During the past decade there has been a shift in thinking within the podiatric medical and orthopedic communities concerning the surgical treatment of “Morton’s neuroma.” We believe that this condition should be known as “Morton’s entrapment” when it is in the third interspace and simply as “forefoot intermetatarsal nerve entrapment” when it appears in other interspaces. Other names have been used for different anatomical locations in the foot (Fig. 1).1 The mainstay of treatment for this condition in the 1970s and 1980s was simple nerve excision. In 1989, Dellon2 showed that there can be serious complications from common plantar digital nerve excision and described his surgical method for treating painful recurrent Morton’s neuroma. Gauthier,3 in 1979, was the first to describe decompression rather than excision for Morton’s entrapment, and other researchers have since reported successful results with decompression.4-8 There is now strong evidence that this common forefoot nerve entrapment is no different from any other human peripheral nerve entrapment.3, 5, 6, 9-15

In addition to this paradigm shift from resection toward decompression of forefoot nerve entrapments, exogenous mechanical forces that subject the forefoot to higher pressures during gait must be considered.16 Various studies17, 18 have identified the characteristic neural sequelae of exogenous mechanical pressure, such as tourniquets used in surgery. Graham et al19 indicate that the use of tourniquets frequently causes subclinical neurologic injury. They demonstrated in cadavers that there was nearly the same level of pressure at the perineural level compared with that of the subcutaneous tissue just beneath the skin with application of tourniquet pressure. The intervening soft tissues did not seem to decrease the applied pressure at the deeper level of the nerve tissue. It could be extrapolated that in-
increased plantar forefoot pressures due to changes in human gait as a result of an equinus deformity, in an anatomical area containing minimal soft tissue to cushion the common plantar digital nerve, could lead to a common forefoot nerve entrapment, such as Morton’s.

Talipes equinus is a relatively new term in the medical literature, initially used to refer to the condition classically known as “footdrop.” Currently, the term is used to indicate some degree of limitation of dorsiflexion at the ankle joint, usually to 10° or less, and is reported to be a significant factor in the development of forefoot pathology. Lavery et al found that equinus deformity was present in 10.3% of 1,666 patients with diabetes mellitus. However, they defined equinus deformity as dorsiflexion of 0° or less. If they had used the conventional definition of equinus deformity as dorsiflexion of 10° or less, they would have found a significantly higher percentage of patients affected. A recent study of patients with diabetes by Caselli et al found that increased plantar pressure under the forefoot is a risk factor for the development of ulceration. Pathologic limitation of ankle joint motion has been documented to increase forefoot plantar pressures and thus is a major risk factor for the development of ulceration in patients with diabetes. Likewise, increased forefoot pressures due to equinus deformity may contribute to the development of forefoot nerve compressions, whether or not neuropathy is present. Therefore, equinus deformity should be considered during surgical planning for treatment of forefoot nerve entrapment by means of nerve decompression.

**Case Report**

A well-nourished, healthy 46-year-old man presented to the private office of the primary author (S.L.B.) in The Woodlands, Texas, for the evaluation and treatment of diffuse forefoot pain bilaterally and contracted hammer digit syndrome. Physical examination findings were essentially normal except for exquisite pain on palpation of the second and third interspaces, contracted digits at the level of the metatarsophalangeal joints, and severe equinus deformity bilaterally. Maximum dorsiflexion at the ankle joint with the knee extended was –5°, and with the knee flexed was 13°. The patient described the pain as being of a burning nature, which increased with standing or walking. Careful examination showed that he had no symptoms related to the severe contracture of his toes, although he initially attributed his pain to “hammer toes.” The patient underwent a thorough biomechanical examination and was evaluated using the F-Scan system (Tekscan, Boston, Massachusetts) to document forefoot pressures before and after surgical treatment (Fig. 2). He also underwent neurosensory testing using the Pressure-Specified Sensory Device (Sensory Management Services LLC, Baltimore, Maryland), which ruled out proximal tibial nerve entrapment at the level of the tarsal tunnel (the medial plantar and medial calcaneal cutaneous pressure thresholds were normal). He also did not have Tinel’s sign at the level of the tarsal tunnel. The patient was informed that because of his severe gastrocnemius equinus, it was advisable to treat that component of...
the overall symptom complex, with the understanding that subsequent decompression of the intermetatarsal nerves might be necessary.

The equinus deformity on his right side was treated previously, by the primary author, by means of percutaneous tendo Achillis lengthening. Although healing took several months, the contractures of his hammered digits diminished, he gained more than 10° of dorsiflexion with the knee extended, and the nerve symptoms disappeared. The left side was treated approximately 8 months later. This time, endoscopic gastrocnemius recession was performed instead of percutaneous tendo Achillis lengthening. With this method, the patient had a faster recovery, experienced less postoperative pain, and eventually gained more muscle strength than on the contralateral side. The neuritic pain in his left foot also subsided quickly after the procedure. Decompression of the interdigital nerve was, therefore, not needed.

Surgical Technique

With the patient in the supine position, a small vertical incision is made at the lateral aspect of the leg, at the level of the distal gastrocnemius aponeurosis. This level is usually very easy to palpate because the proximal extent of the tendo Achillis fans out into the aponeurotic fibers. The subcutaneous tissue is reflected from the deep fascia using dissection scissors. The Endotract System (Instratek Inc, Spring, Texas) is used, which is a two-portal system originally designed for endoscopic plantar fasciotomy. The tissue elevator is then used to separate all of the subcutaneous tissue from the superficial fibers of the gastrocnemius aponeurosis. This is a critical step in the procedure because it decreases the chance that the sural nerve will be confused or transected. The subcutaneous tissue is reflected all the way to the medial side of the lower leg. The obturator or cannula is then introduced in a similar manner and is passed through the skin on the medial side of the leg after another vertical incision is made over the tip of the instrument. At this point, the camera can be introduced into either portal, and the aponeurotic fibers are visualized. The surgical assistant should then dorsiflex and plantarflex the foot with the knee fully extended. This will allow visualization of the aponeurotic fibers passing over the slot in the cannula, ensuring that the sural neurovascular structures are protected. The fibers of the gastrocnemius aponeurosis are then transected from medial to lateral, with careful attention to avoid cutting any muscle tissue beneath the aponeurosis. The plantaris tendon is almost always visualized medially and is also cut.

With the surgical assistant applying dorsiflexory force throughout the procedure, the surgeon will note a dramatic increase in motion at the level of the ankle joint. The small skin incisions are then closed using two small interrupted sutures. After surgery, the patient is placed in a below-the-knee cast boot, which is worn for 4 weeks. Sutures are removed at 14 days. The patient is allowed to shower the day after surgery, replacing the bandage with sterile bandage strips.

Discussion

Gastrocnemius recession is well described in the literature for the treatment of forefoot pathology in patients with cerebral palsy and after stroke. Tashjian et al described an endoscopic approach to gastrocnemius recession in 15 cadaver legs, with a high degree of success. They did have one injury to the sural nerve, and they describe their technique as going deep to the aponeurotic fibers of the gastrocnemius. Numerous podiatric surgeons currently perform endoscopic gastrocnemius recessions throughout the country; however, only one article has recently been published, by Saxena and Widtfeldt. They found an overall improvement at 1-year follow-up of 12.6° in 18 patients, and they believe that this is a safe method for addressing contracture of the gastrocnemius. Lawrence A. DiDomenico, DPM, of Youngstown, Ohio, has extensive surgical experience with this technique and reports that the most serious complication is occasional neuropraxia of the sural nerve (oral communication, 2004).

Before any surgical intervention involving gastrocnemius recession, open or endoscopic, it is imperative that the surgeon rule out other limitations to ankle joint dorsiflexion, such as a bony block, which would not allow for an increase in dorsiflexion after lengthening of the gastrocnemius aponeurosis. This can easily be done using the Silfverskiöld maneuver (Figs. 3 and 4).

We believe that although the surgeon is frequently aware of the presence of equinus deformity in the patient demonstrating forefoot nerve entrapment symptoms, as well as other common conditions, the pathomechanics of this deformity are rarely addressed surgically in these patients, for several reasons. Previously, more invasive techniques, such as open gastrocnemius recessions and tendo Achillis lengthening, required longer operative times and increased periods of postoperative morbidity for the patient. Endoscopic gastrocnemius recession is minimally invasive, requires little operative time, and is minimally painful after surgery. The technique seems to be well
accepted by patients, especially those who have previously undergone another procedure, such as tendo Achillis lengthening, on the contralateral side. In the panoply of complex pedal conditions that require surgical intervention, endoscopic gastrocnemius recession offers an additional technique to enhance patient surgical outcomes by reducing the pathomechanical effects of equinus deformity.

References

patients with transmetatarsal amputations. JAPMA **83**: 96, 1993.


