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Technical note

Arthroscopic anatomical reconstruction of the lateral ankle ligaments: A technical simplification

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ABSTRACT

Anatomical reconstruction of the lateral ankle ligaments has become a pivotal component of the treatment strategy for chronic ankle instability. The recently described arthroscopic version of this procedure is indispensable to ensure that concomitant lesions are appropriately managed, yet remains technically demanding. Here, we describe a simplified variant involving percutaneous creation of the calcaneal tunnel for the distal attachment of the calcaneo-fibular ligament. The rationale for this technical stratagem was provided by a preliminary cadaver study that demonstrated a correlation between the lateral malleolus and the distal footprint of the calcaneo-fibular ligament. The main objectives are simplification of the operative technique and decreased injury to tissues whose function is crucial to the recovery of proprioception.

1. Introduction

Surgery on the lateral ankle ligaments has been proven effective in the treatment of chronic ankle instability. Anatomical ligament reconstruction [1,2] is steadily gaining ground as a means of avoiding the long-term risk of osteoarthritis seen with non-anatomical reconstruction [3,4]. Furthermore, failures have been reported after direct repair with or without tissue augmentation, which has a number of contra-indications [4]. An arthroscopic variant of anatomical lateral ankle ligament reconstruction was described recently [5,6]. It remains technically challenging, however, particularly regarding the accurate placement of the calcaneal tunnel [7].

Here, we describe a technical stratagem for positioning the distal insertion of the calcaneo-fibular ligament (CFL). This stratagem was developed based on a cadaver study [8]. It simplifies the technique of arthroscopic anatomical reconstruction of the lateral ankle ligaments.

2. Operative technique

The patient is supine with the feet hanging over the edge of the table. A pad is placed under the ipsilateral buttock to rotate the foot medially, thus facilitating access to the lateral malleolus (Fig. 1a).

To harvest the gracilis, the knee must be flexed at 90°. During this manoeuvre, a counter-support is placed laterally, in contact with the tourniquet at the root of the thigh (Fig. 1b).

Standard arthroscopy equipment is used.

2.1. Transplant harvesting and preparation

The gracilis tendon is harvested according to the safe mode described by Lanternier et al. [9], using a tendon stripped introduced through a short, oblique, anteromedial incision centred on the pes anserinus. A transplant length of 10 cm is sufficient.

The transplant is then simply prepared by threading #2/0 Fiberloop on a straight needle (Arthrex, Naples, FL, USA) through each of its ends.

A Bio-Tenodesis Screw™ system (4.75 mm × 15 mm, Arthrex, Naples, FL, USA) is placed at one end of the transplant for fixation to the talus (Fig. 2).

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Fig. 1. (a) The patient is supine with the foot rotated medially. (b) The knee is flexed at 90° for harvesting of the gracilis tendon.

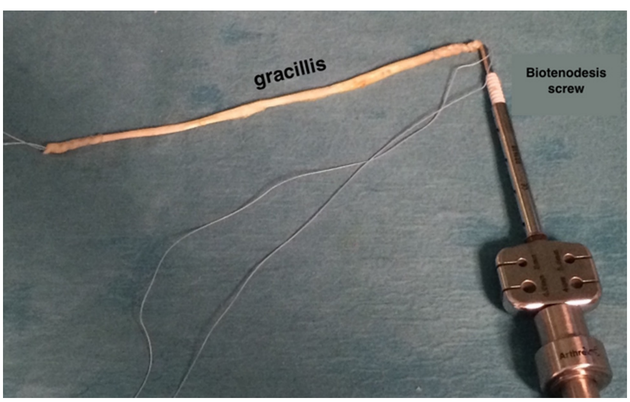

Fig. 2. Preparation of the transplant. Bio-Tenodesis Screw.

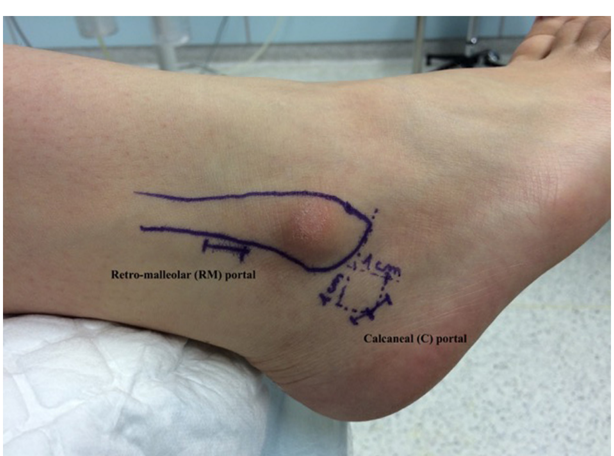

Fig. 3. Skin markings for the calcaneal (C) portal and retro-malleolar (RM) portal. Retro-malleolar (RM) portal. Calcaneal (C) portal.

Fig. 4. Creation of the calcaneal tunnel while spreading the portal open.

2.2. Creating the calcaneal portal (C), calcaneal tunnel, and retro-malleolar portal (RM)

The technical stratagem consists in creating the calcaneal tunnel percutaneously using a method based on a preliminary cadaver study [8] that demonstrated an anatomical correlation between the lateral malleolus and the distal insertion of CFL.

A dermographic pen is used to draw a vertical line along the posterior cortex of the fibular shaft and another line perpendicular to the first and running through the tip of the lateral malleolus. The point located 1 cm inferior and posterior to the intersection of these two lines indicates the C portal (Fig. 3).

A 1 cm-long incision cutting only through the skin is made and the underlying tissues are spread painstakingly down to the bone. An eyelet wire 2.4 mm in diameter is introduced using a power tool towards the posterior, inferior, and medial edge of the calcaneus (Fig. 4). A calcaneal tunnel open at both ends is then over-drilled using a cannulated 6-mm bit. The lead suture n° 1 is positioned (Fig. 5).

A 1 cm-long retro-malleolar (RM) portal (Fig. 5) is created 3 cm above the tip of the lateral malleolus, just behind the posterior fibular cortex. This portal allows protection of the fibular tendons during drilling of the fibular tunnel and ensures proper positioning of the cortical endobutton.

Fig. 5. Creation of the retro-malleolar (RM) portal and lead suture n° 1.

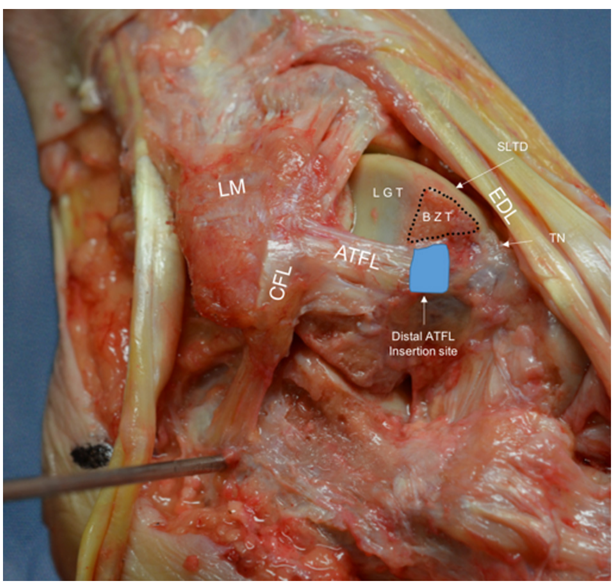

Fig. 6. Identification of the distal ATFL insertion site, under the bare area of the talus. LM, lateral malleolus; CFL, calcaneo-fibular ligament; ATFL, anterior talo-fibular ligament; LGT, lateral groove of talus; EDL (extensor digitorum longus), TN (talar neck); SLTD, superior-lateral talar dome.

Fig. 7. Creation of the talar tunnel through the antero-lateral (AL) portal.

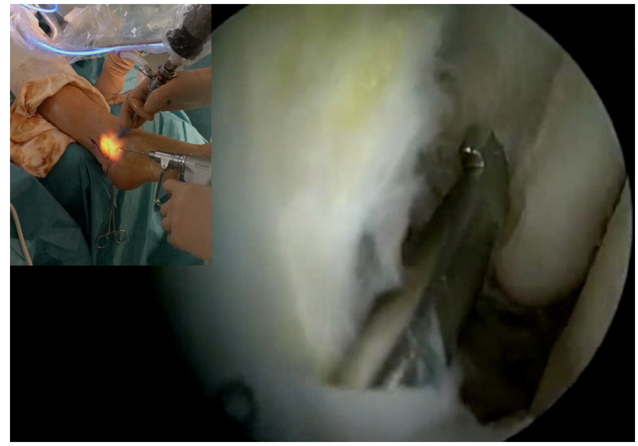

Fig. 8. Creation of the fibular tunnel through the sub-talar (ST) portal.

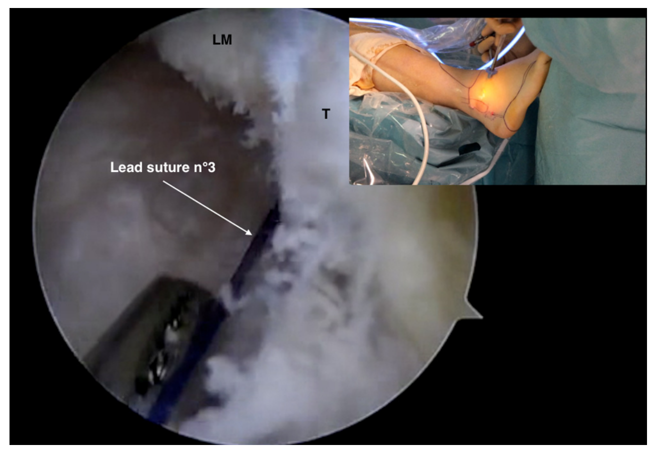

Fig. 9. Retrieval of lead suture n° 3.

2.3. Creating the antero-medial (AM), and antero-lateral (AL) portals and exploring the joint

A standard antero-medial (AM) arthroscopy portal is created. The antero-lateral (AL) portal for the instruments is located distal and medial to the usual site. Its location is determined under arthroscopic guidance, using a needle, to ensure that the direction is tangential to the lateral groove of the talus.

The arthroscope and palpation hook are introduced and the joint is explored thoroughly to identify all lesions (condition of the anterior talo-fibular ligament [ATFL], syndesmosis, medial collateral ligament, cartilage, and bone; and detection of impingements of bone or other tissues).

2.4. Creating the talar tunnel

A 6 mm × 20 mm PassPort Button^{TM} Cannula (Arthrex, Naples, FL, USA) is inserted through the AL portal inferiorly.

In most cases, residual fibres of the distal ATFL insertion are present and serve to guide the introduction of the wire. When there are no ATFL fibres, the landmark is a "bare area of the talus" that is consistently present behind the talar neck, in front of the lateral articular surface of the talus, below the anterior cartilaginous part of the talar dome, and above the distal ATFL insertion (Fig. 6).

The guide wire is introduced through the cannula in a slightly upwards direction (to avoid penetrating the sinus tarsi), in a posterior and medial direction, towards the medial malleolus. An appropriate drill bit is used to create the talar tunnel over the guide

Fig. 10. Fixation to the talus.

Fig. 11. Positioning of the cortical endobutton on the transplant.

wire. The tunnel should be 5 mm in diameter and 20 mm in depth (Fig. 7).

2.5. *Creating the sub-talar (ST) portal and fibular tunnel*

The arthroscope is introduced through the cannula into the AL portal. The entire lateral gutter is visible through the arthroscope, allowing creation of the subtalar (ST) portal.

A guide wire specific of the cortical endobutton is introduced through the ST portal. The entry point is at the lower part of the distal insertion of the anterior-inferior tibio-fibular ligament, as described for instance by Golano et al. [10,11]. The wire is directed towards the RM portal, through which it exits (Fig. 8).

A blind fibular tunnel is created over the guide wire using a cannulated drill bit. The tunnel is 6 mm in diameter and 15 mm in depth. The lead suture n° 2 is positioned.

2.6. *Threading the lead sutures n° 2 and 3 into the cannula*

The arthroscope is returned to the AM portal and the lead suture n° 2 that has just been fed into the fibular tunnel is retrieved in the cannula.

A curved mosquito clamp is slipped into the cannula in the AL portal along the lateral aspect of the talus and calcaneus (to avoid damaging the fibular tendons) to the C portal, where the loop of the lead suture n° 3 is retrieved and pulled up into the cannula (Fig. 9).

Fixation of the transplant to the talus, insertion of the endobutton on the transplant, and retrieval of the transplant tip in the C portal

The transplant with its Bio-Tenodesis Screw is introduced through the AL portal and screwed into place under arthroscopic guidance (Fig. 10).

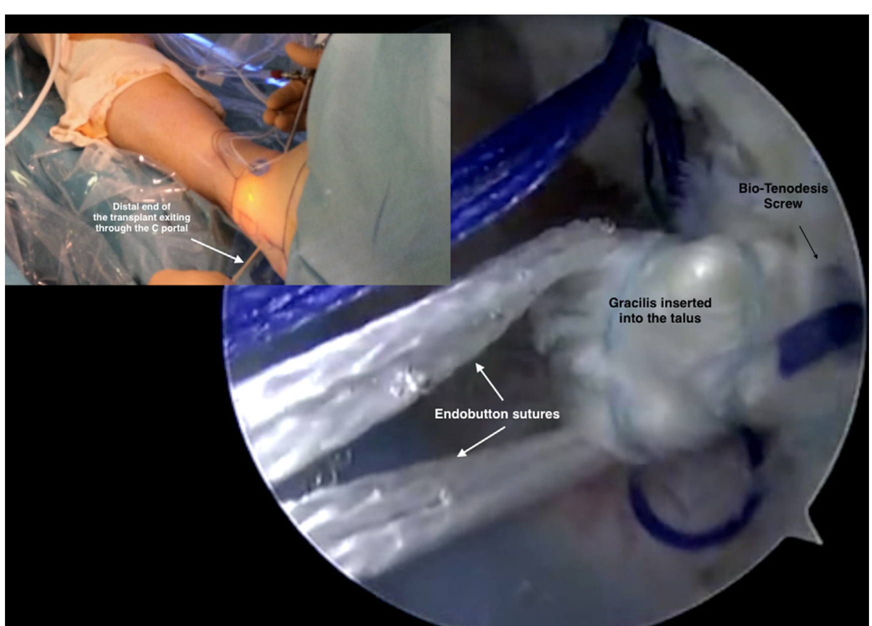

Fig. 12. Retrieval of the transplant through the C portal. Extrémité. . . = Distal end of the transplant exiting through the C portal. Vis de. . . = Bio-Tenodesis Screw. Gracilis. . . = Gracilis inserted into the talus. Fils. . . = Endobutton sutures.

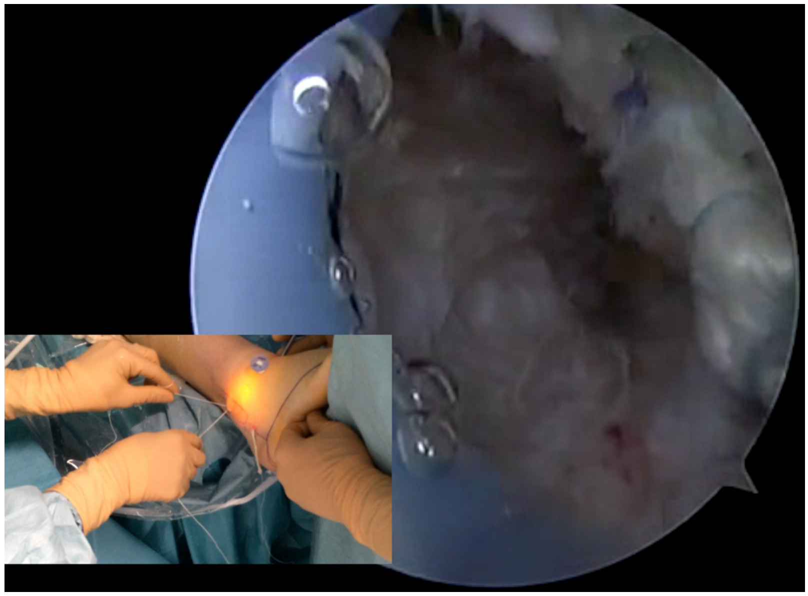

Fig. 13. Positioning the cortical endobutton.

The cortical endobutton (ACL TightRope® RT, Arthrex, Naples, FL, USA) is mounted on the distal end of the transplant hanging out of the cannula (Fig. 11).

The lead suture n° 3 is used to retrieve the distal end of the transplant in the C portal. This manoeuvre pulls the cortical endobutton into the cannula (Fig. 12).

2.7. Positioning the endobutton and transplant in the fibular tunnel

The lead suture n° 2 is used to pull the endobutton into the fibular tunnel. Once the endobutton is in the proper position and the transplant is secured to the talus, the blind tunnel is filled using the distal end of the transplant, which serves to reconstruct the CFL, thus avoiding any problems with adjusting transplant tension or length. The cortical endobutton is then positioned against the fibular diaphysis but not tightened (Fig. 13).

2.8. Passing and fixing the transplant to the calcaneus-adjusting final tension

A flexible guide wire is introduced and the lead suture n° 1 is then used to pass the distal end of the transplant into the full-thickness calcaneal tunnel (Fig. 14).

With the ankle and foot in the neutral position, fixation to the calcaneus is achieved using a 6 mm × 15 mm Bio-Tenodesis Screw introduced in a lateral-to-medial direction along the guide wire (Fig. 15).

The cortical endobutton is then tightened in its final position, under arthroscopic guidance (Fig. 16).

A palpation hook is used to check that transplant tension is optimal and that the transplant moves harmoniously during dorsal and plantar flexion of the ankle.

The tendon is cut to size at the medial end.

Fig. 14. Passage of the transplant through the full-thickness calcaneal tunnel.

Fig. 15. Fixation to the calcaneus.

3. Discussion

Arthroscopic anatomical reconstruction of the lateral ankle ligaments has been found both feasible and reproducible [5,6,12,13]. However, there is still room to improve this technically demanding procedure [7].

Here, we describe a technical stratagem that we developed based on a preliminary cadaver study [8]. This stratagem allows a full-thickness calcaneal tunnel to be created percutaneously. The resulting mixed (percutaneous and arthroscopic) technique has several advantages: the patient is supine; neither tendinoscopy nor extensive debridement is needed to identify the distal CFL

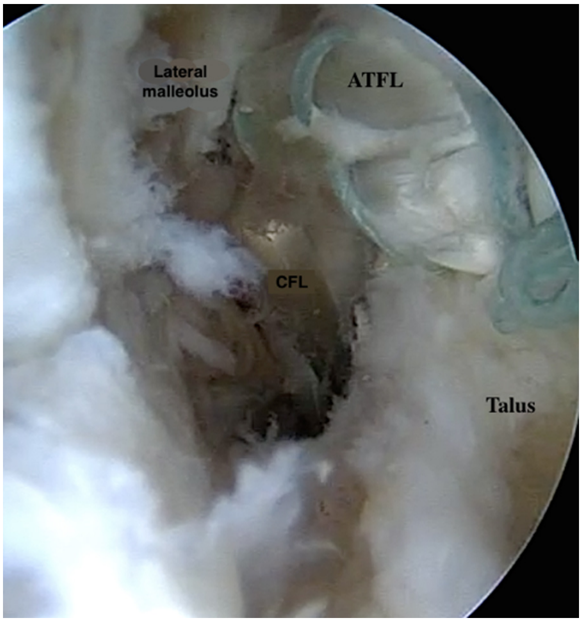

Fig. 16. Final appearance of the ligament reconstruction.

footprint, a fact that has the important advantage of preserving tissue structure and biological function (as with ligament reconstruction surgery at the knee); no specific or complex preparation of the transplant is required; and final adjustment of ligament tension is readily achieved, in particular by virtue of the creation of a full-thickness calcaneal tunnel.

The main risk associated with this technical stratagem is injury to the sural nerve, as demonstrated clearly during the preliminary cadaver study [8,14]. To avoid sural nerve injury, Glazebrook et al. [15] emphasised the need for using the nick-and-spread technique involving an incision through the skin only followed by spreading of the underlying tissues.

Disclosure of interest

Lopes R is a consultant for Arthrex. Decante C, Geffroy L, Brulefert K, and Noailles T have no conflicts of interest to declare.

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