

Writing Orthotic Prescriptions—The Basics

Writing orthotic prescriptions is more science than art. It requires that you understand the “Why” behind the “What” when writing and modifying options. This article will discuss the “Why” and “What” for the key parameters in orthotic prescription writing.

Orthotic Materials

All orthotics are made from combinations of composites, plastics, foams, vinyls, and leather. Some materials are used to make the orthotic shell only. Some are used for top covers, extrinsic posts, and other accommodations. Some are used for both.

Orthotic Materials—Composites

Composites are composed of either graphite or fiberglass and are used to make the orthotic shell. Composites get their properties from the strands of graphite or fiberglass that are layered in the materials. Unlike other materials, composites come in a standard thickness. Graphite composites usually are 1 to 2 millimeters (mm) in thickness. Fiberglass composites are typically 2 to 3 mm thick.

The stiffness of a composite is determined by both the weave pattern and the size of the graphite or fiberglass strands. Composites have the thinnest profile of all the materials, allowing for better shoe fit and also for more options on the orthoses.



They also are lightest in weight and offer the longest lifespan before losing their ability to rebound to their original corrected shape. The down side is composites are the most expensive of all the materials used to make orthotics.

Orthotic Materials—Plastics

The most widely used materials for the orthotic shell are plastics called Polypropylene, Subortholene, and Polyethylene. Plastics materials come in sheets of different thicknesses and colors. The thickness of the material determines the stiffness or rigidity of the orthotic shell. A 3 mm thick Polypropylene orthotic is more flexible (less rigid) than a 5 mm thick Polypropylene orthotic.



Thickness also affects how long the shell can flex and rebound to its original shape. A 3 mm thick polypropylene orthotic will lose its ability to rebound to its original corrected shape faster than a 4 mm or 5 mm thick polypropylene orthotic on the same patient.

Polypropylene, subortholene, and polyethylene offer a medium lifespan before losing their ability to rebound to the original corrected shape, with polypropylene lasting longer than subortholene, which lasts longer than polyethylene. Polypropylene, subortholene, and polyethylene also represent the least expensive material for making orthotics and represent the middle, or median, as far as orthotic weight. They make heavier orthotics than composites and lighter orthotics than the materials described next.

Orthotic Materials—EVA Foams, Plastizote, and Leather Materials

When patients cannot tolerate plastics or composites for the orthotic shell, the best options are ethyl vinyl acetate (EVA) foams, plastizote, or leather.

EVA foams, like plastics, come in many colors and styles. Plastizotes come in three basic colors, pink, white, and black. Leather also comes in many colors and styles. EVA foams, plastizotes, and leather are often used to make the orthotic shell in diabetic and/or geriatric patients who need a softer, more forgiving orthotic shell.



EVA foams, plastizote, and leather materials typically are requested for the orthotic shell when making accommodative orthoses. They almost always require shoes with removable insoles or extra depth shoes, and represent the heaviest and bulkiest materials for making orthotics.

The stiffness is determined by both the thickness and durometer or density of the materials. The thinner the EVA foam or leather shell and the lower the durometer of the shell, the softer and more flexible the device will be. Most diabetic orthotics are made from a 45 durometer EVA foam and are soft and flexible. Likewise, 75 durometer materials are quite hard and stiff.

Plastizotes come in three stiffnesses that are related to color: pink is softest, white is the median, and black is very stiff and hard.

Orthotic Materials—Vinyls, Foams, Plastizote, and Leather Materials

Vinyls, foams, plastizotes, and leather are also used in various combinations to add padding, shock absorption, support, and to enhance product appearance.

Vinyls are the most popular material used for the interface against the skin—the final top layer of the orthotic. They are least expensive, can be printed on, and come in many colors and styles. Vinyls, however, have no wicking properties: they do not absorb water.

Foams are often added to provide additional padding on the top surface of the orthotic or to add padding under the ball of the foot to the sulcus or the end of the toes. Foams also are used for heel pads, metatarsal pads, and forefoot accommodations. Foams are made of EVA, Poron, or Neoprene.

EVA foams come in many colors and thicknesses. Thin 15 to 35 durometer EVA foams are excellent materials for extra padding and shock absorption, or as the final top layer for interfacing the skin. EVA foams do not absorb water and represent least expense materials for extra padding. EVAs also wear faster and bottom out quicker than the other soft materials.

Poron foams come in many different colors and thicknesses but only one standard durometer. Poron foams are soft and are typically used to provide extra padding and shock absorption. Poron foams also do not absorb water and require a top cover as they are not a good interface with the skin. Poron represents the most expensive of the shock absorbing materials and has the longest life span before bottoming out.

Neoprenes are closed cell foams that have a cloth or lycra top cover. Neoprene foam comes in black but the top covers come in many different colors. Neoprenes do not absorb water and offer the median in regards to cost as well as life span. They also are insulators and can cause feet to sweat.

Plastizote is another closed cell foam that is excellent for diabetics. Pink plastizote is used for the final top layer for interfacing with the skin. Pink plastizote is usually a required top cover for diabetic orthotics that are reimbursable under medicare guidelines, whether custom or preformed.

Leather is the best top cover material for the interface with the skin with non diabetic patients. It comes in many colors and patterns and has the best appearance and longevity of all the top cover materials. Leather also absorbs water and provides excellent wicking capabilities. It is also the most expensive of the top cover materials.

Orthotic Materials—How to Order

The key to ordering materials is to match cost, stiffness, and durability with the patient's shoes, specific application, and special requirements. For example, graphite composites are excellent for men's and women's fashion shoes—or hard-to-fit shoes that do not have removable insoles. Polypropylene is excellent for sport applications where you want low cost and require flexibility in the shell. EVA foams, plastizote, and leather provide comfortable support for diabetics and geriatric patients.

First, consider the patient's age, sex, weight, physical condition, and biomechanical requirements to determine how much control the patient can tolerate. Then look at the patient's shoe requirements and application to determine the shell material and stiffness.

Prescribing the Orthotic

The most complicated part of prescription writing is understanding the patient's biomechanical requirements and applying that knowledge to:

The Heel Area

The Medial Arch

The Lateral Arch

The Transverse Arch

The Forefoot Area.

The Heel Area—Heel Cup

The vast majority of variables are in the heel area. It is best to begin with the Heel Cup height.

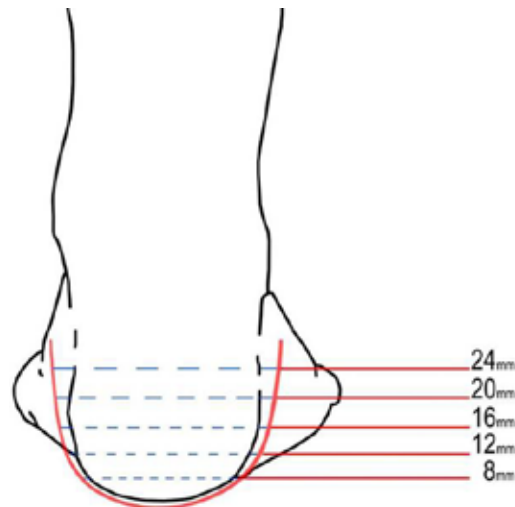
Most labs choose their standard heel cup height based on gender and shoe type. Typically, men's orthotics have a 12 mm heel cup and women's have a 10 mm heel cup. This is because women's shoes are usually less accommodating for orthotics. The higher heel cup has a tendency to lift the heel higher in the shoe and also makes the orthotic wider, making it difficult to fit comfortably in fashion or tight fitting shoes.

Most sport related orthotics have a 14 mm heel cup. Luckily, most sport and work shoes now have removable insoles, which provides more options that will increase control and not create shoe fit problems.



It is very important to understand how your lab measures their heel cup heights. Some labs use the outside measurement of the orthotic shell. Some use the inside. The inside heel cup and the outside are usually different and depend on the thickness of the orthotic material, as this can matter in tight fitting shoes. Too much thickness can lift the heel out of the shoe.

To counter this, you can ask the lab to lower the heel cup or to plantar grind the heel to 1 mm thick at the heel contact point. Some materials, like graphite or fiberglass, cannot be thinned plantarly without damaging the inherent structure of the material—i.e. you cannot order a plantar grind on a composite device to plantar thin the heel.



The basic rule is this: The higher the heel cup, the more the orthotic will contour the heel, and the more control you will have on the foot. A higher heel cup increases the stiffness of the orthotic due to the increased amount of curvature where the heel transitions into the medial and lateral arch. A higher heel cup also widens the device in the heel area.

You can also order different heel cup heights for the medial and lateral sides. Certain conditions call for deeper heel cups on one side only. For example, an increased medial heel cup height will better control early midstance pronation. Or, an increased lateral heel cup height will improve control of heel inversion in cavus feet or patients who have a tendency for lateral ankle sprains.

The Heel Area—Rearfoot Posts

Rearfoot posts are usually added to resist and control heel contact pronation from heel contact through the early stance phase of gait. Posts are usually made from hard rubber or EVA foams. Many standard orthotics designs come with rearfoot posts, such as most sports orthotics. Rearfoot posts are also an excellent option for patients with a low subtalar joint axis, or whenever there is significant subtalar joint motion in the frontal plane.



Typically rearfoot posts are ground flat with a slight inflare to a certain degree of inversion—the standard is 4 degrees. But you can order more or less. For example, you may want to order 6 degrees if the patient has a high calcaneal inclination angle. Or, zero degrees if you want to prevent heel contact supination.

Note, the more inversion you order in the rearfoot post, the more you raise the heel in the shoe, which can cause the foot to lift out of the heel counter.

Most posts are ground flat in an inverted position and use the materials compression properties to allow eversion. A soft, 45 durometer EVA rearfoot post will resist pronation or supination less than a hard, 65 durometer post.

You can also order an exact amount of motion ground into the post. For example, 4 degrees of inversion with 4 degrees of motion. This allows for better shoe fit. But no matter how you slice it, the rearfoot post will lift the heel in the shoe, so shoe style is a very important variable in the prescription writing process.

The Heel Area—Flares

Another important option for rearfoot posts is a Flare. Adding a flare increases the area of control. Lateral flares are quite common for patients with lateral ankle instability. Likewise, a medial flare can help delay both the speed and extent of heel contact pronation. Flares are often used in combination with other modifications. More on this as we go.



And like most orthotic modifications, flares can cause shoe fit problems.

The Heel Area—Heel Lifts

You can also add Heel Lifts to rearfoot posts. Lifts are often added to the prescription for a limb length discrepancy. They also can be used to address a patient's equinus condition, especially osseous equinus or forefoot equinus.



Shoes with removable insoles allow you to elevate the heel in the shoe up to about 1/4 inch (6mm) and most labs recommend never going higher than that. Extra depth shoes allow for even higher heel lifts, or lifts that raise the heel, arch, and forefoot areas of the foot simultaneously—which is the best way to accommodate a limb length discrepancy.

The Heel Area—Skives

Skives are another important option. Medial Skives involve flattening the heel area under the medial aspect of the positive cast, or mold, generating a corresponding flat shape on the orthotic under the medial posterior aspect of the calcaneus.

Medial skives create a supinatory moment from heel contact through the early stance phase of gait and thus create additional resistance to pronation, as with an inverted rearfoot post. Studies have also shown that skives can be more effective than rearfoot posts. Skives are also a great option when the patient's shoes cannot accommodate a rearfoot post.



Many patients benefit by the use of combining techniques. For example, increasing the medial heel cup height, adding a medial flare to the rearfoot post, and adding a medial skive are excellent combinations for controlling early midstance pronation.

The same is true of Lateral Skives. Same principle—the lateral skive causes a pronatory moment from heel contact through the early stance phase of gait and thus create resistance to supination, much like a flat or everted rearfoot post. Combining an increased lateral heel cup height with a lateral flare on the rearfoot post, and a lateral skive are excellent options for patients who have a tendency for lateral ankle sprains.



The Heel Area—Heel Pads

Heel Padding can be added to any orthotic. Heel pads provide additional comfort to tender heels. They also can be cut to off-load pressure from a sore spot to the surrounding area with a horseshoe cut out or donut cut out.



Heel Pad



Horseshoe Pad



Donut Pad

Both horseshoe cut outs and donut cut outs are very effective for offloading heel spurs or pain from plantar fasciitis. Most labs recommend no more than 1/8th inch (3mm) thick heel pads because they lift the heel higher in the shoe causing shoe fit problems.

The Medial Arch—Cast Correction

The role of the Medial Arch Fill is to flare the medial edge of the orthotic away from the foot's natural contour to allow for some flattening of medial arch. You can increase or decrease the medial arch fill on the positive mold based upon patient need.

Increasing the arch fill will lower the medial arch height of the orthotic and allow the foot to pronate more on the device. This can be especially helpful for older patients or obese patients who cannot tolerate full correction.



Increased Fill



Normal Fill



Decreased Fill

Decreasing the arch fill will raise the medial arch height on the orthotic, allowing for a closer fit to the foot's medial arch and provide more control of pronation and the foot in general—most often used for kids, young adults, and athletes.

Thus, the height of the arch directly affects the stiffness, or rigidity, of the orthotic shell. See the arches below. Both have the same width and thickness. The higher arch will be stiffer or more rigid because of the increased curvature. This rule applies to all spring like arches.



Clinical pearl: by ordering less Medial Arch Fill, you can get the same stiffness out of an orthotic from a thinner plastic plate, or a more flexible composite weave. By ordering more Medial Arch Fill, you get a more flexible (less stiff) orthotic.

The Medial Arch—Plantar Fill

A very popular addition is a Plantar Arch Fill, which is very common with many types of sport applications. Plantar Arch Fills are added when you want some flexibility in the shell, but don't want the shell to "bottom out." Plantar arch fills are usually done with EVA foams or Poron. The higher the durometer or density of the fill material, the stiffer the orthotic. So an Aerobic orthotic for a woman would typically use poron. Tennis orthotics for a serious player would be 65 durometer EVA.



Note that plantar arch fills also fill the shoe and can cause shoe fit problems especially with shoes that do not have removable insoles.

The Medial Arch—Medial Flange

Medial Flanges are added to increase orthotic stiffness and pronation control. This is achieved by rounding up the medial aspect of the arch correction and shaping the device so that it wraps medially up around the first ray and talar/navicular (TN) area. Medial flanges are usually accompanied with a higher medial heel cup.



Medial flanges, however, can create shoe fit problems in adult shoes. And most adults cannot tolerate the additional stiffness and control. Medial flanges are used most often with children and are an integral part of a standard UCBL type device.

Also look for a TN bulge on your pes planus patients during midstance. You will need to accommodate it in the flange correction, creating a pocket to accommodate the TN bulge. It also helps to add a little padding in the pocket.

The Medial Arch—Fascial Band Accommodation

Fascial Band Accommodations are added when patients have a flexible anterior cavus causing the Hallucis Longus Tendon (HL) to “bowstring” at heel off, irritating the medial arch of the foot. You can test for this by dorsiflexing the first toe and watching the HL under the first/second metatarsals.



If you see this bowstring, mark it with an ink pencil so it will transfer to the plaster cast. If you use foam or a digital scanner, make sure it is visible in the foam or in a photograph. The lab can then add a ridge to the positive mold at that location, mimicking the prominence created by bowstringing of the plantar fascia.



The resulting orthotic will have a groove under the HL, eliminating the irritation.

The Lateral Arch—Cast Correction

The purpose of the Lateral Correction is to account for fat pad expansion along the heel and lateral border during weight bearing. Typically added to non weight bearing casts or digital scans.



So it is important to identify patients with excess fat or who lack tissue tone in the heel area, when considering how much lateral correction to request. Excess fat add more. Lack of fat tissue, add less.

The Lateral Arch—Styloid Process Accommodation

When patients have a large or tender styloid process on the base of the 5th metatarsal, order a Styloid Process accommodation. The lab will add additional expansion laterally around the base of the 5th met and also under it. The resulting orthotic will have a pocket for the Styloid Process to fit into comfortably. You also can add soft foam in the pocket to provide additional comfort.



Styloid process accommodations also are useful with patients who tend to subluxate the lateral column at the cuboid 5th metatarsal joint during heel off and into propulsion.

The Lateral Arch—Lateral Flange

Lateral Flanges help prevent the patient’s foot from sliding laterally off of the orthotic and also resist unwanted supination during the stance phase of gait. Lateral flanges are usually accompanied with a higher lateral heel cup and especially useful for patients with increased transverse compensating midtarsal joints, and for increased medial-lateral control at midstance.



Lateral flanges also increase the bulk of the device and make it difficult to fit properly in most adult shoes. Lateral Flanges, like Medial Flanges, are typically used more for children and are an integral part of a standard UCBL type device.

The Transverse Arch—Metatarsal Raise

Most labs carve a 1/8 inch (3 mm) metatarsal raise into the cast correction in the transverse arch on the positive mold, which translates into a raise on the distal edge the orthotic shell orthotic shell under 2nd, 3rd, and 4th metatarsals with the apex of the raise under the 3rd metatarsal head. You can order more or less according to patient needs.



Many practitioners add metatarsal raises with soft, cushioning materials called Met Pads. Most labs offer different sizes, such as small, medium, large, and extra large.



You also can order different amounts of padding thickness, such as 1/8 inch (3 mm,) 3/16 inch (4.5 mm,) or 1/4 inch (6 mm.) So you can order an extra large met pad that is 1/8 inch (3 mm) thick. Or a medium met pad that is 3/16 inch (4.5 mm) thick, etc. Met pads are great for supporting and cushioning the transverse arch comfortably. You choose the material, durometer, thickness, and size of the pad.

The Tranverse Arch—Metatarsal Bar

Metatarsal Bars (Met Bars) are pads that lift and cushion all five metatarsal heads simultaneously. Met bars are excellent for adding additional shock absorption at the metatarsal heads or for engaging the foot's windlass mechanism.

You choose the material, the durometer, and the thickness of the Met Bar.



The Tranverse Arch—Neuroma Pad

Neuroma Pads are ordered to lift and separate the metatarsal heads, taking pressure off the tender nerve pinched between the heads.



Order by telling the lab which interspace to place the pad in—such as 2nd/3rd interspace—and also how thick to make the pad—1/8 inch (3 mm,) 3/16 inch (4.5 mm,) or 1/4 inch (6 mm.)

Special Note: Met Pads, Met Bars, and Neuroma Pads lift the forefoot up in the toe box and can cause shoe fit problems. So be aware of shoe style.

The Forefoot Area—Forefoot Accommodation

The most popular additions to the forefoot area are Forefoot Accommodations. Forefoot accommodations off load sore tender areas, IPKs, lesions, callouses, etc. A padded extension is added to the distal edge of the device that extends to either the sulcus groove or the end of the toes. Then another pad is added that has cut outs for areas that need to be offloaded. You choose the material, the durometer, and the thickness of both the extension and the cut out pad. Forefoot accommodations are often combined with a met pad to lift the metatarsal proximal to the area to be offloaded.



The Forefoot Area—Morton's Extension

A Morton's Extension is indicated for a structural elevatus of the 1st ray, which causes the 2nd metatarsal head to bear weight excessively because the 1st ray cannot plantarflex in late midstance and propulsion.



Its purpose is to preload the first metatarsal head and hallux and balance the load on the 2nd ray. Very useful for structural hallux limitus and rigidus, or whenever motion at the 1st metatarsal phalangeal joint is not desired. The Morton's Extension supports the 1st metatarsal head and hallux in relation to the 2nd through 5th metatarsal heads and engages the windlass mechanism in late stance and propulsion.

The Forefoot Area—Dancer's Pad or Kinetic Wedge

A Dancer's Pad or Kinetic Wedge is usually ordered to treat Functional Hallux Limitus.



Similar to a forefoot accommodation of the 1st metatarsal head, the pad lifts 2 through 5 metatarsal heads, allowing the 1st metatarsal to drop and function below the others, thus enabling 1st metatarsal phalangeal joint dorsiflexion. Usually combined with a medial tip grind and a flat forefoot post to further allow the first ray and hallux to function below 2 through 5.

The Forefoot Area—Varus or Valgus Wedge

Varus or Valgus Wedges are added to carry the correction from the orthotic forward to the sulcus groove or the end of the toes. For example, if a 5 degree forefoot varus correction is added to the positive cast to invert the forefoot on the rearfoot, this correction ends at the distal edge of the orthosis. Once the heel comes off the ground during gait, the correction is lost. So if rearfoot control does not result in the medial column plantarflexing during propulsion, undesired pronation will occur from heel off through propulsion. Adding a 5 degree Varus Sulcus Wedge extends this correction beyond the distal edge of the orthotic and maintains the correction through heel off and propulsion.



Similarly a Valgus Wedge is used to carry a valgus correction to the sulcus groove or the end of the toes. Very effective for increasing 1st ray stability and engaging the windlass mechanism.

Varus and Valgus wedges fill the toe box of the shoe and are only recommended for patient's whose shoes have removable insoles. In addition, the amount of wedging available is limited by how much room is available in the toe box of the shoe.

The Forefoot Area—Extrinsic Forefoot Post

During the early days of orthotic fabrication, extrinsic forefoot posts were used to invert or evert the forefoot on the rearfoot. Today, this is usually done intrinsically in the cast correction process because there is less bulk and better shoe fit in the device. But you can still order an extrinsic forefoot post rather than have the casts balanced intrinsically.



Extrinsic Forefoot Posts are typically ordered when you want to stabilize the distal edge of the orthotic. Especially useful if you are grinding back the medial distal tip of the orthotic to allow the 1st to drop and function below the level of 2 through 5.

The Forefoot Area—Toe Crest

A Toe Crest is ordered when you want to fill the sulcus groove. Toe crests can be ordered from soft materials such as poron and low durometer EVA foams, or from firm materials such as cork or high durometer EVA foams.



Toe Crests are very effective for stabilizing and supporting rigid or semi-rigid hammertoes. They often are used in combination with other special features to help stabilize the foot from heel contact through midstance and into propulsion.

Orthotic Width, Shoes and Removable Insoles

On a final note, the width of your orthotic is a primary consideration. The goal of all foot orthotics is to contour as much of the foot as possible and still fit into the shoe.



Too Narrow



Too Wide

The lab will want to error on the side of less contour (narrower orthotics) to avoid shoe fit problems and returned orthotics. The practitioner will want to error on the side of more contour (wider orthotics) to contact and control more of the foot. Note that if you order wide orthotics on a regular basis, a grinder in the office is a must as you will be adjusting orthotic width on the medial side of the device if the orthotic is too wide.

So it is very important to specify the patient's shoe type for the lab. Also, with women's fashion shoes, it may be worthwhile to send a patient's representative pair to the lab so they don't have to guess at heel height, shank curvature, and any other interior limitations.

With certain conditions, such as cavus feet with metatarsalgia, you want the orthotic as wide as possible. Other conditions where you want the 1st metatarsal head to function below 2 through 5, you will want a narrow orthotic with the 1st met area cut back at a slant to allow the 1st ray to plantarflex.



And always, always, always advise patients to buy shoes with removable insoles to allow for more orthotic options.

Summary

As a foot care specialist, your primary goal is to improve foot and ankle function and/or alleviate pain. Surgery, orthoses, and shoe therapy are all tools to achieve that goal. Clinical Biomechanics is the core knowledge required for the use of all of these tools. And the best practitioners integrate all three.

More importantly, the lab never sees the patient. The lab technicians just receive a shape. They haven't seen the patient walk and they haven't done a biomechanical evaluation of the patient. So the more information and instruction you provide your orthotic lab, the better your results will be.