

DIAGNOSIS, BIOMECHANICS, AND ORTHOSIS TREATMENT OF DORSAL MIDFOOT PAIN

Dorsal midfoot pain, with no history of direct trauma, is a relatively common complaint seen within podiatric practices. To my knowledge, the first individual to name the condition causing pain within the lateral aspect of the dorsal midfoot from non-traumatic origins was Steven Palladino, DPM. He named the condition, *Lateral Column Overuse Syndrome* (LCOS), in a lecture he gave on LCOS in November 1996.

I started seeing increasing numbers of patients complaining not only of dorsal-lateral midfoot pain but also complaining of dorsal-medial midfoot pain early within my private podiatric practice. In order to better describe these painful, non-traumatic conditions within either the medial and lateral midfoot, the condition of *Dorsal Midfoot Interosseous Compression Syndrome* (DMICS) was named and introduced into the podiatric medical literature in February 1997 (Kirby KA: *Foot and Lower Extremity Biomechanics: A Ten-Year Collection of Precision Intricast Newsletters*. Precision Intricast, Inc., Payson, Arizona, 1997, pp. 165-166).

DMICS is a non-traumatic, painful condition of the dorsal midfoot that seems to be caused by excessive and prolonged interosseous compression forces acting within the dorsal midfoot joints. Patients with DMICS will have some dorsal midfoot tenderness and complain of dorsal midfoot pain in early propulsion during walking gait. It is important to understand that, during weightbearing activities, the dorsal midfoot joints are all subjected to high magnitudes of interosseous compression forces which are due to the inherent longitudinal arch-flattening moments acting across the midfoot joints. These longitudinal arch-flattening moments are largely caused by the Achilles tendon plantarflexing the rearfoot and plantar forefoot ground reaction force (GRF) dorsiflexing the forefoot. As the Achilles tendon becomes tighter and the patient becomes heavier, there will naturally be increased longitudinal arch flattening moments which will also increase the magnitudes dorsal midfoot interosseous compression forces during gait. Even without trauma to the dorsal midfoot, too large a magnitude of these dorsal midfoot interosseous compression forces acting over too long of a period of time will increase the risk of the patient developing dorsal midfoot pain, or DMICS.

In order to better diagnose DMICS, there are a few clinical tests that can be quite useful. My favorite clinical test is the Forefoot Plantarflexion Test (FPT), which I developed in about 2005 to help diagnosis and following the progression of DMICS healing. The FPT is performed with the patient resting in the examination

chair with the foot resting off of the chair (Fig 1). The examiner then stabilizes the posterior calcaneus with one hand while the opposite hand of the examiner grasps the forefoot and plantarflexes the forefoot on the rearfoot. The test will be painful (i.e., positive test) when plantarflexing the medial forefoot if the patient has medial DMICS, and the FPT will be positive when the lateral forefoot is plantarflexed in lateral DMICS. The Piano Key Test, which was first described by Keiserman and colleagues in 2003, is a similar clinical test which can also be used to help diagnose and follow the clinical progress of midfoot pathology (Keiserman LS et al. The piano key test: a clinical sign for the identification of subtle tarsometatarsal pathology. *Foot Ankle Intl*, 24(5):437-438, 2003).

The Midfoot Compression Test (MCT) is another test I developed a number

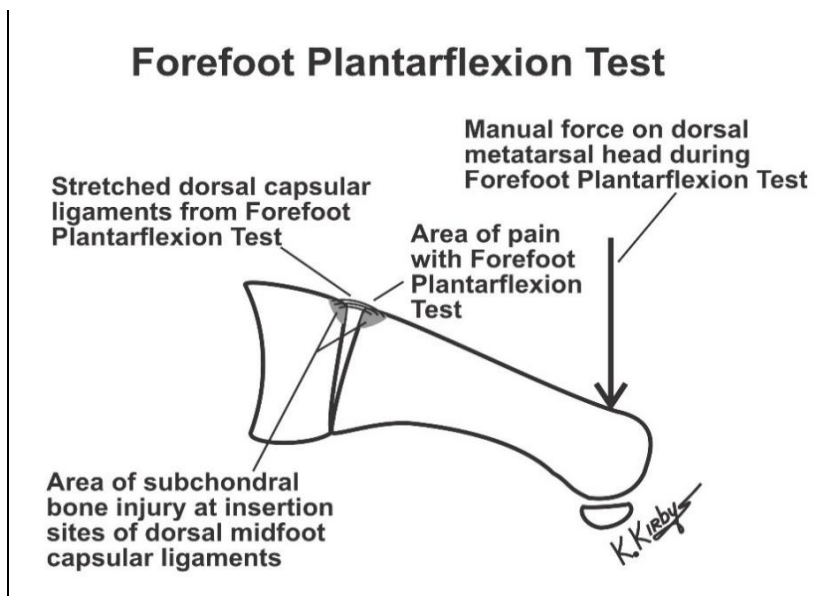


Figure 1. When performing the Forefoot Plantarflexion Test (FPT), the examiner plantarflexes the forefoot on the rearfoot in order to see if dorsal midfoot pain results. The likely cause of a positive FPT is the stretching of dorsal midfoot joint ligaments directly attached to areas of subchondral bone injury at the dorsal midfoot joint margins.

of years ago for diagnosing DMICS. To perform the MCT, the examiner grasps the medial and lateral aspects of the midfoot at the level of the tarso-metatarsal joints with one hand then firmly compresses the midfoot from side to side. When the MCT is positive, the patient will complain of midfoot pain. In general, in more severe cases of DMICS, both the FPT and MCT will be positive, but in milder cases of DMICS, only the FPT will be positive.

The most likely biomechanical explanation for the pain seen in a positive FPT or MCT is that the dorsal surfaces of the midfoot joints have developed “bone bruises” or bone marrow lesions (BMLs) as a result of the prolonged and excessive magnitudes of dorsal midfoot interosseous compression forces (Fig. 1). Since the dorsal articular surfaces of the midfoot joints also serve as the points of attachment for the dorsal midfoot joint ligaments, then any subchondral bone damage within these dorsal midfoot joint surfaces will result in pain when the dorsal midfoot ligaments, which are attached to these damaged joint surfaces, are stretched during performance of the FPT or MCT, or stretched during the propulsive phase of gait.

In support of this idea that damage to the dorsal osseous surfaces of the midfoot joints is the cause of DMICS, Halstead and coworkers published a study using foot orthoses and sham insoles in 42 patients with mechanical midfoot pain. Magnetic resonance imaging (MRI) was used to diagnose a total of 108 BMLs in the patients’ feet, most of which were located within the midfoot. The foot orthosis group showed a greater reduction in pain than the sham insole group after 6-12 weeks of treatment. After 3 months of treatment with foot orthoses and sham insoles, the volume of BMLs in the patients’ feet showed a 26% reduction with foot orthosis and only a reduction of 4% with sham insoles (Halstead J et al: An exploration into the effect of foot orthoses on bone marrow lesions associated with mechanical foot pain. J Foot Ankle Res, 7(2): A1, 2014).

To best treat DMICS, the podiatrist needs to understand the biomechanical cause of the patient’s dorsal midfoot pain. During my initial visit in DMICS patients, my standard treatment includes: 1) 3-times/day gastrocnemius and soleus stretching exercises to reduce the tension forces from the Achilles tendon, 2) icing therapy on the dorsal midfoot 20 minutes twice daily to reduce inflammation to the dorsal midfoot joints, 3) oral and/or topical non-steroidal anti-inflammatory medication to reduce the dorsal joint inflammation, 4) shoe relacing to create a space within the shoe lacing so that the symptomatic dorsal joints are not being compressed by the lacing of the shoe, and 5) adding 1/4” (i.e., 6 mm) heel lifts to their shoes to reduce Achilles tendon tension forces. In more severe cases of DMICS, initial treatment may require dispensing and 3-6 weeks of boot-brace walker (i.e., cam-walker boot) use in order to allow the patient to heal more rapidly.

On subsequent visits, if initial conservative care measures do not resolve at least 75% of the patient’s DMICS symptoms, I highly recommend custom foot orthoses in order to increase the arch-raising moments coming from the custom foot orthoses and to decrease the arch-flattening moments causing the DMICS. In medial DMICS, a 4 mm polypropylene orthosis is ordered along with a 2-4 mm *medial heel skive*, a 16-18mm heel cup, a 2-3⁰ inverted balancing position, and a 2-3 mm heel contact point (i.e., slight heel lift). However, in DMICS in the lateral midfoot (i.e., lateral DMICS) the custom foot orthosis is designed to pronate the foot away from the lateral column which may include a 2-4 mm *lateral heel skive*, a 16 mm heel cup, a flat rearfoot post, a vertical balancing position, a korex valgus forefoot extension and also a plantar arch fill of korex placed underneath the lateral midfoot of the orthosis shell (i.e., Denton modification) in order to help support the lateral longitudinal arch, help prevent over-supination of the foot and to help prevent excessive dorsiflexion forces from acting on the joints of the lateral midfoot.

With the ability to diagnose DMICS using clinical tests such as the FPT and MCT, along with the biomechanical knowledge of its etiology, the podiatrist should be able to easily treat the common problem of DMICS with the above therapeutic measures. In most cases of DMICS, custom foot orthoses, when properly prescribed, are a key element in allowing healing from this painful, and sometimes disabling condition.



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