Pearls for the Orthotic Management of Athletes

These device modifications can improve patient outcomes.

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The Merriam-Webster Dictionary defines an orthotic as a device [such as a brace or splint] for supporting, immobilizing, or treating muscles, joints, or skeletal parts which are weak, ineffective, deformed or injured. While we in podiatry think of an orthotic in the context of our profession, we know that orthotics in general are used for a multiplicity of body parts including: shoulder, elbow, wrist and hand, back and hip, knee, and of course ankle and foot. Many of the devices that we utilize, including braces, gauntlets, immobilizers, insoles, and our custom foot orthoses, all fall into this category. We will focus here on custom foot orthoses—specifically, functional orthoses.

Influencing Foot Function

A functional foot orthosis is theoretically designed to influence the function of the foot. There is great debate as to exactly how an orthotic is capable of doing this. This differs from an accommodative orthotic, which would be used to accommodate rather than change the quality of specific foot anatomy and alignment.

Orthotics can be made direct-milled, vacuumed-formed, or now 3D-printed. Directed milled orthoses have the advantage of being a one-piece solid unit, with a posting and a shell, and are comprised of one cut of material. Because this is a quicker and easier manufacturing process, this can be a more cost-effective option. Direct milled orthotics tend to be more rigid than a vacuum-formed device. Vacuum-formed devices require more hands-on from the technicians. Orthoses that are 3D-printed are beginning to become more present in the orthotic market. The main restriction to these devices becoming more pervasive has been the cost of 3D printers; however, as these costs come down, we can anticipate seeing more and more 3D printed devices available on the market.

While orthotics can be used in our practices for all age ranges of individuals, we will focus on their use for athletes. Oftentimes, an athlete will present to us in pain, or an athlete may present to us looking to address aspects of their function in order to prevent injury. We can also use orthoses for athletes to treat injury or become incorporated as a part of a treatment plan. If an orthotic can increase the efficiency of the athlete and conserve his/her energy, this can also be an advantage in performance. A major goal in treating athletes is to optimize function and to have the athlete's body moving as effortlessly as possible, utilizing the least amount of energy required for their performance.

Not every athlete requires the use of a custom foot orthosis, but if an athlete's lower extremity function can be improved with the use of such a device, then it can be part of an overall treatment plan. The conditions that we address with custom foot orthoses in an athlete are identical to those that we see in our non-athletic patients, such as: Achilles tendonitis, plantar fasciitis, after Achilles tendon ruptures, posterior tibial dysfunction and tendonitis, knee pain, iliotibial band syndrome; to address hallux valgus, early stages of hallux rigidus, neuromas, after stress fractures, sesamoid pathology, peroneal tendon issues, osteoarthritis, limb length discrepancy, status post-calcaneal fractures, chronic ankle sprains, s/p Lis Franc injuries, s/p sub tailor joint surgery, and many other uses. Any time that there is a strong index of suspicion that mechanics are the cause or are contributory to what the patient is experiencing, a custom foot orthosis can be an asset in treatment.

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Human movement is as unique to the individual as a fingerprint is. Therefore, one must thoroughly examine the athlete in both off-weight-bearing and on-weight-bearing, in walking, and in their athletic activity, in order to truly assess how they are functioning and what can possibly be done to help them. In terms of specific orthotic modifications you can create to address plantar fasciitis or Achilles tendonitis, look to assess their flexibility, their strength and their envelope of function. Having looked in all these areas, you can then evaluate where function may be suboptimal and look

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to address your use both of orthotics and other aspects of the treatment plan to focus on those areas where function is suboptimal.

After completing a thorough examination, look at the actual diagnosis and determine if the information noted in your examination would lead you to see the pathway to the problem that the patient is experiencing. It is important to keep in mind that an injury may appear in one area, while the dysfunction lies in a different area. It is important to keep in mind the big picture and to examine the athlete from head to toe. It is all about the process of evaluating the athlete and then seeing if that brings you to a conclusion consistent with the problem that the athlete is experiencing. It comes down to the mechanics, the anatomy, and the function of that particular athlete. This will dictate your treatment plan, and what you utilize in your orthotic to address that.

Examination and Treatment

A work-up of the athlete involves an off-weight-bearing biomechanical examination, a weight-bearing biomechanical examination looking at the relationship of the anatomical parts from the toes to the head, stressing this athlete in movement, having the patient walk, then lastly having the patient engage in their particular sport. Evaluate the patient in the frontal view, side view, and posterior view in all these activities to try to obtain as complete as possible a picture as to their function.

One of the main goals, always, is to try to achieve symmetry of limb movement for the patient. If you can get the left and right limbs functioning in a relatively similar movement pattern and alignment throughout the gait cycle, you can feel reasonably assured that their problems will be helped. We must always be looking up the kinetic chain in our patients. Our examination should not stop at the ankle or the knee, but must continue up through the hips, the lower back, shoulder and head position—again, in order to truly be able to help the patient. With the use of smart phones, it is very easy to film your patient and then look at the film in slow motion and analyze their functions. The goal is always to get the first metatarsal head purchasing the ground at the proper point in the gait cycle, with a stable position of the foot in good alignment, and therefore the ability to move the body forward.

The most important part then in the orthotic prescription writing process is the impression of the foot that is taken. Without a good impression, it is impossible to get effective custom foot orthoses. The lab will only be able to work with what they are sent,

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and if there is a less than optimal impression, this will result in a less than optimal device and a poor outcome for the patient. Cast off-weight-bearing in the prone position, as this optimizes the ability to capture the foot in its best possible alignment and its best possible relationship to the entire lower extremity. Cast in-weight-bearing if you are dealing with a severely anatomically deformed foot, where you are looking to make a more accommodating device.

There are many methods available to us for capturing a good image of the foot, starting with off-weight-bearing plaster images, progressing to flatbed scanners, and of course newer iPad scanners, as well as slipper socks. If you do not like the impression that you have, take another one. This is a much easier process than attempting post-dispensing to modify a device. Additionally, when a device is dispensed if it does not look as though it is correct and the contour is not what you wish it to be, do not dispense, and start over at that point.

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Posting and Fill

Custom foot orthoses consist of a shell to which multiple components are added. We add posting both in the rearfoot and forefoot if we wish, as well as top and bottom covers. This constitutes a fairly basic device; we can then choose the amount of arch fill. Use minimal arch fill in all of your devices, as this creates the tightest contact of the orthotic device against the foot. In this way, the orthotic can have the greatest influence on foot function. The fill comes in minimum, standard, and maximum.

The amount of fill dictates if the device contours exactly to the image you have sent or if the arch height is decreased from that image. In a very rigid cavus foot, I sometimes use a standard fill, where the arch contour of the device is lower than what appears in the images we've sent to the lab, and then will add a scaphoid pad to fill in the differential. In some very rigid, cavus foot types with limited ankle dorsiflexion, minimum fill will cause the patient's mid-foot to impact too harshly onto the device and will cause the patient discomfort.

Choosing the Shell Thickness and Material

Shell thickness and material choice reflect the amount of control we wish the device to have on foot function. It also is a function of the patient's weight, as the heavier the patient, the greater their ability to deform the shell underneath them. Heavier patients require thicker shells in order to influence foot function. Your choice of shell material should be influenced by how rigid or flexible you wish the device to be—the amount of flexibility in the device reflects what you are seeing in the patient. In a more hypermobile foot, we may want more control and therefore

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wish a device to be semi-rigid for that particular patient. In a more rigid-type foot, with limited ankle dorsiflexion, we might want a more flexible device and therefore will choose something lighter and thinner. Some labs now will allow you to specify whether you want a flexible, semi-flexible, semirigid, or rigid device for the patient, and they will make the material choice for you. While this can be very helpful, it is always a good idea for the podiatrist to understand and be knowledgeable in shell material types and shell thickness for the individual patient's needs. For the athlete who may be requiring a higher level of function, it is important that the doctor make the choice of the material.

As good as our labs are, they do not have the patient in front of them. We have them in our hands and are able to truly understand their biomechanical function to the greatest degree. Our foams and leathers constitute our more flexible devices, followed by our polyethylenes and our polypropylenes, then moving into our carbon graphite fibers as we move up the rigidity scale. The newly engineered nylon blends tend to be very comfortable for the patient, and they conform very well to the anatomy of the foot due to their pliability and flexibility, while at the same time offering the ability to influence the foot function. Again, the material choice is primarily based on the degree of influence we wish to achieve on the function of the athlete's foot.

After choosing the plate, the next item that we would look at is the depth of the heel cup. Again, heel cup depth is related to foot type and how much influence we wish the device to have on the patient's foot. It is also to a lesser extent related to footgear. The deeper the heel cup, the greater is the ability of the device to influence the rearfoot and to hold it in a better alignment. A shallow heel cup is a choice usually reserved only for a device that will fit into a dress shoe.

The next item we get to choose is the width of the device. Again, this directly reflects how much influence we wish the orthotic to have upon the foot. A full-width device is made as wide as the foot, yet patients will often find that they cannot fit a full-width device inside their shoes—simply because their shoes are too narrow. A full-width device provides maximum contact from medial to lateral, and therefore is best able to influence the foot function. As the device narrows in its width, its ability to influence the foot diminishes as well. A narrow device is generally reserved for a dress shoe. While optimizing foot function is best achieved by full correction within a device, if a device is used in all situations, this also is a good scenario and therefore you can make dress devices for your patients.

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Flanges

Next, we will talk about flanges, which can be either medial or lateral. The flange exists to (again) provide additional control for the patient. In utilizing a flange in your prescription, it can often be an asset to outline any prominent anatomy, such as the navicular, on the impression of the foot. This will allow the lab to take that anatomy into greater consideration when fabricating the flanges, so that the flange does not push into the foot or irritate it. Oftentimes, a padding or accommodation can be made on any prominent anatomical area in order to prevent irritation. Another option that is less able to influence and hold the foot but is oftentimes more tolerated by a patient is a mini-arch platform. In a mini-arch platform, the medial aspect of the device is extended even more medially to provide additional influence against the foot. Medial and lateral clips can also be used to provide additional support to either the medial or lateral aspect of the foot.

Metatarsal Cut-outs

To completely address function of the first metatarsal phalangeal joint and the medial column, several different adjustments can be made to a device. One choice is a first metatarsal head cut-out. This will allow the first metatarsal head to purchase the ground more completely and can be an asset in optimizing first MPJ function. Another option is the kinetic wedge, or first ray cut-out, where a deeper cut-out of the shell is made, allowing the first ray to more easily purchase the ground.

Another accommodation that can be used to influence first MTPJ function is the reverse Morton's extension. In this case, an extension is added from the shell to the sulcus of the lesser metatarsal heads. This allows a relative plantar flexion of the first metatarsal head against the ground, also providing greater influence on first MTPJ function. A reverse Morton's is also helpful to address chronic ankle sprainers, as it will influence the late resupination phase of gait. Its polar opposite is the Morton's extension, where a similar extension sits under the first MTPJ to limit function in this area. The choice is dependent upon which you are looking to provide for your patient, either more motion at the joint or the elimination of motion at the joint. Morton's extensions are also often used to treat turf toe injuries. Another addition that can be chosen to influence first MTPJ function is the use of a cluffy wedge. This wedge, which sits under the hallux, was designed to create a retrograde plantar flexion of the first metatarsal phalangeal joint.

Posting is the amount of degrees that the device is ground or angled to influence the degrees of motion within the foot. The amount of posting that you order is based upon your goals for treatment. Rearfoot posting is available with specifics of 0/0, 4/4, depending on the amount of influence you wish the device to have against foot function. Posting in the rearfoot can be extrinsic or intrinsic.

Posting in the forefoot can also be extrinsic or intrinsic. You may prefer an intrinsic post as it guides the foot to the ground in its totality versus an extrinsic forefoot post, which

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exerts a late gait cycle influence against the foot. Tip posts and runners wedges can also be added to provide a greater forefoot influence to the orthotic.

Returning to the heel area, an additional element to further influence the foot is the use of skive in the heel area. Skive can be achieved either built into the shell, as in a Kirby Skive, or extrinsic through the use of a separate material, such as a medial or lateral heel skive. This type of addition serves to add an increased medial or lateral "push" to the calcaneus in order to better influence its movement in one direction.

Pads, Cushions, Heel Lifts, Metatarsal Bars, and Arch Reinforcement

We also can utilize heel lifts when necessary. Heel lifts can be used to address limb-length discrepancy and can also be used to address limited ankle dorsiflexion, or to address both on the same device. The lack of heel lift on a device is one of the most common issues when a patient presents to the office with a bag filled with failed orthoses. When using heel lifts, keep in mind that if the discrepancy that you are looking to address is significant, the lift may need to extend beyond the heel. Some patients, even those requiring a smaller lift, will also feel better when the lift extends beyond the heel area.

When you treat a cyclist, be aware that the cyclist is clipped into pedals at the forefoot and therefore any limb-length discrepancy you are looking to address must extend into that area in order for the lift to work. It also is possible to have your lab add heel lifts to dress devices, which contain intrinsic rearfoot posting. Oftentimes, a lab will add a rearfoot post to a dress device and then add a heel lift on top of this, making the device impossible to fit in shoes. Utilizing a heel lift that cups the intrinsic heel post will be tolerable in a patient's shoe.

Heel cushions and heel spur pads are also elements that can be added into the heel area of a device to provide for greater patient comfort. Heel cushions and heel spur pads require a deeper heel seat.

Metatarsal pads and interspace pads can also be used to address neuromas. Metatarsal bars can also be a helpful addition to forefoot pain of any type.

Scaphoid pads can be useful in providing increased arch height to a device, while also providing a softer shell for the patient to land against. This is helpful in a patient with limited ankle dorsiflexion, and with some rigid cavus foot types.

Arch reinforcement can be used to add to the firmness of a device and also to provide a padding to the device. The use of arch reinforcement as an additional element of foot influence often allows you to use a more flexible shell for a patient. Arch reinforcement can also be very helpful for patients in jumping sports, as it will provide a greater buffer when they land. Keep in mind that adding arch reinforcement, even in a soft material such as a poron, will increase the amount of control that the device exerts to the athlete.

A cuboid pad is designed to fit in the cuboid groove, therefore exerting an influence on the peroneus longus and allowing a more stable and earlier purchase of the first metatarsal head against the ground.

Lateral Wedges and Shell Modifications

Other modifications that can be added to orthotic devices are a lateral wedge, which will help move the foot more medially in a patient who is very supinated.

Shell modifications can be made for a variety of reasons. A shell can be depressed to offload a prominent anatomical area, it can be depressed and padding added in the depression, or the shell can be cut out entirely in a particular area. This can work for prominent anatomical areas, or to offload any other areas of concern.

A plantar fascial groove can also be used to allow accommodation for a prominent plantar fascia.

Other Padding

Padding can be very helpful to an athlete to provide a softer landing in their sports and to buffer the stress and strains that they experience. Padding comes in a variety of materials and can be added in a variety of lengths to a device. Keep in mind the patient's sport when you are choosing the type and length of the padding. Also remember that thick padding will lessen the ability of the device to influence the foot.

If one has made multiple modifications to a device, it is a good idea to leave the top cover unglued in the forefoot.

Cut-outs can also be made in the padding to off-load any particular areas of concern.

A balance pad is a pad added to disperse pressure around any one particular area. A dancer's pad is a reverse Morton's in a soft material.

Top Cover and Shoe Concerns

If one has made multiple modifications to a device, it is a good idea to leave the top cover unglued in the forefoot. The lab will glue the top cover in the rearfoot, but not beyond. This allows the podiatrist to make modifications more easily to the device in the office.

The athlete's sport and shoe should also be analyzed when you write a prescription for custom foot orthoses. It is preferential to optimize the device and have the athlete change shoes than to alter a device for a shoe. Always have a discussion with your athlete patient about your shoe concerns. **PM**

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