

TARSAL TUNNEL SYNDROME AND ITS SURGICAL TREATMENT

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INTRODUCTION

The tarsal tunnel is a fibro-osseous space located posterior to the medial malleolus. Several structures pass through this space, including the posterior tibial nerve, the posterior tibial artery and vein, and the tendons of the flexor hallucis longus, flexor digitorum longus, and posterior tibial muscles. The tarsal tunnel is bordered by the tibia anteriorly and the talus and calcaneus laterally. Medially it is covered by the flexor retinaculum. The flexor retinaculum, also referred to as the lacinate ligament, is contiguous with the crural fascia proximally.

Tarsal tunnel syndrome is an entrapment neuropathy of the tibial nerve or one of its branches as it passes through the tarsal tunnel. Potential causes of tarsal tunnel syndrome include trauma, varicosities, tenosynovitis, space-occupying lesions, and hindfoot deformity; however, in many cases the aetiology is idiopathic [1-4]. It is also important to note that compression of one of the distal branches of the nerve as they pass deep to the abductor hallucis muscle can produce symptoms similar to those caused by proximal compression within the tarsal tunnel proper [5]. Compared with carpal tunnel syndrome, tarsal tunnel syndrome is much less common. One possible explanation for this is the fact that the tarsal tunnel is wide and shallow. Further, it is covered by a thin retinaculum making it a more compliant space than the carpal tunnel [6].

PREOPERATIVE ASSESMENT

Patients with tarsal tunnel syndrome typically complain of burning pain and/or paraesthesia along the medial ankle and the plantar aspect of the foot. The pain may radiate distally or proximally. Proximal radiation, although less common, is referred to as the Valleix phenomenon. Infrequently, patients will complain of numbness in the sole of the foot. A complete past medical history and review of systems should always be obtained. Specifically, patients should be queried about

a history of back pain, radiculopathy, diabetes, or peripheral neuropathy.

Physical examination of a patient suspected of having tarsal tunnel syndrome begins with assessment of hindfoot alignment with the patient standing. Biomechanically, hindfoot valgus puts the tibial nerve under tension. Alternatively, hindfoot varus may contribute to nerve compression. Next, with the patient sitting, the tarsal tunnel is inspected for inflammation and palpated for masses. The posterior tibial nerve should be percussed over its entire course. Percussion over the entrapped segment of nerve typically produces a Tinel's sign and reproduces the patient's symptoms. Kinoshita et al. have described a dorsiflexion-eversion test for diagnosing tarsal tunnel syndrome [7]. With this test, the ankle is passively maximally everted and dorsiflexed while all of the metatarsophalangeal joints are maximally dorsiflexed and held in this position for 10 seconds. This should temporarily induce or exacerbate the numbness or pain. Distal sensory examination of the foot should be performed although usually it is not revealing.

Weight-bearing radiographs of the foot and ankle should be obtained in all patients suspected of having tarsal tunnel syndrome. These will identify bony abnormalities and allow for further assessment of hindfoot alignment.

Magnetic resonance imaging (MRI) plays a valuable role in elucidating the individual aetiology of tarsal tunnel syndrome. In one recent investigation, abnormal findings were present in 85% of patients with this disorder [8]. While in most cases the abnormal pathology consisted of tenosynovitis, other diagnoses included varicosities, ganglion, lipoma, hemangioma, and neurofibrosarcoma. Given this data, we routinely obtain MRI scans in patients with refractory symptoms and in those undergoing surgical release. (Figure 1)



Fig 1:
A 42-year old male presented with tarsal tunnel syndrome. The T1 axial MRI-scan showed a posteromedial mass. This lesion was found to be a nerve sheath tumour.

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Electrodiagnostic studies also play a crucial role in the pre-operative evaluation of patients with tarsal tunnel syndrome. In addition to confirming the diagnosis, electrodiagnostic studies also help to differentiate tarsal tunnel syndrome from radiculopathy or peripheral neuropathy. Motor-nerve conduc-

tion studies are the least reliable with an overall diagnostic sensitivity of 47% [9] while the reported diagnostic sensitivity of sensory-nerve conduction studies ranges from 90-100% [10]. Mixed-nerve conduction studies have been used in the assessment of patients with tarsal tunnel syndrome. Although this technique has a sensitivity of 86% [11], its specificity is superior to sensory-nerve conduction velocities and is therefore a useful adjunct. When a patient's symptoms and physical examination are consistent with tarsal tunnel syndrome, a positive electrodiagnostic test can help to confirm the diagnosis. It is important to note, however, that electrodiagnostic tests are not 100% accurate and that a normal study does not exclude the diagnosis.

The differential diagnosis of tarsal tunnel syndrome is extensive and includes posterior tibial tendon dysfunction, FHL and FDL tenosynovitis, plantar fasciitis, stress fracture, arthritis, hindfoot deformity, radiculopathy, peripheral neuropathy, peripheral vascular disease, and venous varicosities. Each of these disorders should be considered in the evaluation of patients with symptoms of tarsal tunnel syndrome.

TECHNIQUE FOR SURGICAL RELEASE

Surgical release of the tarsal tunnel is indicated in symptomatic individuals who do not respond to at least three months of non-operative therapy. Potential non-operative treatment measures include non-steroidal anti-inflammatory medications, physical therapy, orthotics, and immobilization in a cast or fracture boot.



Fig 2: The skin incision for tarsal tunnel release.

At surgery, the patient is positioned supine on the operating table. Either general or regional anesthesia is used. To maximize visualization of the nerve, especially its smaller distal branches, the use of a pneumatic thigh tourniquet and loupe magnification is recommended. Bipolar electrocautery should also be used; otherwise, no special instrumentation is required.

The incision begins 6-8 centimeters proximal to the tip of the medial malleolus and extends distally along the course of the nerve, approximately 1-2 centimeters posterior to the tibia and medial malleolus. Respectful handling of the soft-tissues and meticulous hemostasis will help to minimize post-operative swelling and pain. At the level of the malleolus, the incision curves gently anteriorly, approximating the course of the main branch of the lateral plantar nerve (Figure 2). The incision

is deepened through the subcutaneous tissues to expose the crural fascia and flexor retinaculum. At the level of the ankle, the posterior tibial tendon travels in its own sheath directly posterior to the tibia. The posterior tibial nerve, artery and vein travel in another sheath. This is separate from the flexor hallucis longus tendon, which is covered by intermediate fascia.

Under loupe magnification, the crural fascia is divided proximally and the tibial nerve is identified proximal to the flexor retinaculum. At this level the nerve is not tethered or scarred to adjacent structures and can be safely identified. Dissection is then carried distally. The flexor retinaculum is identified

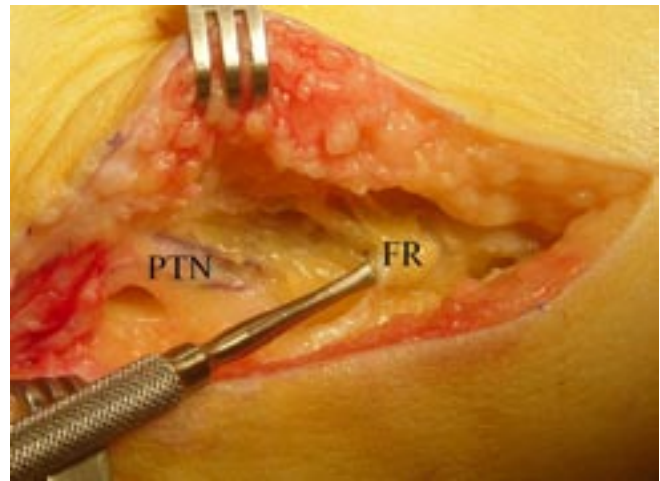


Fig 3: The posterior tibial nerve (PTN) is identified proximally. The flexor retinaculum (FR) is divided over a smooth periosteal elevator.



Fig 4: Tarsal tunnel syndrome caused by an accessory soleus muscle. To decompress the nerve, the muscle is excised.

and divided with curved scissors or by passing a smooth elevator deep to the retinaculum and then sharply releasing the retinaculum directly over the elevator (Figure 3). Any space-occupying lesions are excised (Figure 4). If a ganglion is present it should be traced back to the tendon or joint from which it arises. The posterior tibial nerve is next traced distally and decompressed. In this region, constricting vascular bands may be encountered and should be ligated after the principal posterior tibial artery is identified (Figure 5). Of note, a simple release is adequate and internal neurolysis should be avoided as it may lead to perineural fibrosis

Distal to the tarsal tunnel, the medial and lateral plantar nerves are released as they pass beneath the deep fascia of the abductor hallucis muscle. Although not a component of the tarsal tunnel proper, the fascia of the abductor hallucis is a proven potential source of compression. To this end, an incomplete release has been associated with poor clinical out-

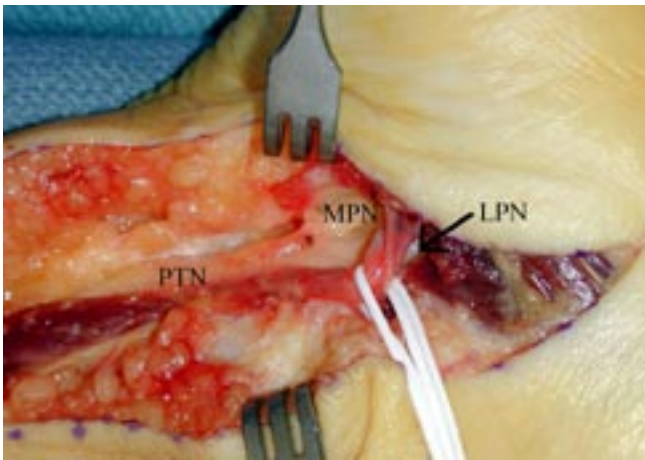


Fig. 5: The posterior tibial nerve (PTN) terminates into the medial and lateral plantar nerves (MPN, LPN). A large vascular leash (tagged) is pressing on the nerve and requires ligation.

come following tarsal tunnel surgery [12]. For these reasons, we routinely release the deep abductor fascia.

To accomplish this, the superior and lateral fascia of the abductor muscle is first identified and divided sharply. Next, the muscle belly is mobilized inferiorly with a small right angle retractor and the deep fascia then released. Care is taken to protect the first branch of the lateral plantar nerve as excessive manipulation may cause neuralgia. In revision cases, the abductor hallucis muscle may need to be divided to safely visualize the first branch of the lateral plantar nerve (Figure 6).

The muscle belly of abductor Hallucis is then retracted superiorly and the course of the first branch of the lateral plantar nerve (Baxter's nerve) is traced deep to flexor digitorum brevis lying on the surface of plantar quadratus. If tight, the fascia over these muscles may need to be divided under direct vision. More distally the course of the medial and lateral plantar nerves should also be probed to confirm their free passage. Distal compression is rare but may be associated with use of a hard orthotic insole or overuse activities (jogger's foot). The nerve is now inspected along its entire course to confirm that a complete release has been performed and that no constricting structures remain.

The tourniquet is then deflated and final hemostasis obtained using bipolar electrocautery. The flexor retinaculum is not repaired. The subcutaneous tissues are closed with interrupted 4-0 resorbable sutures. The skin is closed with 4-0 nylon sutures.

Post-operatively a compression dressing with a posterior splint is applied. The patient is advised to elevate the ankle

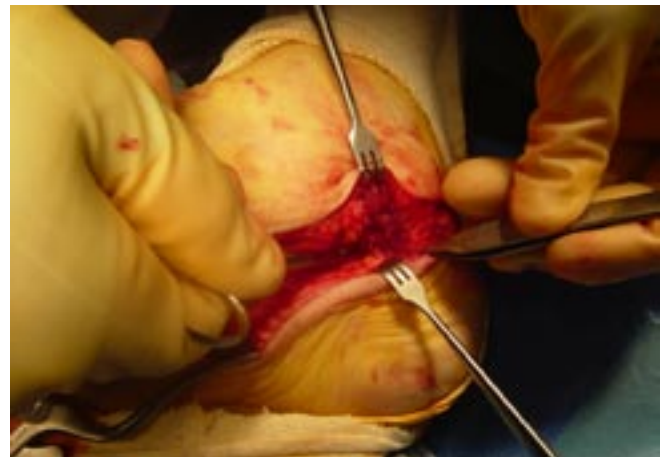


Fig. 6: Release of the deep fascia of the abductor hallucis muscle. This was a revision procedure so abductor Hallucis was divided.

and is kept non-weight bearing. At two weeks the stitches are removed. The ankle is protected in either a fracture boot or a walking cast for a further two weeks at which stage gentle active range-of-motion exercises initiated. Weight bearing is typically initiated four weeks post-operatively.

Historically, the results of tarsal tunnel release have varied [13- 15]. When a specific cause is identified (such as a well-defined mass lesion), an early improvement in symptoms is usually noted. Pfeiffer and Cracchiolo assessed a series of 32 cases using a pain-based scale and found that only 44% of feet had an excellent or good result [16]. Gondring and co-workers have recently performed a more extensive outcome analysis on 60 patients with tarsal tunnel syndrome [17]. All had a positive Tinel's sign and abnormal nerve conduction studies pre-operatively. Post-operatively, the Tinel's sign and nerve conduction studies normalized in 85% of patients. However, only 51% of patients reported complete or near-complete subjective improvement. Another study has also reported variable results with tarsal tunnel surgery, suggesting that there is a clinical dichotomy between objective and subjective outcome parameters [18].

CONCLUSION

In this paper we highlight the physical assessment and clinical evaluation of tarsal tunnel syndrome. In those patients who remain symptomatic despite three months of non-operative therapy, surgical release of the tarsal tunnel is warranted. To ensure a safe and complete release, several steps must be taken. Despite this, the clinical results of tarsal tunnel release remain variable.

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