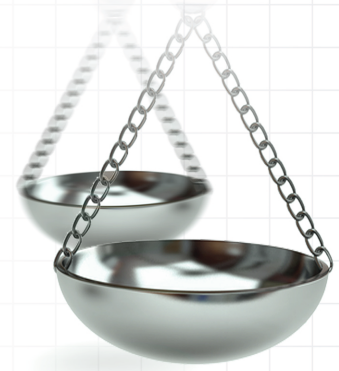




Autograft versus allograft tenodesis for chronic ankle instability: a single-center retrospective comparative study

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Aim: To compare the outcomes of patients who underwent autograft tenodesis with those who underwent allograft tenodesis for the treatment of chronic mechanical ankle instability. **Patients & methods:** Ten patients who underwent allograft lateral tenodesis were compared with 15 patients who underwent lateral tenodesis using a split peroneus brevis tendon. Patients were followed up after an average time of 10.5 years. **Results:** No statistically significant differences concerning American Orthopaedic Foot and Ankle Society and Karlsson–Peterson scores were reported ($p = n.s.$). A reduced average radiographic anterior talar translation was observed in the autograft group compared with the allograft group (1.4 and 4.0 mm respectively, $p < 0.001$). **Conclusion:** Both surgical techniques significantly improved subjective and objective outcomes in patients suffering from chronic ankle instability compared with pre-operative status. Autograft stabilization provided reduced post-operative anterior talar translation compared with allograft tenodesis.

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Keywords: allograft • ankle • autograft • chronic ankle instability • lateral ligament reconstruction • tenodesis

Chronic ankle instability (CAI) is a condition of persistent pain and giving-way symptoms, usually following multiple ankle sprains [1–3].

When conservative treatment fails, chronic ankle instability is frequently addressed surgically. Different surgical procedures according to its severity exist. The most popular surgical approach is the Broström–Gould procedure, which consists in direct ligament repair augmented with the inferior extensor retinaculum [4]; In order to reduce invasiveness and shorten rehabilitation period, arthroscopic techniques have been proposed for the treatment of functional or mild ankle instability [5,6].

However, in case of severe mechanical joint laxity, or whenever no viable ligamentous structures are available for direct repair, lateral tenodesis with auto- or allografts tendons is advocated [7–13]. In order to reduce postoperative pain, donor site morbidity and shorter operative time, some authors recommended the use of allografts [14–18], although this tissue carries drawbacks such as risk of disease transmission and bacterial infection as well as increased costs [19,20].

The purpose of the present study was to retrospectively compare the outcomes of patients who underwent autograft or allograft tenodesis. The hypothesis was that these procedures would effectively treat chronic mechanical ankle instability, without significant differences in outcomes between graft choices.

Materials & methods

Twenty-five patients affected by CAI treated at the Sports Traumatology Unit of The G. Pini Hospital in Milan, Italy were included in this retrospective single-center study and reviewed at an average follow-up of 10.5 years (range, 5–15 years). Ten consecutive patients who underwent allograft tenodesis between 2009 and 2011 were compared with 15 consecutive patients taken from a larger cohort of prospectively recruited subjects who underwent lateral tenodesis using a split peroneus brevis tendon between 1997 and 1998. Inclusion criteria were: age 18–40 years, positivity to anterior drawer greater than 5 mm and talar tilt greater than 9° on stress radiography, absence of

Table 1. Patient demographics and anthropometric data.		
Demographics	Autograft lateral ligament reconstruction	Allograft lateral ligament reconstruction
Patients (n)	15	10
Gender		
– Male	10	7
– Female	5	3
Mean BMI (SD)	25.4 (SD: 7.4)	25.7 (SD: 8.2)
Age at surgery (range in years)	29.1 (10.1)	29.4 (9.2)
SD: Standard deviation.		

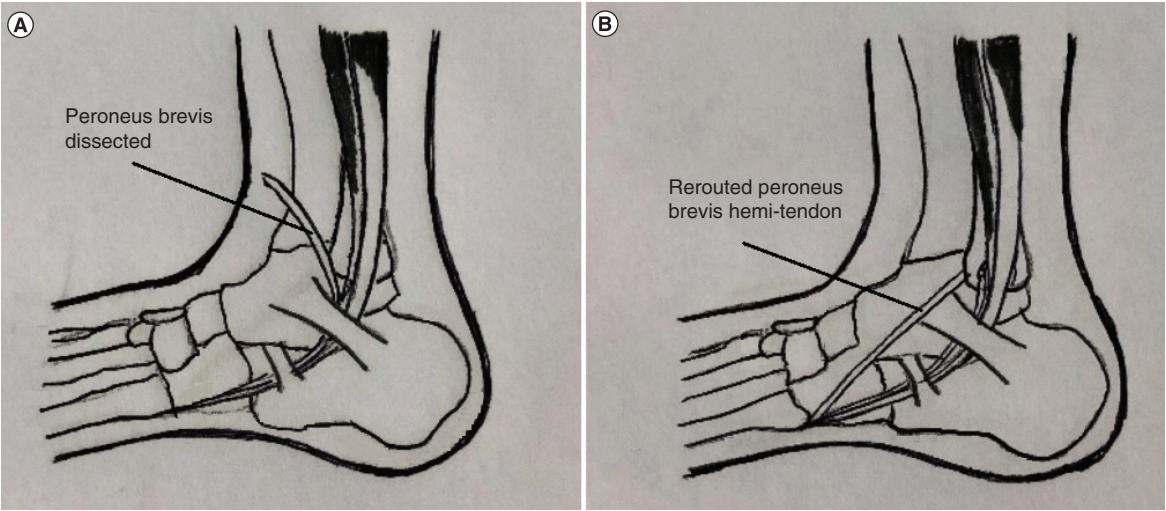


Figure 1. Schematic drawing of split peroneus brevis tendon lateral tenodesis.

previous ankle surgery, no cartilage defects requiring surgery. All the operations were performed by the same experienced senior surgeon. Mean age at surgery was 29.5 years (range: 18–40; Table 1).

Surgical technique of split peroneus brevis tendon lateral tenodesis

A curvilinear incision was made starting from the origin of the peroneus brevis tendon distally to the lateral malleolus and reaching the base of the fifth metatarsal bone. The tendon of the peroneus brevis muscle and the inferior extensor retinaculum were exposed. Care was taken not to damage the sural nerve. A proximal longitudinal hemi-section of the tendon measuring approximately 8 cm was performed. A bone tunnel measuring 5 mm of diameter was then drilled from posterior to anterior and from lateral to medial into the lateral malleolus. The hemi-tendon was then passed through the tunnel in the lateral malleolus and secured to the fifth metatarsal base with the use of No.2 absorbable sutures and sutured distally under tension while maintaining the foot in a neutral anatomical position. In order to enhance graft fixation, sutures were added proximally with the same suture thread (Figure 1).

Surgical technique of allograft lateral tenodesis

The procedure was carried out in the same way of autograft tenodesis with the exception that allograft (semitendinosus tendon or long digitorum tendon allograft) were used. After cryopreservation at -80°C and reconstitution in 500 ml sterile saline solution with 250 mg of Rifampicin for 15 min at 40°C, the graft underwent testing for Gram-positive and -negative micro-organisms. Then it was cut to a size of approximately 20–28 cm, passed through the bone tunnel, secured to the base of the fifth metatarsal bone and then sutured proximally to enhance tension with the ankle held in a neutral anatomical position (Figure 2).

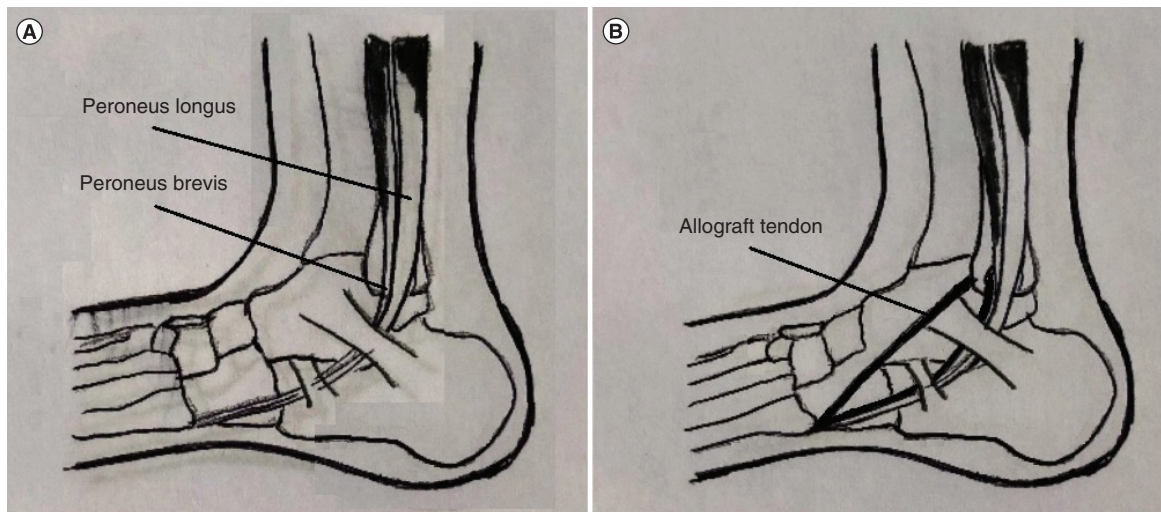


Figure 2. Schematic drawing of allograft tenodesis.

Rehabilitation protocol

In both groups cast or boot (Fixwalker, Ro + Ten, Arcore, Italy) at neutral position were applied after surgery and kept for 25 days with the prescription of walking with non-weightbearing with the use of two crutches. Following the removal of the boot, weightbearing as tolerated was permitted and peroneal muscle strengthening, proprioceptive and complete ankle range of motion (ROM) exercises were started. Return to sports was allowed after 3 months from surgery.

Outcome measures

Patients were examined pre-operatively and followed up after an average time of 10.5 years (range, 5–15 years). All of them underwent pre- and postoperative assessment including the American Orthopaedic Foot and Ankle Society (AOFAS) ankle and hindfoot scoring system [21], Karlsson–Peterson score [22] and objective examination comprehending ROM and manual laxity tests. Anterior drawer and talar tilt tests were measured radiographically pre-operatively and at follow-up using Telos Stress equipment (TELOS GmbH, Marburg, Germany). All investigations were conducted in conformity with ethical principles of research and according to the guidelines expressed by authors' Institution, and informed consent was obtained.

Statistical analysis

Data extracted were analyzed using the program IBM SPSS Statistics for Windows®, Version 21.0 (IBM Corp., NY, USA). Data were not normally distributed according to the Shapiro–Wilk test. Wilcoxon signed-rank test for related samples was utilized to compare the pre-operative and follow-up status. The Mann–Whitney U test was used to make comparisons between the two surgical techniques. Statistical significance was established at $p < 0.05$.

Results

Mean AOFAS and Karlsson–Peterson scores increased at follow-up compared with pre-operative status in both groups, showing a significant difference ($p < 0.05$). Similarly both manual laxity tests and average radiographic anterior talar translation and talar tilt angle under varus stress documented a significant improvement from baseline ($p < 0.05$; Table 2). No statistically significant differences concerning AOFAS and Karlsson–Peterson scores were observed between the two groups ($p = \text{n.s.}$). Concerning sagittal ROM four patients in the autograft tenodesis group experienced 5° dorsiflexion limitation compared with the contralateral side, while one patient experienced 15° dorsiflexion limitations in the allograft group. A reduced value of average radiographic anterior talar translation was reported in the autograft group compared with the allograft group (1.4 and 4.0 mm respectively, $p < 0.05$), while no differences were reported in terms of radiographic talar tilt test ($p = \text{n.s.}$; Table 3). No donor-site morbidity was observed in the autograft group. No intra- nor postoperative fibular fractures occurred in proximity to the bone tunnel.

Table 2. Comparison between pre-operative and follow-up status.

	Autograft lateral ligament reconstruction			Allograft lateral ligament reconstruction		
	Pre-operative	Follow-up	p-value	Pre-operative	Follow-up	p-value
AOFAS scale (mean)	60.3 (SD: 10.3)	89.7 (SD: 8.4)	<0.05	67.0 (SD: 15.4)	86.9 (SD: 12.2)	<0.05
Karlsson–Peterson score (mean)	59.7 (SD: 9.3)	91.9 (SD: 8.8)	<0.05	49.5 (SD: 17.7)	89.7 (SD: 7.0)	<0.05
Manual anterior drawer test (positivity)	15 (100 %)	0 (0 %)	<0.05	10 (100 %)	0 (0 %)	<0.05
Manual talar tilt test (positivity)	15 (100 %)	0 (0 %)	<0.05	10 (100 %)	0 (0 %)	<0.05
Radiographic anterior drawer test (mean)	7.7 mm (SD: 1.6)	1.5 mm (SD: 0.9)	<0.05	8.7 mm (SD: 0.8)	4.0 mm (SD: 0.8)	<0.05
Radiographic talar tilt test (mean)	11.8° (SD: 2.5)	2.5° (SD: 2.1)	<0.05	12.3° (SD: 1.2)	3.3° (SD: 0.6)	<0.05

AOFAS: American Orthopaedic Foot and Ankle Society; SD: Standard deviation.

Table 3. Comparison between groups.

	Autograft lateral ligament reconstruction	Allograft lateral ligament reconstruction	p-value
AOFAS scale (mean)	89.7 (SD: 8.4)	86.9 (SD: 12.2)	n.s.
Karlsson–Peterson score (mean)	91.9 (SD: 8.8)	89.7 (SD: 7.0)	n.s.
Manual anterior drawer test (positivity)	0 (0 %)	0 (0 %)	n.s.
Manual talar tilt test (positivity)	0 (0 %)	0 (0 %)	n.s.
Radiographic anterior drawer test (mean)	1.5 mm (SD: 0.9)	4.0 mm (SD: 0.8)	<0.05
Radiographic talar tilt test (mean)	2.5° (SD: 2.1)	3.3° (SD: 0.6)	n.s.

AOFAS: American Orthopaedic Foot and Ankle Society; SD: Standard deviation.

Discussion

The findings of our study showed that both surgical techniques represent a valid treatment option in patients with chronic lateral ankle instability from both a subjective and objective standpoint. Patients who underwent autograft lateral tenodesis achieved increased anteroposterior ankle stability compared with those who underwent allograft lateral tenodesis.

Compared with the Gould modification of the Broström procedure [4] which is considered the gold standard treatment for CAI, external tenodesis possess the advantages of providing stability in case no viable ligamentous structures are present.

According to current literature, much emphasis is put in reproducing the course of the natural ligament in order to obtain proper joint stability [23–25]. Criticisms to non-anatomical tenodesis techniques include increased invasiveness, risks of neurovascular injuries and postoperative joint stiffness. The two techniques described in the present paper are not anatomical. However, the use of the base of the fifth metatarsal bone as an anchor for the suture, allows to address subtalar joint instability brought by the calcaneo-fibular ligament incompetence, thus leading to improved stability in both ankle and subtalar joint. Restricting subtalar motion may account for increased joint stiffness, and in our case series the presence of dorsiflexion deficit was noted in a relatively high percentage of patients (5/25, 20%), although it did not considerably affect the overall functional outcome.

In our case series patients showed significant ameliorations in both AOFAS and Karlsson–Peterson score and improved ankle stability without significant complications irrespectively of the surgical technique adopted. According to our findings, a reduced value of average radiographic anterior talar translation was reported in the autograft group compared with the allograft group.

The advantages of using an allograft tissue instead of a rerouted autograft tendon include shorter operative time, less postoperative pain and decreased donor site morbidity, since the muscle strength which is important for eversion of the ankle is preserved [26–28]. However, the increased anteroposterior motion reported in the allograft group compared with the autograft may be related to its reduced biomechanical properties. Although the issue is controversial and no consensus exist about allograft properties, host immunologic responses and decreased strength have been reported [29–31]; conversely, other studies report no disadvantages in terms of biomechanical properties for allograft tissues [32]. Additional concerns include risk of disease transmission and bacterial infection as well as increased costs [19,20].

Fibular fractures are potential although uncommon complications which may occur while drilling the bone tunnel during lateral ligament reconstruction procedures. In our case series we suffered no complications when drilling a 5 mm tunnel into the distal fibula. No donor-site morbidity was observed in the autograft group. Additional complications such as sural or superficial peroneal nerve injury or wound complications were not reported, thus supporting these procedure as safe and effective techniques. Eventually, we found no evidence for a learning curve given the small number of complications reported in this case series, probably because all the operations were performed by the same well-experienced surgeon.

Limitations of the present study include the small sample size and the retrospective nature of its analysis. Further possible weaknesses are that the AOFAS which is not a validated score was used and the two groups were not randomized and have different follow-up times. Long-term studies with larger cohorts are needed to test the long-term survival of the grafts with regards to joint stability and progression of degenerative changes affecting the ankle joint.

Conclusion

Both surgical techniques significantly improved subjective and objective outcomes in patients suffering from chronic ankle instability compared with pre-operative status. Improved ankle stability was noted irrespectively of the surgical technique adopted, although objectively autograft stabilization provided reduced postoperative anterior talar translation compared with allograft tenodesis.

Summary points

- Chronic ankle instability (CAI) is a condition of persistent pain and giving-way symptoms, usually following multiple ankle sprains. Different surgical procedures according to its severity exist.
- In case of severe mechanical joint laxity, tenodesis with auto- or allografts tendons is advocated. In order to reduce postoperative pain, donor site morbidity and shorter operative time, some authors recommended the use of allografts.
- The purpose of the present study was to retrospectively compare the outcomes of patients who underwent autograft or allograft tenodesis to generate comparative evidence within the setting of the treatment of chronic ankle instability.
- Data collected from 25 patients affected by CAI were included in this retrospective single-center study and reviewed at an average follow-up of 10.5 years. Ten consecutive patients who underwent allograft tenodesis were compared with 15 consecutive patients who underwent lateral tenodesis using a split peroneus brevis tendon.
- Both surgical techniques significantly improved subjective and objective outcomes in patients suffering from chronic ankle instability compared with pre-operative status. Improved ankle stability was noted irrespectively of the surgical technique adopted. Autograft lateral tenodesis was associated with a significantly increased anteroposterior ankle stability compared with allograft lateral tenodesis.
- Long-term studies with larger cohorts are needed to test the long-term survival of the grafts with regards to joint stability and progression of degenerative changes affecting the ankle joint.

Author contributions

Study concepts/designing was done by A Ventura and C Legnani. Data acquisition was done by C Legnani, E Borgo and V Macchi. Data analysis/interpretation and statistical analysis was performed by C Legnani and V Macchi.

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Ethical conduct of research

The authors state that they have obtained appropriate institutional review board approval or have followed the principles outlined in the Declaration of Helsinki for all human or animal experimental investigations. In addition, for investigations involving human subjects, informed consent has been obtained from the participants involved.

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