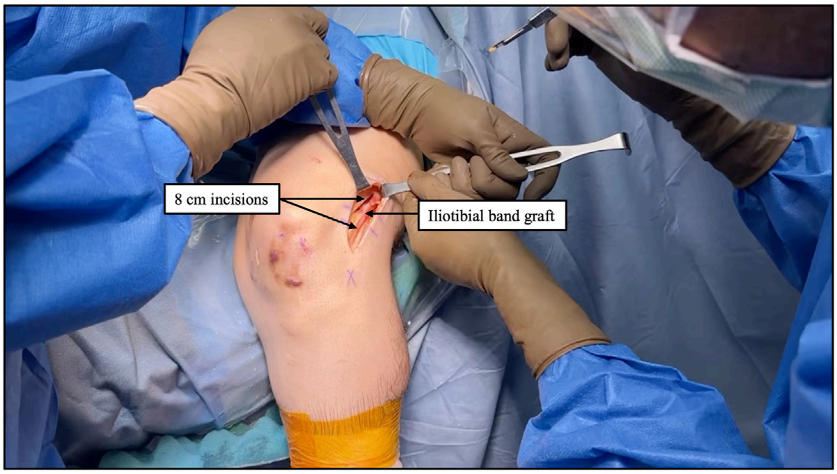

Fig 3. Patient is in a supine position with the left operative knee flexed over the side of the bed. Using a No. 15 blade, a 1-cm × 8-cm strip of the iliotibial band (ITB) is harvested from the middle third of the ITB while maintaining its distal connection to Gerdy's tubercle. This strip of the ITB will be used as the graft for the lateral extra-articular tenodesis.

femoral tunnel too proximal and close to the staple as to avoid tunnel convergence.

Once the ACL graft is tensioned and fixed in standard fashion, attention is turned back to completing the LET. The ITB graft is stitched with a suture and then passed underneath the LCL and the staple (Fig 5). At approximately 30° to 60° of knee flexion and neutral tibial rotation, the graft is fixed and tensioned by malleting a tamp against the staple until it is fully seated against the femur.

Rehabilitation

The postoperative protocol for ACLR with LET focuses on gradually restoring range of motion, initially allowing movement as tolerated and progressing to full range of motion by 6 to 12 weeks. Rehabilitation exercises advance from basic mobilization and stretching in the early weeks to open-chain strengthening, balance, and plyometric drills, with jogging introduced by 4 months. A gradual return to sport is recommended starting at approximately 9 to 12 months, after clearance by isokinetic strength, functional, and psychological readiness testing.

Discussion

The described technique for LET utilizes a biointegrative OSSIOfiber Compression Staple in the fixation of the ITB graft.

Previously, staples used in the literature for LET fixation were made of metal.[7,13,14] Metal implants on postoperative magnetic resonance imaging can result in artifact, which can make it difficult to interpret pathology around the knee accurately. Radiologists have created methods with metal suppression to reduce this influence, but they do not resolve it completely.[15,16] Implants composed of OSSIOfiber material do not cause metal artifact on radiographic imaging, therefore simplifying radiologic interpretation.

Current literature states that metal allergies are prevalent in 10% to 17% of the general population.[17]

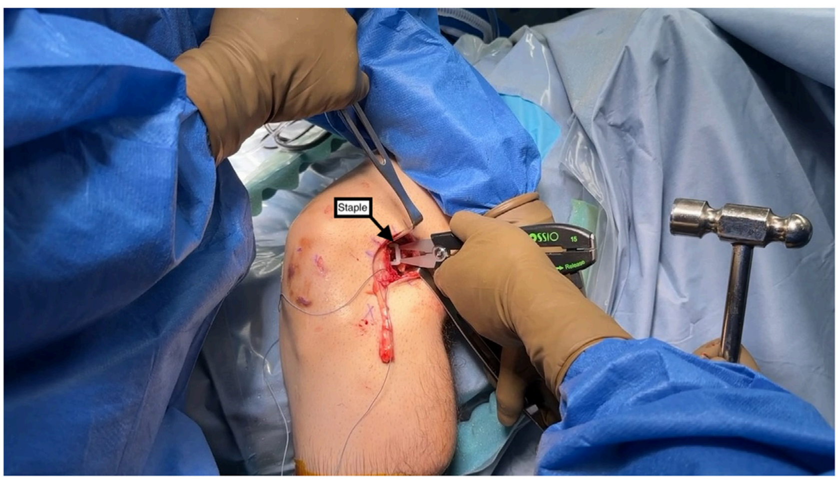

Fig 4. Patient is in a supine position with the left operative knee flexed over side of bed. The OSSIOfiber Compression Staple (OSSIO) is guided into the bone tunnels on the inserter and malleted in. Initially, enough space is left under the staple so that the iliotibial band graft can be passed under later in surgery.

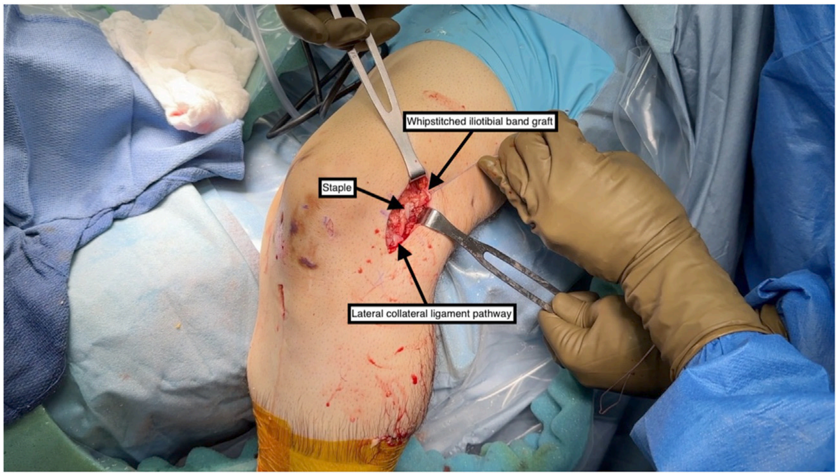

Fig 5. Patient is in a supine position with the left operative knee flexed over side of bed. The iliotibial band graft is whipstitched and passed underneath the lateral collateral ligament and then under the staple. The iliotibial band graft is finally fixed as the staple is fully malleted down flush to the bone.

Patients with metal allergies or hypersensitivities can experience localized or generalized reactions with metal orthopaedic implants. This can lead to patient symptomatology or even implant loosening in rare cases.[18,19] OSSIOfiber implants are not made of metal and have a material composition of nearly 50% natural mineral fibers. Thus, patients are much less likely to experience adverse reactions to the implant material.[11]

LET-augmented ACLR does not greatly increase the rate of adverse events. In the STABILITY study that examined 2-year postoperative outcomes for ACLR with LET versus standard ACLR, the only increased complication occurred at 3 months postoperatively—patients had increased hardware irritation and increased pain. These symptoms may be attributed to the use of metal staples in the study, which can be proud and irritate the soft tissue, requiring hardware removal.[12,13,20] While metal staples may migrate, causing soft tissue irritation, the OSSIOfiber staple is biointegrative and resorbable. The biointegrative properties of this staple make it less likely to pull out over time and instead incorporate into the bone. In addition, the biointegrative property may aid in revision cases. Future femoral tunnel planning is not complicated with prior hardware on the femoral cortex.

The use of biointegrative compressive staples for LET has not been validated in current literature. However, utilization of these staples has been studied with other orthopaedic pathologies. In ankle fractures, the biointegrative staples provided satisfactory results in fracture healing and functional results compared to conventional metal fixation and reduced the need for implant removal.[21,22] In ACLR, biointegrative screws demonstrated no differences in comparison to titanium screws in clinical outcomes or objective knee laxity. Biointegrative screws also demonstrated functional osseointegration by narrowing the tibial tunnel on computed tomography scans.[23,24]

This technique is not without disadvantages. The cost of a biointegrative staple is more than a conventional metal staple or anchor. In addition, 2 drill holes are required for the staple legs as opposed to 1 drill hole for a single anchor. Also, it may be difficult to insert the staple perfectly perpendicular to the surface of the femur in this location, which may compromise fixation strength if off angle. A summary of advantages and disadvantages and pearls and pitfalls of this technique can be found in Tables 1 and 2, respectively. In conclusion, we present a technique utilizing the OSSIOfiber Compression Staple for LET fixation.

Table 1. Advantages/Disadvantages

Advantages	Disadvantages
Staple is biointegrative	Increased cost
Reduced radiographic artifact on postoperative imaging	Possible increased operative time
Enhanced mechanical strength at initial fixation	Two drill tunnels and risk of femoral tunnel convergence
Lower risk of hypersensitivity reactions	Lack of long-term, clinical outcomes

Table 2. Pearls/Pitfalls

Pearls	Pitfalls
Ensure upon initially malleting the staple that enough space is maintained between the staple and bony footprint so that the iliotibial band graft can be passed underneath later in surgery.	Failure to find a surface for perpendicular staple placement may compromise fixation.
When drilling the femoral tunnel for the anterior cruciate ligament reconstruction, ensure the femoral tunnel and staple tunnels do not converge.	Avoid overtensioning the iliotibial band graft when fully seating the staple against the bony footprint.

Disclosures

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: E.W.B. is a board member of EBSCO and is a consultant or advisor for Link Orthopaedics Pty Ltd and Orthopaedic Design NA. A.J.C. is a board member of the American Orthopaedic Society for Sports Medicine and is a consultant or advisor for Arthrex. A.M.M. is a board member of Arthroscopy; is a consultant or advisor for Arthrex, CONMED Linvatec, Fidia Pharma USA, and Miach Orthopaedics; and has equity and stocks with Reparel. All other authors (C.A.R., D.D., H.V.B., M.L.H., T.B.E.) 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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