PROLAB ORTHOTICS
Evidence-Based Medicine

Biomechanics & Orthotic Therapy Newsletter
October 2023

SHANK DEPENDENT AND SHANK INDEPENDENT CUSTOM FOOT ORTHOSES

In the late 1980s, a few years after completing my Biomechanics Fellowship at the California College of Podiatric Medicine (CCPM), I attended a seminar where Dr. Michael Burns, former Chairman of the Department of Orthopedics at the Pennsylvania College of Podiatric Medicine, was lecturing. During his lecture, Dr. Burns discussed the concept of *shank dependent* and *shank independent foot orthoses.* This was a new concept for me since the idea of shank dependent and shank independent orthoses had never been discussed while I was a student at CCPM or while in my fellowship at CCPM. This important idea, introduced to me by Dr. Burns early on in my podiatric practice career, made a huge impact in my understanding of how orthoses work and how orthoses can be adjusted to better accomplish the therapeutic goals of custom foot orthosis therapy.

The terms "shank dependent" and "shank independent" used to describe foot orthoses separate foot orthoses into two basic types. Shank dependent orthoses are those foot orthoses made from materials such as Plastazote or ethylene vinyl acetate (EVA), which are relatively flexible and easily bend out of the shoe, but are not readily compressible under the same loads inside a shoe. As a result of these material characteristics of shank dependent orthoses, the plantar aspect of these orthoses must contact the shank of the shoe in order to resist deformation under weightbearing loads (Fig. 1). If, however, the orthosis material is relatively rigid, such as polypropylene or graphite laminates, they can still resist deformation under weightbearing loads without the plantar aspect of the longitudinal arch of the orthosis contacting the shank of the shoe. Therefore, foot orthoses made from these relative stiff materials that are good at resisting bending loads are named "shank independent orthoses".

There are advantages and disadvantages to both shank dependent and shank independent orthoses. Shank dependent orthoses, such as the firm Plastazote Functional offered by ProLab, are relatively flexible materials when they are out of the shoe and manually being flexed by the podiatrist. However, when these orthoses are placed inside the shoe and the plantar aspect of their longitudinal arches are firmly contacting the shank of the shoe, these seemingly flexible Plastazote custom foot orthoses can be just as rigid and resist deformation just as well as a more rigid shank independent polypropylene foot orthosis.

One of the disadvantages of shank dependent orthosis is that they do not so readily transfer between shoes with different shank shapes as do shank independent orthoses which are able to literally bridge the shank of many shoes. However, because of their materials they are constructed from, one of the advantages of shank dependent orthoses is that they are relatively easy to adjust with an office grinder to add orthosis modifications such as plantar fascial or painful plantar prominence accommodations. In addition, the plantar arch of shank dependent orthoses can be ground relatively easily to allow the shank dependent orthosis to become "less shank dependent" and "more shank

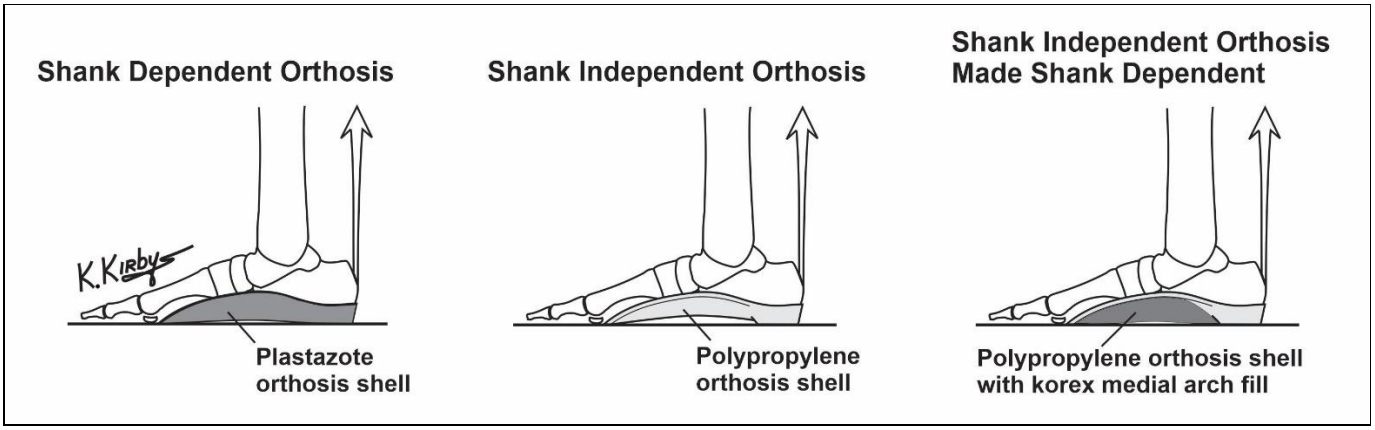


Figure 1. In a shank dependent orthosis, such as that made with a Plastazote shell (left), the orthosis relies on the contacting the shank of the shoe to maintain its shape and to resist deformation. In a shank independent orthosis, such as that made with a polypropylene shell (middle), the orthosis has enough inherent stiffness to maintain its shape and doesn't need the orthosis plantar arch to contact the shank of the shoe to resist deformation. Also, in some cases, a shank independent orthosis may need extra arch rigidity. In this case, the treating podiatrist can add korex (right) or EVA to the arch of the shank independent orthosis, making that orthosis, now, shank dependent.

independent" which, in effect, will make the orthosis more flexible and less prominent in the plantar arch of the patient's foot during their weightbearing activities.

As noted in my previous ProLab newsletters from April and May 2023, foot orthoses exert their kinematic (i.e., motion) effects and kinetic (i.e., forces and moments) effects on the foot and lower extremity by both a *direct mechanical effect* and a *neuromotor effect.* The way foot orthoses exert these effects on the feet and lower extremities of our patients is by altering the magnitudes, specific locations and temporal patterns of reaction forces acting on the plantar foot during weightbearing activities. By being shaped exactly to the contours of the plantar foot, and by resisting deformation under the weightbearing loads exerted by the foot on the orthosis, foot orthoses can modify plantar foot reaction forces in such a fashion to accomplish the therapeutic goals of the custom foot orthoses.

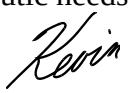
The realization that foot orthoses work by altering plantar reaction forces on the foot becomes very important when considering the concepts of shank dependent and shank independent designs of foot orthoses. Why are these concepts so important for the podiatrist making custom foot orthoses for patients? Because the mechanical interaction of the orthosis shell material with the shoe will help determine not only the magnitudes, but also the temporal patterns and locations of reaction forces acting on the patient's plantar foot.

For example, if a shank independent orthosis material such as polypropylene is used to construct custom foot orthoses for a patient, then these orthoses will be expected to deform very little inside the shoe. During non-weightbearing custom foot orthosis fitting of the patient, when the podiatrist compares the three-dimensional contours of the custom foot orthosis to the plantar arch of the patient's foot, the shank independent orthosis may appear to be a perfect fit to the patient's foot when the orthosis has no load upon it. However, if the patient has a medial and/or lateral longitudinal arch which flattens significantly during weightbearing loads, that polypropylene shell may deform much more in the longitudinal arch than what the podiatrist expected. This is one of the reasons that the prescribing podiatrist must pay special attention to orthosis plate thickness in their shank independent orthoses, such as polypropylene, since without the longitudinal arch of the orthosis being supported by the shank of the shoe, there is really no way of knowing how much the foot orthosis is deforming when inside the shoe of the patient.

With these concepts in mind, one of the most common modifications used in my practice when shank independent polypropylene orthoses do not seem to be supporting the medial and/or lateral longitudinal arch of the patient sufficiently is to simply convert the shank independent orthosis into a shank dependent orthosis. When extra medial arch support is needed from the orthosis in order to better relieve symptoms or improve gait function, 1/8" (3 mm) thick or 1/4" (6 mm) korex or EVA is added to the plantar medial arch of the orthoses to help the orthosis better resist medial arch flattening (Fig. 1). This, for example, may be done in patients with posterior tibial tendon dysfunction or plantar medial arch symptoms to increase medial longitudinal arch support from the orthosis to improve the patient's symptoms or gait function.

Alternatively, when extra lateral arch support is needed from the orthosis, adding 1/8" thick or 1/4" korex or EVA to the plantar lateral arch of the orthoses will help the orthosis better resist lateral arch flattening under weightbearing conditions. This is yet another example of converting a shank independent orthosis to a shank dependent orthosis and is commonly used in my practice for patients with peroneal tendinopathy, lateral column overload syndrome or an excessively supinated foot.

In conclusion, the concept of shank dependent and shank independent custom foot orthosis design is very important when selecting the best orthosis shell material for a patient and also when considering how that custom foot orthosis may be modified to better accomplish the therapeutic goals of foot orthosis therapy. Using these concepts will allow the treating podiatrist to better develop into an expert at designing and modifying custom foot orthoses for the specific biomechanical and therapeutic needs of their patients.



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