PROLAB ORTHOTICS
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TROUBLESHOOTING PLANTAR FASCIAL IRRITATION IN FOOT ORTHOSES

One of the most common complaints with custom foot orthosis from patients that I have seen over my four decades of private practice is irritation to the plantar aspect of the medial longitudinal arch of the foot. In 90% of those cases, the actual anatomic structure which is being irritated by the custom orthosis is the medial band of the plantar fascia. It will be helpful to review the biomechanical cause of plantar fascial irritation and a few easy fixes that the skilled podiatrist can make in their office to relieve a patient's complaint of medial arch pain from their custom foot orthoses in the area of the medial band of the plantar fascia.

The medial band of the plantar fascia, otherwise known as the medial slip of the central component of the plantar aponeurosis, is the part of the plantar fascia which originates from the medial calcaneal tubercle and inserts into the medial and lateral sesamoids at the plantar aspect of the first metatarsophalangeal joint. The plantar fascia has multiple functions during weightbearing activities including, but not limited to, helping to prevent flattening of the medial longitudinal arch, helping to resupinate the foot during propulsion, assisting the plantar intrinsic muscles and deep posterior compartment muscles in maintaining the medial arch height, allowing the windlass mechanism to help supinate the foot during propulsion and helping to provide elastic strain energy to the foot during running and jumping activities (Kirby KA: Understanding ten key biomechanical functions of the plantar fascia. Podiatry Today, 29(7):62-71, 2016).

Since the medial band of the plantar fascia is a passive structure, the central nervous system has no direct effect on the plantar fascial tension force. In that regard, the tension force within the medial band of the plantar fascia will only increase when the medial forefoot is dorsiflexed relative to the rearfoot during activities. For example, when the foot is non-weightbearing while the individual is sitting or lying down, the medial band of the plantar fascia will have minimal tension force within it. However, as soon as the forefoot becomes a weightbearing structure and the plantar forefoot bears body weight, the resultant dorsiflexion of the forefoot on the rearfoot will cause increased tension force within the medial band of the plantar fascia.

The tension force within the medial band of the plantar fascia will also increase as the ground reaction force (GRF) acting on the forefoot increases. Increased GRF on the plantar forefoot will dorsiflex the forefoot further on the rearfoot, stretching and increasing the plantar fascial tension force.

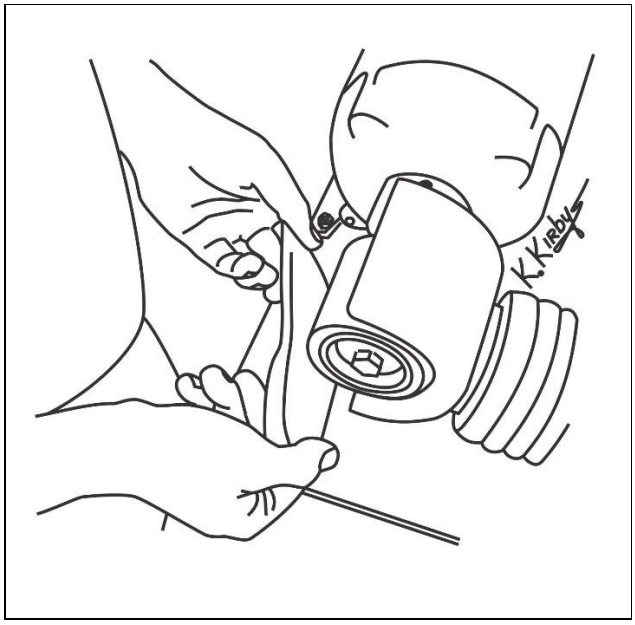

Figure 1. One option for relieving irritation to the medial band of the plantar fascia is to grind a "plantar fascial accommodation" into the dorsal aspect of the orthosis medial arch. The best location for the plantar fascial accommodation is along a line from the medial calcaneal tubercle to the 1st intermetatarsal space.

During walking, scientific research has also shown that the tension force within the plantar fascia and Achilles tendon are proportional to each other. Therefore, during gait, as the foot begins to bear more weight on the forefoot, there will be not only an increase in Achilles tendon tension but also an increase in plantar fascial tension. A study by Erdemir et al. using a dynamic gait simulator on fresh frozen cadaver specimens directly measured the tension force within the plantar fascia and found that the plantar fascia tension and Achilles tendon tension forces were directly related with the tension force within the plantar fascia peaking at 0.96-times body weight (Erdemir A, Hamel AJ, Fauth AR, Piazza SJ, Sharkey NA: Dynamic loading of the plantar aponeurosis in walking. JBJS, 86A:546-552, 2004).

Therefore, the plantar fascia is subjected to very large tension forces during walking and other weightbearing activities. These large tension forces, probably close to being equal to the body weight of the individual during late midstance and early propulsion will,

in turn, make the plantar fascia forcefully "bowstring" plantarly away from the foot during late midstance and early propulsion. These large tension forces within the plantar fascia will also make the plantar fascia become a relatively stiff and unmovable structure in late midstance and early propulsion. This increased plantar fascial tension and stiffness will make it more likely to become irritated by the dorsal surface of a custom foot orthosis, especially if the orthosis is relatively stiff and congruent to the medial arch of the foot.

Another one of the likely reasons why irritation to the medial band of the plantar fascia is so common with custom foot orthoses is that, during casting or scanning of the plantar foot for custom foot orthoses, the medial longitudinal arch is typically non-weightbearing or has very little plantar loading forces acting on it. By making a plaster impression or scan of the foot with the medial longitudinal arch of the foot not being plantarly loaded, the medial longitudinal arch of the resultant cast or scan will be higher and shorter than when the medial forefoot is loaded by GRF during weightbearing activities. Thus, the direct result of our custom as podiatrists to cast or scan a foot with the medial longitudinal arch being unloaded and, therefore, higher in arch shape than when weightbearing, is that the resultant foot orthosis made from this higher arched cast or scan may be much higher in medial longitudinal arch shape than is present in the weightbearing foot.

Patients with irritation to the medial band of the plantar fascia may have only a slight amount of irritation, or "annoying" discomfort, in the fascia, or the irritation can be so bad that the patient simply doesn't want to wear the orthoses at all. As soon as the patient complains of plantar medial arch irritation in the office, I have the patient wear the orthosis for a few steps in the office and then have them sit down, and point out to me with their fingers on their plantar foot where the irritation is occurring. Invariably, the patient will point to their plantar medial arch somewhere along a line from their medial calcaneal tubercle to their sesamoids, indicating irritation occurring within the medial band of the plantar fascia.

To clinically identify if the medial band of the plantar fascia is, indeed, the structure causing the medial arch irritation for the patient, the patient is asked to sit on the examining chair or table with their knee extended. Then, with the examiner's hand loading the plantar medial forefoot and plantar hallux to place the plantar fascia under tension, the examiner uses the thumb of their other hand to palpate along the full length of the medial band of the plantar fascia to find out where the irritation is occurring within the length of the plantar fascia (i.e., proximal section, middle section and/or distal section of the medial band of plantar fascia).

Once the podiatrist has determined that the medial band of the plantar fascia is the irritated structure and where in the fascia the irritation is occurring, the orthosis will need to be modified to create a shallow "groove" or "furrow" along the dorsal aspect of the medial arch of the orthosis to create a "plantar fascial accommodation". The creation of a plantar fascial accommodation in the dorsal orthosis plate will reduce the compression force between the dorsal aspect of the orthosis and the plantar aspect of the medial band of the plantar fascia. Invariably, this relatively simple modification will completely eliminate the irritation to the plantar fascia so that the patient will typically feel significant relief of irritation and plantar arch discomfort when they first walk on the modified orthosis in the office.

My preferred method for adding in a plantar fascial modification into a foot orthosis is to use a drum grinder (e.g., SaniGrinder) to grind a shallow groove into the dorsal medial arch of the orthosis along a line from the medial calcaneal tubercle to the first intermetatarsal space (Fig. 1). A properly-made plantar fascial accommodation should relieve the compression force from the orthosis on the medial band of the plantar fascia, and make the orthosis immediately more comfortable for the patient. If grinding a plantar fascial accommodation is not an option then an additional layer of topcover material with a "plantar fascial channel" cut into it may be added either underneath, or on top of the original custom orthosis topcover. Learning to add a plantar fascial accommodation into custom foot orthoses is probably one of the most valuable foot orthosis modification skills that a podiatric biomechanics specialist can learn during their years of practice.

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