Failed synthetic graft after acute Achilles tendon repair

Asmaa Mohamed[1]
Francesco Oliva[2]
Stefano Nardoni[3]
Nicola Maffulli[4]

[1] Department of Physical and Rehabilitation Medicine, School of Medicine, University of Rome "Tor Vergata", Italy Physical medicine, Rheumatology and rehabilitation Department, Faculty of Medicine, Ain Shams University, Cairo, Egypt
[2] Department of Orthopaedics and Traumatology, University of Rome "Tor Vergata", Italy
[3] Department of Pathology "San Filippo Neri Hospital" Rome, Italy
[4] Head of Department of Orthopaedics and Traumatology, Azienda Ospedaliera San Giovanni di Dio e Ruggi d'Aragona, University of Salerno, Italy; Queen Mary University of London, Barts and the London School of Medicine and Dentistry, Centre for Sports and Exercise Medicine, Mile End Hospital, London, UK

Corresponding author:
Francesco Oliva
Department of Orthopaedics and Traumatology,
University of Rome "Tor Vergata"
Viale Oxford 81
00133 Rome, Italy
Email: olivafrancesco@hotmail.com

Summary

Background: **The present case report aimed to determine the results of Flexor Hallucis Longus (FHL) transfer as a second surgery after synthetic tissue reinforcement graft (Artelon®) implanted to a primary repaired Achilles tendon (AT), that was undertaken by another orthopedic. One year postoperative the patient was referred to us with retrocalcaneal pain and difficulty in walking, associated with stiffness and significant impairment of daily living activities.**
Methods: **MRI and full clinical examination were the outcome measures applied before and 1 year after surgery. Removal of the synthetic graft and subsequent FHL autologous transfer was undertaken and the graft was sent for histology examination. After removing the below knee leg cast, patient started rehabilitation program supervised by a trained physiotherapist.**
Results: **The patient was allowed to return to his normal activities at the sixth postoperative month, 1 year post-surgery MRI showed correct position of the autograft in the calcaneous bone and in the centre of the native AT plus reduced oedema of the AT body, with clinical improvement of the patient who reported no pain and was able to walk on tiptoes.**
Conclusion: **Synthetic patch augmentation to enhance tendon healing should be subjected to proper investigation before using it in routine parctice, as it may act as a barrier against proper tendon healing.**
Level of evidence: V.

KEY WORDS: Achilles tendon, tears, augmentation, artelon, Flexor Hallux Longus (FHL), tendon autograft.

Background

The AT is the strongest tendon in the body. It can bear up to 12 times of the body weight, and accounts for 20% of all large tendon ruptures[1, 2]. AT rupture is commonly seen in middle age athletes, usually after sudden push off on the weight bearing foot[3]. Different materials and techniques have been investigated for AT repair; some studies reported the use of synthetic patches for tendon reinforcement[4-6]. We discuss the long-term viability of a patient who had undergone synthetic augmentation to a sutured AT after four days. To restore lost of AT function, a FHL transfer was undertaken. Synthetic patch augmentation to enhance tendon healing should be subjected to proper investigation before using it in routine practice, as it may act as a barrier against proper tendon healing.

Case report

A caucasian 45-year-old male, manager, with a body mass index of 23,51 kg/m^2 in good general condition suffered from a right AT rupture while running. Open surgical repair with end to end sutures was performed by another orthopaedic surgeon after four days from the injury and tissue augmentation graft (Artelon®) was undertaken. The patient followed a routine rehabilitation program without any apparent complication.

One year later, the patient was referred to us with retrocalcaneal pain and difficulty in walking, partially improved with rest. The pain worsened at the end of the day especially after prolonged weight bearing and climbing. This pain was associated with stiffness and significant impairment of daily living including sports activities. There were no other comorbidities. On clinical examination, a longitudinal discoloured 12 cm long scar adherent to the tendon was present on the posterior aspect of the right ankle (Fig.1). The patient was unable to walk on tiptoes, has limited dorsiflexion of the right ankle, with painful eversion and inversion. There was moreover tenderness over the posterior and lateral aspects of the AT. Antalgic gait was observed, The calf squeeze test (Simmond's test), the Royal London Hospital test and painful arc sign[2] were positive. MRI showed Achilles tendon thickening with a longitudinal area of intrasubstance degeneration (Fig. 2). After thorough discussion, removal of the synthetic graft and subsequent Flexor hallucis longus autologous transfer was recommended[7-9].

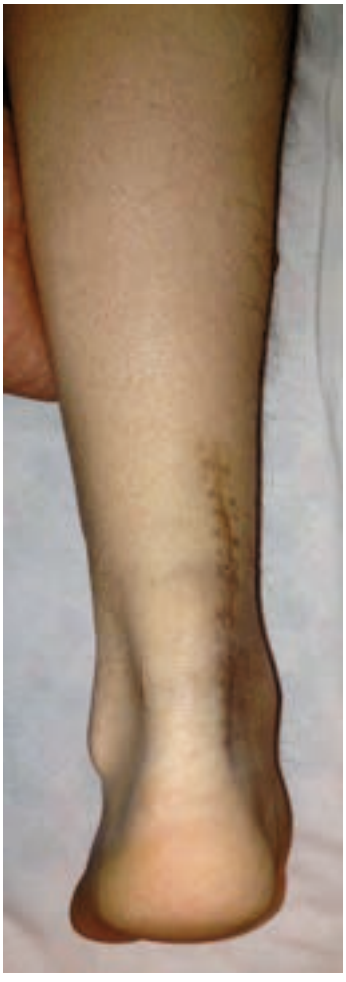

Figure 1. 12 cm longitudinal scar of earlier AT open repair.

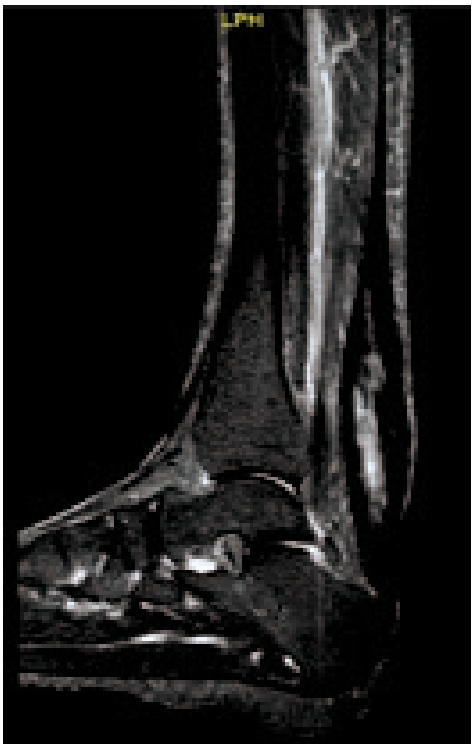

Figure 2. Sagittal T1 fat suppressed with contrast MR imaging showed Achilles tendon thickening with a longitudinal area of intra-substance degeneration.

Surgical procedure

Under spinal anesthesia, the patient was placed prone with the ankles clear of the operating table. A tourniquet was applied to the limb root thigh to be operated on. The limb was exsanguinated, and the tourniquet is inflated to 300 mmHg. Intravenous antibiotic prophylaxis was administered through a dorsal vein of the ipsilateral foot after the tourniquet had been inflated[10].

The incision was made on the previous scar. The very thin and hypo-vascularized skin edge of the incision was handled with extreme care to avoid wound healing problems (Fig. 3). The paratenon was adherent to the body of the AT and thickened for all the length of the tendon. After its identificaton and incision a sort of redundant tendinopathic tissue was observed and a longitudinal incision splitting the AT in two parts was performed (Fig. 4). Within this tissue the hidden Artelon was identified and completely removed. The graft was sent for histology examination (Fig .5). The FHL tendon graft was harvested through a longitudinal incision of the fascia medially along the distal portion of the AT. After its harvest, the free end of the tendon was prepared with a whip stitch with No. 1 Vicryl (Ethicon, Edinburgh, Scotland) (Fig. 6). The Kager space anterior to the distally splitted tendon was exposed, providing access to the postero-superior corner of the calcaneus. With an oscillating saw, an osteotomy of the postero-superior corner of

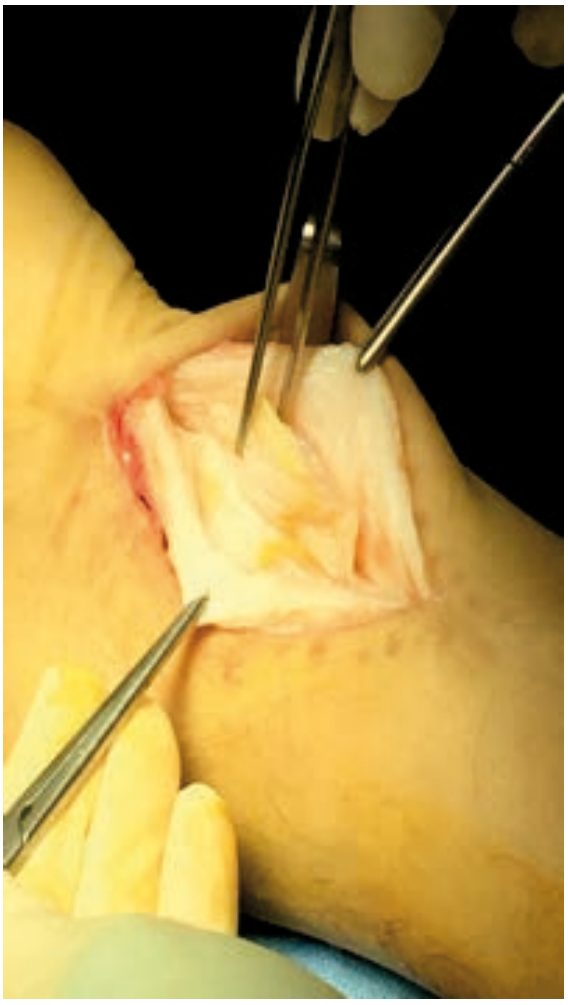

Figure 3. The incision on the previous scar with a longitudinal incision splitting the AT in two parts.

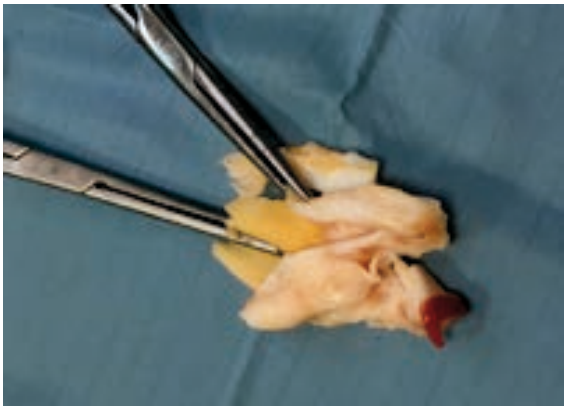

Figure 4. Redundant tendinopathic tissue removed.

the calcaneus was performed, making sure that no sharp edges of bone were left impinging on the anterior aspect of the insertion of the Achilles tendon. The osteotomy allowed to expose the insertion of the tendon on the calcaneus and to avoid impingement between the AT and the FHL tendon graft, preventing excessive tension on the skin covering the insertion of the tendon. A Beath pin was drilled in an anterograde direction, starting from anterior to the mid portion of the insertion of the AT, in a posterior to anterior direction of approximately 45°. A 7 mm cannulated headed reamer was used to produce a bone tunnel into the calcaneus for the passage of the flexor hallux longus tendon. The tendon graft was shuttled through the calcaneal tunnel and placed in the middle part of the split AT, covering the longitudinal gap left by the graft. Finally, the tendon graft was placed in tension with the ankle in maximal plantar flexion, and was fixed to the calcaneus using a 7 mm by 25 mm bioabsorbable interference screw inserted over a guide wire into the tunnel in the calcaneus (Fig. 7). The grafted tendon was sutured along the AT with 2-0 Vicryl (Polyglactin 910 braided absorbable suture; Johnson & Johnson, Brussels, Belgium). The grafted FHL tendon in this way represent the core of the neo-Achilles Tendon and the outer layers the old AT (Fig.

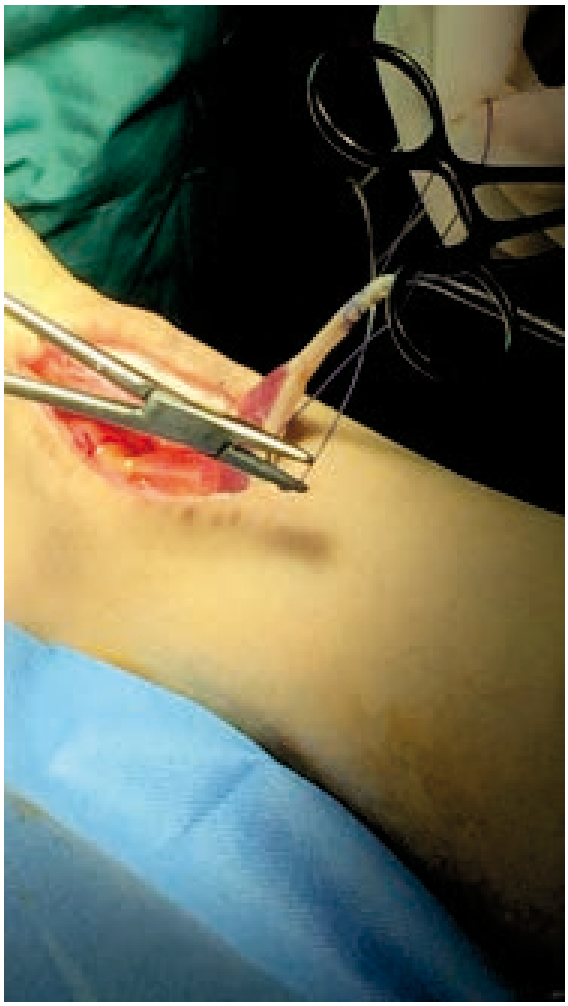

Figure 5. The hidden Artelon® was identified and completely removed.

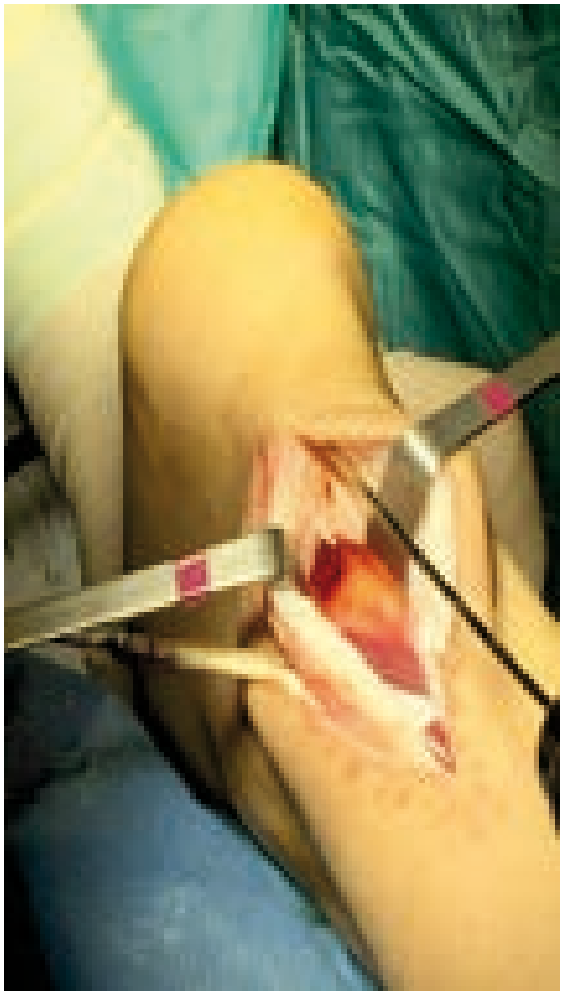

Figure 6. The FHL tendon graft was harvested through longitudinal incision of the fascia medially along the distal portion of the AT. After the harvest, the free end of the tendon was prepared with a whip stitch with No. 1 Vicryl (Ethicon, Edinburgh, Scotland).

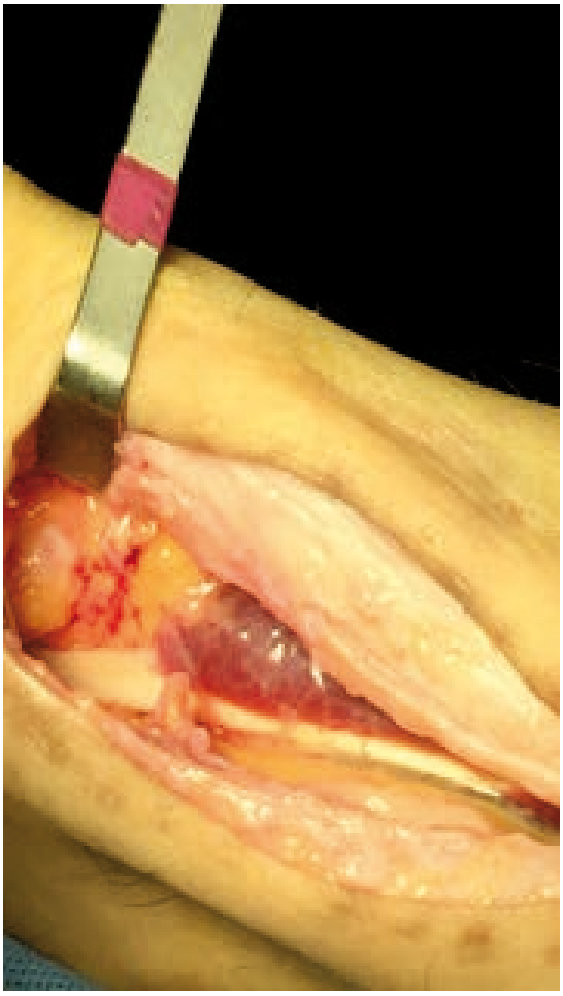

Figure 7. The tendon graft was placed in tension with the ankle in maximal plantar flexion, and was fixed to the calcaneus using a 7 mm by 25 mm bio-absorbable interference screw inserted over a guide wire into a tunnel in the calcaneus.

8). MRI after 12 months showed the correct position of the autograft in the calcaneous bone and in the centre of the native AT, plus reduced oedema of the AT body from absence of the synthetic graft (Fig. 9). This was associated with clinical improvement of the patient who reported no pain and was able to walk on tiptoes.

Histology

There was loose connective tissue scarcely vascularized within which numerous branches of non structured acellular tissue, likely synthetic material. There was scarce marginal inflammatory reaction (CD68+). The appereance was compatible with synthetic material (Fig. 10).

Post operative care

The patient was discharged the day after surgery with a synthetic below knee leg cast, after have been taught to use crutches by an orthopedic physiotherapist. Thrombo-prophylaxis was provided (Heparin), dose determined according to the patient weight. Patient was instructed to keep operated leg elevated as much as possible at home for the first 2 postoperative weeks, then to bear weight on the tiptoes as tolerated. The cast and skin staples were removed 14 days after, and the synthetic anterior below-knee slab was applied with the foot in maximal equinus. Patient was allowed to gradually progress to full weight bearing over 4 weeks. A trained physiotherapist supervises the introduction of stretching and gentle mobilization

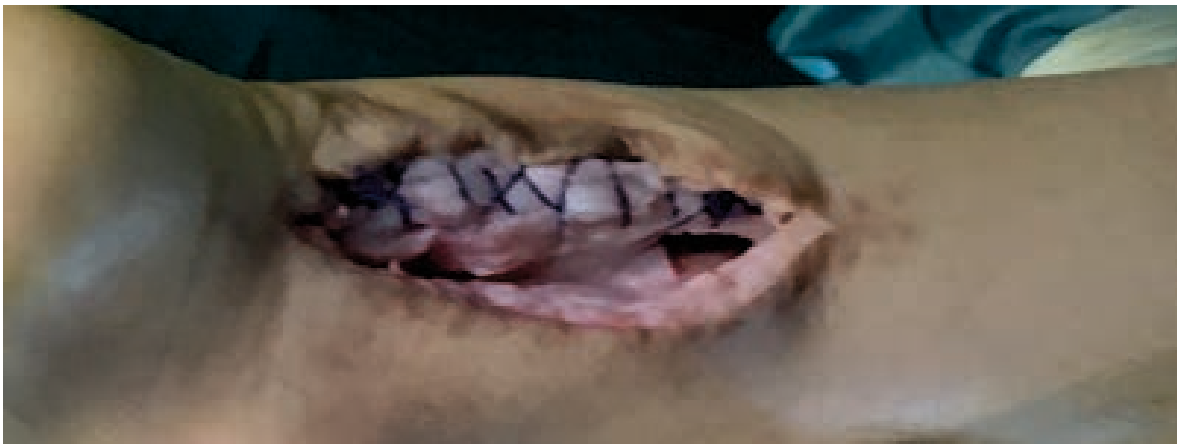

Figure 8. The grafted tendon was sutured along the AT with 2-0 Vicryl representing the core of the neo-Achilles Tendon and the outer layers of the old AT.

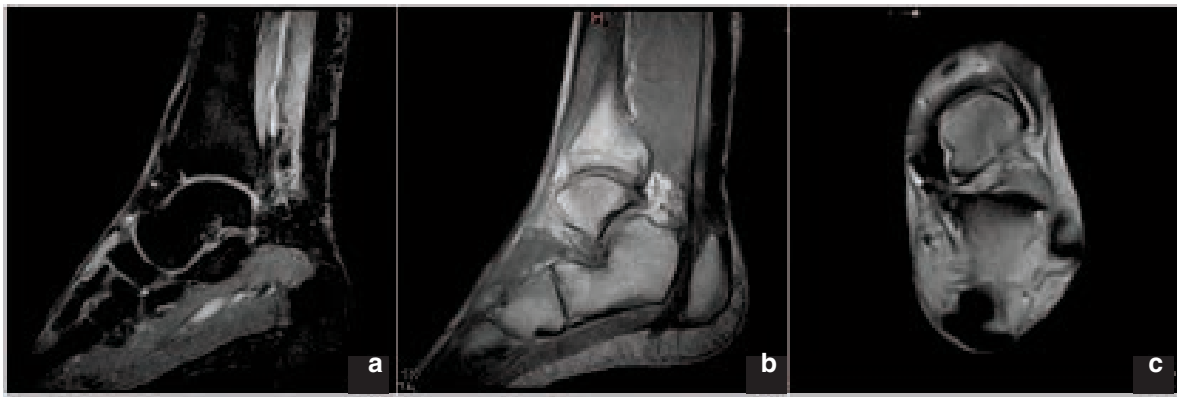

Figure 9 a-c. MRI 12-months-postoperative; (a). Sagittal Proton Density with fat suppression; (b). Sagittal Proton Density; (c). Axial Proton Density images showing the correct position of the FHL autograft in the calcaneus in the centre of the native AT, plus reduced oedema of the AT body.

exercises of the ankle, isometric contraction of the gastrocnemius-soleus complex, and gentle concentric contraction of the calf muscles. Inversion and eversion of the ankle were encouraged. At 6 weeks postoperatively the anterior slab was removed. The physiotherapist continued gradual strengthening exercises. Cycling and swimming were started 8 weeks postoperatively. The patient was allowed to return to his normal activities at the sixth postoperative month.

Discussion

This study conformed to the guidelines of the Declaration of Helsinki, met the ethical standards of the Journal[11]. Based on the patient's history, clinical examination, and imaging/histological findings we believe that the patient's symptoms arose from the synthetic graft wrapped around the tendon for a year. Most probably it interfered with the proper blood supply that choked the tendon, delaying instead of enhancing the healing process. Tendon and ligament pathologies are extremely common in the adult population with 1 million ankle injuries reported per year, 85% of which are ankle sprains[12]. Generally, patients feel better when the repaired tendon heals[13]; to enhance healing, the medical community has actively sought the augmentation of tendon repairs with two types of augmentation grafts, namely biologic and synthetic. Synthetic graft exhibit stronger mechanical strength, in severely neglected repairs was recommended for this capability to act as permanent replacement tissue[14,15].

Artelon® is a porous polyurethane urea synthetic graft, which performs as a scaffold allowing ingrowth of host tissue. This material has been in use in surgical procedures for over 30 years, and for approximately 15 years in orthopedic procedures. According to some orthopedic surgeons, the application of Artelon® and similar materials reinforce the soft tissue in the repair, and provide a biodegradable scaffold that incorporates into the patient's native tissue[16,17]. Artelon® degrades non-enzymatically in the presence of water. A non-enzymatic degradation is predictable and not dependent on the patient or an implant site.

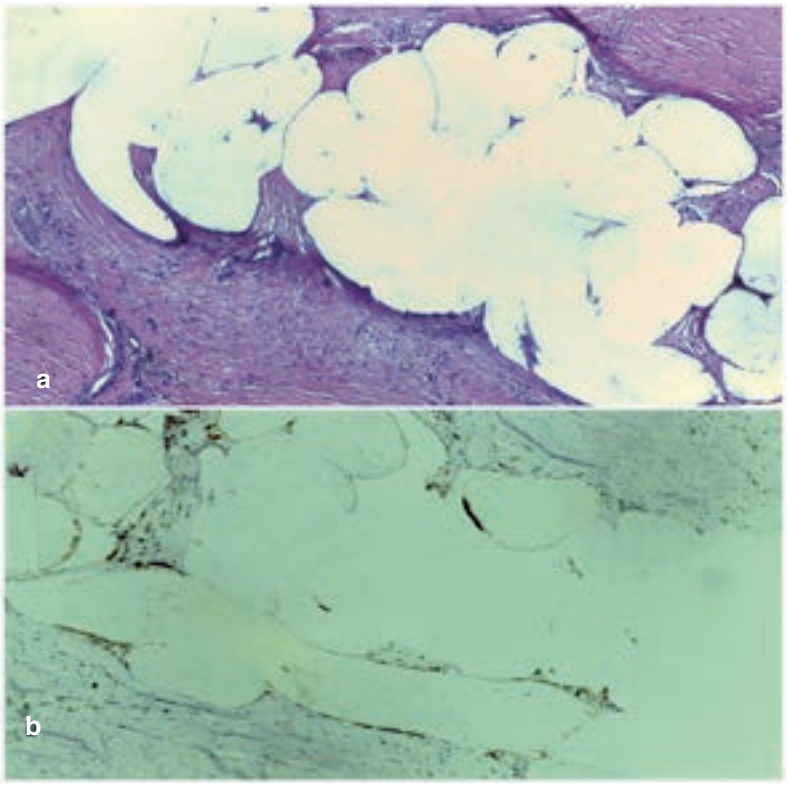

Figure 10 a, b. (a). 20X; H.&E.; glassy synthetic material surrounded by little inflammatory reaction; (b). 20X; Sporadic giant cells are highlighted by immunostaining CD68+.

During degradation, the Artelon® polymer breaks down to shorter chains resulting in a resorbable and non-resorbable fraction. The resorbable fraction (6-hydroxycaproic acid) is eliminated from the body through the Krebs cycle (citric acid cycle)[18,19]. The non-resorbable fraction [low molecular weight poly (urethane urea) segments] is incorporated into the surrounding host tissue. Very few studies have reported about graft implantation as an augmentation material in Achilles tendon repair[20, 21], while no study has clearly demonstrated improved AT healing or clinical outcomes using synthetic reinforcement in patients compared to a control group. A comprehensive search of PubMed, Medline, Cochrane, CINAHL, and Embase databases about Tendon augmentation grafts by Longo et al., 2010 reports that many biomaterials are available in the market for tendon augmentation while scanty evidence is available for the use of these scaffolds[22]. The Artelon® tissue augmentation scaffold provided a statistically significant improvement in AT load to failure when compared to control specimens in a cadaver model[23]. It is still a must for the surgeons to employ caution when using any orthobiologic material until more level 1 studies are conducted to examine the consequences of its use.

We suggest that autologous tendon transfer to restore AT function is still more reasonable management in cases of irreparable ruptures even if the optimal positioning of the FHL tendon to the calcaneus is still debate[24].

Conclusion

We describe the long-term outcomes of synthetic augmentation support of a sutured AT at one year postoperatively: the patient reported retrocalcaneal pain and decrease function. A second operation was needed to remove the synthetic augmentation and flexor hallux longus graft. Safety and efficacy of AT repair with synthetic augmentation is mandatory to be properly investigated before implenting it into real practice.

Conflict of interest

The Authors have no conflict of interest.

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