PROLAB ORTHOTICS
Evidence-Based Medicine

Biomechanics & Orthotic Therapy Newsletter
June 2024

BIOMECHANICS AND FOOT ORTHOSIS TREATMENT OF MORTON'S NEUROMA

Plantar neuromas in the 3rd intermetatarsal space of the foot, otherwise known as *Morton's neuroma*, are a relatively common clinical condition of the foot which can cause significant pain and disability. Morton's neuroma is named for civil war surgeon, Thomas George Morton, MD, who was thought to be the first to describe this painful condition within the 3rd intermetatarsal space (Morton TG: A peculiar and painful affection of the fourth metatarsophalangeal articulation. *Am J Med Sci*, 71:37-45, 1876). However, 31 years before Morton, Lewis Durlacher, a British surgeon-chiropodist for King George IV, King William IV and Queen Victoria, first described the painful condition of intermetatarsal neuromas in his book on the diagnosis and treatment of foot pathologies (Durlacher L. A treatise on corns, bunions, the diseases of nails, and the general management of the feet. Lea & Blanchard; 1845).

Accurate diagnosis of Morton's neuroma requires that the podiatrist obtain a good history and perform a detailed manual physical examination of the patient's foot. Since the plantar 3rd intermetatarsal nerve of the foot is purely sensory, the patient with Morton's neuroma may have symptoms including a burning, aching, cramping and/or tingling sensation in the area of the 3rd and 4th metatarsal heads and digits. On physical examination of the foot, tenderness may be present plantarly in the area of the 3rd and 4th metatarsal heads. There will likely also be a partial or complete loss of sharp/dull sensation in the plantar aspect of the 3rd interdigital space. Finally, manual side-to-side compression of the metatarsal heads may reveal a "clicking mass" between the plantar aspects of the 3rd and 4th metatarsal heads, known as a positive "Mulder's sign". It must be emphasized that injuries to the plantar plates of the lesser metatarsophalangeal joints (MPJs) can also produce localized inflammation and edema within the plantar MPJs which may mimic neuroma symptoms due to irritation of the adjacent intermetatarsal nerves. Therefore, when a neuroma is suspected, the clinician should also carefully palpate the adjacent plantar metatarsal heads to make certain that a plantar plate injury is not the cause of all or a part of the patient's plantar forefoot symptoms.

Anatomically, one of the reasons why Morton's neuroma is so common is that the deep intermetatarsal ligament lies directly over the plantar intermetatarsal nerves (Fig. 1). Because of this anatomical arrangement, shoes with higher heels can cause sufficient compression and tension loading forces on the plantar intermetatarsal nerves which may, over time, lead to Morton's neuroma (Miller SJ, Nakra A: Morton's Neuroma. In: Banks AS, Downey MS, Martin DE, Miller SJ (eds): *McGlamry's Comprehensive Textbook of Foot and Ankle Surgery*, Vol. 1, 3rd ed, Lippincott Williams & Wilkins, 2001, pp. 231-252.)

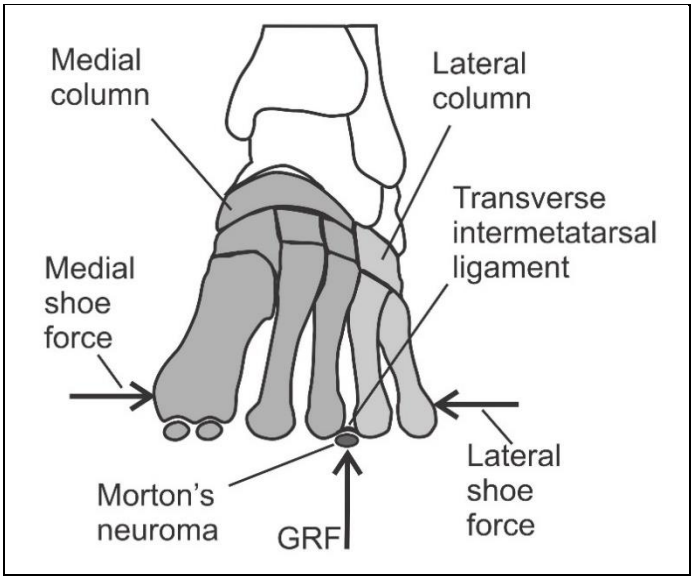

Figure 1. If shoes which are too narrow in the forefoot are habitually worn, the increased medial and lateral shoe force on the forefoot will increase the internal forces on the 3rd intermetatarsal nerve which may, over time, lead to Morton's neuroma.

It is common clinically to find that individuals who frequently wear narrow or pointed toebox shoes are the patients who are more likely to develop Morton's neuroma (Fig. 1). Habitual wearing of shoes with a narrow toebox will lead to excessive compression forces on the digits and forefoot which will, in turn, lead to increased internal compression and shearing forces on the 3rd intermetatarsal nerve. Research has shown that the space between the 3rd and 4th metatarsal heads is actually smaller than the space between the 1st and 2nd metatarsal heads and between the 4th and 5th metatarsal heads, which may help explain one of the reasons for the 3rd intermetatarsal space being a common site for neuromas (Levitsky KA et al: Digital nerves of the foot: anatomic variations and implications regarding the pathogenesis of

interdigital neuroma. Foot & Ankle.14(4):208-214, 1993).

When a Morton's neuroma is suspected due to a patient's clinical presentation and their physical examination, the podiatrist should spend time discussing their shoe choices since a change in shoes can often be the difference between treatment success and treatment failure. Since shoes which cause the digits to crowd together in an unnatural "pointed-toe" arrangement will increase the internal compression pressure on the intermetatarsal nerves, initial treatment should involve a recommendation to avoid all pointed-toe or too-short shoes and to avoid shoe heel heights exceeding one inch. In addition, daily plantar forefoot icing therapy, oral non-steroidal anti-inflammatory medicines and metatarsal pads placed proximal to the suspected neuroma in all shoes generally help reduce the discomfort from Morton's neuroma. Cortisone injection or alcohol sclerosing injections may also effectively treat Morton's neuroma. Of course, surgical treatment may involve excision of the neuroma and/or surgical transection of the deep intermetatarsal ligament.

Even though there are many conservative and invasive treatments for Morton's neuroma, my clinical experience over the years has consistently been that custom foot orthoses (CFOs) can be quite effective in relieving the pain and eliminating the disability that often accompanies this pathological condition of the forefoot. Initially, when a Morton's neuroma is suspected, in addition to switching the patient to wider toebox shoes, I will place a metatarsal pad inside their shoes or on their pre-made foot orthosis to see if the metatarsal pad helps relieve the discomfort from their neuroma. If some, but not all clinical improvement with this initial treatment is observed, CFOs are made for the patient to optimize the reduction in abnormal internal forces acting on the 3rd intermetatarsal nerve in an attempt to eliminate the patient's forefoot discomfort.

One of the leading causes of Morton's neuroma may be abnormal gait mechanics. Late midstance pronation, where the foot is abnormally pronating when it should be supinating, seems to be a common gait finding in patients with Morton's neuroma. Abnormal late midstance pronation causes the medial column of the foot (i.e., 1st, 2nd and 3rd rays) to dorsiflex excessively relative to the lateral column (i.e., 4th and 5th rays), which may cause "pinching" of the 3rd intermetatarsal nerve between the bones of the medial and lateral columns with each step (Fig. 1). CFOs which limit excessive subtalar joint pronation can be very effective at reducing late midstance pronation and will commonly help relieve the symptoms from Morton's neuroma.

CFO modifications which help treat Morton's neuroma include a congruent and sufficiently stiff medial longitudinal arch in the orthosis to resist excessive flattening of the medial arch of the foot during late midstance. In this way, when the ground reaction force (GRF) acting on the forefoot is at a maximum, the CFO will limit late midstance pronation. In addition, CFOs should be made with a firm rearfoot post and at least a 2 mm medial heel skive to reduce late midstance pronation during walking (Kirby KA: The medial heel skive technique: improving pronation control in foot orthoses. JAPMA, 82: 177-188, 1992).

A soft metatarsal pad is also commonly added to the CFO, placed between the orthosis plate and a topcover, in order to increase the GRF on the distal 3rd and 4th metatarsal shafts so that they are spread further apart, thereby lessening the side-to-side compression force on the neuroma. A soft metatarsal pad may be temporarily adhered to the anterior orthosis edge with tape and its place marked with a pen on the CFO to allow the patient to find, on their own, the most comfortable location for the metatarsal pad on their orthosis. In general, the metatarsal pad is positioned so that its leading edge is 15 mm anterior to the distal edge of the orthosis since this seems to be the most comfortable and effective metatarsal pad position for most patients.

In conclusion, effective conservative treatment of Morton's neuroma may include shoe gear changes, icing, metatarsal pads and custom foot orthoses. The podiatrist should offer their patients a wide range of treatment options in order to allow them to choose the treatment which best suits their work schedule and their active lifestyles. In this regard, CFOs modified specifically to relieve the internal stresses on a Morton's neuroma can be a very helpful conservative treatment option for patients with this painful forefoot condition.

Kevin

Kevin A. Kirby, D.P.M.
Biomechanics Director