PROLAB ORTHOTICS
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TROUBLESHOOTING SHOE HEEL SLIPPAGE WITH FOOT ORTHOSES

Heel slippage is a common complaint with foot orthoses for the simple reason that orthoses always take up extra room inside the patient's shoes. As a result of the extra bulk of an orthosis inside the shoe, the calcaneus is often lifted upwards and/or positioned anteriorly inside the shoe, so that the heel counter of the shoe no longer fits snugly against the patient's heel, causing heel slippage during the propulsive phase of gait. In order to better understand why heel slippage occurs with foot orthoses and better appreciate how to reduce or eliminate heel slippage in the clinical setting, it will be helpful to review the biomechanics of gait and the how specific shoe construction characteristics can influence the possibility of heel slippage with foot orthoses.

During walking and running, rapid ankle plantarflexion occurs at the beginning of propulsion. This rapid ankle joint plantarflexion at the beginning of propulsion causes the calcaneus to lift rapidly from the ground and, normally, also causes the heel of the shoe to lift rapidly from the ground along with the calcaneus. If, however, the rearfoot portion of the shoe resists moving away from the ground at the same speed as does the calcaneus during propulsion, the risk for significant heel slippage will increase.

The internal structure of the heel counter of most shoes is designed with a concavity which is made to be congruous to, and fit snugly against, the posterior calcaneus during gait (Fig. 1). In this fashion, when propulsion begins and the calcaneus starts to lift rapidly away from the ground, the superior "lip" of the posterior heel counter of the shoe will "grab" the calcaneus and will ride upwards with the calcaneus during propulsion, preventing heel slippage. However, in order for the heel counter of the shoe to be able to "grab" the calcaneus and move upwards with the calcaneus during propulsion, the internal contour of the shoe heel counter must fit firmly and congruently against the posterior calcaneus. Unfortunately, the extra bulk of foot orthoses often interferes with the ability of the shoe heel counter to fit snugly and congruently against the posterior calcaneus, leading to an increased tendency for heel slippage to occur during the propulsive phase of gait.

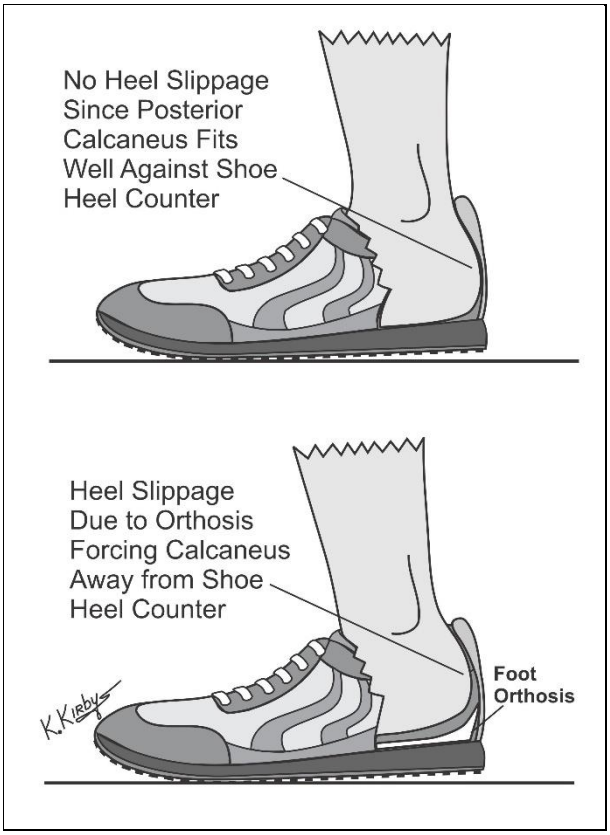

Figure 1. Without the added bulk of a foot orthosis inside the shoe, there is less likely to be heel slippage during propulsion (top). With the orthosis inside the shoe, the increased thickness and heel cup depth of the orthosis may push the calcaneus upwards and forwards away from the heel counter increasing the risk of heel slippage (bottom).

The two most common reasons why foot orthoses cause a loss of congruity and firm contact between the posterior heel counter of the shoe and the posterior aspect of the calcaneus, is that the orthosis is excessively lifting the calcaneus up out of the shoe and/or the orthosis is pushing the calcaneus too far anteriorly inside the shoe. Specific orthosis design parameters which can lead to a greater chance of heel slippage due to the calcaneus being lifted too high inside the shoe are added heel lifts, thicker rearfoot posts and/or thicker topcovers.

In addition, orthoses made with heel cups over 16 mm will tend to push the calcaneus, and rest of the foot, anteriorly inside the shoe due to the orthosis heel cup not fitting as tightly against the posterior shoe heel counter. If the calcaneus is pushed only 2-3 mm forward inside the shoe due to the orthosis heel cup not fitting snugly against the posterior heel counter of the shoe, heel slippage is more likely to occur. In these instances, simply grinding the plantar rearfoot post thinner and/or grinding the orthosis heel cup narrower is often all that is needed to reduce the patient complaining of heel slippage inside the shoe.

Since many custom foot orthoses are designed with a heel cup, rearfoot post and/or a thick topcover, the podiatrist must

carefully question the patient about what types of shoes they will be wearing their orthoses in. If the shoe being worn is a lace-up athletic/walking/running shoe with a removable sockliner (i.e. insole), then by simply removing the sockliner and making a standard full-length custom orthosis without an extra heel lift, deep heel cup and/or thick topcover will virtually eliminate the risk of heel slippage since removing the insole/sockliner allows for more room inside the shoe for the orthosis to fit properly. However, if the shoe does not have a removable insole, the podiatrist should appreciate that any added thickness of orthosis material plantar to the patient's calcaneus will increase the risk of heel slippage inside the shoe.

As mentioned previously, heel slippage occurs when the posterior aspect of the shoe does not move upwards with the calcaneus during propulsion. Not only does the posterior heel counter of the shoe need to fit snugly and congruently against the posterior calcaneus, but also the shoe closure system (e.g., shoe laces, dorsal straps) need to be positioned as far posterior toward the ankle as possible in order to allow the shoe to securely move upwards with the calcaneus during propulsion. For this reason, lace-up shoes that have laces extending towards the ankle, or shoes with a dorsal strap over the proximal midfoot (i.e., Mary Jane style shoes), are much less likely to cause heel slippage when foot orthoses are added to the shoe. Shoes that are designed to be "slip-on", such a pumps in women's shoes or loafers in men's shoes, all will tend to increase the risk of heel slippage when the extra bulk of custom foot orthoses are added to the shoe. Since pumps and loafers both have a lower-cut dorsal upper (i.e., vamp), these shoes simply do not have enough contact area on the more proximal area of the dorsal midfoot to allow the shoe to move properly upwards with the calcaneus during propulsion when most types of custom foot orthoses are added into the patient's shoe.

If the foot orthosis must be made with a deeper heel cup and/or a thicker rearfoot post for the patient, and the patient is already wearing a lace-up shoe and experiencing heel slippage when walking or running, there are few simple shoe "remedies" that can be used to solve the annoying heel slippage problem. One of the most reliable methods of reducing heel slippage in lace-up shoes is to add a 1/8" felt *tongue pad* to the underside of the tongue of the shoe. The tongue pad should be adhered to the undersurface of the proximal tongue of the shoe so that its proximal edge is just underneath the most proximal lace in the shoe upper. The tongue pad effectively increases the contact force between the proximal tongue of the shoe and the proximal aspect of the dorsal foot, allowing the shoe to better move upwards with the calcaneus during propulsion.

Another strategy for reducing heel slippage in newer shoes with a relatively stiff sole is to increase the flexibility of the shoe in the region of the metatarsophalangeal joints (MPJs) by manually flexing the shoe sole repeatedly to increase the flexibility of the forefoot sole. Flexing each shoe about 50-100 times at the MPJs will generally be sufficient to increase shoe sole flexibility. As a result of this increased shoe sole flexibility, the ability of the shoe sole to bend more easily during propulsion will allow the posterior portion of the shoe to more easily rise upwards with the calcaneus, thus lessening the likelihood of heel slippage. However, it must be realized that with the more recent and popular rocker-sole "maximalist" athletic shoe designs, their rocker soles will tend to decrease the risk of heel slippage since the rearfoot portion of the shoe is able to more easily rock upwards with the calcaneus without any bending of the shoe sole.

Another method, of course, by which to reduce heel slippage with custom foot orthoses is to reduce the bulk of the orthosis so that the orthosis does not significantly lift the calcaneus inside the shoe. The cobra-style dress orthosis, where the central-heel and lateral-midfoot portions of the orthosis plate are removed will virtually eliminate heel slippage in most shoes. In addition, making the orthosis with a lower heel cup height, no topcovers, and also ground to minimal thickness in the plantar heel will reduce heel slippage in most shoes. Since heel slippage can frequently occur with foot orthoses, the podiatrist must take into account not only the design of the orthosis but also the design of the shoe being worn in order to reduce the risk of heel slippage.

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