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Art and Science: Prescribing, Fabricating, and Dispensing Orthotics

Our experts discuss the latest trends in this vital area of practice.

BY MARC HASPEL, DPM

This past spring, comedian Jerry Seinfeld expressed his gratitude to Dr. Joseph D'Amico of NYCPM by making two generous donations to that institution for Dr. D'Amico's use of podiatric biomechanics to successfully end Seinfeld's thirty-year struggle with heel pain. The good publicity surrounding the act notwithstanding, this successful patient outcome only serves to underscore the continued importance of biomechanics and orthotics in podiatric medicine.

The prescribing, fabricating, and dispensing of orthoses remain the hallmark of conservative care in the modern podiatric practice. Of course, there are various approaches to each step of the process and a wide range of conditions that can be treated as a result. Whether they be pre-fabricated or custom-made, the vital role of orthotics in the profession is indisputable. Certainly, an appreciation of impression techniques, materials selection, and good communication between physician and orthotic laboratory are necessities in order to perform the discipline effectively.

Podiatry Management has invited several leaders in the field of podiatric biomechanics from across the nation to participate in a lively discussion on the practice of prescribing orthotics. Their insight will undoubtedly assist any practitioner considering expanding a practice in this direction.

Joining this round table panel:

Joseph D'Amico, DPM is professor and past chairman of the Division of Orthopedic Sciences, New York College of Podiatric Medicine. He is a diplomate of the American Board of Podiatric Medicine and is a fellow of the ACFAOM, the American Academy of Podiatric Sports Medicine, and the American Academy of Foot and Ankle Pediatrics. He is in private practice in New York City.

Patrick DeHeer, DPM is a member of the APMA, ACFAS and ASPS. He is in private practice in Central Indiana, and he is the team podiatrist for the Indiana Pacers and Indiana Fever. Dr. DeHeer is president of the Indiana Podiatric Medical Association and continuing education chairperson. He won the 2011 APMA Humanitarian of the Year Award.

Beth Jarrett, DPM is a graduate of Dr. Wm. M. Scholl College of Podiatric Medicine, where she has been lecturing and teaching workshops on biomechanics, orthoses, and footgear in the Department of Podiatric Surgery and Applied Biomechanics since 1988. She is currently the associate dean of Clerkship and Residency Placement. She is a diplomate of ABPM and is a fellow and has served as president of ACFAOM. Dr. Jarrett is board certified in pedorthics as well.

Kevin Kirby, DPM is an adjunct associate professor of Biomechanics at the California School of Podiatric Medicine, is the Director of Clinical Biomechanics for Precision Intricast Orthotic Lab, and is in private practice in Sacramento, California.

Russell Volpe, DPM is a professor

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in the Departments of Pediatrics and Orthopedics at the New York College of Podiatric Medicine. From 1993—2006, he served as chair of the Department of Pediatrics. He served as medical consultant to Langer, Inc. from 1992—2002. He is a diplomate of the American Board of Podiatric Medicine. Dr. Volpe lectures widely on pediatrics and biomechanics topics in the US and internationally.

PM: *What are the advantages and disadvantages of the following various methods of taking negative impression casts for the fabrication of custom orthoses: foam, plaster, STS slipper sock, pressure technology (e.g., force mat), and digital scanning technology?*

Volpe: I have found advantages and disadvantages to each of the aforementioned impression techniques. For using foam impression technique, I feel that it is difficult to position the foot in loaded off weight-bearing position. While this technique is best suited for semi weight-bearing, it still can be difficult to maintain proper sagittal plane relationship of the forefoot and rear foot. Also, frontal plane forefoot deformities (varus/valgus) are difficult to capture as they tend to be obscured when the forefoot is pushed down in the foam. Still the advantages of this technique are the inexpensive cost and speed of the impression.

As for plaster impressions, I think the advantages are clear. It is simply the gold standard. This technique accurately captures the three-dimensional components required for good custom foot orthoses as well as the bony-prominences for dispersion and off-loading. It is also relatively easy, quick, and inexpensive. It is also excellent for capturing forefoot to rear foot relationship and can be done off and semi-weight-bearing easily. Likewise, the technique can be modified for an in-shoe cast for an orthosis intended for a difficult-to-fit shoe. There are minor disadvantages, however, in that the technique tends to be messy, takes slightly longer than foam, and some practitioners may not feel that this technique is as technological advanced as a scanned image, for instance.

The STS sock technique poses advantages and disadvantages as well. First, it involves a fast, easy application that is clean, with no mess. The disadvantages are, however, that it is more expensive and does not capture bony prominences as well as plaster. Also, sizing can be an issue. For example, a pediatric slipper sock comes in one size, which does not work well for all children's feet.

I think the more important question to consider is whether the foot is cast in a corrected position.—DeHeer

The advantages of the scanning technique are that it is closest to plaster in capability of capturing the three-dimensional model of the foot. It also eliminates plaster, foam, and resin completely. Also noteworthy is the speedy turn-around from images digitally transmitted to the lab. The disadvantages of this technique are that many scanners do not capture enough data to represent the three-dimensional contours of the foot adequately, though admittedly some do more than others. Also, there is a high initial investment that amortizes over time. I find that dispersion/accommodation can be more difficult with this technique and that skill and training are needed to correctly capture the foot position.

Lastly, I don't find pressure mat technique appropriate for fabricating custom foot orthoses, although I think that this technique may have some value in pressure re-distribution.

D'Amico: I agree that the subtalar neutral suspension plaster impression cast is the gold standard and still the most accurate method of taking an impression of the foot. It provides a realistic, three-dimensional model that the practitioner may examine and appreciate to see if it has accurately captured the structural imperfections brought to light from the biomechanical examination. The resultant positive need not be adjusted by the laboratory to fit into the shoe. The goal of any impression technique is to capture the foot before it has a chance to be influenced and, subsequently, deformed by the sum total of structural deficiencies that have their final expression in the foot. This negative model may be held in the hand, and certain areas may be manually enhanced or reduced prior to complete hardening. I often accentuate plantarflexion of the first ray in the cast to reduce and basically neutralize a severe forefoot varus deformity. Angled extrinsic post wedge templates of varying degrees may be placed in the forefoot and rear foot of the negative and their effect observed and assessed.

The STS slipper sock has all the advantages of the off weight-bearing neutral plaster suspension cast technique without all the mess.

There are a number of practitioners as well as make-believe doctors in shoe stores or ski shops that have a customer sit on a low stool and place the foot in foam, gel or plaster. These partial weight-bearing techniques are inaccurate since the foot deforms as it goes into the material; it also spreads, and you cannot position the plantar aspect of the foot—in fact, it cannot even be seen. In essence, the model of the foot that is obtained is as is, not as it should be. The device that is fabricated is perfectly matched to the deformed foot and accommodates it well. This technique utilizing subtalar neutral positioning developed by Richard Schuster, DPM does not negate the fact that the positive model is now longer and wider than the off-weight cast and therefore lab adjustments have to be made. Additionally, when this method is utilized and the foot placed on foam greater than one inch thick, the medial segment of the forefoot is pushed up in a varus direction creating additional frontal plane deformity in the model. One clear advantage of this method is that it does capture all the influences from the leg in the cast. With the sus-

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pension method only, the rear foot to forefoot relationship is obtained, and therefore rear foot varus influence must be measured.

Full weight-bearing cast techniques or pressure or force mat technology identify increased pressure points on the foot and then redistribute these hot spots to be more equitably shared over the entire plantar surface. Essentially, there has been no alteration in function, just the same amount of pressure, but now it is distributed over the entire foot instead of in discrete areas.

No matter which of these weight-bearing techniques is employed, all result in a device that is usually very comfortable, but not corrective. I liken it to buying pants in a larger size.

DeHeer: I believe the impression does matter ultimately in the success of the product. I agree that the worst of the potential measurements is pressure technology, which does not provide any three-dimensional impression of the foot for arch height and plantar contour. Digital scanning ability has improved significantly over the past few years, and I believe an accurate three-dimensional impression can be obtained, but the issue with scanning is the positioning of the foot during the scanning. Foam, plaster, and STS slipper socks all provide excellent three-dimensional impressions, but the more important point is the foot positioning during impression-taking. I think the most important question to consider is whether the foot is cast in a corrected position, for example, by plantarflexing the first ray to remove the forefoot varus deformity or whether it is cast in such a way to accommodate for the deformity instead.

Kirby: Even though I prefer to use plaster splints for all of my foot orthosis negative casting, there are other acceptable methods of obtaining three-dimensional images of the plantar foot that allow for accurate prescription foot orthoses to be made. Foam boxes can allow good casts to be made, and are faster and cleaner than plaster splints. Foam boxes, however, potentially suffer from the inability of the podiatrist to visualize the plantar aspect of the foot during the molding procedure, which may lead to errors in casting.

The STS slipper sock is a simple and clean method of negative casting but, if one is not careful, the sock can easily pull away from the medial arch, creating too flat a medial arch contour. Digital scanning is becoming more popular and allows the podiatrist to nearly instantly send the digitized image of the foot electronically to the lab, saving on shipment costs and time. It, however, is very difficult to accurately compare the three-dimensional shape of the plantar foot to the two-dimensional image on the computer screen, after scanning, to determine whether the true geometry of the plantar foot has been accurately captured by the scanner.

Finally, force mats and pressure mats, even though they are the only technology which allow plantar forces to be determined, clearly are not three-dimensional but are rather two-dimensional technologies. As such, they are also not able to accurately capture the three dimensional contours of the plantar foot and should not be used as methods to gather the data necessary to produce accurate prescription foot orthoses.

Jarrett: The most important thing to remember is that no matter what technique is chosen, the method is still only as good as the person positioning the patient. Plaster casting is being used less often now, but still has the advantages of being relatively inexpensive, and particularly for teaching purposes, allows for enough time to position the patient. Plaster and the STS slipper sock both have advantage of allowing for thorough cast evaluation. On the other hand, plaster does take more time, tends to be messier, and requires drying time before being mailed. Plaster is easily washable, however.

STS has the advantage of setting very quickly, but does not allow for direct contact with the skin or any transfer of cast markings. It is more expensive, but for experienced practitioners, it is probably worth the time saved, and in addition, can be mailed right away. Both plaster and STS allow for off-weight-bearing casts, allowing the caster to maintain the midtarsal joint in a maximally pronated position. STS, however, is not easily washable, and care must be taken to not come in direct contact with it or have any contact with clothing, treatment chairs, etc.

Computer milled orthoses made from digital scans have the advantage of being carved rather than heated and vacuum pressed.—Jarrett

Foam boxes are very convenient and very clean. They provide partial weight-bearing or full weight-bearing impressions. Foam boxes are excellent for accommodative orthoses and Shaffer plate types of orthoses, but may not be ideal for situations in which maintaining the midtarsal joint in a maximally pronated position is desirable. All three of the techniques mentioned so far require the impressions to be sent to the lab.

Orthoses made from pressure mats have the advantages of being very clean, very easy-to-use, and the images are generally sent via computer to the lab, unless the practitioner has a milling machine as well. The primary downside is that the images are generally taken during gait while the foot is in its fully compensated position, and the orthoses are not made to the actual three-dimensional shape of the foot. Likewise, digital scanning is also very clean and can be relatively easy depending on the technique: partial weight-bearing or off weight-bearing. As long as the images are true three-dimensional images of the foot itself, this technique can be used for off weight-bearing, subtalar joint neutral position, midtarsal joint maximally pronated impressions. The actual imaging technique in terms of positioning the foot properly relative to the scanner can be tricky, however. The additional benefit of computer imaging is that the positives are stored in the computer for access at any time, rather than having to store the actual positives.

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Lastly, computer-milled orthoses made from digital scans have the advantage of being carved rather than heated and vacuum pressed. Although there are some limitations in terms of modifications, etc. with computer milled devices, the advantages include: the posting is included in the shell, which minimizes stress risers; the shell can be contoured (thinner in some areas like the plantar aspect of the heel and the distal edge of the device, and thicker in other areas such as the medial arch), which allows for a much thinner device; and a computer milled shell has less tendency to bottom out.

PM: *In what ways does material selection impact the success of custom—made orthoses in terms of shell, posting and top covers in relation to the patient's profile?*

Kirby: Material selection is one of the keys to a successful custom foot orthosis. Material selection items such as the type of material used for the orthosis shell, the thickness of the shell material, whether the shell material is a shank-dependent material (e.g., Plastazote) or a shank-independent material (e.g., polypropylene) and the use of rear foot posts all affect the stiffness of the orthosis (i.e., the ability of the orthosis to resist deformation from the foot).

Top cover material type, texture, durometer, and thickness will also have a kinetic effect at the plantar foot-orthosis interface and be able to increase the shock-absorbing abilities of the orthosis, thereby decreasing the magnitude of plantar pressures on the foot. For example, in patients with plantar heel pain, I often use a 1/8" to 1/4" neoprene top cover on the orthosis to help provide more shock absorption to the plantar heel and reduce the plantar heel pressures since, in most cases of plantar heel pain, the compression force from the heel hitting the ground with each step is at least partly responsible for the heel pain. Proper orthosis material selection is, therefore, very important in achieving excellent orthosis outcomes for podiatric patients.

Volpe: Material selection is one of the most important components in designing the correct custom foot orthosis for a patient. The level of control for a given patient's body weight may be altered by either increasing or decreasing the thickness of a given material in the shell. Selection of material, based on its properties, is also a factor in level of control. Certain materials will be better when accommodation is the goal, others when motion control is the goal. Some materials, such as graphite. are ideal in low-volume shoes as they tend to provide a high level of control with a very thin module.

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Posting may also be altered based upon the material selected. An acrylic or poly post will be among the most durable and provide the greatest level of control. An EVA post, which may be made of EVA of varying durometers, provides high-level control with some shock absorbing properties as well. In heavier individuals, one might choose more durable posts, and in lighter individuals less dense. In patients needing more shock absorption, one might want a lower durometer post, and in patients needing more control, a higher durometer interface between the orthosis and the foot.

Top covers can provide a soft-tissue interface between the orthosis and the foot and are very useful when dispersion, shock-absorption, and soft-tissue supplementation are desired. There are a wide variety of materials available for this purpose and most labs offer many choices that help accomplish different goals. Top covers may also be useful to keep devices from moving in a shoe, enabling the device to fit the full-foot and replace a shoe sock liner more easily.

Jarrett: Material selection is very important to the success of the orthosis. Shell selection is generally based on the type of device and any modifications that may be required, as well as the weight of the patient, the amount of control desired, and shoe gear. In addition, a thicker or more rigid material may be required in a larger as opposed to a relatively small foot.

Variations in posting material are generally based on durometer of material rather than on specific material. Medium high to high durometer EVA or crepe is most common, and the decision should be made based on shock absorption vs. control.

A wide variety of top-covers are available. The choice should be based on purpose. If shock absorption is needed, then Spenco, Poron, and EVA are all good choices. If total contact is required, then one should use something that molds to the foot, such as the lower durometer Plastazotes. Generally, the materials that mold to the foot are not good shock absorbers, so if both are needed, then one should consider bi-laminer or tri-laminer materials, such as EVA and Plastazote, or Poron and Plastazote.

D'Amico: Many factors go into the prescription of foot orthoses. In fact, the more questions that are answered, the more time that is spent with the patients, the more thorough the examinations, the more successful the outcomes. In terms of material shell selection and top covers, posting is all based on individual patients' needs and what the practitioner is trying to accomplish. Personal and biographical factors that play a role in successful orthotic prescriptions include physiologic age, weight, activities (including sports, fitness, and recreational), footwear, injury history, previous orthoses tolerance and success, history of falls, instability, joint laxity, et al.

As a general rule, posting should be that amount that is required to realign the osseous and soft tissue structures and provide optimum function. Not everyone, however, is able to tolerate—at least, not initially—complete neutralization of structural imperfections in the lower extremity. There are certain caveats that should not be overlooked such as the avoidance of aggressive rear foot posting in individuals with chronic ankle instability, or the complete neutralization of all structural deficiencies in patients with limited or absent subtalar joint motion.

Dr. Schuster again once told me that when it comes to cushioning and top covers, less is always more. The reason is that the more cushioning that is provided the less control that is obtained. There is a concomitant increase in energy expenditure as one moves to thicker cushioned devices. Essentially, it becomes similar to walking in mud, very comfortable, but not very efficient. Shoes today have more than enough cushioning built into their construct, and what most people need is something to limit the negative effects of too soft a landing. What would be best to recreate is the feel and spring-like action of a basketball court—when the rubber hits that surface, those wooden floorboards give a great return of energy.

PM: *What are the pros and cons of using custom-made versus pre-fabricated orthoses?*

Kirby: All foot orthoses, whether custom or pre-fabs, work the same way: by altering the locations, magnitudes, and temporal patterns of ground reaction force acting on the plantar foot during weight-bearing activities. Therefore, pre-fabs can be a good first choice for patients with milder problems and who have relatively symmetrical foot structure. Prefab orthoses are also readily available to be dispensed within a short period of time and are a fraction of the cost of custom foot orthoses.

Custom foot orthoses, however, since they are made from three-dimensional images of the plantar feet, have the distinct advantage of being totally customizable and can, therefore, be very precisely designed to reduce the abnormal pathological tissue forces that have resulted in the patient's pedal and/or lower extremity injuries. In addition, custom orthoses can often last over ten years, whereas it is rare to see prefab orthoses last over one year without serious degradation. Ethical and proficient podiatrists will know the pros and cons of both prefab and custom foot orthoses so that they can recommend the best type of foot orthoses to give each patient the excellent therapeutic results that they deserve.

I recommend contacting the lab if a desired item is not on the form.—Jarrett

DeHeer: I seldom if ever use prefabricated orthoses. I believe in biomechanics and the role of custom orthoses. I look at it realistically, from the point of view of the patient's expense. I believe any pair of devices that allow patients to alleviate pain and prevent future conditions from developing are worth a few hundred dollars. With that being said, I do admit that prefabricated orthoses that have a semi-flexible, or preferably, a semi-rigid shell can be decent alternatives.

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Jarrett: The pros of over-the-counter orthoses are that they are readily available, easily modifiable, and much less expensive. They are good choices for patients who may only need orthoses temporarily, or if some modifications need to be tested before custom orthoses are ordered. The cons are that they tend to be "one kind for all" and as such, may not be appropriate for certain situations. The pros of custom orthoses are that the devices are designed for specific patients' needs in terms of foot size/shape, pathology, biomechanical correction, footgear, etc. The most significant con is the cost, often borne by the patients.

D'Amico: Patients have come into my office for years with bags of orthotics, some over-the-counter and some custom. A very small percentage of these devices are found to function properly. The first thing I look at is whether or not the device matches the foot when it is in the neutral off weight-bearing position. This should occur with a custom device if the cast was taken in the proper manner and the laboratory filled the prescription correctly. I find that most do not. Secondly, pre-fabricated devices match no one's foot perfectly and, furthermore, there's often a difference from left to right. That's because no two feet are identical. Pre-fabricated devices are the same for all general size categories and the same from left to right. In any given year, I doubt I've written a prescription that is the same from one person to another, and even less likely to find one that is the same from left to right.

PM: *Please discuss how you effectively communicate your specific orthotic needs to the lab from which you are ordering?*

Jarrett: Before using a lab, I recommend having a conversation with the lab's representative. I recommend being sure that one's definitions and the lab's definitions are the same. Problems often arise as a result of miscommunication rather than laboratory error. In addition, I believe in getting into the habit of writing the prescription on a blank piece of paper first, and then completing the orthotic lab prescription form. I often find people not necessarily ordering what they want because they cannot find it on the form.

For most labs, what is on the orthotic prescription form represents what is most frequently ordered from that lab. I recommend contacting the lab if a desired item is not on the form.

Kirby: In most cases, I simply fill out the prescription order form completely for each patient. Oftentimes, however, I may need to write special instructions or even draw a picture on the prescription order form to properly convey the information needed. There are even times that I may need to call the orthosis lab to express some special modification I want to try. The bottom line is that no matter which orthosis lab is being used, if the podiatrist and orthotic lab are not communicating clearly and effectively, the podiatrist is not likely to get the exact type of orthotic he wants.

There is clearly a preventative role for orthoses in some children determined to be at-risk for foot and leg deformities.—Volpe

Volpe: My rule of thumb is to write, write, and write. I make sure I include everything I want done to the positive model, to the shell, and to the device itself on the Rx form. I also expect the lab to record preferences and requests that appear repeatedly, so they can be routinely included when casts come in from me. Working consistently with the same labs is helpful as they will come to know one's personal approaches and requests, making it more likely that devices will come back from the lab as prescribed. Also, the best labs have top account representatives who are there to help meet the needs of difficult feet and challenging cases. They have a wealth of experience and should be consulted. It always helps to pick up the phone to talk to someone, or e-mail someone with specific or special requests to make sure they are included. Of course, the very best labs have DPM consultants, who are terrifically talented experts in designing the best device for any particular patient.

D'Amico: I have utilized the same laboratory for the past twenty-five years, and there is a personal account representative assigned to me who is very familiar with my particular preferences and objectives. Each orthotic prescription is detailed with specific lab instructions, and as I previously mentioned, no two are ever the same in terms of material, modifications, posting, top covers, shell thickness etc. It's very rare that I have to return a device. For each device, I specify rear foot and forefoot posting as to degree, amount, and type, and let the lab determine the material durometer based on the information I provide and the intended use. Heel seat depth is another characteristic that I detail for each patient.

Occasionally, I indicate shell thickness if I prefer a device to be more rigid or more flexible than body weight would dictate. For example, I would lower the shell thickness to achieve additional module forgiveness in the case of equinus influences, and increase shell thickness in the case of a child with a flexible pes planovalgus foot type to provide additional control.

PM: *How can orthoses be used in the treatment of pediatric pes planovalgus?*

Volpe: The standard-of-care for the non-operative treatment of a symptomatic pediatric pes planovalgus is a foot orthosis. This may be a pre-fab or custom orthotic, depending on the situation. The expert biomechanical evaluation of the practitioner determines the etiology, diagnosis, and approach to treatment.

The use of orthoses in the asymptomatic moderate to severe pediatric pes planovalgus is more controversial.

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There is clearly a preventative role for orthoses in some children determined to be at-risk for foot and leg deformities over time based upon the aforementioned expert biomechanical examination. These conditions are often associated with moderate-to-severe pes planovalgus. A good pre-fabricated device, particularly in younger children and in milder cases, may be sufficient, but often custom orthoses are necessary to correctly address all of the factors contributing to the compensatory foot deformity.

Kirby: Over two decades ago, Dr. Donald Green and I co-authored a book chapter on the treatment of pediatric pes valgus deformity which detailed the history, biomechanics theory, and clinical use of custom foot orthoses for flat-footed children (Kirby KA, Green DR: *Evaluation and Nonoperative Management of Pes Valgus,* pp. 295-327, in DeValentine, S.(ed), *Foot and Ankle Disorders in Children.* Churchill-Livingstone, New York, 1992).

Not only can custom foot orthoses be used to effectively treat the symptoms that are often associated with the flat-footed child, but they can also be used to improve the function of the foot and lower extremity of these young individuals during everyday weight-bearing activities. By using orthosis modifications such as the medial heel skive (Kirby KA: *The medial heel skive technique: improving pronation control in foot orthoses. JAPMA,* 82: 177-188, 1992), the podiatrist can effectively increase the subtalar joint supination moments acting on the foot to not only reduce the pronated position of children with flatfoot deformity, but to also allow them to play painlessly and function more normally so that they can have more active lives during their youth. In my opinion, foot orthoses are very much under-utilized for pediatric pes planovalgus deformity.

DeHeer: This is a topic I also have written and lectured about often. I use type "C" heel stabilizers from age 4 to 8 roughly, then Whittman-Roberts devices until early teenage years, and finally, I deploy standard devices once children becomes teenagers. I do think it is important in children to post in neutral position to prevent a forefoot supinatus from becoming a rigid forefoot varus. I think most symptomatic pediatric flatfoot cases, and the more severe asymptomatic cases, can be managed with orthoses. The key that is often overlooked is equinus. It must be treated, and must be treated prior to use of the orthoses.

The literature is clear that equinus results in plantarflexory force through the navicular-cuneiform joint. If this condition is not treated, tolerance of a rigid orthotic trying to stabilize the medial arch with a deforming plantarflexory force at the arch from the leg is poor. The orthoses are often blamed in these examples, and rarely are they the problem. The problem is lack of treatment of the equinus. One must treat equinus first, and then use orthoses thereafter.

D'Amico: Growth and development may be effectively used in the management of the excessively pronated pediatric foot if the orthoses are worn faithfully, and for a prolonged period of time. It is the same principle as serial plaster immobilization for the correction of lower extremity orthopedic disorders—in essence, they can be considered "orthodonture" for the feet.

Treatment may be instituted when the child begins to stand at seven to nine months of age, although serial plaster immobilization prior to this has been suggested and utilized by some. The devices should be changed at one to two year intervals, or with two to three shoe sizes. Treatment is continued until no visible pronation is observable without the devices, and normal function and alignment are achieved. Failure to act will leave the child subject to the perpetuating and deforming effect of gravity on an immature plastic system that, by itself, is incapable of counterbalancing these stresses.

Forefoot valgus posting, when indicated, spreads the metatarsal heads and reduces the symptomatology of Morton's neuroma.—D'Amico

PM: *How can orthoses be used in the successful treatment of Morton's neuroma?*

Volpe: I have not found orthoses to be as successful as I would like in the treatment of Morton's neuroma. The use of a metatarsal raise on the device to attempt to create more space between the metatarsals is a common technique. In my experience, it depends upon what degree that irritation of the nerve by the metatarsals is the issue, and how successful one is at separating them through the use of a met pad. I do find orthoses useful in managing neuroma in those cases with biomechanical imbalances and compensation. In these patients with these feet, normalizing the foot position may decrease the stresses on the forefoot and decrease the irritation of the neuroma.

Jarrett: I have heard many people say that they have not had success treating Morton's neuroma with orthoses, but I have seen significant improvement and even resolution of symptoms with orthoses (including my own condition). I am not sure if it is anything special about the orthoses, or if it is recognizing that a change in footgear is generally also required. If a patient is wearing shoes that are already too small and orthoses are added, they won't work. One should be sure that the patient is wearing shoes that fit correctly in the arch length. If possible, I recommend avoiding a forefoot extension, since this will only take up more room in the shoe, and minimize the thickness of the top cover. A metatarsal raise needs to be placed in the correct position, approximately one cm proximal to the metatarsal heads.

Kirby: Foot orthoses can be used to reduce the symptoms of Morton's neuroma by reducing the pressure on the neuroma from the adjacent metatarsals. My clinical experience has taught me that using foot orthoses to reduce the pain from Morton's neuroma is much more easily accomplished in male pa-

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tients versus female patients, and this clinical observation appears to be related to footgear. In other words, if orthoses are used in shoes with a wider toe box, then the orthoses are routinely successful at relieving much, if not all the pain from Morton's neuroma.

In the more tightly fitting shoes that female patients often wear, however, the therapeutic results with foot orthoses are much less successful. Therefore, the podiatrist needs to make a well-fitting orthosis, use a well-placed metatarsal pad on the orthosis, and also make sure the patient is wearing shoes with a wide toe box, i.e., shoes that do not squeeze the metatarsals from side to side.

D'Amico: Orthoses can be successful in managing Morton's neuroma by, first and foremost, controlling the abnormal forces that have served to precipitate, perpetuate, or aggravate the condition. This would include a functional device with the appropriate rear foot and forefoot posting. My experience has been that aggressive or inappropriate forefoot varus posting in the presence of neuromas may crowd the metatarsals laterally, thereby irritating the neural mass. Forefoot valgus posting, when indicated, spreads the metatarsal heads and reduces symptomatology. A two-five bar or sulcus post of zero degrees will have a similar effect.

Useful orthotic modifications include a metatarsal pad or a neuroma plug. It has been my experience that metatarsal pads cause a supinatory effect on the forefoot with a propulsive phase adduction force, thereby shifting the center of pressure or line of force laterally and, in turn, inadvertently increasing stress on third interspace neuromas. This scenario is especially true in those individuals possessing in-toe or rectus gait patterns.

Q ***PM:*** *What recommendations do you have for podiatrists seeking to expand the orthotics portion of their practices?*

DeHeer: I recommend learning about biomechanics by reading our fellow panelist Kevin Kirby's *Foot and Lower Extremity Biomechanics Precision Intricast Newsletters,* taking time to do biomechanical exams both weight-bearing and non-weight-bearing on patients, understanding the role of biomechanics in pathological conditions, and putting some thought into the orthoses being ordered. One can't expect orthoses to treat a pathological condition alone. I believe in treating the pathology in its entirety, and utilizing orthoses is usually only one component of the treatment. For example, 80% or more of plantar fasciitis cases have associated equinus, which must be treated and, certainly, the inflammatory component of the problem must also be treated as well.

Volpe: Here are my recommendations for expanding an orthotic practice. First, I recommend dispensing top quality, biomechanically correct devices in one's practice. They, by themselves, will generate referrals of other patients from satisfied, happy patients. Next, I recommend letting other practitioners in one's area know of one's expertise and interest in working with orthoses by sending them reports or notes on patients of theirs that have been treated biomechanically. Of course, one should include reference to the orthosis component of the patient management, planting seeds for future patient referrals.

In addition, I feel it is wise to give lectures to sports clubs, teams and other related venues where patients who might benefit from orthoses are most likely to gather. Yet, I must caution to take care not to suggest orthoses for everyone. A podiatrist should not want to be known as someone who thinks that orthoses are the solution to every foot problem, and be one who prescribes them in cases when they may not be necessary or beneficial.

D'Amico: The majority of individuals who come into our practices come in with diseases and disorders that are caused, or at the least perpetuated, by patho-mechanical function of the lower extremity. Since the foot is the foundation for the rest of the superstructure, it is imperative that it not only aligns properly, but that it performs efficiently as well. In medicine today, we are the best qualified practitioners to evaluate and relate the functional health and performance of the foot to the entire individual. Since starting in practice, and with rare exception, I have performed a complete biomechanical examination on every patient including observational and computer-assisted gait analysis, both before and two weeks after orthotic devices are dispensed. I do not perform any osseous surgery on the foot unless the patient is adequately controlled with orthoses and any superstructural equinus influences negated.

Kirby: In order to expand the use of foot orthoses in any podiatric practice, podiatrists must become more educated in all phases of foot orthosis therapy. First, podiatrists must become more proficient at evaluating the biomechanical makeup of their patients and must better understand foot and lower extremity biomechanical theory. Second, podiatrists must become more adept at taking proper negative casts or three-dimensional images of their patients' feet. Third, podiatrists must better learn the characteristics of different foot orthosis materials and orthosis modifications in order to prescribe the best custom foot orthoses for their patient. Fourth, podiatrists should better learn the methods of foot orthosis modification in order to improve the comfort, therapeutic effectiveness, and fit of orthoses into their patients' shoes. Fifth, podiatrists must ever remain students of biomechanics, foot and lower extremity pathologies, foot orthosis therapy, and shoe construction in order to properly develop the life-long habit of intellectual growth that is clearly evident in those podiatrists who have achieved the most successful foot orthosis practices.

It is not an easy task, but those podiatrists who can achieve successful foot orthosis practices will be recognized indeed as being the best within their medical communities at making foot orthoses for the injured individuals of their communities. **PM**

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