# How to Approach Orthotic Modifications

*Customizing these devices improves their performance.*

By Jay D. Segel, DPM

Have you ever noticed that most people in nursing homes have foot problems? It's not something in the water, on the admission orders, or that happens when you reach a certain chronological age. It is often the end result of microtraumatic or macrotraumatic events. For example, let's say that a patient worked on feet with unequal limb-lengths. The mal-alignment results in joint and muscle imbalances and, in turn, trauma that happens during motion.

Now let's go back in time and put that same person in an appropriate orthotic. A child is less likely to have the same microtrauma that leads to joint wear, weakened bones and eventually pain, falls, and joint replacements. Thus if one provides the child's foot with an amended surface before the foot is fully formed, that child would have a less harsh interaction with his two-dimensional walking surface: that is, an orthosis with a deepened heel cup for increased rear foot control and better proprioceptive cueing.

People the world over understand the concept of adapters. They know that an American cell phone wall charger cannot be plugged into a rural French electrical outlet because of its shape. An orthotic is really just an adapter from a three-dimensional foot to function on a two-dimensional flooring surface. But let's also consider that just as there are many other countries with differing electrical configurations, there are different foot types, ages and medical situations to consider before settling on a particular orthotic prescription.

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Just as children's orthotics require adaptive consideration, the same is true for diabetics, runners, in-toers, golfers, tennis players, chefs, people who are carrying extra weight, and mid-stance sportsmen who ski and skate. Each has specific biomechanical challenges that benefit from additions and/or modifications beyond those seen in what I call boilerplate orthotics. There are many ways to improve and further customize orthotics just as chefs use spices and sauces to improve a culinary experience.

Often during the course of patient care the topic of orthotic therapy comes up. The approach to this discussion varies based on a person's exposure to the concept of custom prescription inserts. First, try to discern whether this is a new thought for the patient, the result of previous orthotics experience, or perhaps the patient may have seen devices on some TV advertisment.

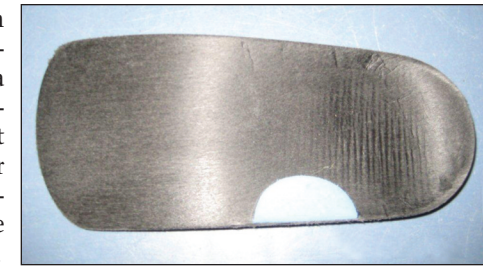

**Figure 1: Cuboid Raise**

Regarding the latter, I say that any monkey can make an orthotic, but to have them truly effective, there are three important considerations:

- the method used to obtain and communicate foot structure
- the materials used
- the modifications applied to the orthotic

For educational purposes and to create realistic expectations, you should invariably steer the conversation around to just two central points: the issues of accommodation versus correction, and the concept of making an adaptor to manage the effects of a three-dimensional foot interacting with a two-dimensional unyielding floor, and the orthotics process itself. But how much thought do we give to materials and modifications?

**Some Pearls**

1) ***The cuboid raise*** (Figure 1) is a very stabilizing and under-used orthotic modification for high-arch foot types and for lateral ankle sprainers. We often concentrate on the medial longitudinal arch, forgetting that there are three plantar arches on the foot to consider. The

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lateral longitudinal arch is formed proximally by the calcaneus, distally by the base of the fifth metatarsal and superiorly or dorsally by the cuboid. Given that the cuboid has no purchase on the ground, it frequently subluxes and causes an antalgic gait. In the old days, to guard against these lateral column issues, we would accentuate the lateral arch by sanding a positive mold more aggressively, but today, most orthotic labs can add this accommodation with a mere request.

Figure 2: UCBL

2) ***The deep-seated heel cup*** is an orthotic shell modification that extends the superior proximal rim from a normal 8-10mm to 14-17 mm in depth. The advantages of this modification are increased motion control, enhanced proprioception, and somewhat better plantar cushion secondary to limitation of fat pad displacement. Deepening the heel cup of a semi-rigid orthotic shell can also decrease plate flexibility for individuals having long feet or carrying excess weight. In addition, this is useful for kids and patients with mild to moderate unsteady gait patterns or peripheral neuropathy.

3) Perhaps the most under-utilized orthotic is the ***UCBL*** (Figure 2). Its roughly 20 mm deep heel cup and tall flanges give maximum control and proprioceptive cueing, constantly reminding the brain and body of the foot's drift from neutral position. This may be an alternative to the more bulky ankle-foot orthosis (AFO) used in patients with mild to moderate multiple sclerosis, neuropathy, Parkinson's disease, and the like. The low profile version of the UCBL is useful for kids needing strong correction, and for adults with limited posterior tibial dysfunction. Ask for a soft medial flange to manage the excess pronation.


Figure 3: Heel Lift

4) Perhaps the most over-used orthotic modification is the ***heel lift*** (Figure 3). Whereas it may be beneficial to raise the heel in situations that include equinus, knee pain, or inadequate ankle dorsiflexion, and those times when you want a bit more arch without actually sending the orthotic back to the lab, remember that you are now placing more burden on the forefoot. So, in patients who present with forefoot issues, including ingrown nails, and for those who have adequate ankle range of motion, you might omit the lift.

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Additionally, when you make a choice to use a lift to correct a limb-length differential, ask yourself if you are trying to raise the heel or the whole limb. Consider a graded sole lift starting at half the measured amount and see how the body adjusts over a four-week period before altering the column.

5) ***Dynamic posting*** is a fairly new concept based around managing motion, rather than arresting motion. It works in a spring-like fashion, much like with a semi-rigid orthotic shell. Modifications like the "DynaFlange™" rear foot post (Figure 4) have the ability to absorb shock, direct the foot towards subtalar joint neutral, and provide energy return. They have the additional benefit of active foot management for those chefs, clerks, cashiers, and others whose jobs keep them in mid-stance for long periods of time.


Figure 4: Dynaflange™

6) Benefits of using a full-length ***padded top cover*** include a reduction in orthotic shift in footwear, adding cushion, and preventing that feeling in the forefoot of "falling off the end of the world." The practical use is that it has an integrated plantar platform for forefoot modifications like Morton's extensions, metatarsal pads, and neuroma bars that you may wish to add in-office. Using a light-colored, smooth leather top cover will also provide the most useful data that you can get because the top cover stains with wear. You can use this objective data to off-load or otherwise judge and modify orthoses.

7) ***Metatarsal pads*** (Figure 5) have been used historically for neuroma patients and also for correcting the transverse arch, aiding in forefoot mechanics. This modification is meant to be a semi-hard

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sphere of sorts, applied proximal to the pan met head parabola, plantar-central. This is a useful modification to help rebalance the relationship between the digital flexors and extensors in patients with high-arch foot types and contracted digits.

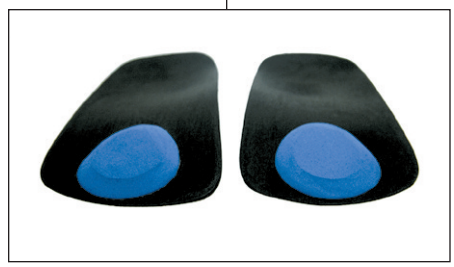

Figure 5: Metatarsal Pads

When prescribing new orthotics for a patient who wears inserts with met pads, the patient may feel like something is missing. In these cases, try using a low-profile metatarsal pad.

*Perhaps the most over-used orthotic modification is the heel lift.*

8) ***Morton's extensions*** (Figure 6) are used to bring the ground up to a 1st metatarsal that is not bearing its share of the forefoot load. In a patient who presents with a hypermobile 1st ray, adding this padding to the medial plantar surface can aid in weight redistribution and a more fluid gait pattern.

9) ***Reverse Morton's extensions*** (Figure 7) are particularly useful in rigid cavus feet that present with callus accumulation. Raising the ground up to the lesser metatarsal heads relieves pressure from the 1st met head and the sesamoid apparatus. This is a good accommodation for patients with hallux elevatus, as the dorsally displaced hallux often enhances the plantar grade declination angle of the 1st metatarsal bone.

10) Neuroma bars (Figure 8) are indeed tricky, as the goal is to spread the involved metatarsal heads during the propulsive phase of gait. Though orthotic labs offer this as an add-on, you can build these bars in the office. Order a semi-rigid orthotic with a full-length, light-colored, smooth leather top cover and wait a few weeks for a staining pattern. With use, the metatarsal heads leave a discernible set of marks. Take a 2 mm sliver of Poron that is 4 mm's deep and place it between the third and forth metatarsals (or second and third, as the case may be) and cover the strip with a large kidney-shaped piece of moleskin.

Figure 6: Morton's Extensions

Figure 7: Reverse Morton's Extension

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The patient with the neuroma should be able to verify the position or guide you to perfect the placement. This same technique can be used to create a built-in toe crest by locating the appropriate IPJ on the underside of the top cover and orienting the Poron longitudinally in an arc shape.

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11) ***"Software Upgrade"***—Change covers, padding, and posts. Given that these additions and modifications are made of materials known to deform and wear out over time, they should be checked and replaced when necessary. Tell patients that they should expect to refurbish the orthotic software every year, or more often with heavy use.

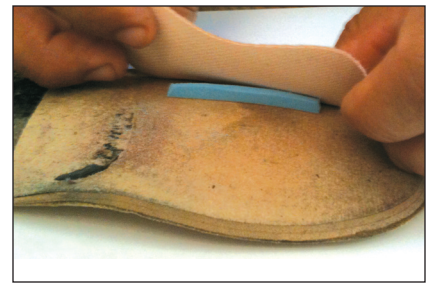

**Figure 8: Neuroma Bar**

12) Morton's and reverse Morton's extensions are specific examples of commonly used off-load and balance padding; however, there are many other practical applications for these techniques. Do the initial padding with felt strips and then, after patient corroboration, send the altered insole back to the lab for permanent inclusion in the prescription. Though lesions can be identified in molds, the 3-D scanning devices and pressure pads are a great help in pin-pointing areas of concern and facilitating communication and proper placement. Staining the top cover trick is also useful in situations where you expect to be adding these types of orthotic modifications.

Although footwear in general is not part of an orthotic, it is a necessary partner. The best and most biomechanically-engineered orthotic cannot function properly in a poorly designed, spent, or ill-fitting shoe. Take time to educate your patient on the importance of length, width, and shoe depth, as well as counter construction, shank style and mid-sole integrity.

Remind patients that a snug fit might feel secure, but it doesn't allow for proper mechanics or necessary foot expansion during gait cycle. An expanded foot means more area on the ground, and thus more stability. At the end of the day, when we suggest a treatment protocol that includes shoes and a patient-specific orthotic, remember that the best way to customize is to accessorize. ■

**Dr. Jay Segel graduated from the Ohio College of Podiatric Medicine in 1979. He completed his surgical residency at Cambridge City Hospital, a Harvard Teaching Affiliate. After residency, he moved to Martha's Vineyard, where he still practices. He is a member of the American Academy of Sports Medicine, has been an advisor to shoe companies and holds several utilities patents on footwear.**