INTRODUCTION

Flexor hallucis longus (FHL) tendon injuries can range from tenosynovitis to partial tears and complete ruptures. These injuries can be caused by both mechanical and pathologic processes, and traumatic ruptures result from either direct, indirect, or repetitive injuries. The FHL is an active ankle plantar flexor, subtalar joint invertor, and helps with push-off power of the hallux during gait by plantarflexing the first metatarsophalangeal joint (MPJ) and hallux interphalangeal joint (HIPJ). Injuries of this tendon can lead to hyperextension at the first metatarsophalangeal joint and pain with prolonged walking or running. A thorough history and physical examination provide information necessary for making the proper diagnosis, and further imaging modalities help confirm the diagnosis, determine the location of injury, and assist with surgical planning. Ruptures can occur at 1 of 3 zones: Zone 1 (distal to sesamoids), Zone 2 (between the sesamoids and the knot of Henry), and Zone 3 (proximal to the knot of Henry) (1).

In this article, we will present a case report, discuss the anatomic considerations, and review current literature of FHL tendon ruptures.

CASE REPORT

A 38-year-old man presented to the clinic for evaluation of swelling and a “lump” that had formed at the plantar aspect of his right foot proximal to the first metatarsophalangeal joint region. The patient stated that the “lump” had been present for approximately 1.5 months. He had a significant medical history of chronic inflammatory demyelinating polyneuropathy (CIDP) and also a surgical history of a right foot Akin osteotomy with second toe distal interphalangeal joint arthroplasty performed in the previous year. The patient then underwent surgical hardware removal with HIPJ capsulotomy performed by another physician 4 months prior to his visit (Figure 1 and Figure 2). There were no reported complications with the previous surgeries, but the patient did have neurological deficits associated with the CIDP, and was being treated with azathioprine and gabapentin.

CIDP is a progressive neurological disorder characterized by weakness and impaired sensory function in the legs and arms (2). Clinically, the patient had symmetric weakness of all muscle groups crossing the ankle joint bilaterally. He could actively plantarflex and dorsiflex all of his toes bilaterally with the exception of the right hallux,
which he was not able to actively plantarflex at the HIPJ. The patient was able to plantarflex the right first MPJ, and no instability with dorsal drawer testing of the first MPJ was noted. Protective sensation was decreased at the plantar aspect of both of his feet with Semmes Weinstein 5.07 monofilament testing. There was a prominent palpable soft tissue mass present at the plantar medial forefoot region. The patient was able to ambulate with a cane and wore custom ankle foot orthoses (AFO). He stated that the mass was bothersome when wearing his AFO.

Magnetic resonance imaging (MRI) was performed. The results showed that the FHL tendon was torn at the level of the great toe and retracted to the level of the first metatarsal neck region with the retracted tendon showing hypertrophic tendinosis (Figures 3-5). It was also noted that there was diffuse muscular edema and mild to moderate severe fatty infiltration and atrophy of the musculature of the forefoot, suggestive of muscular denervation associated with CIDP. The patient was educated concerning his condition, and treatment options were reviewed. Nonsurgical options were discussed as well as surgical options, which included either an HIPJ fusion with excision of the hypertrophic tendon or repair of the ruptured FHL tendon with possible use of an allograft tendon. The patient consented to having the FHL tendon repaired.

The patient underwent a surgical repair of the FHL tendon rupture under general anesthesia. The patient was placed in a supine position and a mid-calf tourniquet was utilized to maintain surgical hemostasis. The skin incision was created at the plantar aspect of the right hallux extending to the midshaft region of the first metatarsal. This skin incision was placed in a controlled depth fashion, and any vessels crossing the incision site were ligated as needed to maintain hemostasis. Dissection was carried to the flexor tendon sheath, which was then incised, and blunt dissection was carried out both distally and proximally to identify the ruptured ends of the FHL (Figure 6). There was a 5-cm gap, and the tendon ends could not be reapproximated end-to-end. Utilizing 2-0 fiber wire in a modified Krakow-type fashion, the ruptured tendon ends were reapproximated with the use of a semitendinosus allograft to span the defect after
proper preparation and pre-tensioning (Figure 7). Adequate tension of the graft and repaired tendon was achieved. These ends were further stabilized with 3-0 Vicryl in an over-and-over fashion. The deep fascial layer overlying the tendon was then reappproximated utilizing 3-0 Vicryl in an over-and-over fashion. The mid-calf tourniquet was released, and the skin incision was reapproximated utilizing 3-0 nylon in a horizontal mattress fashion. A non-adherent dressing was then applied over the incision site followed by dry sterile dressings and a well-padded below-knee posterior splint with the hallux in a neutral position and ankle placed in plantar flexion.

The postoperative course consisted of suture removal at 3 weeks (Figure 8), and the patient being non-weightbearing for 6 weeks. He then transitioned to progressive full weight-bearing over the next 6 weeks with use of a controlled ankle motion boot before being able to transition back to his AFO and supportive shoes. The patient was able to successfully transition back to his AFO without pain and no remaining soft tissue mass was present (Figure 9 and Figure 10). The patient returned to the clinic on an annual basis, and due to the progression of his CIDP ultimately developed a rigid hallux malleus contracture and underwent a HIPJ arthrodesis 3 years after the FHL tendon repair.

### ANATOMICAL CONSIDERATIONS

The FHL muscle originates at the interosseous membrane between the tibia and fibula fascia covering the tibialis posterior muscle and distal two thirds of the posterior surface of the fibula. A synovial sheath covers the FHL tendon, and there is a proximal and distal component of this sheath. Proximally, the synovial sheath extends 1 centimeter proximal to the ankle joint and surrounds the tendon as it courses through the fibro-osseous tunnel of the talus, inferior to the sustentaculum tali of the calcaneus, and it ends generally at the navicular cuneiform joint region on the plantar aspect of the tibialis posterior tendon. The distal
segment of the FHL sheath covers the tendon near the base of the first metatarsal and extends to the insertion of the tendon at the base of the distal phalanx of the hallux (3). Innervated by the tibial nerve, the FHL acts to plantarflex the great toe at the HIPJ and first MPJ, supports the arch, inverts the subtalar joint and plantarflexes the ankle joint. The FHL crosses the flexor digitorum longus (FDL) tendon from lateral to medial, and anatomic variations have been described between the distal relationship of the FHL and FDL tendons.

In a cadaver study of 24 legs, three different configurations were identified. Type 1 was an attachment from the FHL tendon proximally to the FDL tendon (42%), type 2 were attachments from the FHL tendon proximally to the FDL tendon and from the FDL tendon proximally to the FHL tendon (42%), and type 3 no attachment (17%) (4).

**DISCUSSION**

FHL tendon injuries can occur at various locations along its course, and traumatic ruptures occur by direct, indirect, or repetitive overuse injuries. Treatment options of an FHL rupture include nonsurgical treatment, primary repair, tenodesis to the FDL tendon or flexor hallucis brevis, tendon transfers, and HIPJ arthrodesis. Wei et al noted that surgery for FHL tendon ruptures should be performed primarily for pain relief (5).

Diagnosing FHL tendon injuries are based on a thorough clinical examination, and advanced imaging is helpful in determining the extent of injury. In FHL pathology, the deep location and changes in direction of the tendon create difficulty in ultrasound evaluation (6). MRI is useful in traumatic tendon injuries, and coronal images provide key insight in distal FHL injuries (7). MRI evaluation is helpful in assisting with surgical planning to determine the extent of injury, and whether a primary repair or graft may be necessary.

In chronic tears distally, some studies have suggested utilizing a free tendon graft for FHL rupture repair when direct repair is not possible. Recently, Anastasopoulos et al reported on a neglected FHL tendon rupture, which they treated with a free autogenic plantaris tendon graft. They noted that hyperextension of the distal phalanx was avoided, and active plantarflexion of the great toe was present at final follow-up examination 18 months postoperatively (8). In 2014, Grady et al described a case of a complete rupture of the FHL that was 20 centimeters in length in a marathon runner. They utilized a posterior tibial tendon allograft, and noted that their patient was able to resume competitive running (9).

There are advantages in using allografts, which include decreased surgical time and lack of donor site morbidity. The disadvantages are the higher cost, limited availability, possible risk of rejection secondary to immune-incompatibility, and potential disease transmission (10). The process of incorporation of tendon grafts involve graft necrosis, revascularization, cell repopulation, and remodeling (11). Prior to using an allograft, it is important to discuss the risks and benefits of these with the patient. The surgeon also needs to understand how the allograft was processed and proper preparation of the tendon graft intraoperatively.

Common complications after repair of FHL ruptures involve restricted HIPJ motion and possible contracture of the HIPJ secondary to overtightening the tendon (8). If not surgically repaired, the patient can experience decreased toe push off, hyperextension of the first MPJ, and possible long-term pain. Reports in the literature support the repair of a ruptured FHL tendon, but patients need to be informed...
of expected outcomes and potential complications. In this case, the tendon repair healed successfully; however, 3 years after the FHL tendon repair, the patient ultimately underwent a HIPJ arthrodesis secondary to the progression of his neurologic condition and the development of a rigid hallux malleus contracture.

This case report of a neglected FHL rupture with a 5-centimeter gap, treated with a free semitendinosus allograft, was unique due to the patient’s neurologic condition and prior surgical history. The repair of the ruptured FHL tendon was primarily performed to allow the patient to return to wearing his AFO without discomfort. Three years after the FHL repair, the patient ultimately underwent a HIPJ arthrodesis secondary to the progression of his neurological disease. Unique considerations need to be taken for these patients. There are many causes of FHL tendon ruptures, and a thorough clinical examination and advance imaging studies are necessary to determine the extent of injury and allow for proper surgical planning.

REFERENCES


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