PROLAB ORTHOTICS
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FOOT ORTHOSIS PEARLS: EFFECTIVE USE OF FOREFOOT EXTENSIONS

In last month's ProLab newsletter, the reverse Morton's extension was discussed as one of the most commonly-used forefoot extension modifications in custom foot orthoses. In this newsletter, the other common forefoot extension modifications that are routinely used to optimize the therapeutic value of custom foot orthoses and to improve the biomechanical function of the foot and lower extremity will be discussed.

Forefoot extensions in custom foot orthoses generally consist of a piece of flexible but relatively non-compressible material of variable thickness extending from the distal edge of the orthosis to either the digital sulcus or to the end of the toes, and is attached to the orthosis with a topcover. The most common materials used in forefoot extensions are either korex or ethylene vinyl acetate (EVA). By using a flexible material, each metatarsophalangeal joint (MPJ) is allowed to freely dorsiflex during propulsion. By using a relatively non-compressible korex or EVA of variable thickness, the ground reaction force (GRF) under each metatarsal head may be specifically modified to relieve pain and improve function of the foot and lower extremity.

As mentioned in last month's newsletter, a forefoot extension that is placed only under the 1st MPJ is known as a Morton's extension, named after Dudley Joy Morton who first described this forefoot extension 90 years ago in 1935. In my practice, Morton's extensions are used for patients that have a congenital or acquired metatarsus primus elevates deformity and also for patients with more advanced hallux rigidus, where the goal of the Morton's extension is to limit painful 1st MPJ dorsiflexion during gait. However, one must be careful to not routinely prescribe Morton's extensions by themselves since they may limit 1st MPJ dorsiflexion during gait and may even over-supinate a more normal foot that does not have an elevated first ray.

Morton's extensions may also be combined with other forefoot extensions that are located plantar to the 3rd, 4th and/or the 5th metatarsal heads in order decrease GRF acting on painful metatarsal heads during gait. This type of forefoot extension, where the forefoot extension is placed under not only the 1st MPJ but also under other lesser MPJs is very commonly used to reduce the GRF acting plantar to painful central metatarsal heads (Fig. 1). A common example of this type of "accommodative" forefoot extension is to place korex or EVA from the distal orthosis plate to the sulcus under only the 1st, 3rd, 4th and 5th metatarsal heads. This type of commonly-used forefoot extension accommodates the 2nd metatarsal head in cases of 2nd MPJ capsulitis and/or plantar plate tears and helps to decrease the GRF under the 2nd MPJ which will, over time, help reduce pain, improve function and speed healing from these very common injuries to the forefoot.

Another common forefoot extension accommodates the 2nd and 3rd metatarsal heads with a layer of 1/8" (i.e., 3 mm) korex or EVA in patients where both the 2nd and 3rd MPJs are tender and painful. As with other cases where forefoot extensions are used, the thickness of the forefoot extension may also be increased under the metatarsal heads that were not accommodated in order to further decrease the GRF plantar to the affected metatarsal heads.

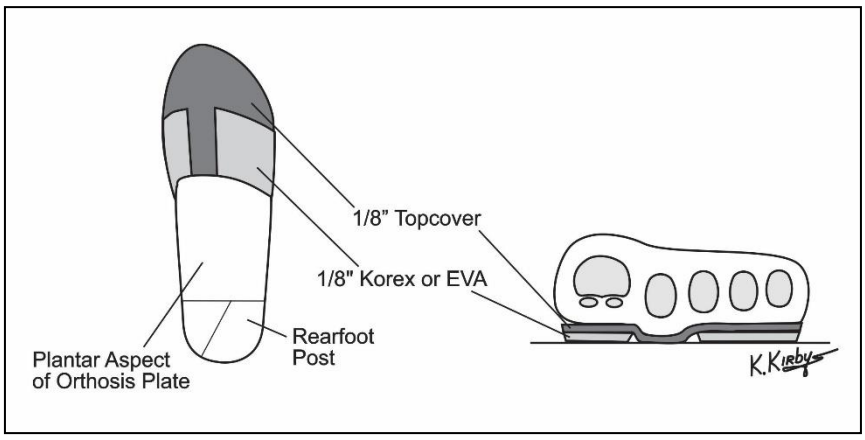

Figure 1. In a custom foot orthosis made with a forefoot extension for patients with 2nd metatarsophalangeal joint capsulitis or plantar plate injury, the Morton's extension is combined with a forefoot extension plantar to the 3rd, 4th and 5th metatarsal heads to help offload the symptomatic 2nd metatarsal head. This forefoot extension will reduce the ground reaction force acting plantar to the 2nd metatarsal head in order to help speed healing in this common injury of the forefoot.

However, there may be cases where, on follow-up visits of patients with orthoses made with these thicker forefoot extensions, the patient starts to complain of pain at one of the metatarsal heads that has had too thick of a forefoot extension material underneath it. In cases such as this, a grinder can be used to slightly decrease the thickness of the

portion of the forefoot extension under the symptomatic metatarsal head.

When using these "accommodative" forefoot extensions to reduce GRF at a specific metatarsal head, another clinical pearl is to extend the forefoot extension material proximally so that the anterior edge of the orthosis plate is, effectively, also made thicker to cause an "internal metatarsal bar" effect. In other words, instead of the forefoot extension material starting at the distal edge of the orthosis and extending distally to the sulcus, the forefoot extension material starts about 2-inches (i.e., 5 cm) proximal to the distal orthosis edge. In this fashion, not only is the whole anterior edge of the orthosis made thicker to decrease the GRF at all the plantar metatarsal heads, but also the affected metatarsal heads that are accommodated by the forefoot extension have a greater chance of becoming less painful over time.

One of the more common forefoot extensions used in my athletic patients who participate in running sports is the varus forefoot extension. The varus forefoot extension is basically a forefoot extension extending from the 1st MPJ to the 4th MPJ, and not plantar to the 5th MPJ. The thickest part of the varus forefoot extension is medial and thinnest part is lateral, where it becomes paper-thin at the 4th MPJ. I will rarely use varus forefoot extensions on patients who are just walking for exercise due to concern for creating lateral subtalar joint (STJ) instability and possibly hallux limitus from occurring. However, in the runner-patient with pronation-related symptoms, orthoses made with a varus forefoot extension can mean the difference between treatment-success and treatment-failure.

The common running-related injuries of medial tibial stress syndrome (MTSS) and patellofemoral syndrome (PFS) are the good examples of injuries where the varus forefoot extension can be very useful. In running, any varus alignment of the forefoot at footstrike will greatly increase STJ pronation during the early support phase after forefoot contact with the ground. By using an anti-pronation foot orthosis with a well-formed medial arch, varus forefoot extension and a medial heel skive (Kirby KA: The medial heel skive technique: improving pronation control in foot orthoses. JAPMA, 82: 177-188, 1992), the initial STJ pronation seen just after running footstrike will be greatly reduced, which invariably will help reduce the symptoms seen in cases of MTSS and PFS. In other words, by "bringing the ground up to the medial forefoot" with the use of a varus forefoot extension on a custom foot orthosis, the success rate of treating the common running injuries of MTSS and PFS, in my clinical experience, increases dramatically.

The valgus forefoot extension is another forefoot extension which I commonly use in my practice, but unlike the varus forefoot extension, the valgus forefoot extension, like a reverse Morton's extension, has no forefoot extension material plantar to the 1st metatarsal head. Different from a reverse Morton's extension which has a constant forefoot extension thickness from medial to lateral, the valgus forefoot extension has increased thickness laterally and decreased thickness medially. The valgus forefoot wedge creates additional STJ pronation moment and can even transmit additional valgus moments to the knee during weightbearing activities. For example, a forefoot valgus extension of up to 5° may be helpful in cases of peroneal tendinopathy, lateral-dorsal midfoot pain and/or in chronic lateral instability due to the extra STJ pronation moments it can provide. In addition, patients with medial knee osteoarthritis will also commonly benefit from valgus forefoot extensions due to the valgus moment generated at the knee from the valgus-wedging which will help unload the medial knee compartment and may help reduce pain in the knee with activities.

The podiatrist who is comfortable with the many forms of forefoot extensions available will have improved orthosis outcomes with their patients who need more specialized orthosis modifications to render them less symptomatic. To simply prescribe a ¾-length orthotic to all patients without considering these clinically valuable custom foot orthoses modifications extending past the distal orthosis shell will significantly restrict the ability of the podiatrist to fully heal their patients with custom foot orthoses.

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