Postoperative Management

The lower limb is put into a cast for 1 week. The cast should be put in neutral position. Walking with crutches is recommended for 1 week. After that time period, gradual resumption of weight bearing in a boot for 3 weeks as tolerated is allowed. Physical therapy, including range of motion (ROM) exercises and wobble-board training, are begun. Full athletic training can be resumed 4 to 6 weeks postoperatively. In case of extensile surgery affecting a joint or including complex osteotomies, a boot should be worn for 4 weeks and training not resumed before 8 weeks postoperatively.

Results

In case of space-occupying lesions, resection yields satisfactory symptomatic relief. Decompression of the sural nerve by ganglia excision with neurolysis could be curative.[7] Posttraumatic bony impingement for sural nerve entrapment can be addressed by restoring anatomy. Gould and Trevino described three cases of fractures of the base of the fifth metatarsal with dorsal displacement of the fracture fragment and tenting of the sural nerve. After reduction of the fracture fragment and neurolysis, all patients improved within several months.[12] In a study performed by Fabre et al., 13 athletes (18 limbs) were treated due to sural nerve entrapment. Nine limbs showed an excellent result, eight limbs a good result, and one limb a fair result at time of follow-up. Ten patients had cessation of calf pain.[7] However, in patients in whom prior surgical scarring or injury was the cause, the results of nerve release are less predictable, and may ultimately require resection and burial despite not having a true neuroma. In the presence of a neuroma, resection of the damaged nerve and burial into healthy tissue (muscle, bone) can improve symptoms. In cases of ankle instability, lateral ankle ligament reconstruction without nerve release could be enough to help the patients reduce pain and discomfort and is reasonable to perform if no neuroma is present.[27]

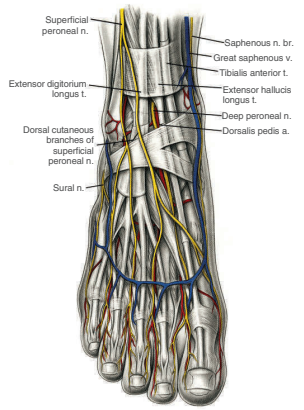

Fig. 114.5 Illustrated is an artistic drawing of the anatomy of the dorsum of the foot. (From Ferkel RD, Weiss RA. Correlative surgical anatomy. In: Ferkel RD, Whipple TL, eds. *Arthroscopic Surgery. The Foot and Ankle*. Philadelphia/New York: Lippincott-Raven; 1996:89, Fig. 5.6, with permission.)

SAPHENOUS NERVE ENTRAPMENT

Saphenous nerve entrapment is rare.[4] The saphenous nerve is the longest sensory branch of the femoral nerve arising from the L1,2,3 nerve roots. The nerve leaves the femoral triangle to enter the adductor canal (or subsartorial canal of Hunter) together with the femoral artery and vein. The walls of the canal comprise vastus medialis and adductor longus muscle and the membrane of the vastus and adductor bridges the roof. The sartorius muscle covers the proximal portion of the canal and also covers the two terminal branches of the saphenous nerve—the infrapatellar branch and the descending branch. The infrapatellar branch supplies the sensation to the medial portion of the knee joint and the overlying anteromedial skin. The descending branch accompanies the saphenous vein to supply the skin of the medial leg and foot (Figs. 114.5 and 114.6).[10,11,28]

Entrapment occurs at the subsartorial fascia just proximal to the femoral condyle.[29,30] Local trauma can damage the nerve. Harvesting the saphenous vein for cardiac or vascular surgery can potentially lead to damage to the saphenous nerve.[31] Other etiologies include angulation, stretch, pressure, and friction.

History

Saphenous nerve entrapment can present itself in a variety of different symptoms. As a rule, symptomatology depends on site of entrapment. Proximal involvement of the saphenous nerve, (i.e., the infrapatellar branch) could result in atypical or refractory knee pain.[29] Flexion of the knee joint might worsen the symptoms. Some patients receive incorrect knee treatment by application of a constricting brace due to missed or neglected saphenous nerve entrapment and report pain. Patients may report claudicant or exercise-related medial leg or knee pain. This syndrome has been observed in cyclists and rowers. With distal involvement of the saphenous nerve patients may feel pain, numbness, or paresthesias localized to the medial side of the leg or foot (typically proximal to the first metatarsophalangeal [MTP] joint).

Physical Examination

The nerve should be palpated along its anatomic course starting proximally from the medial condyle of the femur and traced

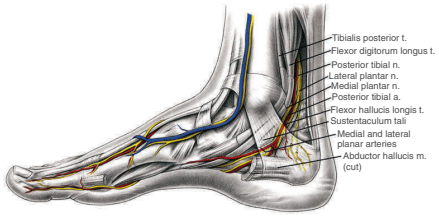

Fig. 114.6 Depicted is an artistic drawing presenting the anatomy of the medial aspect of the foot and ankle. (From Ferkel RD, Weiss RA. Correlative surgical anatomy. In: Ferkel RD, Whipple TL, eds. *Arthroscopic Surgery. The Foot and Ankle*. Philadelphia/New York: Lippincott-Raven; 1996:90, Fig. 5.8, with permission.)

down the medial side of the leg and the foot. Tenderness to palpation along the course of the nerve is the hallmark of diagnosis. Tenderness at the subsartorial fascia might be found. It might be associated with a reproducible Tinel sign at the site of entrapment.[32] Relief of pain with injection of a local anesthetic suggests localization of a more precise site of entrapment.

It is possible to use nerve conduction studies to assess the main branch of the saphenous nerve or the terminal branches.[33] However, routine testing may not yield useful results in patients with significant subcutaneous adipose tissue or swelling of the extremity.[34]

Electromyography for suspected saphenous nerve impingement should include testing of the adductor longus and quadriceps muscles. While electromyography is expected to be negative in saphenous nerve entrapment, it could be helpful to assess the presence of radiculopathy.[35]

Imaging

Conventional radiographs help identify posttraumatic and primary impingement on the nerve. Advanced diagnostic studies such as MRI or CT are not routinely indicated but can be considered to more clearly elucidate bony structures surrounding the course of the nerve (CT) or for preoperative planning and more precise localization of impingement in cases refractory to conservative measures.

Treatment Options

Conservative Treatment

Nonoperative treatment encompasses removal of any extrinsic factors that could lead to saphenous nerve entrapment. Activity modifications and physical therapy (strengthening exercises and proprioception) may help reduce pain. NSAIDs, topical analgesics, and systemic nerve modulators have been recommended in presence of saphenous nerve entrapment syndrome.[32] Local injections of anesthetics with or without steroids could alleviate pain. Romanoff et al. reported an 80% success rate after a series of injections in 30 patients without application of steroids.[30] However, if all those measures do not improve the symptoms, surgery should be considered.

Surgical Treatment

Surgical treatment includes decompression, neurectomy, and neurolysis. Decompression is preferred and can be achieved by release of the anterior aspect of Hunter's canal and dissection of the saphenous nerve fibers from the surrounding sartorial fascia. Local nerve release may be necessary for more distal entrapments.

The best management for the transected proximal nerve is to bury and secure the nerve within an adjacent muscle belly. The nerve can also be compressed as it travels between the sartorius and gracilis muscles near their insertion. The nerve can either be released or divided in this region. Probably the most frequently seen problem in the sporting population is a neuroma of the infrapatellar branch. This can be irritated by repetitive movement of the knee or by direct pressure producing symptoms from the neuroma. Surgical treatment is simple. A straight incision is made over the neuroma, which is then excised, dividing the infrapatellar branch fairly proximally. In the author's experience, simple transection and placing it into muscle is all that is necessary.

Results

A reduction or elimination of pain can be expected in 60% to 80% of cases.[34] However, a large number of patients might still require neurectomy. There is an ongoing debate on whether neurolysis of the nerve or neurectomy achieves the best results. The chief problem with division of the saphenous nerve is the resulting distal anesthesia, with subjective discomfort in some patients. In the other hand, simple neurolysis includes complete fascial band release around the saphenous nerve with potential scar tissue formation, which could itself lead to new entrapment

of the nerve. Worth et al. were able to show that in 15 patients suffering from saphenous nerve entrapment, complete relief was achieved in 13 knees after neurectomy. The authors concluded that neurectomy gave a more predictable result than neurolysis.[36] Neurectomy should be best performed proximal to the fascia in the canal between the vastus medialis and adductor magnus.[34]

Two patients in a study by Koppel and Thompson had relief of symptoms 24 hours after decompression. However, they were not followed up for a longer time. As such interpretation of those results is maximally limited. Dellon et al. reported the results of neurectomy in 70 patients. Of these, 62 patients were treated by neurectomy of the infrapatellar branch. Eighty-four percent revealed improvement of pain (Visual Analogue Scale).

TARSAL TUNNEL SYNDROME

Introduction

First described by Keck and Lam in 1962, tarsal tunnel syndrome is an entrapment neuropathy involving the tibial nerve. It is relatively uncommon in athletes and thus may go mis- or undiagnosed. While nonathletic patients are often middle-aged to elderly and an equal distribution among males and females is found, in athletes the patients are younger with a tendency to female preponderance.[37-39]

The tibial nerve arises from the sciatic nerve. The tarsal tunnel is located behind the medial malleolus (see Fig. 114.6). Its borders are created by the tibia anteriorly, the posterior process of the talus and calcaneus laterally, and the flexor retinaculum medially.

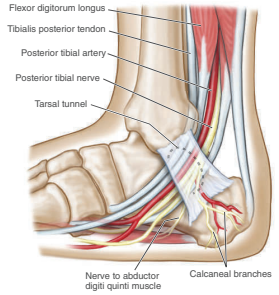

Fig. 114.7 The image shows the course of the tibial nerve and its branches in the distal aspect of the lower limb and ankle.

The flexor retinaculum is confluent with the sheaths of the posterior tibial tendon, the flexor hallucis longus tendon, and the flexor digitorum longus tendon. The flexor retinaculum and the abductor hallucis both are frequent sites of compression.[11] More recently, Singh et al. were able to demonstrate three well-defined, fascial septae in the sole of the foot.[40] Two of these septae represented potential sites of compression of the posterior tibial nerve and its branches and were distinct when compared with the classic entrapment sites. In most of the cases (93%), the tibial nerve splits into three major branches within the tarsal tunnel: the medial plantar nerve, the lateral plantar nerve, and the medial calcaneal branch. The medial calcaneal branch arises from the tibial nerve in 75% to 90% of cases and in 10% to 25% from the lateral plantar nerve, and it originates proximal to the tarsal tunnel in 39%, within the tarsal canal in 34%, and distal to the tunnel in 16%. In 21% of patients, multiple calcaneal branches are found (Fig. 114.7).[41,42]

Etiologies

A specific cause can be identified in approximately 60% to 80% of patients.[4,34,43] Table 114.1 provides a synopsis of the possible causes according to the work of Cimino.[44] Engorged varicose veins,[45] systemic diseases,[46] neurilemmoma (benign nerve sheath tumor),[47] pigmented villonodular synovitis,[48] lipomas, synovial cysts, intraneural degenerative cysts, ganglion cysts (flexor hallucis longus tendon sheaths), and accessory muscles[49] all can result in tibial nerve entrapment.

Postural deformities or mechanical abnormalities may contribute to the development of tarsal tunnel syndrome.[2,44,50-57]

TABLE 114.1 Causes of Tarsal Tunnel Syndrome

Causes	Cases
Idiopathic	25
Traumatic	21
Varicosities	16
Heel varus	14
Fibrosis	11
Ganglion	10
Diabetes	3
Obesity	3
Tight tarsal canal	3
Hypertrophic abductor hallucis	3
Rheumatoid arthritis	3
Lipoma	2
Anomalous artery	1
Acromegaly	1
Ankylosing spondylitis	1
Regional migratory osteoporosis	1
Flexor digitorum accessorius longus	1
Subtotal	**122**
Causes not reported	**64**
Total	**186**

Work of Cimino WR, who summarized 24 studies.
From Cimino WR. Tarsal tunnel syndrome: review of the literature. *Foot Ankle*. 1990;11(1):47–52.