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Case Report

Modified bridle tendon transfer procedure following a complete musculature loss of the anterior leg compartment: Case report and literature review

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ABSTRACT

The complete musculature loss of the anterior compartment of the leg is a rare complication that occurs as a result of local tissue damage, intracompartmental bleeding and ischemia-reperfusion events. It causes foot drop and equinovarus deformity that negatively impact the quality of life of affected patients. This report describes a modified bridle tendon transfer procedure to correct this defect in a case of extensive muscle necrosis secondary to local hemorrhage.

A review of the literature was carried out to elucidate the benefits and risks associated to this technique.

Introduction

Lack of musculature function of the anterior compartment of the leg can cause dropfoot with equinovarus deformity of the foot and inability to dorsiflex the ankle [1]. This situation is mainly seen in injuries of common/deep peroneal nerves and in damage of the tibialis anterior muscle following tibial fractures [1,2]. Occasionally, compartment leg syndromes are no promptly detected and/or inadequately managed in multisystem trauma cases [1]. This condition can occur after intracompartmental hemorrhage, direct tissue damage (i.e., crush injury) or ischemia-reperfusion events [3]. The resulting muscle necrosis and subsequently scarring may affect the quality of life of these patients due to chronic pain, limitations in range of motion and deformities of foot/ankle [4].

This report describes the surgical management of an unusual loss of the entire musculature of the anterior leg compartment followed by the review of the existing literature.

Case report

A 36-year-old healthy male admitted to the hospital due to a knife stab wound on the right leg resulting in a large hematoma and anterior compartment syndrome. All muscles of this compartment became necrotic requiring excisional debridement. The patient developed foot drop, foot inversion and lack of dorsiflexion of toes and ankle. Muscles of the lateral and posterior compartments remained intact. The decision was made to perform tendons' transfer to minimize irreversible functional deficits caused by this tissue damage.

After appropriate debridement of the wound, an incision was made in the medial aspect of the foot to find the insertion of the tibialis posterior tendon at the navicular tuberosity. The tendon along with a periosteal flap was detached from the bone and the

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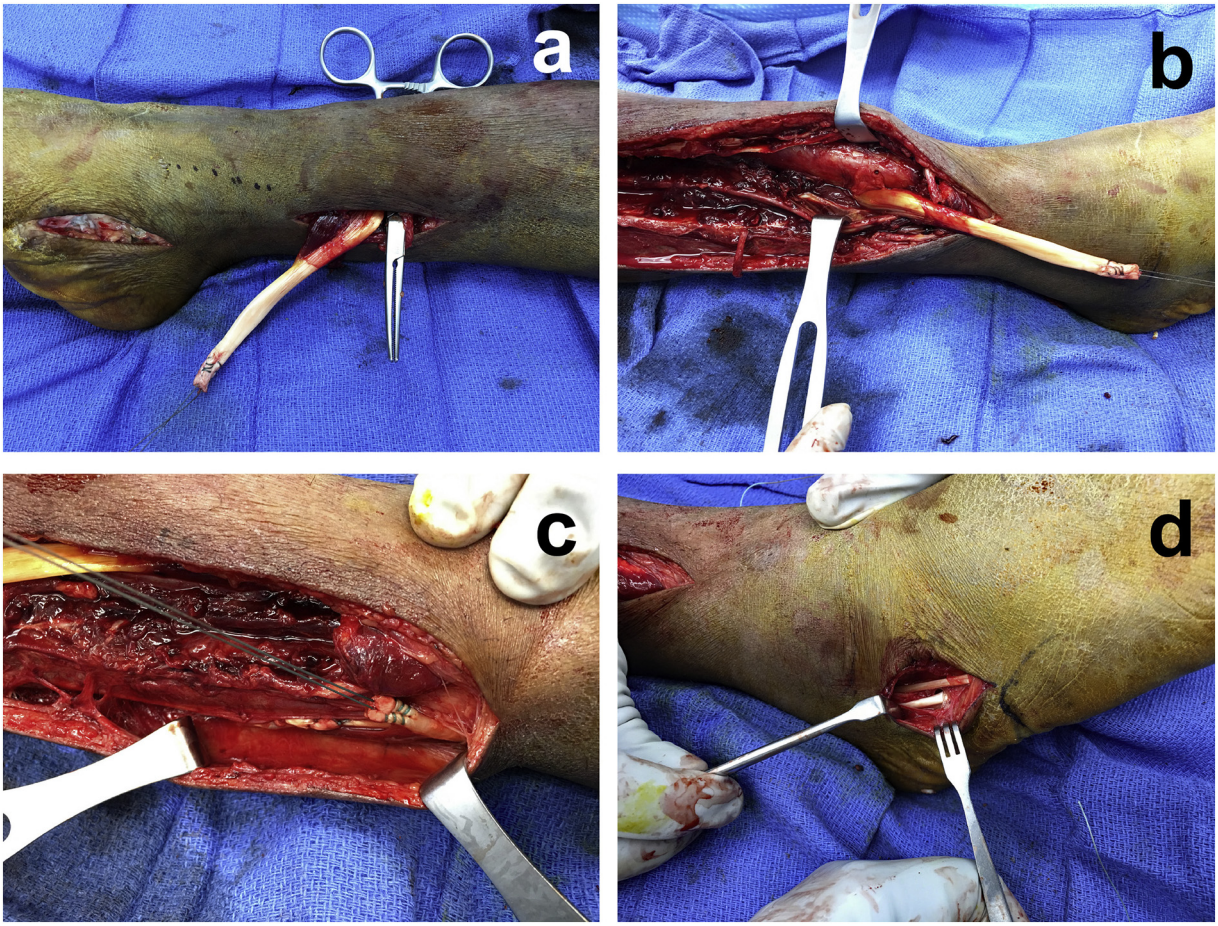

Fig. 1. (a) Tunnel between interosseous membrane slit and medial leg incision. (b) Transfer of tibialis posterior muscle to the anterior compartment. (c) Division of peroneus longus tendon and use of grasping sutures. (d) Identification of peroneus longus tendon in the lateral aspect of the foot.

resulting end secured with a grasping non-absorbable suture (Ethibond®; Johnson & Johnson; Somerville, NJ, USA). The tendon was subsequently pulled to the deep posterior leg compartment (distal third) through a longitudinal incision made just posterior to the medial tibial edge (Fig. 1a). Through the fasciotomy wound in the anterior compartment, a slit (8 cm long) in the interosseous membrane was created and then connected with the medial leg incision through a tunnel around the posterior surface of the tibia. Using this tunnel, the tibialis posterior muscle (tendon and muscle belly) was transferred to the anterior compartment (Fig. 1b). The peroneus longus tendon was reached through the fasciotomy wound and divided 10 cm proximal to the lateral malleolus. Both ends of the tendon were secured with grasping sutures (Fig. 1c). The proximal end was then passed through a slit in the peroneus brevis tendon and sutured with horizontal mattress sutures. Then, the tendon of the peroneus longus was isolated in the lateral aspect of the foot (Fig. 1d), so that the distal segment of the tendon could be pulled out from the lateral compartment (Fig. 2a). Thereafter, this segment of the tendon was redirected under the ankle extensor retinaculum into the anterior compartment. At this point, the posterior tibialis tendon was passed through slits made in the remaining distal part of the anterior tibialis tendon and then in the distal end of the peroneus longus tendon (Fig. 2b-c). Keeping the ankle in neutral position, Pulvertaft weave tendon repairs were performed and then secured with several horizontal mattress stitches of non-absorbable suture. An incision was then made over the dorsum of the foot proximal to the base of the second metatarsal bone. Dissection was carried down to the periosteum until the second cuneiform was encountered. Fluoroscopy was used to drill a K-wire through this bone. A cannulated drill (Arthrex system cannulated drill, Arthrex, Inc., Naples, FL, USA) with the same diameter as the distal end of the tibialis posterior tendon was used over the K-wire to create a hole from the dorsal to the plantar aspect of the cuneiform. Using a Keith needle, the grasping suture attached to the end of the tibialis posterior tendon was passed through the bone tunnel and exteriorized on the plantar skin (Fig. 2c; Fig. 3). Pulling this suture while maintaining the foot in slight dorsiflexion, the tendon was buried in the bony hole and tightened in this position with the appropriate Arthrex® biotenodesis screw (Fig. 3). Finally, the suture was passed through and tightened over a button at the plantar skin (Fig. 4). All surgical incisions were closed in two layers. The fasciotomy was reduced in size by soft tissue rearrangement and the remaining open wound was covered with 0.012-inch split thickness skin graft (Fig. 4). A well-padded dressing was applied along with a short-leg non-weight bearing fiberglass splint to maintain the ankle in neutral position. Patient received regular dressing changes until the healing process was completed. Skin sutures were removed at 14 days. Edema control measurements and positional support

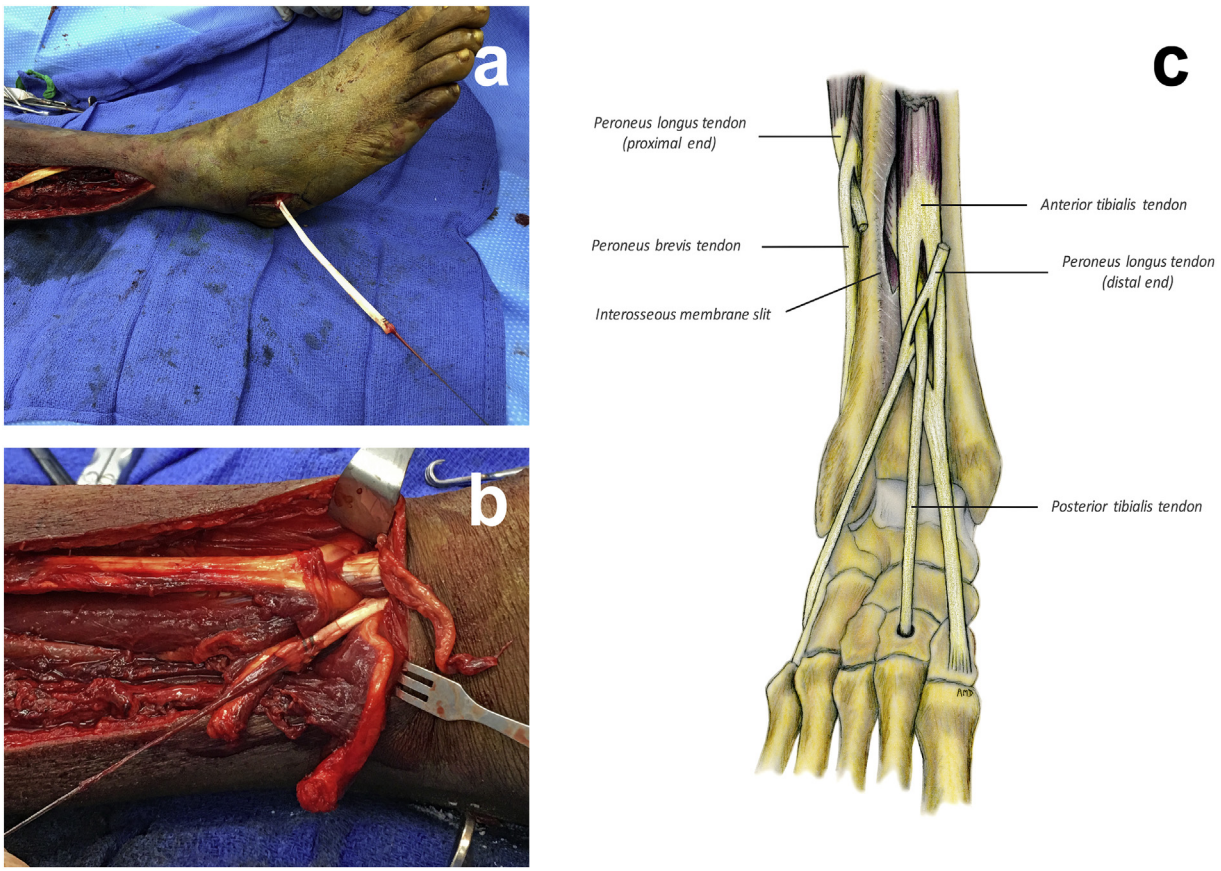

Fig. 2. (a) The distal end of the peroneus longus tendon was pulled out through a lateral foot incision. (b) Tendon anastomoses involving posterior tibialis, anterior tibialis and peroneus longus tendons in a Pulvertaft weave tendon repair fashion. (c) Illustration of tendons' interconnections before the Pulvertaft weave tendon repairs are completed. Passage of peroneus longus tendon (proximal end) through a slit in peroneus brevis tendon and passage of posterior tibialis tendon through the interosseous membrane slit, anterior tibialis tendon and distal end of the peroneus longus tendon, respectively.

with splint were also ordered for several weeks. Partial weightbearing with protected ankle-foot orthosis boot was allowed four weeks after surgery. The grasping suture of the tibialis posterior tendon on the plantar surface was trimmed six weeks after surgery. Active range of motion and progression to full weightbearing as tolerated was allowed six weeks after surgery. Simultaneously, physical therapy was requested to assist with the mobilization and retraining of the tibialis posterior tendon transfer by using active and active-assisted exercises. Eleven months after surgery, patient had full and stable skin coverage with occasional foot pain, ambulation without assistance or orthotic devices and recovery of approximately 40% of the ankle dorsiflexion (compared to the contralateral joint).

Discussion

The use of tendon transfers to restore the function of lower extremity have been described in cases of trauma (i.e., nerve injury), tumors, spine pathology/injuries, poliomyelitis, leprosy, cerebral palsy, Charcot-Marie-Tooth disease, spastic hemiplegia without fixed deformity, Guillain-Barre syndrome, among others [2,4,5]. There have been reported several surgical approaches to correct flexible footdrop deformities with the transfer of tibialis posterior tendon to the dorsal aspect of the midfoot [1,2,6]. In this regard, the bridle tendon transfer was designed not only to restore nonprogressive paralytic drop-foot [7], but also to assist the ankle joint dorsiflexion during the swing phase of the gait and prevent varus or valgus deformities by balancing the lateral and medial motor forces on the foot [2,5]. This procedure consists of the anastomosis of tibialis posterior tendon to the peroneus longus and tibialis anterior tendons above the extensor retinaculum [2,4–6]. Rodriguez modified this procedure by adding the bone insertion of the tibialis posterior tendon into the second cuneiform [8]. This modification provides more predictable and satisfactory long-term outcomes [4,9].

Decreased ankle plantarflexion range has been described in patients who underwent bridle procedure. It is not clear whether this limitation is secondary to scarring adhesion, muscle weakness, prolonged splint immobilization or a combination of them [10]. Our patient exhibits a minor reduction in the plantarflexion that is improving with physical therapy. Another disadvantage of this

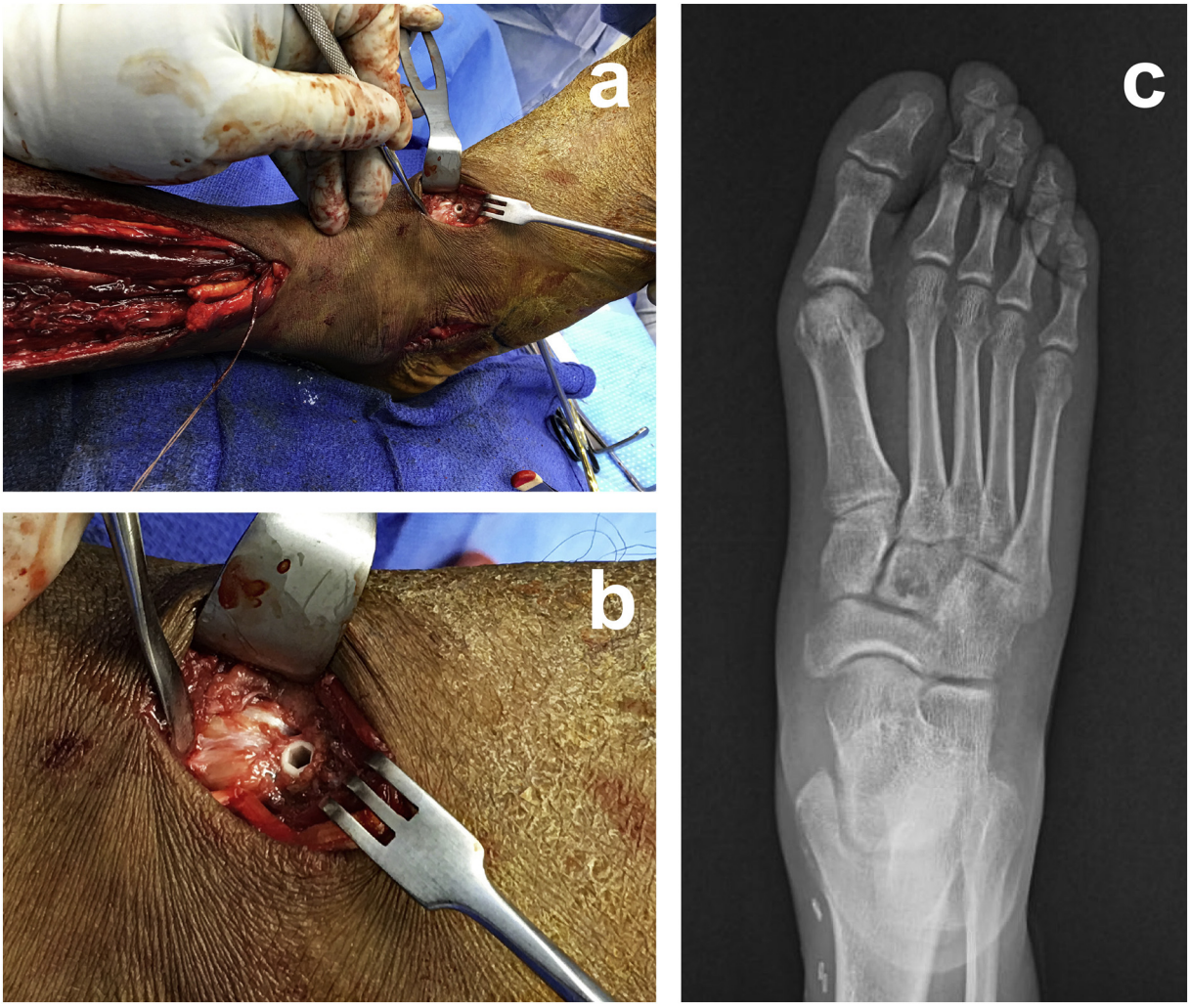

Fig. 3. (a and b) Intraoperative view of the insertion of the posterior tibialis tendon in the second cuneiform using an interference tenodesis screw. (c) X-ray image shows the location of the hole in the second cuneiform.

Fig. 4. Postoperative day 7 of modified bridle tendon transfer procedure.

technique is the bulkiness generated by the tendon anastomoses in the distal anterior compartment. In cases with thin skin and narrow ankle (as our patient), the bridle procedure may have higher risks of wound dehiscence or infection and delays in the healing process.

In summary, the bridle tendon transfer procedure has been described to correct drop-foot in numerous medical settings. However, the results may depend on the nature of the underlying clinical conditions, the timing between the onset of the problem and the surgical intervention and whether or not the deformity is flexible. In optimal condition, this procedure results in improvement of the ankle dorsiflexion with evenly balanced forces from the peroneus longus and tibialis anterior tendons. These effects may provide an orthotic-free ambulation, reduce the risks of recurring deformity and allow a more normal gait.

Patient consent

All patient information has been de-identified and informed consent was obtained from the participant included in the study.

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Declaration of competing interest

The author declares no potential conflict of interests.

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