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Short Communication

Reconstruction of superficial deltoid ligaments with allograft tendons in medial ankle instability: A technical report

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ABSTRACT

Background: Deltoid ligament insufficiency can cause arthritic changes with various symptoms in the ankle joint. However, reconstruction procedures of the medial collateral and deltoid ligaments have drawn less attention than those of the lateral ankle ligaments. Few techniques for reconstructing deltoid ligaments are available, and those that are can be complex.
Objective: We introduce a new surgical method for reconstructing superficial deltoid ligaments that is simple and straightforward.
Conclusion: With this method, the tibionavicular and tibiocalcaneal ligaments can be reconstructed efficiently and easily.

Introduction

Reconstruction procedures of the medial collateral and deltoid ligaments have drawn less attention than those of the lateral ankle ligaments. However, deltoid ligament insufficiency has been known to decrease the tibiotalar contact area and increase peak pressures, which may lead to arthritic changes in the ankle joint [1]. Moreover, disorders that require deltoid ligament reconstruction are not uncommon and include medial ankle instability, which causes residual symptoms after addressing lateral ankle instability; ankle valgus deformity and stage IV; acquired adult flatfoot deformity [2,3].

Nevertheless, few techniques for reconstructing the deltoid ligaments are available [1,2,4–11]. Many of the techniques that have been introduced are technically demanding procedures that may require a learning curve for surgeons who rarely encounter such disorders or procedures that sacrifice autogenous tendons, such as the peroneus longus. Therefore, we introduce a novel surgical method for reconstructing superficial deltoid ligaments (Figs. 1, 2). With this method, we believe that the tibionavicular and tibiocalcaneal ligaments can be reconstructed easily and efficiently.

Materials and methods

The patient is prepared in the supine position, and a tourniquet is applied for a bloodless surgical field. After general or spinal anaesthesia, an inverted 'U'-shaped skin incision, the tip of which is 2 cm above the medial malleolus, is made from the medial edge of the heel to the navicular bone. After reaching the soft tissue, the superomedial side of the navicular and the lateral side of the sustentaculum tali are exposed, which are the insertion sites of the tibionavicular ligament and tibiocalcaneal ligament, respectively. Using C-Arm checking, a 4.75-mm Bio-Tenodesis screw at the end of the prepared semitendinosus allograft tendon is inserted at the pre-marked site of the navicular (Fig. 3). A 4.5-mm drill hole is then made in the anterior-to-posterior direction at the medial malleolus, and a 3.5-mm, 4-strand suture anchor is fixed at the centre of the medial crest of the sustentaculum tali. After passing the other end of the allograft tendon through the hole in the medial malleolus, and while pulling on the tendon to maintain the tension of the tibionavicular (TN) part of the tendon, a 4.0-mm Bio-Tenodesis screw is inserted in the malleolar tunnel to stabilize the reconstructed TN ligament. The distal tendon end is pulled down along the sustentaculum tali, and while pulling on the tendon distally with submaximal force in a neutral ankle position, the tendon is firmly sutured to the sustentaculum tali crest by the suture bone anchor. The remaining distal portion of the tendon is then resected. The stability of the two reconstructed limbs of the

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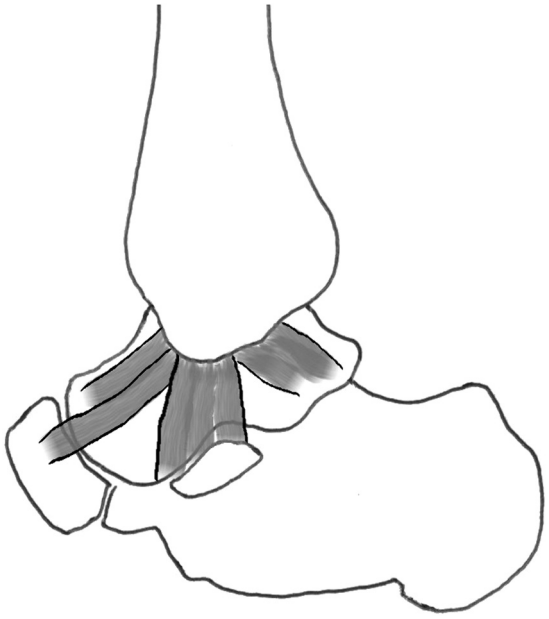

Fig. 1. Anatomy of the deltoid ligaments.

deltoid ligaments, i.e., the tibionavicular and tibiocalcaneal ligaments, with concomitant preservation of the ankle and subtalar joint range of motion is then confirmed by manual examination. (See Figure, Supplemental Digital Content 1, which demonstrates the reconstructed ligaments.)

The surgical wound is then closed layer by layer, and a compressive dressing is applied with a splint. At one week postoperatively, a short leg cast is applied, and the patient is instructed to walk with toe-touch weightbearing. At 6 weeks postoperatively, an ankle strap brace is applied for 6 weeks, and ankle range of motion, muscle strengthening and proprioception exercise are instructed.

Case

A 57-year-old female patient presented with pes planovalgus deformity with foot fatigue pain for several years, which was

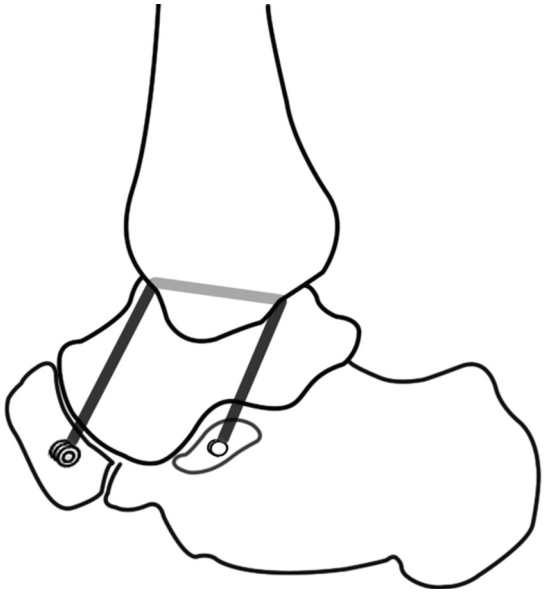

Fig. 2. Schematic drawing of the reconstructed limbs.

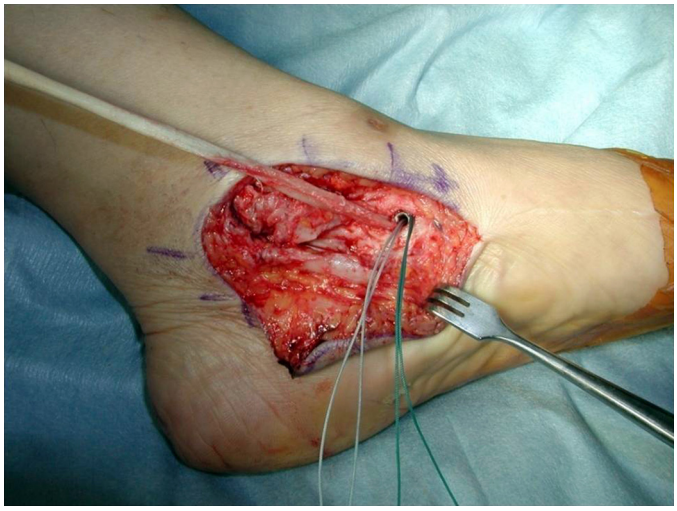

Fig. 3. To create the tibionavicular ligature, an anchor was used at the insertion site of the tibionavicular ligament.

aggravated after a recent ankle slip down injury. She also complained of medial ankle pain of VAS grade 8. She had a past history of hallux valgus correction with ipsilateral medial malleolar fracture fixation performed at another hospital four years prior. Tenderness was felt in the area from the medial malleolus to the deltoid ligament, but the inversion power of the posterior tibial tendon (PTT) was relatively intact (Grade 5-), and the subtalar joint was flexible. The heel valgus alignment in the standing state was prominent on both visual and radiographic examinations. A standing ankle plain radiograph showed a valgus tilted talus with approximately 20° of tibiotalar angle, suggesting medial ankle instability with deltoid ligament insufficiency. A declined talus and marked arch collapse were also found in a foot standing lateral view (Figs. 4A, 5A and 6A). The tibiocalcaneal angle (TCA) in the hindfoot alignment view was 10.9°. An ankle magnetic resonance imaging (MRI) scan showed a chronic tear of the tibionavicular ligament with thickening and a total rupture of the tibiocalcaneal ligament distally retracted from the medial malleolus. Deep deltoid ligaments also showed the morphology of a chronic tear, which included an irregular thinning pattern and increased signal intensity.

Having confirmed the diagnosis of a chronic rupture of the superficial and deep deltoid ligaments with mild tendinosis of the posterior tibial tendon in the operative field, we performed a medial sliding calcaneal osteotomy; a subtalar arthroereisis to realign the flatfoot deformity; and reconstructions of the superficial deltoid ligaments, i.e., tibionavicular and tibiocalcaneal ligaments, with a semitendinosus allograft tendon concomitantly.

At a 3-yearpostoperative evaluation, the patient showed a stable medial ankle and the VAS pain score improved from 8 to 2. The talar tilt angle resolved from 20°to 2°(Fig. 4B), and the flatfoot state in the foot standing view also improved. (Figs 5B, 6B) The tibiocalcaneal angle in the hindfoot alignment view improved from 10.9°to 4.9°. An MRI at the final follow-up showed well-maintained reconstructed ligaments. (See Figure, Supplemental Digital Content 2, which demonstrates the reconstructed ligaments.)

Discussion

The deltoid ligament is the primary medial ligamentous support of the ankle joint [12]. It consists of superficial and deep layers formed by several components. The superficial layer consists of the tibiospring, tibionavicular, superficial posterior