Technical Note

Anatomical Arthroscopic Graft Reconstruction of the Anterior Tibiofibular Ligament for Chronic Disruption of the Distal Syndesmosis

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Abstract: Injuries of the distal tibiofibular syndesmosis are commonly overlooked or mismanaged, and chronic instability is a debilitating condition leading to premature joint degeneration. Several methods of treatment have been described, mainly screw fixation, arthrodesis, or ligament reconstruction. Most clinical evidence is limited to case series, mainly screw fixation, and there is a general paucity of evidence regarding ligament reconstruction, which is considered to be more anatomic and to restore joint biomechanics. Most papers describe open techniques. We describe an original technique for all-inside anatomical arthroscopic graft reconstruction of the anterior-inferior tibiofibular ligament, which is simpler than other previously described reconstruction procedures. In addition to being performed through standard ankle arthroscopy portals, we believe this technique avoids potential complications.

The distal tibiofibular syndesmosis provides dynamic stability of the ankle joint, allowing the distal fibula to accommodate the talar rotation and the broader anterior portion of the talar dome during ankle dorsiflexion. Approximately 1% to 18% of all ankle sprains and up to 23% of ankle fractures involve the distal tibiofibular syndesmosis.1 Chronic syndesmotic injuries are defined as symptomatic injuries more than 6 months after initial trauma. They may occur due to the syndesmotic injury having been overlooked at initial presentation, inadequate initial management of the injury, or premature screw removal following syndesmotic stabilization, before the ligaments have healed. Chronic instability is a debilitating condition leading to premature joint degeneration due to an abnormal distribution of forces across the ankle joint.

Anatomical reduction of the syndesmosis has been found to be the most important predictor of functional outcome following operative treatment of rotational ankle fractures.2 The ligamentous structures stabilizing the distal tibiofibular joint are the anterior-inferior tibiofibular ligament (AITFL), the interosseous membrane and interosseous ligament (IOL), the posterior-inferior tibiofibular ligament (PITFL), and the inferior transverse tibiofibular ligament. Most injuries occur when the foot is subjected to external rotation in a dorsiflexed position; commonly, the AITFL gives way first, as it is the weakest of the syndesmotic ligaments, followed by the IOL and the PITFL. Surgical treatment methods for chronic syndesmosis instability include arthroscopic debridement, screw or suture button fixation, advancement of the tibial insertion of the attenuated AITFL, arthrodesis, and anatomical reconstruction of the syndesmotic ligaments.

The goal of this paper is to describe the surgical technique for an arthroscopic anatomical reconstruction of the AITFL for chronic disruption of the distal tibiofibular syndesmosis using an allograft.

Surgical Technique

Patient Selection

This technique is indicated in patients presenting with a chronic injury to the AITFL and can be performed in addition to arthroscopic procedures addressing other...
Table 1. Key Points

- Perform the anteromedial portal first, then the anterolateral portal.
- Perform a routine examination of the ankle joint from medial to lateral, and then probe the syndesmosis, visualizing ligamentous structures of the distal tibiofibular syndesmosis.
- Stabilize the joint using one or 2 syndesmotic suture buttons under direct fluoroscopic and arthroscopic control.
- Perform the fibular tunnel with a guide wire and cannulated 5- or 6-mm drill, from anterior to posterior and inclined 35° to 40° to ward cranial relative to the horizontal plane.
- Perform the tibial tunnel with a 3.2-mm ACL guidewire and drill to a depth of 25 mm using a 5- to 6-mm drill.
- Fix the graft in the tibial tunnel with a cortical suture button fixation device for ACL grafts.
- Immobilize the ankle in a posterior splint for 3 weeks and then with a walker-type ankle-foot orthosis. Allow for progressive weight bearing in the fifth week, with complete weight bearing at 8 to 12 weeks.

Injuries to the ankle joint, such as osteochondral injuries or associated ligament injuries, in particular to the deltoid ligament, as occurs in Lauge-Hansen pronation-external rotation injuries. Patients usually complain about pain on weight bearing, centered on the anterolateral aspect of the ankle. This is aggravated by combined dorsiflexion and external rotation of the foot. Swelling or giving way of the ankle is also a common complaint. If the physical examination is suggestive of syndesmotic injury (pain upon palpation, positive squeeze and external rotation test), standing x-rays of both ankles are ordered, where the tibiofibular overlap, tibiofibular clear space, and medial clear space can be evaluated. We further recommend performing computed tomography of both ankle joints preoperatively, as well as magnetic resonance imaging. The latter may, however, be compromised by the presence of metallic implants near the ankle joint. We believe this procedure is ideal for patients with long-standing injuries, high-demand athletes, or patients in whom previous surgeries such as screw fixation of the syndesmosis have failed.

Patient Positioning and Arthroscopic Portals

The patient is placed in a supine position, with the affected limb on a thigh holder allowing for free movement of the ankle. A thigh tourniquet is applied. No soft-tissue distraction device is used. A 4-mm 30° scope (Stryker, Kalamazoo, MI) for ankle arthroscopy is used, as well as 3.5- or 4.0-mm synoviotomes (Stryker). Joint distension is achieved using an irrigation pump at 35 to 40 mmHg.

Access is gained to the joint using standard anteromedial (medial to the tibialis anterior tendon) and anterolateral (lateral to the extensor digitorum communis tendon) portals (Table 1). The intermediate cutaneous branch of the superficial peroneal nerve is identified through flexion and inversion of the ankle or by plantar flexion of the fourth toe (Table 2).

The ankle is examined, and any associated lesions (e.g., osteochondral lesions) are addressed accordingly. The distal tibiofibular syndesmosis is assessed using a joint probe and debrided. In normal circumstances, the syndesmosis will only be slightly mobile, but in chronic instability, a significant widening of the syndesmosis will be found, which will allow for insertion of a 2-mm palpation hook or even the entire synoviotome (Video 1). From the anterolateral portal, it is possible to evaluate the PITFL and its deepest portion, the inferior transverse ligament.

Reconstruction of the AITFL

The syndesmosis is then stabilized using one or 2 suture button constructs such as the tightrope device (Arthrex) under arthroscopic and fluoroscopic

Table 2. Pearls and Pitfalls of the Technique Described

| Pearls |
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| - Draw the main ankle landmarks with the ankle in a neutral position. Identify the superficial peroneal nerve. |
| - Identify the fibular insertion of the AITFL immediately proximal to the origin of the anterior talofibular ligament. |
| - Take care not to damage the neurovascular bundle when drilling the tibial tunnel. The use of an ACL guide is of help in this step. |
| - Avoid damaging the suture button device when drilling the tibial tunnel. Using an ACL guide wire and drilling only 25 mm of depth allows for graft fixation and complete filling of the tunnel with the graft, without needing to perform a complete bone tunnel. |

| Pitfalls |
| --- |
| - Ensure adequate reduction of the syndesmosis before beginning the AITFL reconstruction. Arthroscopic visualization of the reduction is key, avoiding the need for intraoperative computed tomography. |
| - Misidentification of Tillaux’s and Wagstaffe’s tubercles will lead to a nonanatomic placement of the graft and jeopardize its function. Fluoroscopy could be of assistance in order to correctly identify these landmarks. |
| - Avoid ankle plantarflexion when fixing the graft to the bone tunnels, as this could compromise ankle dorsiflexion due to overtightening of the syndesmosis. |
| - Overtightening of the graft leads to fibular malrotation and limitation of ankle dorsiflexion and can be evaluated arthroscopically. |
| - Before fixing the fibular aspect of the graft, ensure the graft does not cause any anterolateral impingement through ankle motion. The bone tunnels should be revised, should this occur. |
| - Care should be taken when choosing the length of the screw fixing the fibular aspect of the graft, so as not to irritate the peroneal tendons. The bone tunnel should be placed at an angle of at least approximately 40° relative to the longitudinal aspect of the fibula in order have sufficient length. |

AITFL, anterior-inferior tibiofibular ligament; ACL, anterior cruciate ligament.
guidance, followed by reconstruction of the AITFL. It is important to perform the steps in this order, to ensure perfect stabilization and tensioning of the graft. A gracilis or extensor hallucis longus allograft is used, depending on availability. The ends of the graft are prepared with Krakow sutures to a diameter of 4.5 to 5.0 mm. The fibular insertion of the AITFL is identified immediately proximal to the origin of the anterior talofibular ligament, near Wagstaffe’s tubercle (Fig 1A). A complete bone tunnel is drilled through the fibula using a 5 to 6 mm cannulated drill bit (depending on the size of the graft) over a 3.2-mm guide wire through the anterolateral portal, from anterior to posterior and at a 35° to 40° angle from caudal to cranial. The tibial insertion of the AITFL is identified near Tilleaux’s tubercle, and a 3.2-mm anterior cruciate ligament (ACL) guide wire is inserted from this point toward the medial tibial cortex (Fig 1B), with care not to damage the suture button device. A 5- to 6-mm drill is used, to a depth of 25 mm. Once the tibial and fibular tunnels are drilled, the graft is inserted through the anterolateral portal (Fig 2A), passed through the tibial tunnel, and fixed to the tibia using a cortical fixation suture button such as the ACL tightrope (Arthrex). By alternately tensioning the white sutures, the graft is advanced, ensuring complete graft fill of the tibial tunnel (Fig 2B). A suture is used to pass the graft through the fibular bone tunnel. The graft is then fixed to the fibula using a 5.5 to 6.0 mm biodegradable biotenodesis screw (Arthrex; Fig 3, Video 1). A third portal is not necessary for this procedure.

**Postoperative Care**

Postoperatively, the patient is immobilized in a posterior ankle splint for 3 weeks. The surgical incisions are reviewed 24 hours postoperatively (at the time of discharge from hospital), and after 10 days, during the first postoperative follow-up visit. Only isometric exercises are allowed in the early postoperative period. The ankle splint is replaced by Walker-type ankle-foot

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**Fig 1.** Identification of fibular and tibial insertions of the anterior-inferior tibiofibular ligament. Arthroscopic view through the anteromedial portal, right ankle. (A) Fibular insertion proximal to anterior talofibular ligament. (1) Fibula. (2) Talus. (B) Drilling of tibial insertion near Tilleaux tubercle using an anterior cruciate ligament guide wire (arrow). (1) Fibula. (2) Talus. (3) Tibia. Note the graft suture in the fibular tunnel in the background (*).

**Fig 2.** Insertion of graft through the anterolateral portal. Arthroscopic view through the anteromedial portal, right ankle. (A) Sutures attached to both ends of the grafts in the fibular (•, blue strands) and tibial tunnels (†, white strands). (1) Fibula. (2) Talus. (3) Tibia. (B) Insertion of tibial end of graft into the bone tunnel. (1) Fibula. (2) Talus. (3) Tibia. (4) Graft. The fibular suture is in the background (•).
orthosis (DonJoy, Surrey, UK) after 3 weeks, and progressive partial weight bearing is allowed in the fifth postoperative week. At this time, physiotherapy is commenced including mobility exercises, electrotherapy, and muscle strengthening and proprioception exercises. The orthosis is generally worn for 9 weeks, after which gradual return to sports participation is allowed.

**Discussion**

Several techniques for chronic syndesmosis instability of the ankle are available, including arthroscopic debridement, screw or suture button fixation, arthrodesis, advancement of the tibial insertion of the attenuated AITFL, and anatomical reconstruction of the syndesmotic ligaments. However, experience is mostly limited to small retrospective case series, there is no “gold standard” technique, and the optimal method of treatment remains a topic of debate.

A recent systematic review found an 87% success rate for stabilization of chronic syndesmotic injuries using screw fixation, but in 8 of the 11 studies included, it was used in conjunction with associated procedures and/or anatomic reconstruction of the syndesmotic ligaments. Ligamentoplasty of the syndesmotic ligaments was initially described by Castaing in 1961, and in the past 2 decades, several investigators have presented retrospective case series with different modifications, using hamstring, gracilis, or peroneus longus autografts.

Compared with syndesmotic screws or arthrodesis, ligament reconstruction is considered to be more anatomic, attempting to restore ankle joint biomechanics, which would be of particular interest in younger patients or high-demand athletes (Table 3). However, all the reported series used open approaches for the ligament reconstruction, and several described wound complications or injury to the superficial peroneal nerve in their series.

Arthroscopy is considered the gold standard for diagnosing syndesmotic instability, superior to any other physical examination or diagnostic imaging method. In addition, it allows for diagnosis and management of associated intra-articular pathology. In a recent series, cartilage damage was observed in 8 of 12 patients treated for chronic syndesmosis instability.

However, there is a lack of published experience regarding arthroscopic graft reconstruction of syndesmotic injuries, acute as well as chronic. Arthroscopic surgery would be desirable in these cases, as it involves less morbidity than traditional open surgery, with reduced postoperative pain, shorter hospitalization times, and better cosmesis, as well as increased patient satisfaction.

Lui described an arthroscopic method of triligamentous reconstruction of the distal tibiofibular syndesmosis using a free peroneus longus autograft using 3 bone tunnels and a complex and meticulous sequence.

**Table 3. Advantages and Disadvantages of the Technique Described**

| Advantages                                      | Disadvantages                                      |
|------------------------------------------------|---------------------------------------------------|
| Syndesmotic screw fixation                     | Potential for screw breakage                       |
| Arthrodesis of the syndesmosis                  | Potential for need of screw removal                |
| Syndesmotic ligament reconstruction             | Potential for limitation of ankle dorsiflexion     |
| Anterior-inferior tibiofibular ligament         | Not indicated in high-demand patients              |
| reconstruction                                  | Ankle rigidity and nonphysiological joint mechanics|
|                                                | Potential for accelerating tibiotalar joint degeneration|
|                                                | Technically demanding                              |
|                                                | Risk of fibular fracture due to multiple bone tunnels|
|                                                | Simpler than previously described reconstructions. |
|                                                | Single fibular bone tunnel reduces the risk of iatrogenic fractures. |
|                                                | Incomplete tibial bone tunnel avoids risk of damage to neurovascular structures. |
of steps that requires accuracy and precision, making their technique demanding. In addition, repeated drilling of the fibula in an anteroposterior and lateromedial direction raises concerns for possible iatrogenic fractures of the fibula. Grass also described a technique for open reconstruction of the syndesmotic ligaments that used multiple bone tunnels. We believe the technique described in this paper avoids excessive weakening of the fibula, reducing the risk of iatrogenic fibular fracture. In contrast to the technique described by Morris et al., in which the graft is fixed with a screw inserted into the medial side of the tibia, we recommend tibial fixation using an incomplete bone tunnel, thus avoiding injury to the posterior tibial neurovascular bundle. Furthermore, our method involves fewer steps than other techniques, making it feasible for the standard arthroscopist to perform.

In conclusion, an arthroscopic technique is described for reconstruction of the AITFL supplemented by percutaneous syndesmotic suture button constructs for cases of chronic syndesmotic instability. The technique is simple and has fewer steps than other previously described methods, reducing the risk of technical errors. We believe the described technique can be performed by most ankle arthroscopists, although we admit clinical studies are necessary to determine the expected results and complication rates.

References
1. Parlamas G, Hannon CP, Murawski CD, et al. Treatment of chronic syndesmotic injury: A systematic review and meta-analysis. *Knee Surg Sports Traumatol Arthrosc* 2013;21:1931-1939.
2. Sagi HC, Shah AR, Sanders RW. The functional consequence of syndesmotic joint malreduction at a minimum 2-year follow-up. *J Orthop Trauma* 2012;26:439-443.
3. Yasui Y, Takao M, Miyamoto W, Innami K, Matsushita T. Anatomical reconstruction of the anterior inferior tibiofibular ligament for chronic disruption of the distal tibiofibular syndesmosis. *Knee Surg Sports Traumatol Arthrosc* 2011;19:691-695.
4. Zamzami MM, Zamzam MM. Chronic isolated distal tibiofibular syndesmotic disruption: Diagnosis and management. *Foot Ankle Surg* 2009;15:14-19.
5. Wagener ML, Beumer A, Swierstra BA. Chronic instability of the anterior tibiofibular syndesmosis of the ankle. Arthroscopic findings and results of anatomical reconstruction. *BMC Musculoskelet Disord* 2011;12:212.
6. Morris MWJ, Rice P, Schneider TE. Distal tibiofibular syndesmosis reconstruction using a free hamstring autograft. *Foot Ankle Int* 2009;30:506-511.
7. Grass R, Rammelt S, Biewener A, Zwipp H. Peroneus longus ligamentoplasty for chronic instability of the distal tibiofibular syndesmosis. *Foot Ankle Int* 2003;24:392-397.
8. Lui TH. Tri-ligamentous reconstruction of the distal tibiofibular syndesmosis: A minimally invasive approach. *J Foot Ankle Surg* 2010;49:495-500.