24 Flexor hallucis longus tenosynovitis

24.1 Introduction

Flexor hallucis longus (FHL) tenosynovitis is sometimes referred to as “dancers tendonitis”, reflecting a patient population that is often afflicted by this ailment. However, while FHL tendonitis has historically been described within the context of dancers, especially classical ballet dancers, symptoms have also been reported in others. At risk individuals include those who require repetitive forefoot push-off and extreme plantar flexion, such as swimmers, ice skaters, long distance runners, and gymnasts. FHL tenosynovitis classically causes pain at the postero-medial ankle, specifically the region of the fibro-osseous tunnel. Pain has also been reported at the knot of Henry and at the level of the sesamoids.

24.2 Anatomy

The FHL originates from the posterior border of the fibula and interosseous membrane of the leg. The FHL passes through the retinacular structures at the postero-medial ankle (fibro-osseous tunnel), the plantar midfoot (knot of Henry), and the sesamoids (inter-sesamoid ligament), before inserting at the base of the distal hallucal phalanx. At all three of these retinacular structures, excessive constriction and abnormal stresses may occur. The FHL is a component of the tarsal tunnel and within the tunnel lies posterior to the neurovascular structures. At the level of the knot of Henry, the FHL is dorsal to the medial edge of the plantar fascia. The blood supply to the FHL arises from the posterior tibial and medial plantar arteries, while the tibial nerve provides innervation to the muscle.

24.3 Biomechanics
The primary function of the FHL is to plantar-flex the first metatarsophalangeal (MTP) and interphalangeal joints and to serve as the primary restraint to passive dorsiflexion at the first MTP joint. Moreover, the FHL functions at the ankle-subtalar joint complex, contributing to ankle plantar flexion and subtalar inversion.  

### 24.4 Clinical Presentation

Patients with FHL tenosynovitis often present with pain at the posterior or postero-medial ankle. However, the site of symptoms can be variable and depends on the anatomic location of the tendon pathology. Heel pain, plantar midfoot pain, and first MTP joint pain have all been reported.  

The proximity of the FHL tendon to more commonly injured structures, such as the posterior tibial tendon (medial ankle), os trigonum (posterior ankle), plantar fascia (plantar midfoot), and first MTP joint (hallux rigidus), may contribute to the delay in diagnosis commonly cited.  

Although pain is the most common presenting symptoms, limited MTP joint motion can occur as well. Limited dorsiflexion in the setting of FHL tenosynovitis without first MTP degenerative changes has been coined “pseudo hallux rigidus”. Pseudo hallux rigidus is thought to result from nodular tenosynovitis proximal to the fibro-osseous tunnel which limits the excursion of the FHL and thus limits first MTP joint dorsiflexion.  
Stenosing tenosynovitis of the FHL at the level of the sesamoids can present as inability to actively flex the hallux at the IP joint.

### 24.5 Pathogenesis

Pathology includes tenosynovitis, partial longitudinal tears, and nodularity of the FHL due to intra-substance degeneration. While the exact etiology is debated, many authors believe constriction occurs at the fibro-osseous tunnel in the posterior ankle, the knot of Henry in the midfoot, and the inter-sesamoid ligament. This pseudo-entrapment induces repetitive micro trauma leading to microscopic and macroscopic tissue damage. Hamilton observed there to be a relative incongruity between the FHL and the fibro-osseous tunnel when the foot is fully plantar flexed, which is postulated to cause abnormal stresses and resultant tenosynovitis. Injury at the level of the talus may be due to an abrupt change in direction at this level. Additional etiologies may relate to a low-lying FHL muscle belly or an accessory flexor digitorum longus. Immunohistochemical studies on cadaveric tendons have identified avascular zones where the tendon wraps around the talus and where the tendon traverses the first metatarsal head.

### 24.6 Classification

FHL tenosynovitis can be classified by anatomic zone: zone 1 is posterior to the ankle joint, zone 2 is from the fibro-osseous tunnel underneath the sustentaculum tali to the knot of Henry, and zone 3 is from the knot of Henry to the FHL insertion at the base of the distal hallucal phalanx.

### 24.7 Physical Examination
The diagnosis of FHL tendonitis can be made primarily by tenderness to direct palpation. Reduced first MTP motion and/or IP motion and triggering of the FHL due to degenerative nodules within the tendon may be present. Clinical examination of the FHL includes specific attention to 4 regions of the foot and ankle: posterior ankle, sustentaculum tali, plantar midfoot, and the level of the sesamoids. During examination, the ankle and hallux are held in either a neutral or dorsiflexed position to place the FHL under tension. Proximally, the muscle belly and the musculotendinous region are palpated just posterior and lateral to the posterior tibial tendon. Medially and inferior to the sustentaculum tali, the FHL can be palpated as it courses through the fibro-osseous tunnel. At the medial plantar foot, just plantar to the navicular and medial cuneiform, the FHL can be palpated as it traverses the knot of Henry. Distally, the FHL is palpated as it travels between the sesamoids.3

The FHL stretch test evaluates the influence of the FHL on first MTP motion; a positive finding is suggestive of “pseudo hallux rigidus”.3 This test is performed by assessing first MTP motion in both in maximal plantar flexion and moderate dorsiflexion of the ankle. To perform the test properly, the first metatarsal (MT) head should be stabilized to prevent compensatory first MT head plantar flexion. A positive test consists of discomfort at the first MTP or a decrease in first MTP joint motion by 20 degrees with ankle dorsiflexion.3 To assess the effect of the FHL on IP joint motion, place the ankle in a neutral position and stabilize the first MTP joint; limited motion at the IP joint is suggestive of FHL tenosynovitis at the level of the sesamoids.4,5

24.8 Imaging

Radiographs are obtained to evaluate a bony source of pain. A lateral radiograph can identify an os trigonum.

Ultrasound can demonstrate fluid within the FHL tendon sheath, swelling of the tendon, and longitudinal split tears. However, ultrasound is less sensitive than MRI and accurate interpretation requires an experienced user.

MRI can confirm the diagnosis of FHL tenosynovitis by revealing excess fluid around the FHL at the fibro-osseous tunnel. MRI is a sensitive tool but still may miss pathology such as tendon tears near the knot of Henry.

24.9 Conservative Treatment

Most authors recommend 6 months of non-surgical treatment prior to consideration of surgical intervention. Various treatment protocols have been described and typically involve rest, NSAIDS, immobilization in a neutral position, and gentle stretching. Success of non-operative measures has been disappointing with failure ranging from 40-100%.9 One of the more successful non-operative treatment protocols is as follows:3

- **FHL stretch exercise**: Patient stands facing the wall with a book placed under the hallux. While keeping the heel on the ground, the ankle is maximally dorsiflexed by bending the knee. This position is held for 10 seconds and repeated 10 times, with each set of ten being repeated 3 to 4 times daily.
- **Immobilization**: A walking boot is utilized as a night splint for 6 weeks. If symptoms fail to diminish, a walking boot or short leg walking cast (extending past the toes) is used full time (23 hrs/day) for 6 weeks. Both forms of immobilization are used in conjunction with the FHL stretch exercise.
24.10 Operative Treatment

With the failure of non-operative treatment, surgery may be indicated to restore function and minimize pain. Surgical techniques vary depending on the location of the pathology, concomitant injuries, and surgeon preference. The goals of all interventions include debridement of the tendon, tenosynovectomy, and treatment of FHL tears. When tendinopathy is located in the postero-medial ankle, release of the fibrous-osseous tunnel is recommended.

24.10.1 Postero-Medial Ankle

- **Medial approach:** This surgical approach is advocated by most authors and allows for clear visualization and protection of the neuro-vascular structures. A curvilinear incision is made posterior to the malleolus, following the course of the underlying neurovascular bundle. The neurovascular structures are retracted posteriorly and the fibro-osseous tunnel is then released from proximal to the level of the sustentaculum tali.

- **Posterior approach:** This approach begins at the lateral edge of the Achilles tendon and proceeds directly anteriorly. The sural nerve is protected and no tendons other than the FHL are manipulated. This approach provides excellent exposure to the musculotendinous junction of the FHL, the os trigonum, and the upper aspect of the fibro-osseous tunnel. Some authors have expressed concern about a higher risk of tibial nerve injury and increased difficulty decompressing the entirety of the fibro-osseous tunnel.

- **Post op plan:** Postoperative treatment for both approaches typically consists of weight bearing as tolerated in a removable walking boot. Immobilization is discontinued after 2 weeks and activities are increased as tolerated.

24.10.2 Endoscopic FHL Decompression 9,10

A viewing portal is placed 1 cm proximal to the calcaneal tuberosity and adjacent to the lateral Achilles tendon border. A working portal is positioned 1 cm proximal to the calcaneal tuberosity and adjacent to the medial Achilles tendon border. A 30°, 4.0-mm arthroscopic camera and 4.5-mm shaver are utilized. The FHL tendon is identified and the surrounding soft tissue is debrided with the blade directed laterally to avoid injury to other medial structures. An arthroscopic straight cutter is then advanced along the plantar margin of the fibro-osseous sheath and the sheath is released. FHL tendoscopy can then be performed to verify completeness of release and evaluate for more distal tendinopathy.

Potential advantages of the endoscopic technique include decreased stiffness, decreased wound complications, and earlier return to activities. Potential problems include incomplete release of the fibro-osseous tunnel, technical challenge, plantar nerve injury, and damage to medial vascular structures.

- **Post op plan:** Weight-bearing as tolerated. The dressing can be taken off after 3 days. As soon as is possible after the surgery, the patient begins range of motion exercises and advances activity.
24.10.3 Knot of Henry

The medial approach is most commonly used.\textsuperscript{1,2,3} FHL tendoscopy has been described.\textsuperscript{8}

24.10.4 Level of the Sesamoids

Medial approach is most often utilized.\textsuperscript{4,5} FHL tendoscopy has been described.\textsuperscript{8}

24.11 Controversy

Currently, debate exists regarding the optimal surgical technique. Successful outcomes have been reported with a medial approach, a posterior approach, and endoscopy.

24.12 References