

Flexible Molds simply less shocking!

The recent success that our customers have reported from using the *Gentleflex* orthotic design has led our laboratory to broaden our selection of flexible, shock attenuating devices. Our product literature now refers to these devices as *Flexible Molds* and there are two types; *Gentle* and *Soft* (Figure 1).

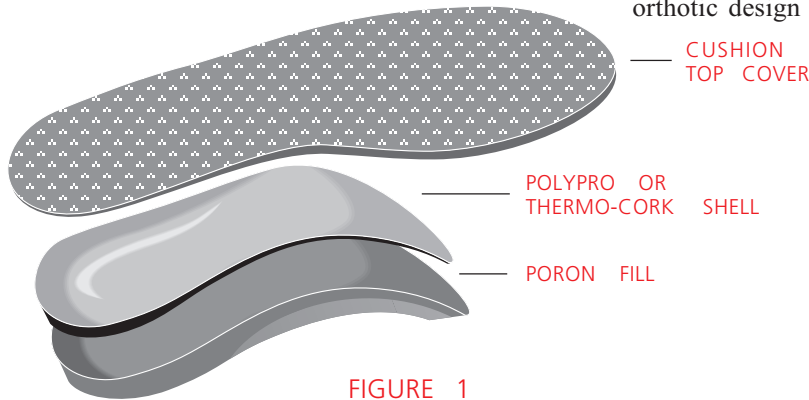


FIGURE 1

The *Gentle* and *Soft* differ in shell material and, therefore, in level of functional control and shock attenuation. The *Gentle* (previously *Gentleflex*) provides more functional control and has a thermoplastic shell reinforced with poron. Shell material choices include polypropylene and copolymer depending on performance expectations and patient body habitus.

The *Gentle* design has proven effective in managing patients suffering from:

- recalcitrant plantar fasciitis
- osteoarthritis
- hypersensitive feet
- reduced functional range of motion; and
- high impact athletic injuries.

Older patients and people having rigid cavus feet who traditionally do not tend to tolerate more rigid devices have also responded favourably to the *Gentle* device. This design is intended to provide a high level of shock attenuation with a moderate level of functional control. Using a more rigid material such as copolymer can increase the level of functional control.

Athletes who participate in high impact sports such as volleyball, basketball and running may benefit from the *Gentle* design. The functional control provided by this device will control the excessive

pronatory motion that can lead to musculoskeletal injury in deceleration-type activities. The shock attenuation properties can help to dissipate impact forces that may be deleterious to bone and joints. The athlete's shoe design should also be considered and never overlooked. Its support and cushion characteristics are as equally important as the foot orthotic design that is worn in it.

There are other clinical cases that may require an even more conservative device. For patients having:

- advanced rheumatoid or osteoarthritis,
- markedly hypersensitive feet; and/or
- an absent functional range of motion

a *Soft* design may be indicated. It has a thermo-cork shell reinforced with poron and provides the maximum level of shock attenuation.

Rheumatoid arthritis can be a complicated clinical case to manage. Patients often suffer from plantar foot complications that are excruciatingly painful. Toe subluxation, the plantar migration of metatarsal heads, and the distal translocation of the plantar fat pad can lead to tender, prominent metatarsal heads (Figure 2). Painful rheumatoid nodules may also develop in the subcutaneous tissue of the plantar heel and forefoot. These patients may benefit from the *Soft* design. It provides a maximum level of shock attenuation and a soft tissue supplement.

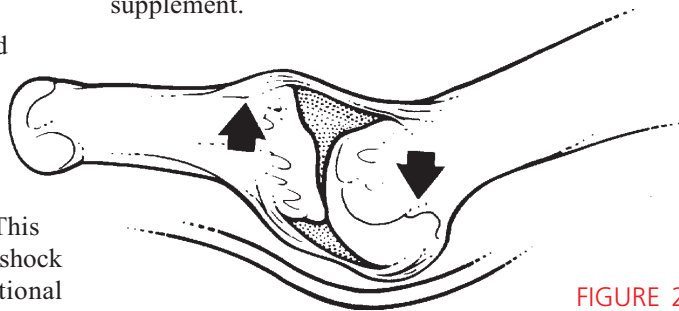


FIGURE 2

Both the *Gentle* and *Soft* are top covered with either microcel puff or vinyl/poron. Our new work order allows the clinician to order either of these devices in one of three lengths; metatarsal head, sulcus or full length.

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Shock value helps materials get noticed

BY: RONALD L. VALMASSY, DPM

In an ongoing effort to share information with our lab service customers we present an article by Dr. Ronald Valmassy. The author presents the clinical considerations that need to be carefully thought about when designing a shock-attenuating orthotic device. Specific cushion materials and their application are also reviewed in detail.

Heel strike, mid-stance, heel-off, and toe-off. We all pass through these stages millions upon millions of times during our lifetimes. Active individuals who run will proceed through heel strike, mid-support, and take-off with increased shock occurring at each footfall. Forceplate investigations of measured ground reactive forces during running indicate that individuals are likely to generate up to 3.6 times their body weight at heel strike with every step. This adds up to a significant amount of force and shock absorbed by the lower extremities over an average person's lifetime. How do our bodies adapt to so much shock?

The body dissipates this energy via both active and passive mechanisms. Active mechanisms include subtalar joint pronation, proprioceptive compression, and muscle toning. Passive shock absorbing mechanisms include the elastic properties of bone, cartilage, and soft tissue (vertebral disks and menisci), synovial fluid, ligaments and tendons of the foot, the heel pad, and calf muscles. Where there is a deficiency in any of these, the body's ability to properly attenuate shock is greatly diminished and injury may occur. This may be evidenced by such common problems as plantar fasciitis, low back pain, Achilles tendinitis, and stress fracture.

On a broader scale, recent research has indicated that an inability to properly absorb shock may result in more significant, long-lasting problems. Prolonged repetitive loading has an effect on both the weight-bearing articular cartilage and on the architecture of its underlying bone. Additionally, there seems to be a direct correlation between a variety of degenerative joint diseases and the shock absorbing capacity of the human locomotor system.

Therefore, when evaluating a patient with lower extremity problems, the practitioner should consider how the individual's body is attenuating shock during his or her normal day-to-day activities. Once all the variables are weighed, including presenting symptoms, level and type of activity, and overall lower extremity function, the practitioner may initiate an attempt to improve the situation.

As always, appropriate evaluation of the patient includes assessment of the lower extremity ranges of motion, manual testing of the intrinsic and extrinsic foot muscles, and appro-

priate gait analysis. If the practitioner finds that there are sufficient biomechanical reasons for inadequate shock absorption to occur, prescribing an appropriate orthotic device becomes critical.

Several choices must be considered whenever a practitioner attempts to alter the shock-absorbing abilities of a patient's lower extremities. The most significant decision is that regarding what type of material to use. Although an initial reaction to a shock-absorption problem may be to prescribe a soft, flexible orthotic device, the patient may in fact require a firm, non-yielding type of orthosis to provide adequate shock absorption.

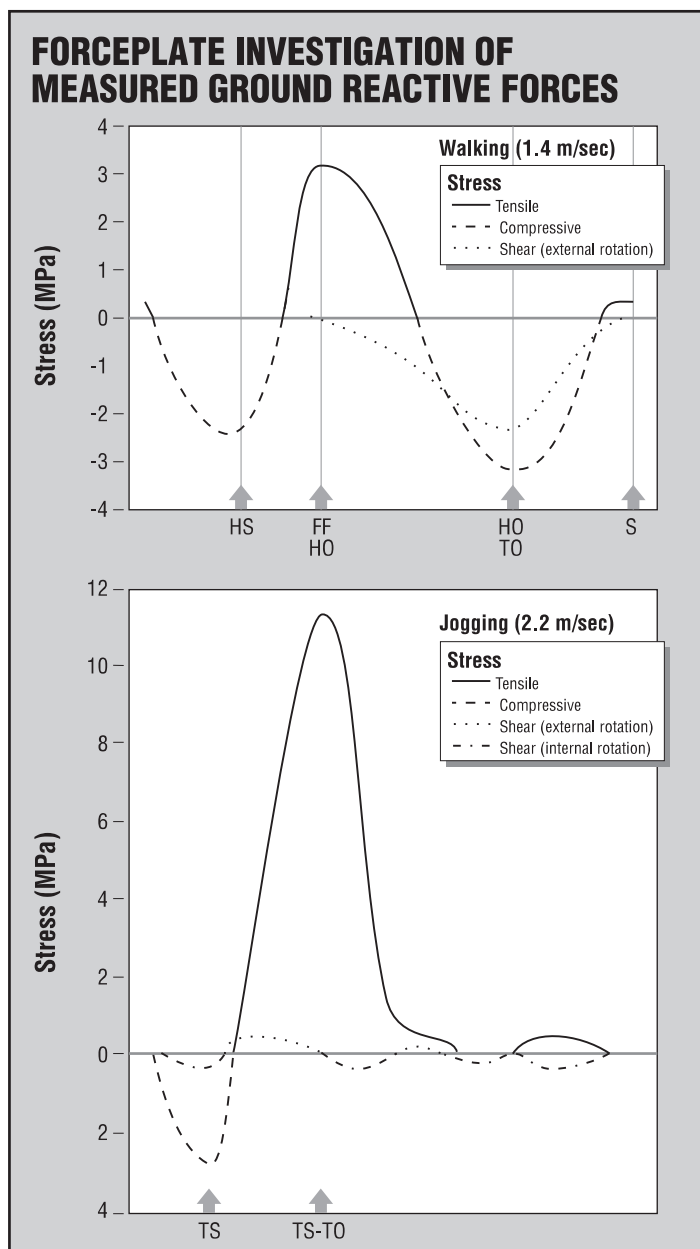
Consider the long-distance runner with a history of multiple lower extremity stress fractures involving the tibia and metatarsals. If this runner functioned with a fairly rigid cavus foot type that demonstrated minimal subtalar joint eversion (as is seen with an uncompensated or partially compensated rearfoot varus), a soft type of orthotic device might be the best one for him or her.

On the other hand, a different long-distance runner demonstrating similar symptoms but possessing a more pronated foot type, would probably not benefit as much from a soft device as from a more rigid type of orthosis. A more rigid device would be capable of arresting the extreme degree of abnormal frontal and transverse plane motion demonstrated by this patient at heel contact and midstance. As Root originally noted, a rigid orthosis combined with a rearfoot varus post and adequate rearfoot motion should be capable of allowing 4° to 6° of normal heel contact pronation. This in turn would promote normal internal tibial rotation with subsequent flexing of the knee. In other words, the body's normal inherent shock-absorbing mechanisms would be allowed to function. Although a soft device may also be utilized for this type of patient, the practitioner must be prepared to regularly adjust or replace the device as the material becomes compressed.

This leads to another consideration regarding shock-absorbing materials. Which specific materials should be used to provide increased shock absorption for our patients?

A single material may be used to fashion an entire orthotic device, two or more may be utilized in combination, or a flexible material may be laminated with thicknesses of more rigid material, such as 1/8-inch polypropylene, to provide both increased shock absorption and moderate biomechanical control of the abnormal foot function.

Some of the more commonly used materials for shock absorption are Plastazote, closed-cell rubber, and open-cell polyurethane foam.



Top: Calculated stresses on the anteromedial cortex of a human adult tibia during walking. Bottom: Calculated stresses on the anteromedial cortex of a human adult tibia during jogging. HS - heel strike; FF - foot flat; HO - heel-off; TO - toe-off; S - swing. (After Lanyon et al, 1975; courtesy of Dennis R. Carter, Ph.D.) Figure reproduced courtesy of Lea & Febiger/Williams and Wilkins from: *Basic Biomechanics of the Musculoskeletal System*, ed 2.

Plastazote is a cross-linked polyethylene foam of closed-cell construction. The foam is composed of polyethylene and nitrogen gas. It is moldable, inert, nontoxic, and impervious to water. It is manufactured in a variety of densities, which are often laminated together to increase function and durability. Overall, however, this material is somewhat limited due to its poor shape retention and ease of compressibility. If you

choose this material, consider laminating two or three densities together, with firm black Plastazote for the bottom layer.

Closed-cell rubber (e.g., Spenco) consists of a mass of natural or synthetic rubber containing multiple pockets of nitrogen gas evenly distributed throughout the material. When used in gait, this material will retain approximately 70% of its original thickness on a day-to-day basis and will return to shape after the deforming force is removed. The thickness of the material determines its ability to reduce shock at heel strike. One-eighth-inch Spenco is often utilized as a topcover for a more rigid functional type of orthosis and seems to be extremely beneficial for individuals engaged in long-distance running, as well as high-impact or step aerobics.

Open-cell polyurethane foam (e.g., PPT) is a frothed cellular urethane material that is soft, resilient, and protective. It is often considered analogous to a soft-tissue supplement that has good application when attempting to protect tissue from damage caused by pressure, shock, or shear forces. This material seems to work well in combination with other, firmer materials. It makes an excellent topcover or forefoot extension. Additionally, it provides excellent shock absorption when used as an arch filler in combination with a functional 1/8-inch polypropylene orthosis.

Ronald Valmassy, DPM, is a professor and past chairman of the department of podiatric biomechanics at the California College of Podiatric Medicine. He is also a staff podiatrist at the Center for Sport Medicine of Saint Francis Memorial Hospital in San Francisco.

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Lower Leg Walkers

The purpose of this article is to share some of our fitting, modifying and dispensing experience of lower leg walkers.

Lower leg walkers are used in the treatment of a variety of conditions including:

- Stable fractures of the foot and distal tibia and fibula,
- Stress fractures of the metatarsals, distal tibia and fibula,
- Diabetic pathologies including recalcitrant plantar ulcer management, and
- As an alternative to plaster or fiberglass casting in a number of post-surgical applications including Achilles tendon repair and fixation of avulsed bone fragments.

Of the dozen or more brands of walkers on the market we have experience dispensing and/or evaluating most of them. We have chosen to carry in inventory the “Foam” and “Pneumatic” walkers by Aircast and have recently added the “DH” and “Equalizer Air” products by Royce Medical. We have found both brands to be well made, versatile and supported by excellent warranty policies. Although these brands are not the least expensive on the market we have found them to be the best.

- For more non-diabetic applications fitting is quite simple—select the appropriate size, perform a trial fit, adjust the straps and air volume where applicable, and instruct patient on proper application. Careful attention must be paid in cases where the patient has a planus foot type with a prominent navicular. Adding an “arch cookie” on the patient’s foot orthotic, if they use them, will prevent irritation of the navicular and medial malleolus caused by contact with the plastic shell.
- For achilles tendon repair applications we add a 4-6 cm, multi-layered, firm EVA heel-to-metatarsal-head lift. Spot gluing the layers allows the patient, under the

guidance of their physician or therapist, to gradually decrease the height of the lift as rehab progresses.

- Diabetes applications require the most careful attention and often the most modifications. In all diabetic cases we remove the manufacturer’s insole and the gray “Poron-like” heel lift from the Aircast products and replace them with either a 3/8 inch Poron-plastazote insole or a custom made *Tridensity* orthotic. The Royce “DH” model comes with a “pressure relief insole” making replacement with a Poron-plastazote insole unnecessary. We have found the Aircast “Pneumatic” and Royce “DH” models to be best suited for diabetic patients. For patients with significant edema, the Aircast products are often too narrow in the mid-foot and calf areas. The Royce products will accommodate this type of patient best. The Aircast has a narrow rocker-bottom that makes it perfect for some but feels unstable to others. For those who feel unstable, the Royce products wide rocker-bottom profile provides a greater feeling of stability.
- Balancing patient leg length in all applications is critical. For short term use applications (6-8 weeks) we ask the patient to wear an athletic style shoe with an in-shoe lift on the non-braced side. For longer term applications we modify the mid-sole of a shoe to achieve leg length balance.



Matching the device to the patient’s activity and pathology, ensuring an accurate fit, and establishing

realistic outcome expectations is as important when dispensing walkers as it is with all types of orthopedic devices. We have found that it is often the little adjustments and modifications that make the difference between a comfortable patient and non-compliant one.

We welcome your input on this subject. If you are getting positive results with a particular product or modification we would like to hear about it.