Austin Journal of Musculoskeletal Disorders

Open Access

Austin Publishing Group

Case Report

Tarsal Tunnel Syndrome: An Overview

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Received: April 30, 2015; **Accepted:** June 24, 2015; **Published:** June 25, 2015

Abstract

Tarsal tunnel syndrome is an uncommon condition which can be painfully debilitating. This clinical diagnosis is often enhanced by electro diagnostic tests. Causes are both extrinsic and intrinsic. Initial treatment is usually non-operative, but at times surgical intervention is indicated at the outset. The surgery is difficult and the literature suggests patient selection is crucial for positive surgical outcomes. Surgical success rates are highest when cause is extrinsic and surgery is performed within 12 months of symptom onset.

Introduction

Tarsal Tunnel Syndrome (TTS) is a type of compression neuropathy where the tibial nerve is compressed within the tarsal tunnel running along the inside of the ankle into the foot. Tarsal Tunnel Syndrome (TTS) is an uncommon condition that can become debilitating as a result of progressive pain. With TTS, pain originates in the ankle from entrapment of the posterior tibial nerve or its medial, lateral or calcaneal branches in the proximal and/or distal tarsal tunnel [1,2]. The flexor retinaculum serves as the roof of the fibro-osseous tunnel connecting the medial malleolus to the calcaneous while the medial aspect of the talus, calcaneum and distal tibia form the floor [2,3]. The tarsal tunnel is posterior and inferior to the medial malleolus and holds, from medial to lateral, the tibialis posterior tendon, the flexor digitroumlongus tendon, the posterior tibial artery and vein, the posterior tibial nerve and the flexor hallucislongus tendon [1,4].The posterior tibial nerve can become compressed at the tarsal tunnel leading to proximal TTS [5]. Calcaneal branches from the posterior tibial nerve penetrate the flexor retinaculum to provide sensation to the posterior and medial heel [1-5]. Ninety-five percent of the time, the posterior tibial nerve bifurcates into the medial and lateral planter nerves distal to the tunnel [1]. The medial and lateral plantar nerves then enter their own distal tunnels [1,6]. Compression of either the proximal or distal tunnels can lead to TTS causing pain and hypoesthesia involving the heel and plantar surfaces of the foot [1,6]. Due to low incidence along with variations in pain, sensory and motor deficits, TTS can be difficult to diagnose. If TTS is suspected, differential diagnoses such as chronic plantar fasciitis with distal TTS or lumbar radiculopathy should be considered [1]. A variety of tests performed on physical exam as well as imaging studies improve the detection and diagnosis of TTS.

Classic Presentation

A 42-year-old female presented with pain and burning of three months duration in her left ankle and sole. She reported increasing discomfort now interfering with her recreational golfing [7]. She denied recent or past ankle trauma. Pain was localized posterior and inferior to her medial malleolus and she complained of numbness along her posterior and medial heel radiating to the plantar surface of the foot [8]. She denied pain upon first step, but reported intensifying pain with activity and "after burn" or lengthened time for pain dissipation post activity [2]. More recently, pain has occurred at rest, waking her at night [3]. She expressed concern over losing the ability to golf, or even walk, if the pain and numbness continued to progress.

On exam, no obvious ankle deformity, such as hindfoot varus or valgus, was appreciated. Ankle erythema and edema were absent. Point tenderness over the soft spot on the medial border of the abductor hallucis was present (Figure 1) [5]. There was a positive Valleix test (pain on deep palpation of the tarsal tunnel) as well as arch tenderness [9]. Neurological examination revealed positive Tinel's sign and decreased two-point discrimination on the plantar surface of the foot.

Etiology

Repetitive actions of dorsiflexion and plantar flexion during activities such as sprinting and jumping can lead to increased tunnel pressures and subsequent irritation. As walking, running and jumping rarely result in tarsal tunnel irritation, many patients diagnosed with TTS have either intrinsic or extrinsic factors predisposing them to TTS [7]. Intrinsic factors may include tendonopathies, osteophytes, anatomical anomalies and space occupying lesions such as accessory muscles, ganglia or lipomas [1,4].Takakura et al. report ganglia to be the most common space occupying lesions in proximal TTS [10]. Intrinsic factors in the distal tarsal tunnel can lead to traction neuritis. For example, the weakening of the plantar fascia can result in stretching of the lateral plantar nerve, impinging it at the soft spot as it turns into the distal foot over the flexor digitorum brevis [2,5]. In

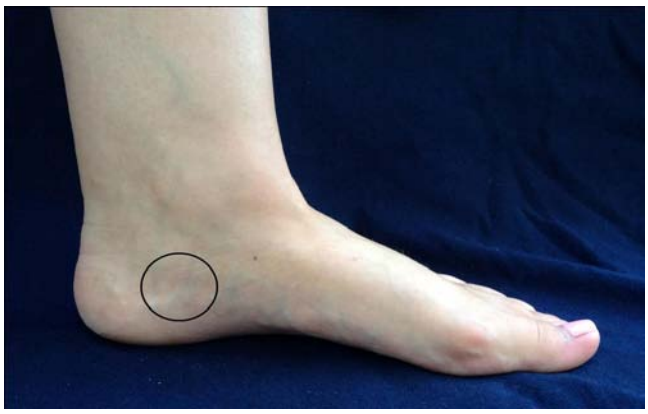

Figure 1: Point tenderness over the soft spot on the medial border of the abductor hallucis.

Citation: Ellison T and Saxena S. Tarsal Tunnel Syndrome: An Overview. Austin J Musculoskelet Disord. 2015;2(3): 1022.

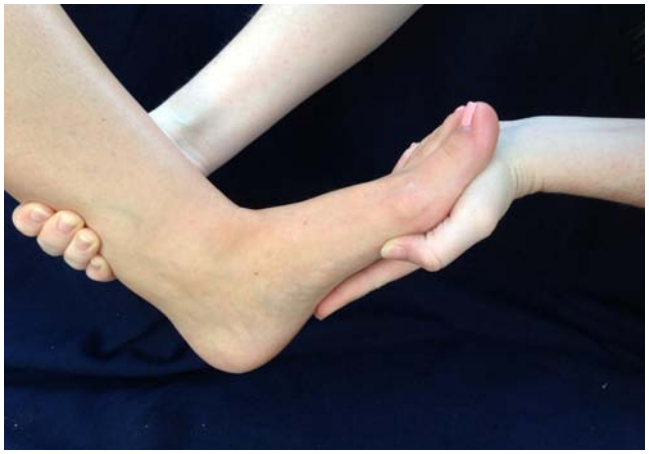

Figure 2: In the dorsiflexion-eversion test, the foot is dorsiflexed, everted and held for 10-15 seconds.

a recent case report, an abnormal branch of the posterior tibial artery penetrated the posterior tibial nerve leading to a vascular leash. The artery created traction on the nerve leading to neuropathy and TTS. This and other idiopathic intrinsic factors reduce operative success rates [8]. Extrinsic factors may include trauma, foot malformations, constrictive footwear, edema and iatrogenic TTS [1,4]. Hindfoot varus or valgus malformations can create increased pressures in the tarsal tunnel leading to TTS. Unfortunately, surgical correction of Hindfoot varus, or a lateral calcaneal osteotomy, can lead to acute iatrogenic TTS requiring immediate surgical release [11]. Despite the differing etiologies, studies suggest TTS causes can be identified 60-80% of the time with proper diagnostic imaging [1,4,8].

Diagnosis

The diagnosis of TTS is clinical. The Tinel, dorsiflexion-eversion and Valleix tests all increase the sensitivity and specificity of the physical exam. Tinel's test, tapping repeatedly on the soft spot to elicit symptoms of pain and/or hypoesthesia, has a reported sensitivity of 92%, specificity of 100% and a positive predictive value of 85% [3,9]. In the dorsiflexion-eversion test, the foot is dorsiflexed, everted and held for 10-15 seconds (Figure 2). A positive test elicits TTS symptoms. Kinoshita et al. studied the sensitivity and specificity of the dorsiflexion-eversion test in 37 patients with TTS against 50 controls. The dorsiflexion-eversion test had a sensitivity of 97% as 43/44 TTS patients were clinically positive and a specificity of 100% as 0/50 controls tested positive [12]. In addition to physical exam, other diagnostic modalities include x-ray, MRI, Magnetic Resonance Neurography (MRN), ultrasound (US) and electro diagnostic studies such as electromyography (EMG) and Nerve Conduction Studies (NCS). X-rays should be taken to rule out fracture and an MRI has high sensitivity for space occupying lesions [2]. As MRN has a sensitivity of 77-100% for detecting nerve irritation, it can be especially useful in the setting of recurrent TTS [5,9]. A 2010 case report found US provided direct visualization of a ganglion compressing the nerve and adequately localized the lesion for surgical removal [13]. EMG and NCS use is controversial. Dellon reports repetitive micro-trauma in normal activity can cause EMG and NCS abnormalities in asymptomatic individuals, thus making it difficult for these electro diagnostics to separate life events from true TTS [3]. However, Yalcinkaya et al. report use of EMG and NCS is crucial, especially in separating TTS from lumbar radiculopathy [9]. False negative electro diagnostic studies are not uncommon and, for best results, should be used to support the physical exam [1-9].

Treatment

Non-operative treatment of TTS consists of activity modification, medications such as systemic NSAIDs and gabapentin, nerve mobilization exercises, night splints and orthotic inserts [1,2]. Gould recommends custom orthotics with specific channels to relieve pressure on the medial and lateral plantar nerves [2]. Other less established non-operative treatments include massage, taping and stretching [1]. Nerve irritants, such as hot or cold compress and vibrations, should be avoided [2]. Kavlak and Uygur studied nerve mobilization exercises as an adjunctive non-opperative treatment. The exercises altered the sensory components of TTS by reducing Tinel's sign and improving two-point discrimination, but had no positive impact on strength or range of motion [6].While non-operative care is usually considered to be conservative care, at times surgical intervention can be the more conservative treatment [2]. For example, competitive athletes wishing to return to competition may benefit from immediate surgical intervention, rather than initial non-operative treatment. Kinoshita et al. studied 15 competitive athletes, all of whom failed non-operative management and required surgery to return to competition [7]. However, when not treating competitive athletes, Gould suggests initial treatment be non-operative unless there are indications for immediate surgery including general neuropathy and radiculopathy on initial exam [2]. Operative intervention, however, usually follows failed non-operative care. Operative intervention is difficult with varying success rates. The surgery begins with a curved medial incision over the tarsal tunnel followed by the complete release of the posterior tibial nerve at the tarsal tunnel as well as the release of its lateral and medial plantar branches [1-9]. Reichert et al. report a 71% surgical success rate while other studies report success rates ranging broadly from 44-96% [4].Yalcinkaya et al. attribute such high failure rates to incorrect diagnosis, unidentified space occupying lesions, surgeon error with inadequate release of all branches, operative re-bleeding with subsequent adhesive neuritis as wells as idiopathic causes [9].Above all, surgical success rates rely heavily on patient selection [1-10].

Discussion

Gould et al. suggest most patients suffering from TTS should complete a trial of the non-operative treatments discussed above. Upon completion of six weeks of non-operative treatment, physician reassessment of the syndrome should be made. If the patient shows symptom improvement, non-operative interventions should continue. However, in the absence of improvement with patient compliance with non-operative treatments, surgery is recommended [2]. Patients with positive Tinel's sign, space occupying lesions, less than 12 months of symptoms and early mobilization are the best surgical candidates [1-7]. Reichert et al. reported 87% of study patients with a positive Tinel's sign had good or very good surgical results [4]. Furthermore, the most predictable positive surgical outcomes occur when a space occupying lesion is identified and removed. Surgical success is further improved with rapid intervention with the best surgical results achieved when surgery was performed within

1 year, and preferably within 6 months, from onset of symptoms [1-4]. Intraneural fibrosis leading to permanent nerve damage has been suggested as the reason early intervention increases surgical success [4-10]. Finally, early post-surgical mobilization also resulted in successful surgical outcomes as early movement promotes nerve gliding through the tarsal tunnel and decreased adhesions at the surgical site [3,9]. Symptoms of 12 or more months, idiopathic factors and rare anatomical abnormalities, such as a vascular leash, result in the worst surgical outcomes [4,8].

Conclusion

TTS can be painfully debilitating. This clinical diagnosis is enhanced with imaging and may be further supported by electro diagnostic tests. Initial treatment is usually non-operative, but at times, surgical intervention is indicated at the outset. The surgery is difficult and the literature suggests patient selection is crucial for positive surgical outcomes. Further, surgical success rates are highest when surgery is performed within 12 months of symptom onset.

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Austin J Musculoskelet Disord - Volume 2 Issue 3 - 2015
ISSN : 2381-8948 | www.austinpublishinggroup.com

Citation: Ellison T and Saxena S. Tarsal Tunnel Syndrome: An Overview. Austin J Musculoskelet Disord. 2015;2(3): 1022.