Anterior Talofibular Ligament Augmentation with A Polycaprolactone Based Polyurethane Suture Scaffold: A Technique Guide

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Post-op Course
Post-operatively the authors recommend application of a NWB short leg cast for four to six weeks. The patient then progresses to protected weight bearing in a pneumatic walking boot for three weeks. Physical therapy is initiated 3 weeks post-operatively. The patient must take care to ensure the rehab process does not compromise the integrity of the augmented ligament. Once the patient is advanced to full unrestricted weight bearing, the patient’s wear an ankle stabilizing brace for several months as the graft is incorporated and replaced with native tissue.

Introduction
Over 30,000 lateral ankle injuries occur each day in the United States with the potential to cause stretching, partial tears or complete rupture of the lateral ankle ligament complex. Each grade of ligamentous injury has a variety of treatment options available to augment/repair the resulting lateral ankle instability for resolution of symptoms. Each technique has indications depending on the varying severity of the pathology. The traditional methods of repair include: primary anatomic reconstruction, suture advancement, or thermal augmentation; anchor fixation, hamstring suture repair and allarthrop repair. In chronic Grade 3 lateral ankle sprains involving complete rupture of the ATFL (anterior talofibular ligament), primary anatomic repair is not always possible as patients typically have a delayed presentation. The authors here present a retrospective case series of lateral ankle ligament augmentation for repair of chronic ATFL injury using a synthetic bio-absorbable implant which enhances the ligaments mechanical strength through its inherent elasticity allowing the surgeon an augmented ligament with improved strength, biocompatibility and long term stability.

Literature Review
In the design of a degradable device for ligament reconstruction, whether a true prosthesis or an augmentation device, many biological and mechanical criteria must be met. High initial strength is needed to prevent mechanical failure prior to tissue ingrowth. In addition, a moderate degradation rate is required to induce ingrowth of organized tissue. If degradation is too slow, the host tissue may be exposed to stresses that are too great, resulting in premature failure. On the other hand, if the degradation is too slow, stress shielding may occur. Thus, an appropriate material for ligament augmentation/reconstruction should be: (1) compatible with surrounding tissues and allow cell ingrowth, (2) mechanically similar to native ligament, (3) degradable, but keeping at least 50% of its strength and stiffness for at least 9-12 months. The graft used for this study is a porous polylactide (PLA) sponge which provides a scaffold allowing ingrowth of collagen fibers. This material has been in use in surgical procedures for over 30 years and more specifically in orthopedic type procedures for approximately 15 years. The implant maintains initial strength and elasticity of the long term to provide support. The polylactide graft retains approximately 50% of its strength after 4 years. It is designed to degrade over the course of 5 to 7 years as the host tissue replaces the majority of the graft material.[1] Integration into the host tissue occurs after 6 months, which promotes the return of the normal physiological properties of the tissue. This synthetic polylactide graft was first used in the human field to augment achilles tendon ruptures, rotator cuff repairs, and ACL repairs. In these applications, the existing ligaments and tendons were wrapped and sutured to a strip of polylester tissue scaffold which then acted as a scaffold to promote healing of the ligament or tendon. With this being a biocompatible synthetic material, there is no risk of collagen rejection or disease transmission.[11,14,15] Grootefeld et al. demonstrated that fibers made of PURU (polyurethane urea) based on PCL530 have superior strength and stiffness compared to other materials, there is no risk of collagen rejection or disease transmission. Thus, a biodegradable implant which enhances the ligaments mechanical strength through its inherent elasticity allowing the surgeon an augmented ligament with improved strength, biocompatibility and long term stability.

Various approaches are appropriate for ATFL repair[2,14]. Anesthesia is surgeon preference. The authors use a combination of general anesthesia with local infiltration of anesthetic or a peripheral popliteal block based on individual patient needs. The authors perform the procedure without the aid of a tourniquet and use a traditional open technique with a curvilinear incision oriented from distal fibula to the sinus tarsi. Anatomic dissection is performed in layers with hemostasis obtained by electrocautery or vicryl ties. Blunt dissection is used to mobilize the fat off the extensor retinaculum, peroneal sheath and anterior ankle joint capsule. The anterior lateral talar shoulder is identified as it abuts the lateral extent of the iliacus. An anterior lateral ankle arthroscopy is created overlying the lateral ankle gutter and a seahussein ribon is used for retraction.[1]

In cases where the ATFL rupture is not amenable to primary repair alone, there is often significant fibrotic tissue from soft tissue remodeling, typically triangular in shape, which is redundant and excised in total.[17] This will expose the lateral shoulder of the talon dome identifying the superior aspect of the ligament so both the superior and inferior portions of the ligament are identified. If there are intracapsular vesicles bleeding, these are easily controlled with electrocautery.

The ATFL is identified. An anterior drawer test is now performed (Figure 2). If a positive drawer sign is identified the surgeon may choose to use a fully synthetic Polycaprolactone based polyurethane graft to augment the compromised ligament repair. Anchor selection to affix the graft is based on surgeon preference. The authors have used knotless systems or traditional anchor fixation ranging from 2.8 mm to 3.5 mm suture anchors. The senior author prefers to use an anchor that has a double strand to afford two separate points of fixation in each of the anchor insertion. Based on the size of the defect and the amount of augmentation needed, the surgeon decides between the 0.5 cm or 0.7 cm wide synthetic strips. The graft requires 5 minutes of soaking in saline prior to its insertion. The authors recommend selecting the appropriate size graft and beginning to soak the graft prior to placement of the suture anchors to avoid unnecessary delay.

Surgical Technique
In preparation of suture anchor placement, dissection is continued distal-medial to access the lateral talar neck. The distal talar neck is now placed into the neck ensuring it is oriented anterior to posterior. This is placed at the level of the insertion of the ATFL into talus and no laxity exists at the attachment interface. Failure to have the graft in the appropriate orientation prior to securing the distal fixation will result in torsion and a significant bend in the synthetic graft once secured proximally.

Once the polylester graft is secured distally dorsflex and evert the foot on the ankle. Place the graft under slight manual tension and secure it to the fibular anchor using the associated suture (Figure 5). If the synthetic graft is not tensioned prior to proximal fixation, the resulting laxity in the augmentation will ultimately fail to address the ligamentous instability. However, take caution not to over tension the synthetic graft as this has the potential to cause pain and rigidity postoperatively. The redundant graft is now cut proximally taking care to leave a 5mm tail. This tail is then buried using the anterior and secured with peristomal Ethibond suture (Figure 6).

An anterior drawer test is now repeated prior to closure of the incision site to directly visualize the strength of the augmentation. The authors recommend dissecting the inferior extensor retinaculum and advancing it proximally to the fibula using 2.0 Ethibond i 
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Figure 1: Tensioning of the Synthetic Graft

Figure 2: Positive Anterior Drawer Test

Figure 3: Suture Anchor

Figure 4: Synthetic Graft Secured into Lateral Talus

Figure 5: Anterior Drawer Test

Figure 6: Proximal Suture Anchor Placement

Figure 7: Completed Prosthesis w/ Incorporation of Medial Ligament Reconstruction - Artelon Cosmetic Basket

References


