Case Report

Tarsal Tunnel Surgery Secondary to a Tarsal Ganglion

Be Prepared Before Performing This Complicated Operation

Joseph A. Cione, DPM, FACFAS, DABPS, John Cozzarelli, DPM, FACFAS, DABPS, Christopher J. Mullin, DPM, FACFAS, DABPS, and A. Lee Dellon, MD, PhD

Abstract: *Tarsal tunnel surgery complicated with ganglia or any other type of cystic mass can be a very challenging operation. Preoperative planning before any tarsal tunnel surgery involving a soft-tissue mass is imperative. Plans to reconstruct the posterior tibial nerve and/or artery should be in place. The authors will present a case study that involved tarsal tunnel syndrome with an associated ganglion in the tarsal canal. They will review what microsurgical techniques and equipment should be on hand prior to performing this complicated surgical procedure.*

Keywords: nerve compression syndromes; tarsal tunnel syndrome; PSSD neurosensory nerve testing

Tarsal tunnel syndrome was first described in 1962 by both Keck[1] and Lam.[2] It is an entrapment neuropathy, involving the posterior tibial nerve within the tarsal canal, posterior to the medial malleolus. The posterior tibial nerve divides into 3 branches, which consist of the medial plantar nerve, lateral plantar nerve, and the medial calcaneal nerve. It travels through a fibro-osseous tunnel that is bounded by the flexor retinaculum superficially, the medial surface of the talus, sustentaculum tali, the medial calcaneal wall laterally, and the abductor hallucis muscle inferiorly.[3]

Tarsal tunnel syndrome is most frequently deemed to have an idiopathic etiology, although some cases are associated with trauma or space-occupying lesion. A metabolic predisposition to a compression neuropathy such as diabetes has also been suggested.[4] Cimino[5] reviewed 24 reports on tarsal tunnel syndrome, which included a total of 186 cases. He reported that 21 cases were secondary to trauma and 3 cases secondary to a ganglion. The etiology given for the remaining patients consisted of idiopathic, varicosities, heel varus, heel valgus, fibrosis, diabetes, obesity, tight tarsal canal, hypertrophic abductor hallucis, rheumatoid arthritis, lipoma, anomalous artery, acromegaly, anklyosing spondylitis, regional migratory osteoporosis, and flexor digitorum accessorius longus.[5]

Stedman's Medical Dictionary (27th edition) defines a ganglion as "a cyst containing muco polysaccharide-fluid within a fibrous tissue, muscle, bone or semi lunar cartilage." The ganglia usually originate "from a tendon sheath in the hand, wrist, foot or can be connected with the underlying joint."[6] Nagaoka and Satou[7] reviewed 30 feet with the occurrence of tarsal tunnel syndrome caused by ganglia. In 15 of the feet, the ganglion originated from the talocalcaneal joint in 14 and from the talocrural joint in 1. In the remaining 15 feet, the origin could not be identified.[7]

> "Preoperative planning before any tarsal tunnel surgery involving a soft-tissue mass is imperative."

Ultrasonography and magnetic resonance imaging (MRI) are the modalities of choice to visualize a space-occupying lesion such as a ganglion in the tarsal tunnel. The ganglion as seen on ultrasonography will show up as an echo-free or hypoechoic area.[7] On MRI, ganglions are cystic, lobulated structures in the vicinity of a joint with a fine synovial or capsular border. The signal behavior is

DOI: 10.1177/1938640008330573. From Podiatry Associates of Belleville, Belleville, New Jersey (JAC, JC, CJM), and Division of Plastic Surgery, Department of Surgery, Department of Neurological Surgery, Johns Hopkins University School of Medicine, Baltimore, Maryland (ALD). Address for correspondence: Joseph A. Cione, DPM, FACFAS, DABPS, Podiatry Associates of Belleville, PC 155, Belleville Ave, Belleville, NJ 07109.

fluid equivalent on T2-weighted and STIR images (white) and gray on T1-weighted images.[8]

The case to be presented involved a patient who suffered from tarsal tunnel syndrome for more than a year following a car accident. It was found that she had tarsal tunnel syndrome secondary to trauma and a ganglion in the tarsal canal. The ganglion was located and involved the posterior tibial nerve and artery. The cyst had 2 communicating stalks originating from the talocalcaneal joint.

Case Study

A 48-year-old woman presented with a chief complaint of severe burning and radiating pain along the medial aspect of the ankle and heel region. The pain radiated into the arch region and to the toes. The patient stated that the pain felt like electricity shooting from the heel to the arch of her left foot. The duration of the symptoms had been noted to be more than 1 year. The patient related a past history of trauma to the ankle. She was involved in an auto accident and related that the pain began after the accident. She stated that her foot jammed into the floorboard of the car and was forced in a dorsiflexed and everted position.

Physical examination of the patient's left foot revealed that the vascular status was intact with palpable pedal pulses and immediate capillary refill time to all the digits. The dermatological examination was unremarkable. The orthopaedic examination showed severe tenderness upon palpation of the plantar medial tubercle of the calcaneus on the left foot. There was tenderness upon palpation of the proximal tarsal tunnel region and along the course of the posterior tibial nerve. The neurological examination of the left foot showed a positive Tinel sign noted on percussion of the posterior tibial nerve that sent radiating pain into the arch of the foot. The position sense and vibration sensation were normal, and the reflexes were 2+ in the lower extremity.

Because of the past history of trauma, the patient was sent for an MRI of the ankle and heel. The T1 axial images of the foot and T1 coronal images of the ankle showed a decreased signal intensity (gray) posterior to the flexor digitorum longus and anterior to the posterior tibial nerve (see Figures 1 and 2). The corresponding views on the STIR sequences showed a rounded abnormality with increased signal intensity (bright) in the same location. All of these MRI findings

Figure 1.

This is the T1 axial view of the foot, which shows a low-signal-intensity (gray) mass in the tarsal tunnel.

Figure 2.

This is the T1 coronal of the ankle, which shows a low-signal-intensity (gray) mass in the tarsal tunnel, which appears to be communicating with the subtalar joint.

Figure 3.

This is the STIR axial view of the foot, which shows an increased signal intensity (bright) mass in the tarsal tunnel.

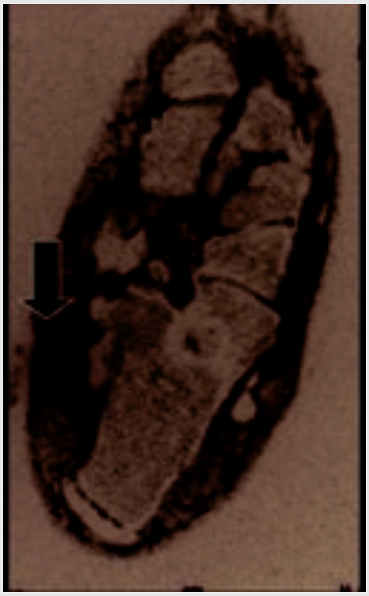


Figure 4.

This is the STIR coronal of the ankle, which shows an increased signal intensity (bright) mass in the tarsal tunnel, which appears to be communicating with the subtalar joint.

were consistent with a synovial or ganglion cyst (see Figures 3 and 4). The STIR coronal views showed a communication stalk to the subtalar joint.

The patient was sent for an electromyogram (EMG)/nerve conduction velocity (NCV) to evaluate the presence of a lumbosacral radiculopathy. The EMG in the left lower extremity was normal. The needle examination of the lumbosacral paraspinal muscles was normal. The NCV that was performed was inconclusive for tarsal tunnel syndrome. The medial and lateral plantar nerves were absent on both lower extremities. In one reported study of 27 patients with neurogenic heel pain, 11 had bilateral symptoms; 23 of the 38 symptomatic heels had abnormal electrical recordings.[9] The study demonstrated that the medial and lateral plantar nerves, being small and distal, cannot actually be evaluated directly by this traditional test.

The best method to evaluate a neural source of pain is to measure the sensibility of the foot. Therefore, we performed neurosensory testing with the Pressure-Specified Sensory Device (Sensory Management Services, Baltimore, Maryland). If the evaluation of sensibility demonstrates abnormality in the pulp of the hallux, then the diagnosis should be tarsal tunnel syndrome.[10] The great toe pulp site and the medial heel showed an increase in 1- and 2-point pressure. With chronic nerve compression, the first perception to become abnormal is the ability to distinguish between 1- and 2-point static points touching the skin.[11] Two-point discrimination was elevated at both sites, which is consistent with axonal loss of the distribution of the medial plantar nerve. All of these findings are consistent with an entrapment neuropathy of the posterior tibial nerve.

The patient's preliminary diagnosis was compression of the posterior tibial nerve by a fluid-filled cyst resulting in tarsal tunnel syndrome of the left foot. Conservative treatment, which consisted of anti-inflammatory medication, cortisone injections, arch supports, physical therapy, and a change in shoe gear, failed to alleviate the pain. The patient's surgical option included a neurolysis of the tibial nerve and excision of the cystic mass in the tarsal tunnel, with disconnection of the ganglion from the joint's articular level.

The entire procedure took place with tourniquet control, bipolar cautery for hemostasis, and loupe magnification.

Attention was then directed to the tibial nerve and its branches at the medial ankle. An incision was planned out with a skin marker on the medial aspect of the ankle. The incision carried down through the skin. At this time, the flexor retinaculum was identified over the tarsal tunnel. An incision was then made in the retinaculum overlying the posterior tibial artery and tibial nerve bundle. The incision was then carried proximally up into the deep posterior compartment and distally to the level of the abductor hallucis muscle belly. The posterior tibial nerve was released along this entire length of the incision. This completed the traditional tarsal tunnel release and nerve decompression of the posterior tibial nerve.

Attention was then turned to the distal branches of the posterior tibial nerve, including the medial plantar, lateral plantar, and calcaneal nerve. The muscle belly of the abductor hallucis was identified at this time. A t-shaped incision was made in the superficial fascia of the abductor hallucis muscle belly. The muscle belly was retracted distally, revealing the deep thick fascial band beneath it, which was released. At this time, we were able to pass our finger distally deep into the plantar surface of the foot. We were able to identify the medial plantar tunnel and the lateral plantar tunnel as they coursed beneath this fascia (see Figure 5). The medial plantar roof fascia was incised and therefore decompressing the medial plantar tunnel. Another separate incision was then made in the roof of the lateral plantar nerve fascia and decompressing the lateral plantar nerve. The septum between the tunnels was cauterized and excised between the 2 tunnels until it was one large tunnel. Attention was now directed to the medial aspect of the heel, where the medial calcaneal nerve branch was identified. The tunnel for that nerve was released, therefore decompressing the medial calcaneal nerve.

Figure 5.

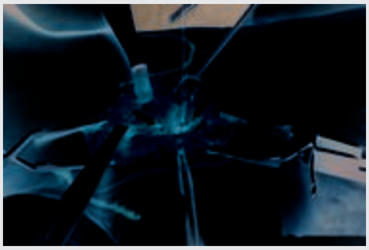
The posterior tibial nerve identified with the branches of the medial plantar nerve (black arrow), and lateral plantar nerve (white arrow) identified to complete the full decompression of the nerves in the tarsal tunnel.

Figure 6.

The stalk identified (white arrow) that was extending from the medial aspect of the talocalcaneal joint to the cyst in the tarsal tunnel.

Figure 7.

The 2 stalks were identified and tied off after total excision of the cyst (white arrows).



Following the release and decompression of the posterior tibial nerve, inspection of the nerve and artery was

Figure 8.

The cyst measuring 1.5 cm in length after total excision.

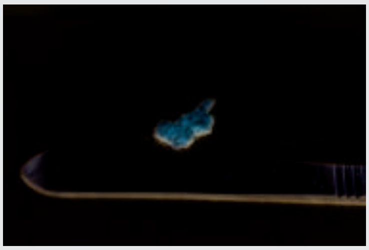


Figure 9.

Loupe glasses with magnification of 3.5× and 2.5×.

Figure 10.

Bipolar coagulator forceps.

performed to locate the cystic mass. Upon careful dissection along the lateral aspect of the posterior tibial nerve, a cystic mass was noted. The capsule of the cyst was adhered to the posterior tibial nerve. The cyst had multiple stalks emanating from the subtalar joint (see Figure 6). The stalks were identified, coagulated, and tied off with 5.0 nylon (see Figure 7). The stalks were coagulated with the bipolar cautery to prevent any recurrence of the cyst. The cyst was then dissected from the subtalar joint and off the neurovascular bundle. With use of microdissection scissors, the epineurium of the posterior tibial nerve was dissected and freed of any remaining cystic mass that was adhered to the nerve. Following the excision of the cyst, the posterior tibial nerve was inspected for any remaining cyst within the nerve. There was no damage to the nerve fascicles upon full inspection. The mass was then sent to pathology for pathological analysis (see Figure 8). The posterior ankle tendons were examined, and all were intact following the excision. There appeared to be no connection of the cyst to any of the posterior tendons. Following the tarsal tunnel release and cyst excision, the ankle tourniquet was deflated, and there was no bleeding noted in the wound; the digits turned pink immediately, with excellent capillary refill time to the digits. We were confident at this time that the blood supply to the foot was adequate and intact. The incision was then closed with multiple intradermal 4.0 Monocryl simple sutures, and the skin was closed with a running 5.0 nylon suture.

Following all of the procedures, adaptic was then placed over all of the incision sites with a dry, sterile bandage; a bulky Robert Jones bandage; and then an ace wrap. The ace wrap was removed in the recovery room after 30 minutes.

The patient was followed up in the office and instructed to ambulate on the foot as tolerated using a walker. The sutures were removed at 3 weeks. At 4 months after the procedure, her symptoms were completely resolved.

Discussion

Surgical outcomes for patients with ganglions or any other cystic masses in the tarsal tunnel are often good.[12-14] Tarsal tunnel surgery complicated with a ganglion or any other type of cystic mass can be a very challenging operation. This type of surgery requires a bloodless field using a tourniquet, loupe magnification (see Figure 9), bipolar coagulation (see Figure 10), and most likely an intraoperative electrical stimulation of the nerve, even if it is performed using only a disposable, battery-operated device.[15]

When encountered by this type of scenario, the surgeon's goals are removing the cyst, preserving the nerve, relieving the symptoms of chronic nerve compression, and preventing cyst recurrence. Rosson et al[15] presented 3 patients, all of whom had tarsal tunnel surgery for excision of ganglion, who demonstrated a recurrent ganglion, but they also demonstrated that the tibial nerve had been resected during the operation. These 3 cases reiterate the fact that surgery for ganglions in the tarsal tunnel region is not simple and can have some serious negative outcomes.

Preoperative imaging with an MRI should be reviewed in full detail to define anatomical relationships and the site of origin of the cyst. It should be determined prior to the surgery whether the ganglion is involving a tendon sheath, arising from a nearby joint, or involving the neurovascular bundle.

Preoperative planning before any tarsal tunnel surgery involving a soft-tissue mass is imperative. The surgeon should be trained in microsurgical techniques or have a vascular or peripheral nerve team available. The soft-tissue mass may involve the nerve or artery, which can complicate total excision of the cyst.

Plans to reconstruct or repair the posterior tibial nerve and/or artery should be in place, in the event there is injury to the nerve while excising the cyst. Microsurgical repair is required only if there is any injury to the posterior tibial nerve during the operation. The best results, when conditions permit, are achieved with a direct nerve repair without grafting. There are 3 types of nerve repair:

1. Perineurial repair: this repair involves the individual fascicles and placing sutures through the perineurium.
2. Group funicular repair: this repair involves repairing grouped fascicles with sutures placed through the

intraneural epineurium, aligning the groups of fascicles.

3. Epineurial repair: this repair involves aligning the nerve ends and placing sutures through the epineurium only.

When continuity defects are present in the injured nerve or created in preparation of the nerve for repair, a nerve graft procedure may be indicated. The surgeon should be trained to repair the nerve and should be able to use a Neurotube (Synovis Microsystem, LLC, Minneapolis, Minnesota) implant to reconstruct the nerve. The bioabsorbable polyglycolic acid conduit has been developed for nerve reconstruction and was approved by the Food and Drug Administration for human use in 1999. This corrugated tube has an internal diameter of 2.0 mm and a length of 4 cm. The characteristics of the tube include the following:

1. Porosity: provides an oxygen-rich environment for the regenerating nerve;
2. Flexibility: to accommodate movement of joints and associated tendon gliding;
3. Corrugation: to resist the occlusive force of surrounding soft tissue; and
4. Bioabsorbability: eliminating the need for removal at a subsequent operation.

In the adverse event of a vessel injury to the posterior tibial artery, a microanastomosis needs to be performed. The fundamental principles of a microsurgical repair of a vessel should be used when repairing the artery. These principles include the following:

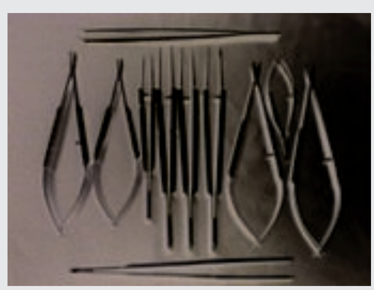
1. The vessel is manipulated as little as possible. These delicate structures should be retracted and manipulated with vessel loops (see Figure 11).
2. The intima is never grasped with forceps.
3. Precise 9-0 nylon suture placement minimizes the number of stitches needed.
4. A smooth transition between donor and recipient vessel lowers turbulence.

Figure 11.

Sterile silicone vessel loops.

Figure 12.

Microsurgical instruments including straight forceps, curved forceps, straight needle holder, curved needle holder, straight scissors, and curved scissors.



5. Each suture everts the vessel edges and approximates the intima.
6. Following the curve of the needle creates a hole in the vessel that matches the diameter of the suture.
7. Care is taken to prevent strands of adventia from draping into the lumen.[16]

When the anastomosis is complete, there should be no leaks. If there any leaks, they should be sutured. Once the vascular clamps are released, good flow must be maintained during the first 20 minutes. A momentary reduction in blood flow can result in rapid platelet aggregation, leading to occlusion of the vessel. A handheld Doppler can be of great assistance to make sure there is blood flow in the vessel.

Figure 13.

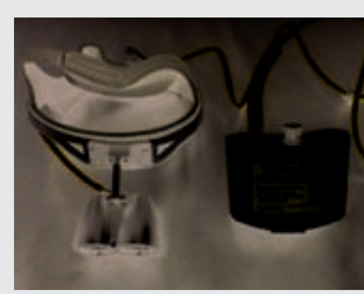
A 9.0 nylon suture.

Figure 14.

Various sizes of vascular clamps.

Figure 15.

Zenon head light.



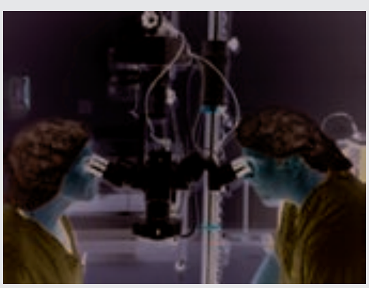
The surgeon needs to be prepared in the event of a serious complication associated with doing tarsal tunnel surgery and excision of a cyst in the tarsal canal. The surgeon should have on hand and be fully equipped with a microsurgical instrument tray (see Figure 12). The surgeon should be equipped with a

Figure 16.

Sterile background plastic fields used during a repair of vessel or nerve.

Figure 17.

Zeiss dual-head 10× microscope.



nonabsorbable 9-0 nylon (see Figure 13), vascular clamps (see Figure 14), a Zenon head lamp with battery pack (which can be helpful if there is not adequate lighting; see Figure 15), and background plastic fields (see Figure 16). A Neurotube implant should be on hand in the event a nerve graft is not possible and repair of the nerve defect is necessary. These kinds of operations should be performed in a facility that has a Zeiss OPI Microscope performing 10× power magnification (see Figure 17). This will allow further enhanced visualization of a vessel or nerve repair.

Conclusion

As the Boy Scout motto says, "Be prepared." This article's intention is not to scare surgeons but rather to prepare them, as these various obstacles can be placed in their way when performing tarsal tunnel surgery complicated with a ganglion in the tarsal canal. To provide the utmost care for a patient, the surgeon should be experienced in microsurgical techniques to repair any damage to the nerve or vessel secondary to the cyst or iatrogenic injury to these vital structures. FAS

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