Treating Metatarsalgia

By Séamus Kennedy, BEng (Mech), CPed

**Metatarsalgia is a global term to describe forefoot pain.** It covers pain occurring at the metatarsal heads, the metatarsophalangeal joints (MPJs), or in the soft tissue in that region and can lead to a variety of diagnoses. In the paper “Metatarsalgia: Diagnosis and Treatment,” Pierce E. Scranton Jr., MD, studied a group of 98 patients who had complaints of pain in the forefoot, and he isolated 23 separate diagnoses!

**Primary and Secondary**

Metatarsalgia can be classified as either primary or secondary. **Primary** metatarsalgia is considered structural in nature—an anatomical abnormality resulting in increased pressure under the metatarsal heads. Examples include hallux rigidus, long or short metatarsal bones, and possibly pes cavus. Treatment should be focused on the imbalance in weight distribution at the metatarsal heads and should mechanically direct force away from the point of pressure.

**Secondary** metatarsalgia is defined as pain that does not originate within the metatarsal area. Conditions such as rheumatoid arthritis, sesamoiditis, and equinus can all lead to localized pain at the ball of the foot. In the case of secondary metatarsalgia, the practitioner should address both the symptom and the cause. The origin of metatarsalgia can be multifactorial. Scranton's study found that 31 of the 98 patients had two or more mechanical etiologies for primary metatarsalgia, and that often primary and secondary metatarsalgia existed together. Effective treatment will address the area of pain, the function of the foot, and, if necessary, the systemic disease.

**Keratosis**

Hyperkeratosis is a thickening of the skin, and in the feet it is often noted under the metatarsals. This may be due to a plantarflexed metatarsal, a hypermobile first ray, or an abnormal foot position. The repetitive pressure created by these conditions can result in tissue build-up. hammertoes are frequently a contributing factor as they can significantly change the metatarsal angle, and they can lead to inadequate pressure transfer across the MPJ.

The resulting callus can be categorized by size. Large, diffuse plantar keratoses lack a discrete core and are typically 1–2cm in diameter. Discrete, intractable plantar keratoses are more localized, deep, and often very painful. They can occur under the larger lateral condyle of the second, third, and fourth metatarsal heads. Plantar keratoses respond well to debridement and orthotic therapy, both of which alleviate the focus of pressure.

**The Role of Biomechanics**

There are many biomechanical reasons why metatarsalgia may occur. Cylindrical excessive pressure can lead to keratoses, fat pad atrophy, inflammation, and associated pain. Patients exhibiting early heel lift are at risk for developing metatarsalgia because they are prematurely transferring body weight to the forefoot—loading it for a longer period of time. Early heel lift can occur when there is an equinus or a leg-length discrepancy (LLD). First ray function also plays an important role in gait. Hallux valgus, a short first metatarsal, or a hypermobile first ray can result in weight being transferred laterally, aggravating the lesser metatarsals. Conversely, conditions such as hallux rigidus cause too much weight to be borne by the first ray leading to pathology at the first metatarsal. Careful examination of the patient's gait and range of motion (ROM) will reveal the cause; from there an appropriate treatment protocol can be developed.

Other etiologies include trauma, post-surgical side effects, arthritis, and neuromuscular diseases causing muscle imbalance. Separately, a Morton's neuroma, due to an entrapped or damaged nerve, causes aching and burning of the forefoot.

**Metatarsal Pads**

The most common approach to treating metatarsalgia is to off-load the affected area. This can be achieved through adequate callus debridement and the application of an appropriate metatarsal pad.

Metatarsal pads are convex-shaped cushions made from a variety of materials, such as sponge rubber, orthopedic rubber, felt, and PPT®. They come in a wide range of sizes, shapes, durometers, and heights (Figure 1). The typical pad is designed to sit under the second to fourth metatarsals just proximal to the heads. In the case of first metatarsal pain, sesamoid, or “dancer’s” pads are shaped to provide a deep well or relief for the first metatarsal head. In all cases, the goal is to redistribute pressure away from the point of tenderness and shift it more proximally to the shaft of the metatarsal bone. Studies using in-shoe pressure-mapping technology show metatarsal pads are quite effective in reducing peak plantar pressures (Figure 2).

In a 2007 study, “The Influence of Metatarsal Support Height and Longitudinal Axis Position on Plantar Foot Loading,”...
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Thor-Henrik Brodtkorb, PhD, CPO, et al. studied the effect of using 5mm- and 10mm-high metatarsal domes to reduce mean plantar force under the second metatarsal head. As part of the study, they also moved the pads back (more proximally) from the second metatarsal head, in 5mm increments, to analyze the effect of proper placement.

The results, shown in Figure 3, shed light on the height of the metatarsal pad you should provide and where you should place the pad for the most effective treatment. The research demonstrates that the application of a metatarsal pad decreases the mean force significantly. The graph indicates that placing a metatarsal pad 5–10mm proximal to the metatarsal head provides maximum load reduction. Surprisingly, placing the pad even farther behind continues to provide almost the same level of relief, although it certainly may not be as comfortable for the wearer! The study also quantified the effect of using a thicker pad. A 10mm pad delivered almost twice the reduction in pressure as noted with a 5mm pad.

Placing metatarsal pads directly inside shoes provides a quick, inexpensive, and low-bulk solution. In well-worn shoes, the practitioner is able to observe the wear pattern on the insole and place the pad in the optimal location. However, fixed pads are not transferrable, so the patient may need pads in many pairs of shoes. Likewise, forefoot padding with discrete drops or depressions specific to the site of a prominent metatarsal also relieves pain.

Foot Orthoses

Custom foot orthotics offer several advantages. They are transferrable across shoes, so the wearer is not restricted to certain footwear. The metatarsal pad size and location are fully adjustable. The orthotic shell supports the medial arch and distributes weight across the entire plantar foot. Orthoses act to control the dynamic foot, limiting abnormal motion and preventing pathologies as the patient walks. Specific prescription requests, such as minimal plaster arch fill on the cast, a medial heel skive, or a rearfoot varus extrinsic post, will restrict pronation, potentially relieving symptoms in the forefoot.

Other accommodations can augment faulty biomechanics. For instance, with Morton’s syndrome (a longer second metatarsal), a flexible cork extension under the first metatarsal will transfer weight medially and help relieve repetitive stress under the second metatarsal. Note, however, that this technique only works if there is no restriction in the first MPJ motion during weight bearing. Conversely, cut-outs allow plantarflexed metatarsals to function normally without having to bear excessive weight. Cushion-top covers also absorb impact and smooth out pressure under the forefoot.

Pedorthics

Footwear can also be modified in many ways to lessen the pain of metatarsalgia. LLDs greater than a half inch (12mm) can be addressed by putting appropriate heel and platform lifts directly onto the midsole of the shoe. If the patient exhibits poor ROM or limited ankle dorsiflexion, a rocker sole can be very beneficial. Rocker bars can be added to the outsole to off-load all of the metatarsal heads. If the patient experiences discomfort as a result of flexion at the metatarsal heads, sole stiffeners (either steel shanks or thin carbon plates) can be used to prevent bending. In such cases, it is advisable to add a rocker sole to aid in smooth ambulation.

Metatarsalgia is one of the more common foot-pain complaints seen by podiatrists. The causes are diverse and the pain can be debilitating. Careful examination of the symptoms and the correct application of metatarsal pads, reliefs, orthoses, and shoe modifications can provide significant relief for the patient and allow him or her to return to an active and healthy lifestyle.

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References


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