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Synovial Cysts as a Rare Cause of Tarsal Tunnel Syndrome Discovered Using Ultrasound: A Case Report

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Background: Tarsal tunnel syndrome (TTS) describes a compression neuropathy of the tibial nerve or its branches as they pass under the flexor retinaculum of the ankle. TTS is a clinical diagnosis, but often involves needle electromyography, nerve conduction studies (NCS), and magnetic resonance imaging. To our knowledge, the use of ultrasound to diagnose tibial nerve compression from synovial cysts (SCs) in the tarsal tunnel has been sparsely reported upon.

Case Report: A 50-year-old male patient suffering from TTS whose diagnosis of SC-related compression was confirmed via ultrasound. Patient underwent excision confirming an intraneural ganglion cyst secondary to subtalar joint synovial fluid extension. At follow-up, the patient endorsed improvement in painful paresthesias and NCS indicated improving symmetry of tibial nerve function.

Conclusions: Our report demonstrates the successful evaluation and treatment of a rare cause of TTS utilizing ultrasound as the primary imaging modality. Ultrasound provides a rapid, cost-effective imaging method of the tarsal tunnel.

Key words: Case report, tarsal tunnel syndrome, synovial cysts, ultrasound

BACKGROUND

Tarsal tunnel syndrome (TTS) describes compression of the posterior tibial nerve or its branches within the tarsal tunnel on the medial aspect of the ankle. Common presenting symptoms of TTS are pain, paresthesia, and/or numbness around the medial malleolus with radiation to the heel and plantar surface of the foot. Roughly 17% to 43% of patients with TTS have sustained previous ankle trauma, such as fractures or sprains (1). Other causes include hypertrophic flexor retinaculum, generalized edema, constrictive footwear, osteophytes, or space-occupying lesions, such as ganglia, lipomas, or neuromas (1,2). In most cases, diagnosis can be made using clinical history and physical exam. Electrophysiological testing, such as electromyography (EMG) and nerve conduction studies (NCS), can help confirm the diagnosis. Advanced imaging, such as magnetic resonance imaging (MRI) has shown high utility in diagnosing TTS when space-occupying lesions are suspected. Diagnostic ultrasound is also useful in detecting ganglia, cysts, and synovitis of peripheral tendon sheaths within the region of the tarsal tunnel and presents a much more cost-effective screening tool for evaluation (3). We present the case of a 50-year-old man with TTS secondary to a complex synovial cyst (SC) discovered using ultrasound imaging.

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CASE

A 50-year-old male patient with a history of well-controlled diabetes mellitus type 2 and obesity was referred to our clinic and evaluated via telehealth due to COVID-19 for complaints of left foot and ankle pain for 2 years, which limited his mobility. He described painful paresthesias emanating from the heel into the plantar aspect of the foot and into all 5 digits, as well as the distal posterior calf. The pain was worse with ambulation and in the evening. Gabapentin provided minimal relief. Prior to our evaluation, he was diagnosed with left tibial mononeuropathy at the tarsal tunnel by NCS/EMG. Previous plain films of the area were unrevealing. We referred him to formal physical therapy and scheduled a face-to-face follow-up.

On examination, there was mild swelling around the left medial malleolus. There was otherwise no gross deformity, skin changes, or asymmetry. He had a positive Tinel's sign inferior to the left medial malleolus. There was decreased sensation to light touch throughout the sole of the left foot with weakness of great toe abduction. Strength was otherwise normal throughout the bilateral lower extremities, as were deep tendon reflexes. Clonus was absent and Babinski response was down bilaterally. A focal ultrasound examination then demonstrated a large, anechoic, homogeneous, and noncompressible cystic structure just distal to the tarsal tunnel (Figs. 1 and 2). Color flow Doppler did not reveal any hypervascularity or flow within the lesion. Loss of normal nerve echogenicity just proximal and adjacent to the cystic structure suggested tibial nerve compression. The tibial nerve was flattened and became difficult to visualize as it coursed through the tarsal tunnel. The medial and lateral plantar nerves were not visible distal to the tarsal tunnel. The tendons of the posterior tibialis, flexor hallucis, and flexor digitorum appeared intact and free of significant tenosynovitis. The posterior tibial artery and vein were not involved with the cystic structure. Examination of the contralateral medial ankle revealed a normal appearance and course of the tibial, medial plantar, and lateral plantar nerves.

X-ray imaging was unremarkable. MRI with and without contrast revealed a large, T2-hyperintense and multicystic-appearing structure coursing within the tarsal tunnel, intimately associated with the posterior tibial nerve (Fig. 3). This structure extended into the soft tissues of the midfoot and measured approximately 7.4 x 1.8 x 1.6 cm. Postcontrast sequences highlighted thin peripheral and septal enhancement, but no suspicious nodular enhancement. The cystic origin could not be definitively identified. Additional findings included abductor hallucis and flexor digitorum brevis muscle edema, sequela of probable prior injuries involving the deltoid and anterior talofibular ligaments, mild medial and lateral ankle tenosynovitis, and sinus tarsi scarring.

The patient was then referred to an orthopedic foot and ankle surgeon (Fig. 4). He underwent a left tarsal tunnel release with resection of the cyst. The orthopedic surgeon felt that the cyst arose from the subtalar joint, as a stalk of the cyst was visualized tracking toward it. Thus, surgical findings were most consistent with an intraneural ganglion cyst (GC) secondary to a subtalar joint synovial fluid extension.

At the 8-week follow-up, he endorsed improvement in the painful paresthesias, especially up the posteromedial calf. He also reported an increasingly normal sensation in the plantar surface of his toes, though he still experienced numbness in the medial plantar

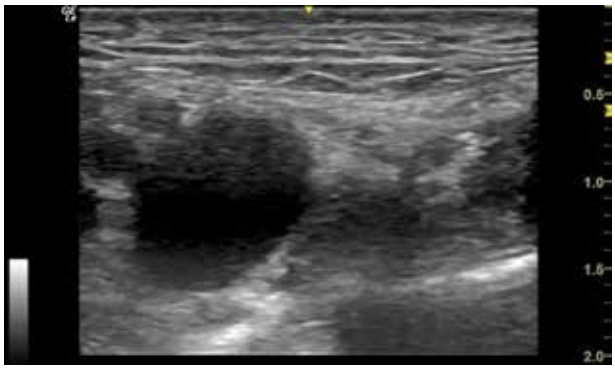

Fig. 1. Transverse plane imaging within the tarsal tunnel with short axis to tendons.

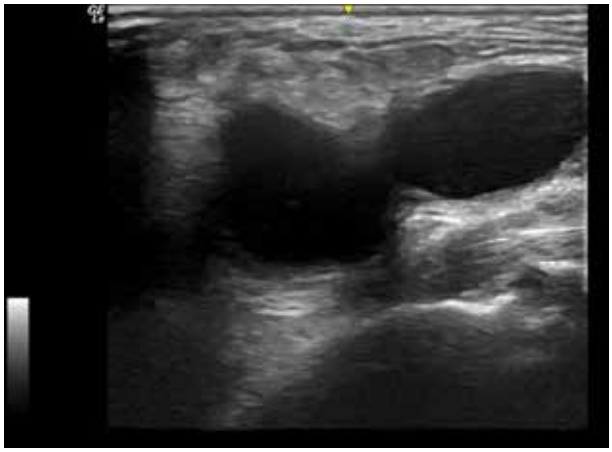

Fig. 2. Coronal plane imaging within the tarsal tunnel with short axis to tendons.

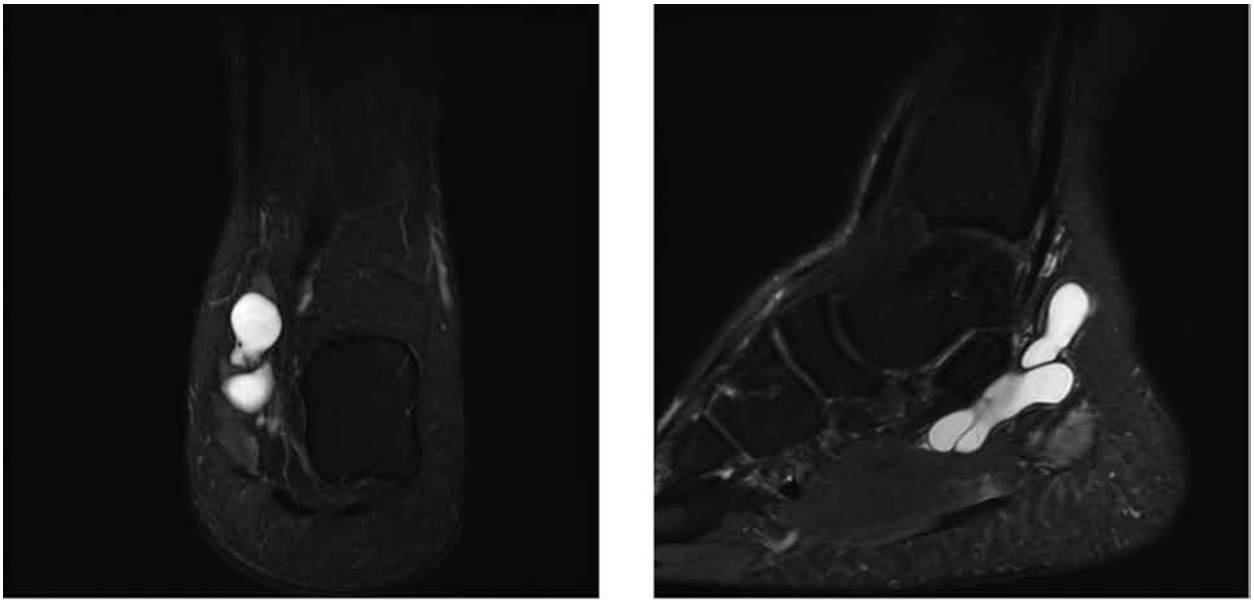

Fig. 3. Coronal and sagittal T2 imaging showing cyst at the level of the tarsal tunnel.

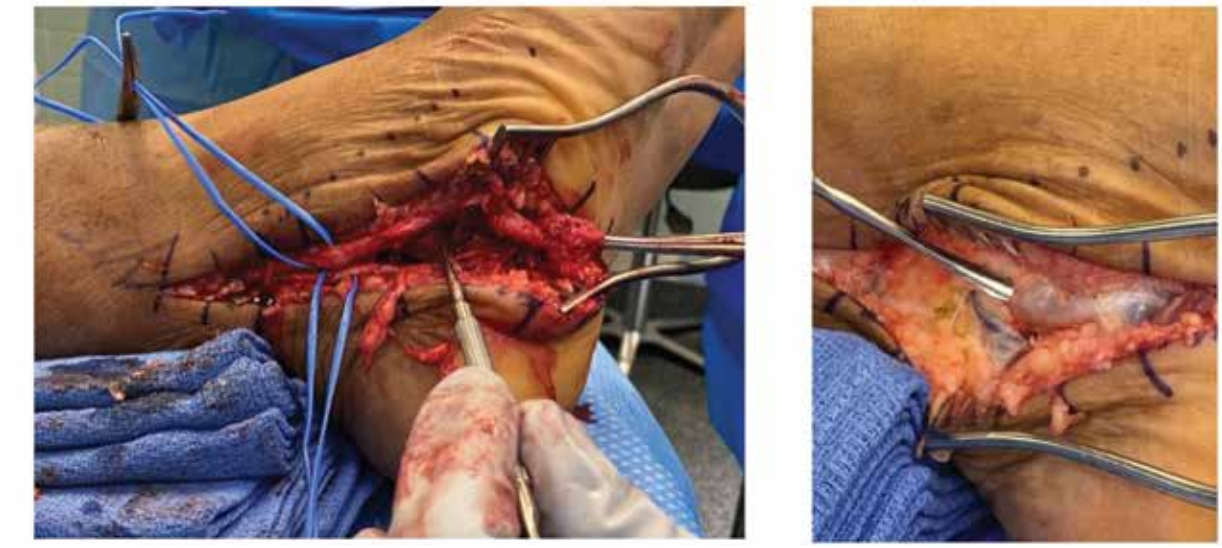

Fig. 4. Surgical extraction of the mass.

aspect of the foot. He remained mildly edematous in the foot and ankle from the surgery with residual incisional pain. Follow-up ultrasound examination was performed showing no evidence of recurrence of the large cystic structure. Overall, the patient was pleased with his progress and remained hopeful for continued improvement.

NCS was repeated during that visit to help guide prognosis and assess current neurological function. Bilateral tibial nerve motor studies were performed as a comparison to the previous NCS performed. There remained evidence of left tibial nerve dysfunction, with compound muscle action potential (CMAP) amplitude loss and slightly prolonged CMAP latency as compared to the contralateral side. While direct reproduction of an outside study is impossible, there was evidence of improving the symmetry of tibial nerve CMAP latency when compared with the contralateral unaffected side.

DISCUSSION

The tarsal tunnel is a space found behind the medial malleolus, which contains the posterior tibialis tendon, flexor digitorum longus tendon, flexor hallucis longus tendon, posterior tibial artery and vein, and posterior tibial nerve branches. The tunnel is bound by the flexor retinaculum superficially, which travels from the tip of the medial malleolus to the medial calcaneal process. It is continuous with the plantar fascia distally and the deep fascia of the leg proximally. The medial surfaces of the talus, calcaneus, and distal tibia create the floor of the tunnel. The tunnel also contains fibrous septae, which create individual channels for each of the tendons and the tibial neurovascular bundle as they traverse the space. The tibial nerve, a division of the sciatic nerve, gives off the calcaneal branch before entering the tarsal tunnel. After giving off the calcaneal branch, it typically branches into the medial and lateral plantar nerves once inside the tunnel, but this may occur more proximally or distally.

TTS occurs when the posterior tibial nerve or its branches become compressed underneath the flexor retinaculum as they travel through the tarsal tunnel (3,4). Differential diagnoses to consider when suspecting TTS are lumbosacral radiculopathy, particularly of the L5 and S1 nerve roots, tendinitis, plantar fasciitis, neurogenic claudication, ischemia, peripheral neuropathy, and deep flexor compartment syndrome, among others (4,5).

Causes of TTS can be divided into intrinsic factors that occur within the borders of the tarsal tunnel or extrinsic factors that result from forces outside the tarsal tunnel. Intrinsic factors include tendinitis, hypertrophic retinaculum, osteophytes, and other space-occupying lesions, such as neuromas, ganglia, lipomas, and enlarged veins (2,3). Extrinsic factors include direct trauma resulting in ankle fractures or sprains, lower extremity edema, varus or valgus foot deformities, postsurgical scarring, and diabetes (2,3). Most cases of TTS are idiopathic; however, a previous history of trauma is the most common factor (6). In our patient's case, the TTS was caused by the compressive effects of a large, complex GC likely arising from the medial subtalar joint, which became intimately involved with the epineurium of the medial and lateral plantar nerves. It appeared to track distally along the nerve branches as it expanded.

This case demonstrates the value of adding ultrasound to the evaluation of TTS. Ultrasound allows for quick and convenient screening of many of the etiologies of TTS, particularly cystic structures like that presented in this case. SCs are defined as juxta-articular fluid collections lined by synovial cells; whereas, GCs are tumor-like lesions surrounded by a dense connective tissue capsule filled with a gelatinous fluid of mucopolysaccharides and hyaluronic acid. Both cysts would appear as anechoic or hypoechoic collections of fluid on ultrasound, but their differing internal components can result in varying degrees of sonocompressibility. SCs will be more compressible than GCs due to their lack of dense connective tissue covering and thinner fluid content (7). Other causes of TTS, such as flexor retinaculum hypertrophy, osteophytes, and peripheral tenosynovitis, can also be detected via ultrasound imaging (3,8). Following surgery or drainage, ultrasound is also useful for noninvasive, efficient monitoring for recurrence of lesions.

Electrodiagnostic testing also proved integral for this patient. NCS/EMG can both identify tibial nerve dysfunction and monitor for neurologic recovery postintervention. As hallmarks of demyelination and axonal loss, respectively, sensory nerve action potentials (SNAPs) of the medial and lateral plantar nerves should be assessed for prolonged latency and/or amplitude loss. Most commonly in TTS, the lateral plantar SNAP is found to be absent; second, in incidence, is absence of the medial plantar SNAP (9). Assessment of CMAPs in the muscles supplied by the medial and lateral plantar nerves is also important for diagnosis, although motor nerve dysfunction is both less frequent and less sensitive than sensory nerve abnormalities (1,3,9). It should be noted that obtaining plantar nerve SNAPs can be technically challenging due to the presence of callus or edema, or confounding diagnoses, such as peripheral neuropathy. Thus, side-to-side comparison of findings is often important.

Repeat NCS in this patient was performed to assess for improvement in tibial nerve function. It was a technically difficult study due to the presence of edema and scar tissue in the vicinity of the distal stimulation and recording sites for the left tibial motor nerve studies. Findings included normal right tibial nerve motor function and borderline normal left tibial nerve motor function, with normalized left tibial nerve CMAP onset latency when compared to prior study. While technically within normal reference range, the left tibial nerve CMAP continued to show decreased amplitude when compared to the right, representing partial axon loss on the affected side. While it is difficult to compare studies from different electrodiagnostic laboratories,

this most recent study suggested a return to the normal range of left tibial nerve CMAP latency status postnerve decompression, signaling continued recovery of neurological function.

EMG is not often performed for TTS, but is more so completed to ensure a confounding lumbosacral radiculopathy is not present. Denervation of the muscles supplied by the plantar nerves may be observed as increased insertional activity (i.e., spontaneous muscle fiber electrical activity, such as positive sharp waves and fibrillation potential), or neurogenic recruitment pattern of motor units. Low-amplitude, short-duration, polyphasic motor units on EMG testing demonstrate the nascent units of axonal regeneration; whereas, long-duration polyphasics with more normal, or even increased, amplitude indicate axon terminal collateral sprouting. Both are forms of peripheral neurological recovery (10). Initial management of TTS includes conservative treatment with lower extremity rest, foot orthotics, physiotherapy, anti-inflammatory drugs, or aspiration of ganglia. Surgical management is often recommended for severe or refractory symptoms (1,3).

CONCLUSIONS

This patient was diagnosed with TTS prior to being seen in our clinic. Unfortunately, no relevant imaging of the ankle was performed until our evaluation. Ultrasound examination proved integral to identifying etiology and establishing treatment. This patient ultimately required surgical decompression to allow for neurologic recovery and symptom improvement. Electrodiagnostic testing was also supportive of the diagnosis and was useful in identifying prognosis. His potential for full recovery is likely limited due to the long-term compression of the nerves involved. Earlier use of ultrasound imaging could have led to a timelier diagnosis and treatment of his cyst. Both EMG/NCS and ultrasound should be utilized when evaluating for TTS, if available.

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