

Modified Bridle Procedure with Flexor Hallucis Longus Transfer for Treatment of Foot Drop: A Case Report and Review of Literature

Rebecca A. Sundling, DPM¹, Elizabeth B. Wakefield, DPM¹, W. Drew Chapman, DPM², Elizabeth A. Hewitt, DPM³

¹ Department of Podiatry, Grant Medical Center, Columbus, Ohio; ² Family Foot and Leg Center, Naples, Florida; ³ Step Lively Foot and Ankle Centers, Columbus, Ohio



ABSTRACT

The transfer of the posterior tibial (PT) tendon to the dorsum of the midfoot has long been described as a treatment option for drop foot. This was modified later to include anastomosis of the PT tendon to the tibialis anterior (TA) and peroneus longus tendons, known as the bridle procedure. As in PT tendon dysfunction, patients with PT tendon transfers are at risk for medial arch collapse. This is frequently circumvented with a flexor digitorum longus (FDL) transfer. We describe a case of a 29 year old male with drop foot who underwent PT tendon transfer with anastomosis to the TA tendon and transfer of the flexor hallucis longus (FHL) tendon to the navicular. The patient developed drop foot of the left lower extremity secondary to a motor vehicle collision three years prior. Preceding the described procedure, the patient underwent a hallux amputation secondary to an ulcer from an ill-fitting AFO, leaving the FHL tendon available for transfer. This allowed us to leave the FDL maintaining its insertion on the medial arch and still bolster the medial arch. After a year follow up, the patient is able to ambulate without the use of an AFO and without radiographic or clinical collapse of medial arch often seen with detachment of the posterior tibial tendon. The FHL tendon proved a convenient option for transfer and was strong enough to counter balance the pull of his posterior compartment.

INTRODUCTION

Drop foot occurs when the foot cannot actively dorsiflex, resulting in dysfunctional gait. The cause of drop foot can be neurologic, traumatic, or systemic¹. Causes include lumbar spinal pathology, closed head injuries, stroke, multiple sclerosis, Charcot-Marie-Tooth disease, compartment syndrome, neuropathies, and direct injury to the common peroneal nerve, among other causes. Typically, the initial treatment of foot drop includes bracing with an ankle foot orthosis (AFO). If an AFO is nonfunctional or undesirable, a muscle-tendon transfer may be indicated for patients with disease that has progressed and is in a stable phase². Posterior tibial (PT) tendon transfer to the midfoot for treatment of drop foot has been well established in the literature^{1,3} with excellent outcomes^{3,4,5}. The bridle procedure traditionally consists of transfer of the PT tendon through the interosseous membrane to the midfoot, with tenodesis to the tibialis anterior (TA) tendon and peroneus longus tendon⁶.

Here, we describe a modification of the bridle procedure where the PT tendon was transferred through the interosseous membrane with insertion into the midfoot with tenodesis to the TA tendon, and transfer of the flexor hallucis longus (FHL) tendon to the navicular to prevent pesplanovalgus deformity, in the presence of previous hallux amputation.

CASE REPORT

Our patient is a 29 year old male with drop foot to the left lower extremity. In October 2010, the patient was involved in a motor vehicle collision, causing a tear of the thoracic aorta and transverse process fractures of L4 and L5. The patient was seen at our institution for this trauma but initially podiatry was not consulted. Our team became involved in the case when the patient presented to the emergency department three years later with concern for ulceration to his left hallux. Since the initial accident, the patient developed drop-foot to the left lower extremity and had been prescribed an ankle-foot orthosis (AFO). The AFO resulted in an ulceration to the left hallux. The patient no longer had follow up care with his primary care doctor so he proceeded to present to the emergency department.

On initial evaluation, there was a small, infected, full thickness ulceration to the medial left hallux. The patient had 0/5 muscle strength to the anterior compartment with protective sensation intact to the level of the midfoot. The patient was discharged home on oral antibiotics and instructed to follow up with the senior author, with plans for wound care and eventually surgery to correct the drop foot. Despite wound care and proper offloading, the ulcer failed to heal. New radiographs were obtained which showed a fracture of the distal phalanx. Bone biopsies of both the distal and proximal phalanges showed evidence of osteomyelitis. The patient subsequently underwent a left hallux amputation and healed uneventfully. Two months following the hallux amputation, the patient underwent a drop foot reconstruction.

OPERATIVE TECHNIQUE

The patient was placed on the operating room table in supine position and general anesthesia was administered. A well-padded pneumatic thigh tourniquet was applied and inflated. Attention was then directed to medial foot. An incision was made from the navicular, extending proximally to the medial malleolus with dissection carried down to the posterior tibial tendon sheath. This was the incised and the tendon was reflected off its insertion. A second incision was then made approximately 15 cm proximal to the medial malleolus, medial to the tibial crest. The PT tendon was brought proximally through this incision.

A third incision was then made 6 cm proximal to the ankle joint and the PT tendon was passed from posterior to anterior through the interosseous membrane and a split made in the tibialis anterior tendon. The two tendons were anastomosed utilizing suture. At this time, a fourth incision was made over the intermediate cuneiform. The PT tendon was then passed deep to the extensor retinaculum and to the intermediate cuneiform utilizing a Houston passer. This was then fixated in the intermediate cuneiform with a biotenodesis screw. Skin was closed utilizing suture and staples.

Attention was redirected to the medial arch incision. Dissection was carried down until the flexor hallucis longus (FHL) tendon was identified and transected just proximal to the Master Knot of Henry. A drill hole was placed in the medial navicular and the tendon was passed from plantar to dorsal, secured in place with an appropriately sized biotenodesis screw. The FHL tendon was then brought back onto itself and secured. The area was irrigated with saline and closed utilizing vicryl and staples.

A posterior splint was then applied with appropriate padding. The patient remained non-weight bearing initially and then began physical therapy. The patient went to physical therapy for 3 months and regained full strength. At 15 months, the patient is now ambulating without an AFO with medial arch intact.

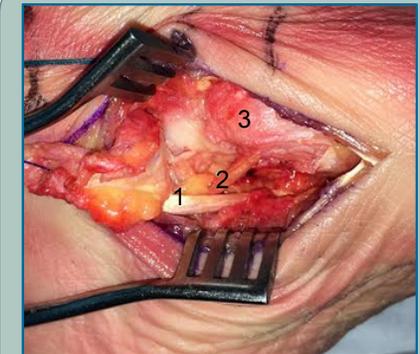
DISCUSSION

The treatment of drop foot must be tailored to an individual patient's needs based on severity, lifestyle, and activities of daily living goals. The transfer of the PT tendon was originally described by Ober⁷ in 1933 and the description of transferring through the interosseous membrane was published by Mayer⁸ in 1937. The term bridle procedure was published in 1991 by McCall⁹ and colleagues, where the anastomosis of the PT tendon, TA tendon, and PL tendon in combination with elongation of the Achilles tendon were described¹⁰.

From a biomechanical standpoint, there is concern that harvesting the PT tendon, the strongest supinator of the foot, there is a risk of arch collapse and development of a valgus deformity^{9,11}. Vertullo and Nunley in 2002 described a case of acquired flat foot after anterior transfer of the PT and FHL tendons after peroneal nerve injury from knee surgery. Flynn et al. in 2015 retrospectively reviewed 15 patients who underwent PT tendon transfer with or without concomitant subtalar implant. Both groups were able to avoid significant arch collapse, however one patient who did not have the implant required a triple arthrodesis during the follow-up period¹⁰. While others report no development of calcaneovalgus deformity after PT tendon transfer^{4,12}.

In our case, there was concern for the development a flat foot due to transfer of the PT tendon and already altered biomechanics due to hallux amputation. We opted to perform another tendon transfer, and harvested the FHL tendon to be transferred to the navicular. Traditionally, the FDL tendon is transferred when the PT tendon is severely degenerated or ruptured, mostly in PT tendon dysfunction^{4,13}. This transfer into the navicular with fixation^{4,13} provides supinatory forces and replicates the function of the PT tendon. In this case, our patient previously underwent a hallux amputation, and the FHL tendon currently served no function, leaving it available for transfer without concern for loss of function distally.

At fifteen months follow-up, the patient is doing well and able to ambulate well without bracing.



1: Flexor Digitorum Longus
2: Flexor Hallucis Longus transferred into navicular
3: Navicular

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