Arthroscopic Reconstruction of the Anterior Tibiotalar Ligament Using a Free Tendon Graft

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Abstract: Deltoid ligament injuries account for 5.1% to 15.8% of ankle sprains and occur with concomitant lateral ankle sprains. The anterior tibiotalar ligament (ATTL), located within the deep layer of the deltoid ligament complex, connects the talus and the tibia on the medial side of the ankle and controls ankle eversion and rotation. If conservative treatment for chronic medial ankle instability after an ankle sprain fails, ATTL repair or reconstruction might be necessary. Arthroscopic reconstruction techniques of the lateral ankle ligaments recently have been reported. Here, we describe arthroscopic reconstruction of the ATTL using a free tendon graft (ARATTL). This technique is less invasive than other treatments and results in a more stable medial ankle joint.

Introduction (With Video Illustration)

Ankle sprains are the most common sports-related injuries. Although the anterior talofibular ligament is the most frequent injury in ankle sprains, epidemiologic surveys indicate that deltoid ligament (DL) injuries account for 5.1% to 15.8% of ankle sprains. The DL is a complex ligament structure spanning from the medial malleolus (MM) of the ankle to the navicular, talus, and calcaneus bones. The DL is divided into superficial and deep layers. The deep layer includes the anterior tibiotalar ligament (ATTL) and the posterior tibiotalar ligament (PTTL). The ATTL can be observed arthroscopically.

There are already several reports of arthroscopic lateral ankle ligament reconstruction for the anterior talofibular ligament, calcaneo-fibular ligament, posterior talofibular ligament, and lateral talocalcaneal ligament. Here we describe the arthroscopic reconstruction of the ATTL using a free tendon graft (ARATTL). A summary of the key steps is provided in Table 1, whereas a summary of the technique is provided in Video 1.

Surgical Technique

Step 1: Patient Positioning
This surgery is performed with the patient under general anesthesia and in the supine position. A tourniquet is placed on the proximal thigh and the patient’s foot is suspended from the distal edge of the bed. The contralateral leg is slightly lowered to provide a wide working space.

Step 2: Graft Preparation
The autogenous hamstring tendon is harvested from the pes anserinus and a 1- to 2-strand graft is prepared. Use of the endoscopic harvest technique is recommended to ensure a smaller scar. An allograft tendon is an alternative. The length is speculated on preoperative magnetic resonance imaging and radiographs. Because ATTL length should be at least 25 mm long, the harvested tendon must be longer than 55 mm to contain a 1-strand bundle or 110 mm long to contain a 2-strand bundle. The 2 ends form a 15-mm-long bundle or loop to facilitate thread attachment for graft delivery. The recommended graft diameter is 4.5 to 5.5 mm.
Step 3: Portal Placement of Ankle Arthroscopy

Two portals—a conventional anteromedial (AM) portal and an accessory anteromedial (AAM) portal—are created step by step. The ankle is positioned neutrally. The AM portal is created medial to the anterior tibial tendon and slightly proximal to the joint line (Fig 2A). A 30° 2.7- or 4.0-mm-diameter arthroscope is introduced through the AM portal. The medial gutter is viewed with the ankle neutral or in a slightly dorsi-flexed position.

After a needle is inserted into the portal site to confirm accessibility to both the ATTL talar and tibial footprints, the AAM portal is created. A 2.4-mm guidewire is inserted through the AAM portal to drill the talus from the ATTL talar footprint toward the lateral side of the talus. Intraoperative fluoroscopy is used to confirm guidewire position and direction.

Step 4: Tunnel Creation

The anteromedial synovium and ATTL remnant around the ATTL talar footprint are dissected using a shaver and a radiofrequency probe. A microfracture awl is used to mark the ATTL talar footprint, which is immediately inferior to the articular cartilage of the trochlea, and a 2.4-mm guidewire is inserted through the AAM portal to drill the talus from the ATTL footprint toward the lateral side of the talus. The insertion point should be posteroinferior to the anteromedial corner of the trochlea (Fig 2B). A 20°–40° fluoroscopy is used to confirm guidewire position (Fig 3B). The guidewire is then overdrilled using a drill with the same or a 0.5-mm larger diameter than the graft end to create a 20-mm-deep talar tunnel (Fig 3C).

When the ATTL tibial footprint is not adequately viewed through the AM portal, surgeons can try to dorsiflex the ankle or change to a 70° arthroscope. The ATTL remnant is dissected at the tibial footprint and a...
guidewire is inserted through the AAM portal. Intraoperative fluoroscopy is used to confirm the guidewire position. The insertion point should be on the anterior colliculus of the MM.\(^{23}\) The angle between guidewire direction and the long axis of the tibia on the lateral view is 20° to 40° (Fig 4A). The guidewire direction is almost on the middle line of the MM on the anteroposterior view (Fig 4B). Viewed from the AM portal, the guidewire is then overdrilled to create a 30-mm-deep tibial tunnel (Fig 4C).

**Step 5: Tendon Graft Introduction**

Viewed from the AM portal, the surgeon penetrates from the tibial tunnel bottom to the opposite cortex using a 2.9-mm drill wire (Zimmer-Biomet, Warsaw, IN) through the AAM portal. A JuggerKnot Soft Anchor
2.9 mm (Zimmer-Biomet) is placed at the tibial cortex behind the tibial tunnel (Fig 5A). Next, a 1.6-mm passing pin (Meira Co., Ltd., Nagoya, Japan) is inserted into the talar tunnel through the AAM portal. The pin penetrates the bone and the skin on the opposite side. A looped thread is passed through the eye of the passing pin, which is completely pulled through (Fig 5B). The looped thread in the talar tunnel is connected with the talar graft end. Next, the ATTL graft is introduced from the AAM portal to the talar tunnel by pulling of the looped thread. One strand of the suture anchor thread is sutured to the tibial side end of the graft (Fig 5C), whereas the other strand is pulled to introduce the graft into the tibial tunnel.

Step 6: Tendon Graft Fixation

The ATTL graft is tensed by pulling the suture anchor thread at the tibial tunnel and the strands are tied (Fig 6A). Subsequently, the graft is fixed with an appropriate diameter 15-mm-long bioabsorbable interference screw in the talar tunnel with the ankle in the 45° to 60° plantar flexion position to avoid restricting postoperative plantar flexion for most patients (Fig 6B and C). However, maximum plantar flexion position is recommended for patients who require excessive plantar flexion angle, e.g., ballet dancers. If the patient is an athlete and wants to start rehabilitation as early as possible, interference screw fixation is added in the tibial tunnel to provide stronger initial fixation.24

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**Fig 4.** Creation of the tibial tunnel (left ankle). (A) The ATTL remnant is dissected at the tibial footprint. A guidewire is inserted through the AAM portal. Intraoperative fluoroscopy is used to confirm the guidewire position. The insertion point should be on the anterior colliculus of the MM.23 The angle between the guidewire direction and the long axis of the tibia on the lateral view is 20 to 40°. (B) The guidewire direction is almost on the middle line of the MM in the anteroposterior view. (C1) Viewed from the AM portal, the guidewire is then overdrilled to create a 30-mm-deep tibial tunnel. (Patient 1 is shown in all panels.) (AAM, accessory anteromedial; ATTL, anterior tibiotalar ligament; MM, medial malleolus.)

**Fig 3.** Creation of the talar tunnel (left ankle). (A) The anteromedial synovium and ATTL remnant around the ATTL talar footprint are dissected using a shaver and a radiofrequency probe. A microfracture awl is used to mark the ATTL talar footprint, which is immediately inferior to the articular cartilage of the trochlea,21 and a 2.4-mm guidewire is inserted through the AAM portal to drill the talus from the ATTL footprint toward the lateral side of the talar neck. (B) The insertion point should be posteroinferior to the anteromedial corner of the trochlea of the talus.21 Intraoperative fluoroscopy is used to confirm guidewire insertion position22 by touching with a drill tip. (C) The guidewire is then overdrilled using a drill with the same or a 0.5-mm larger diameter than the graft end to create a 20-mm-deep talar tunnel. (Patient 1 is shown in all panels.) (AAM, accessory anteromedial; ATTL, anterior tibiotalar ligament; MM, medial malleolus.)
Optional Technique When the Screw Is Not Firmly Fixed or Too Large to Insert

If the screw is not firmly fixed, the screw size is increased or the cancellous bone tips are grafted to the space between the tunnel and the tendon graft.16,24 If the screw is then too large for tunnel insertion, a smaller screw should be chosen.

Discussion

DL injuries account for 5.1%4 to 15.8%5 of ankle sprains and can occur with concomitant lateral ankle sprains.23,25,26 Single or repeated episodes of ankle sprain cause DL insufficiency and may lead to chronic instability.27,28 The DL is divided into superficial and deep layers. The deep layer includes the ATTL and PTTL6,29-31 and prevents eversion of the ankle joint, lateral displacement, and external rotation of the talus.28,32-34 The ATTL is also known as the deep aTTL,23 DATL,21 or DATT.22 The ATTL originates from the most inferior and anterior areas of the MM and inserts onto the anterosuperior portions of the medial talus body immediately inferior to the articular cartilage of the trochlea.21

Patients with chronic external rotation instability of the ankle without severe eversion instability or syndesmosis instability are good candidates for ATTL repair or reconstruction. If severe eversion instability exists, additional treatment of the other DL components, e.g., superficial DL layer or PTTL, should be considered. Although the external rotation stress test applied to the ankle in a neutral position is used to diagnose syndesmosis injury,35 it is also useful for detecting medial ankle instability. The authors recommend the combination of external rotation stress and anterior drawer stress with the fibula as the central axis of rotation with the ankle in slight plantar flexion because it will diminish the posterolateral ankle instability and make it easy to feel subluxation at the anteromedial ankle.
Table 2. Advantages and Disadvantages of Anterior Tibiotalar Ligament Reconstruction

| Advantages | Disadvantages |
|------------|---------------|
| Possibly better medial ankle joint stability and long-term clinical results | Longer tendon graft needed in cases of simultaneous reconstruction of medial and lateral ligaments |
| Less risk of other DL components via the intra-articular approach by arthroscopy | Possible risk of tunnel fracture |
| Only one more portal needed over conventional AM portal | Basic arthroscopy skills needed |
| Safe and reproducible tunnel creation | Need for intraoperative fluoroscopy |
| Anatomical reconstruction and lower postoperative risk of ROM restriction | |

Advantages: Possibly better medial ankle joint stability and long-term clinical results, Less risk of other DL components via the intra-articular approach by arthroscopy, Only one more portal needed over conventional AM portal, Safe and reproducible tunnel creation, Anatomical reconstruction and lower postoperative risk of ROM restriction.

Disadvantages: Longer tendon graft needed in cases of simultaneous reconstruction of medial and lateral ligaments, Possible risk of tunnel fracture, Basic arthroscopy skills needed, Need for intraoperative fluoroscopy.

AM, anteromedial; DL, deltoid ligament; ROM, range of motion.

Acknowledgments

We thank Editage (www.editage.jp) for English-language editing.

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