



All-Inside Arthroscopic Anatomic Anterior Talofibular Ligament Repair for Anterolateral Ankle Instability Using a Knotless Suture Anchor, Allowing for Tension Adjustment

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Abstract: In recent years, arthroscopic anterior talofibular ligament (ATFL) repair techniques have been increasingly used for chronic ankle instability. Besides permitting the treatment of several comorbidities, arthroscopic techniques are applied to minimize the need for aggressive surgery and improve the assessment of anatomic structures. We describe our surgical technique for all-arthroscopic anatomic ATFL repair using a knotless anchor, which can adjust suture tension under direct visualization using a self-locking mechanism. Thus, this technique diminishes the chance of repaired ligament separation from its attachment by obtaining the desired tension. Moreover, its knotless property allows the avoidance of some complications such as neuritis and pain related to bulky knots.

Chronic ankle instability develops in 20% to 30% of patients with ankle sprain injury and is predominantly caused by anterior talofibular ligament (ATFL) tears.¹ The Broström procedure, with its several modifications, has been considered the gold standard of surgical treatment for several years.² With the development of anchor and fixation devices that have facilitated arthroscopic-assisted ligament repair, several arthroscopic ATFL repair techniques have recently been reported and biomechanically and clinically validated in cases where the ATFL remnant's quality is sufficient.³⁻¹⁰

The arthroscopic ATFL repair technique is still challenging, however, with a steep learning curve, and is not exempt from complications (5.3% to 29%), which are mostly neuritis of the superficial peroneal or

sural nerves and pain or discomfort arising from a prominent anchor or suture knot.^{7,11} Recently, an all-inside arthroscopic technique using the loop technique and a knotless PushLock® suture anchor (2.9 × 15 mm; Arthrex, Naples, FL) was developed, with excellent clinical results and low complication rates.⁴ However, there has been concern regarding the tension of the loop stitch that grasps the remnant ATFL. For these reasons, we adjusted our arthroscopic technique for ATFL repair by adapting a recently developed implant primarily used for labral repair in patients with shoulder instability. The Knotless SutureTak® suture anchor (3.0 × 12.7 mm; Arthrex) simplifies arthroscopic ATFL repair by combining a proven and reproducible suture anchor design and insertion procedure with knotless soft-tissue fixation. In addition, this anchor device can adjust the suture tension under arthroscopic direct visualization. Therefore, the aim of this article is to present an arthroscopic technique for all-inside ATFL repair using a knotless SutureTak anchor device.

Surgical Technique

Indications and Contraindications

The indication for ATFL repair is symptomatic or objective chronic anterolateral ankle instability due to an ATFL rupture. The contraindication is poor quality or absent remnant ATFL.

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Patient Positioning

Spinal anesthesia is administered, and the patient is placed in the supine position. Ankle distraction is not used for this procedure. After inflating the tourniquet to 270 mmHg, the ankle is draped and prepared in a sterile fashion.

Diagnostic Arthroscopy

A medial midline (MM) portal (just lateral to the tibialis anterior tendon) is used as a viewing portal for better visualization of the ATFL and surrounding tissue.^{3,8} A 2.9-mm, 30° arthroscope (ConMed Linvatec, Largo, FL) is introduced via the MM port, and the anterolateral portal is the working portal. Intra-articular pathologies are managed with appropriate procedures, including debridement of soft tissue impingement or synovitis, excision of osteophytes, debridement, and bone marrow stimulation procedures, such as microfracture or abrasion arthroplasty, for osteochondral lesions of the talus, and removal of loose bodies. After arthroscopic examination, we remove the ankle joint distraction to perform lateral ligament repair. When the ATFL tear is diagnosed, the quality of the ATFL remnant is assessed. When the tissue is neither severely attenuated nor absent, an all-inside arthroscopic anatomic repair is performed.

Procedure

Micro SutureLasso (TFCC, Short 70° bend, Arthrex) and knotless SutureTak anchor (3.0 × 12.7 mm; Arthrex) are used for ligament repair (Video 1). This anchor includes repair and shuttling sutures (Fig 1). An accessory anterolateral portal is created during the procedure just anterior to the fibula, 0.5 to 1 cm proximal to the tip of the lateral malleolus with transillumination, to protect the superficial peroneal nerve.

After evaluating the ATFL tear, the cortex bone at the footprint of the fibula is debrided with the shaver (Fig 2A). The suture passer is introduced through the acAL portal, and under direct arthroscopic visualization, the ligament is penetrated from the inferolateral to superomedial (Fig 2B). The Nitinol loop wire is pulled out through the acAL portal with the help of an arthroscopic retriever (Fig 2C to 2E), and a drill guide is placed through the acAL portal in the previously prepared bony bed in the distal fibula (Fig 2F). To reproduce the anatomic insertion of the ATFL, the anchor is located on the native fibular attachment of the ATFL around the obscure tubercle. The hole is drilled from the distal to proximal and anterior to posterior direction, and the knotless anchor is inserted through the drill guide (Fig 2G). The repair suture is loaded through the Nitinol wire loop, which is then pulled back (Fig 2H and 2I). The end of the repair suture is run from the acAL portal through the ligament and back to the acAL portal (Fig 2J). The repair suture is then loaded through

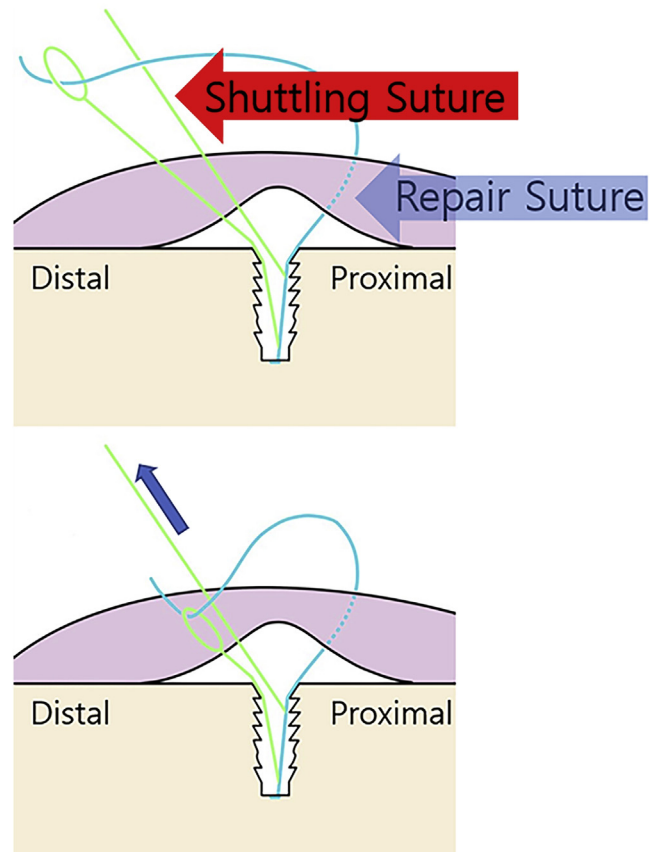


Fig 1. Knotless SutureTak anchor (3.0 × 12.7 mm; Arthrex) repair and shuttling sutures.

the loop of the shuttling suture (Fig 2K). The free end of the shuttling suture is pulled to shuttle the repair suture back into the anchor, and the shuttle suture is advanced with repeated light tugs until the suture passes through the suture splice locking mechanism and back out the acAL portal (Fig 2L). The free end of the repair suture is pulled until the desired tension is achieved (Fig 2M and 2N). The suture is then cut using a mini-suture cutter. The surgical technique can be viewed in the Video.

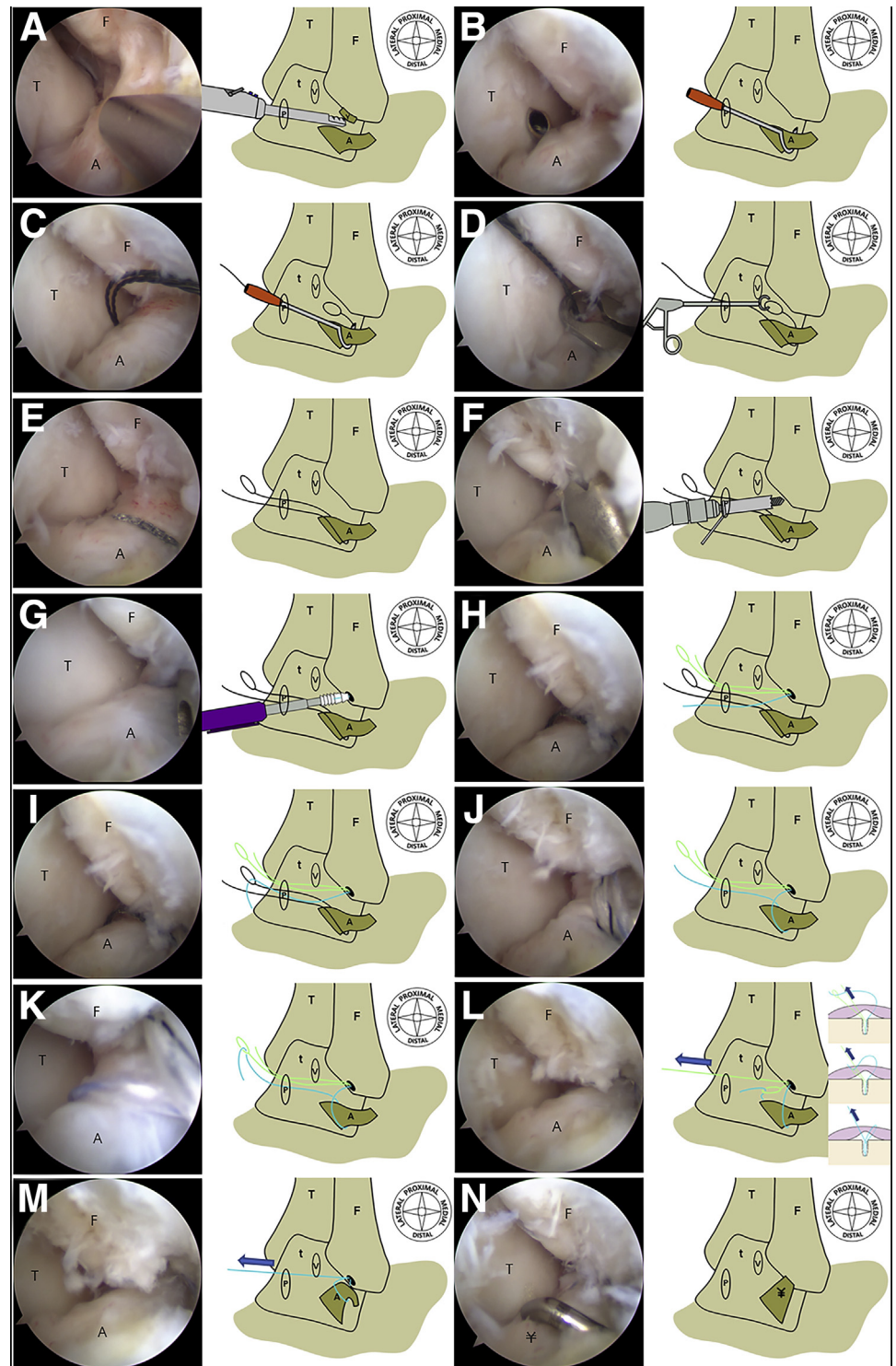
Rehabilitation

A compressive bandage and posterior plaster splint are applied with the ankle in a neutral position and maintained for 2 to 3 days. The bandage is removed on the second or third postoperative day and is switched to a removable walking boot to begin partial weight-bearing with an assistive device for the first 2 weeks. Full weightbearing and active range of motion exercises are permitted 2 weeks after surgery, with the goal of an early return (within 3 months) to sporting activities.

Discussion

This article describes an arthroscopic anatomic ATFL repair technique that allows for the restoration of ankle

Fig 2. Illustrations and arthroscopic views of arthroscopic anterior talofibular ligament (ATFL) repair. (A) Footprint of the torn ATFL is debrided. (B) Suture passer is passed through the accessory anterolateral (acAL) portal and used to penetrate the ATFL from inferolateral to superomedial. (C to E) Nitinol loop wire is passed through the suture passer and pulled out through the acAL using a retriever. (F) Drill guide is placed through the acAL portal in the ATFL insertion site. (G) Hole is drilled from the distal to proximal and anterior to posterior direction, and the knotless anchor is inserted through the drill guide. (H and I) Repair suture is loaded through the Nitinol wire loop which is then pulled back. (J) End of the repair suture is run from the acAL portal through the ligament and back to the acAL portal. (K) Repair suture is loaded through the loop of the shuttling suture. (L) Free end of the shuttling suture is pulled to shuttle the repair suture back into the anchor, and shuttle suture is advanced with repeated light tugs until the suture is passed through the suture splice locking mechanism and back out the acAL portal. (M and N) Free end of the repair suture is pulled until desired tension is achieved. A, remnant of the anterior talofibular ligament; F, fibula; V, medial midline portal; P, accessory anterolateral portal; T, tibia or talus; Y, remnant of anterior talofibular ligament attached to the fibula; ¥, repaired anterior talofibular ligament.



joint stability. A knotless SutureTak anchor is used for repairable ATFL tears, providing a firm repair with the desired tension, which is easily achieved by pulling out the repair suture of the knotless anchor, thereby preventing the separation of the repaired ligament from its attachment and allowing for proper stability

(Table 1). In addition, the knotless property of ligament repair helps to avoid complications such as neuritis and pain or discomfort arising from a prominent suture knot.

The possible advantages and limitations of the technique must be considered, however (Table 2). As

Table 1. Pearls and pitfalls

Key surgical step	Pearls	Pitfalls
Ankle dorsiflexion without distraction	No distraction of ankle joint	Dorsiflexion method for anterior ankle
Creation of MM portal	Arthroscopy creates an anterior working space and relaxes the anatomic structure during the procedure, lowering the rate of complications Create the MM portal just lateral to tibialis anterior tendon and slightly proximal to the joint line for better visualization of the ATFL and surrounding tissue	Maintaining dorsiflexion of ankle joint during surgery is important If the MM portal is created too laterally, there is risk of anterior tibial neurovascular bundle injury.
Creation of acAL portal	The acAL portal should be created under direct control with the arthroscope in the MM portal	Risk of injury of branch of superficial peroneal nerve; make the acAL port with transillumination technique to prevent this injury
ATFL grasping	The suture passer is introduced through the acAL portal, and the ligament is penetrated from inferolateral to superomedial; penetrate ATFL as deep as possible to grasp inferior fascicle of ATFL	If the suture passer penetrates ATFL superficially, it could be a reason for ligament cutting by suture material and weakness of fixation power of ATFL at insertion site
Anchor insertion	To reproduce anatomic insertion of the ATFL, the anchor is located on the native fibular attachment of the ATFL around the obscure tubercle	If anchor inserted at nonanatomic position such as too high, it could be a reason for continuous instability after surgery
Shuttle relay of repair suture	Pull the free end of the shuttling suture to shuttle the repair suture back into the anchor	When repair suture passes ligament through shuttling suture, there is some resistance to pull out repair suture, and overpulling of shuttle suture could occur; thus, advance the shuttle suture with repeated light tugs until the repair suture is back out the acAL portal
Adjustment of repair tension	The free end of the repair suture is pulled until the desired tension is achieved and checked	Avoid overtensioning the structures and always confirm that passive full dorsiflexion and plantarflexion are possible after ligament repair Excessive tension might cause secondary complaints after surgery

ACAL, accessory anterolateral; ATFL, anterior talofibular ligament; MM, medial midline.

an arthroscopic technique, an all-inside anatomic ATFL repair provides the advantages of minimally invasive surgical techniques. There is less trauma to the surrounding tissues compared with open surgery,

Table 2. Advantages and disadvantages

Advantages

- Arthroscopy enables better visualization of tissue quality and characterization.
- Arthroscopy provides a chance to recognize and treat concomitant intra-articular pathologies.
- Arthroscopy results in less postoperative swelling and discomfort.
- Arthroscopic ligament repair provides better cosmetic results.
- The technique provides a firm repair with the desired tension, which is achieved easily by pulling out the repair suture of the knotless anchor.
- The technique does not require experience in knot-tying.
- The knotless property of the ligament repair helps avoid complications such as neuritis and pain or discomfort arising from a prominent suture knot.

Disadvantages

- Ankle ligament arthroscopic repair requires previous experience in ankle arthroscopy.
- The technique is possible only when the quality of the ATFL remnant is suitable for repair.
- The use of suture anchors increases the cost compared with some classic techniques.

ATFL, anterior talofibular ligament.

which reduces postoperative pain and permits early rehabilitation, leading to faster recovery.^{4,7,8,11,12} In addition, arthroscopic visualization of the joint enables anatomic restoration of the ATFL from its fibular to talar footprint. It has been proven that anatomic repair provides proper joint stability and adequate load distribution in the ankle and subtalar joints, which consequently diminishes the risk of future osteoarthritis development.¹³ Moreover, direct visualization of the ankle joint provides a chance to recognize and treat concomitant intra-articular pathologies such as soft tissue impingement, ossicles at the lateral malleolus, syndesmosis widening, or osteochondral lesions in a 1-stage procedure.¹⁴ Arthroscopic visualization of the ATFL also facilitates the decision whether to perform repair or reconstruction.

The described technique also has some disadvantages. First, this surgical procedure has a steep learning curve and needs to be performed by a surgeon with experience in ankle joint arthroscopy. Second, the specific instruments and implants necessary for the procedure can raise costs. Third, a key factor influencing the outcome is proper patient selection. Anatomic repair can be performed only in patients with preservation of a repairable ATFL remnant.¹⁵

Acknowledgments

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