Tarsal tunnel syndrome refers to entrapment of the tibial nerve and/or its branches within the confines of a fibro-osseous tunnel along the medial aspect of the ankle. This tunnel is bounded laterally by the talus and calcaneus and medially by the flexor retinaculum. Within the tarsal tunnel pass the tendons of the posterior tibial, flexor digitorum longus and flexor hallucis muscles, the tibial artery and veins, and the tibial nerve and its terminal branches (medial calcaneal nerve, medial plantar nerve, lateral plantar nerve). The most common presenting complaint is intractable chronic heel pain. Sensory loss along the plantar aspect of the foot and a positive Tinel sign at the tunnel are the most helpful clinical findings.

The three most common causes of tarsal tunnel syndrome are trauma (related to scarring after sprains and fractures), space occupying lesions, and foot deformities with the etiology unknown in 20-40% of cases. Clinical diagnosis can be challenging as the pain may be non specific and intrinsic muscle motor loss can be difficult to assess. Normal EMG studies do not exclude the diagnosis. MR is the optimal imaging study for direct visualization of the nerves, retinaculum, and tunnel contents.

MR studies are particularly well suited to the identification of space occupying lesions such as varicosities, soft tissue and perineural ganglia, tumors, and accessory muscles (such as accessory flexor digitorum and soleus muscles). (Figure 1). MR identification of the cause and location of entrapment is also used in preoperative assessment to determine the extent of required release and for determining causes for failed tarsal tunnel surgery.

BAXTER NEUROPATHY

Entrapment of the inferior calcaneal nerve (Baxter neuropathy), may be associated with ordinary activities but nearly half of the cases are secondary to athletic activity particularly distance running. It has been estimated that up to 15% of athletes with chronic unresolving heel pain suffer from entrapment of the inferior calcaneal nerve. Clinically, the condition typically manifests as intractable heel pain. It can be difficult to diagnose this entity clinically and to differentiate from other causes of heel pain. Electrodiagnostic tests may not be able to distinguish lateral plantar nerve entrapment within the tarsal tunnel from inferior calcaneal nerve entrapment further distally. Baxter neuropathy is also commonly seen in association with plantar fasciitis which can further confuse clinical diagnosis.

Three sites of possible entrapment have been described and include: (1) deep to or adjacent to the fascial edge of a hypertrophied abductor hallucis muscle, (2) along the medial edge of the quadratus plantae muscle, or (3) adjacent to the medial calcaneal tuberosity. MR can be useful in detecting the presence and location of nerve entrapment.

MR detection of denervation edema and atrophy of the abductor digiti quinti muscle, often incidental in our experience, is not uncommon and most likely reflects a clinically missed entrapment of the first branch of the lateral plantar nerve. (Figure 2) Abductor hallucis muscle hypertrophy and plantar fasciitis with medial calcaneal spur formation and adjacent soft tissue edema are also suggestive of nerve entrapment in Baxter’s neuropathy.

(Figure 1A) Sagittal image through the medial aspect of the ankle demonstrating a multi-septated ganglion within the confines of the tarsal tunnel. (Figure 1B) Oblique axial section demonstrates the multilobular mass within the confines of the tarsal tunnel.

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MR IMAGING OF COMMON ENTRAPMENT NEUROPATHIES OF THE FOOT AND ANKLE

Decreased bulk, fatty atrophy, and increased signal on fluid sensitive images of the intrinsic muscles of the foot in a diabetic patient are commonly secondary to peripheral neuropathy.

Rest, orthotics, anti-inflammatory medication, corticosteroid injections and night splints are all part of the first course of treatment. Surgical release of the nerve is attempted if the pain is persistent.

The clinical diagnosis of Morton neuroma is often straightforward but on occasion diagnostic difficulty exists and other causes of metatarsalgia (e.g. intermetatarsal bursitis, synovitis, inflammatory arthritis, stress fracture, Freiberg’s infraction, true neuroma) need to be differentiated. MR imaging has been shown to be useful in narrowing the wide differential diagnosis of forefoot pain. The accuracy of MR has been reported with a sensitivity and specificity of 87% and 100% respectively. The most typical MR appearance is that of a low signal intensity (reflecting the predominant histological composition of dense fibrous tissue) dumbbell shaped mass located in the intermetatarsal space and often extending into the plantar subcutaneous fat (Figure 3). Of note, the MR detection of a Morton neuroma does not necessarily imply symptomatology as the entity has been reported in up to 33% of asymptomatic patients. It appears that the larger lesions (greater then 5mm in diameter) are both more common to be symptomatic and more likely to be associated with a good surgical outcome.

MORTON NEUROMA

Intermetatarsal (Morton) neuroma is not a true tumor but rather a degenerative process of the nerve resulting in a fibrotic nodule caused by damage to the interdigital nerve by either entrapment of the nerve against the transverse metatarsal ligament or by nerve ischemia. Intermetatarsal neuroma is one of the most common causes of metatarsalgia and is most commonly seen in middle aged women, possibly related to the wearing of high heeled tight boxed shoes. Clinically it is characterized by intermetatarsal pain, numbness, and sensory disturbances that radiate to the toes and are exacerbated by standing and walking. The symptoms can be relieved by rest and shoe removal. In up to 80% of patients, intermetatarsal neuromas may be associated with forefoot deformities such as hallux valgus, hammertoe, or pes planus.


(Figure 2) Moderate edema within the abductor digiti minimi muscle reflecting acute denervation related to entrapment of the inferior calcaneal nerve.

(Figure 3A) (Left) There is a complex dumbell shaped mass in the 3rd MT interspace. The plantar aspect measures 16mm x13mm. The dorsal aspect (arrow) demonstrates homogeneous high signal suggesting fluid. (Figure 3B) (Right) Following the injection of contrast material, the volar mass diffusely enhances consistent with a Morton neuroma. The dorsal mass (arrow) demonstrates peripheral enhancement consistent with a distended IM bursa.

(Figure 3) Moderate edema within the abductor digiti minimi muscle reflecting acute denervation related to entrapment of the inferior calcaneal nerve.