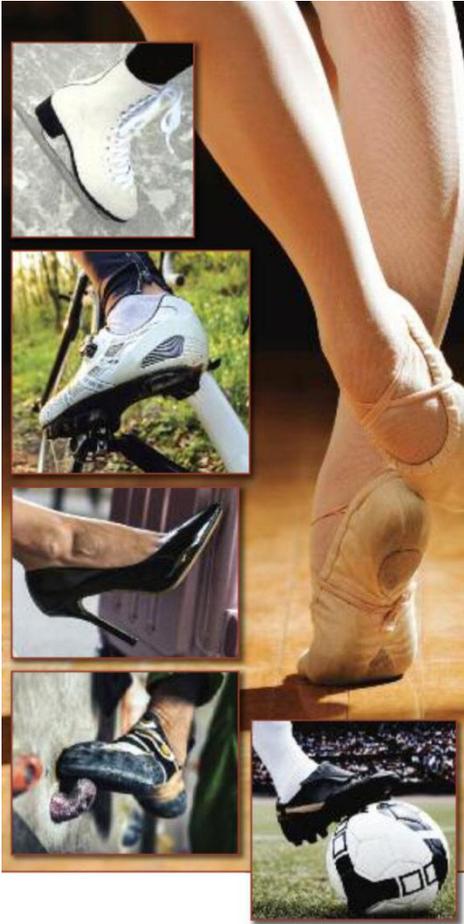


Unique orthotic strategies for low-volume footwear



The low-volume shoes worn by cyclists, figure skaters, and others can make orthotic management of these patients challenging. So, lower extremity practitioners have had to develop creative strategies for achieving the desired biomechanical effects while working within a limited space.

By Jill R. Dorson

Manolo Blahniks, soccer cleats, and an elegant new pair of figure skates might seem to have little in common. But—whether it’s stylish high heels, cleats that allow an athlete to truly to feel the ball, or a boot balanced atop a narrow blade—form-fitting shoes do a job on the feet. And, with little room to negotiate, low-volume styles of footwear can make it a challenge to insert foot orthoses to relieve or prevent pain and injury.

But, experts say, regardless of how much room is available in a shoe, the goals of orthotic management are consistent.

“Whether for a women’s dress shoe, skate, or a soccer cleat, the key is the biomechanical fit of the orthotic,” said Robert Weil, DPM, a podiatrist based in the Chicago suburban area. “Orthotics are all about alignment.”

Anecdotally, many practitioners prefer full-length orthoses for treating foot-related injuries or pain, but low-profile shoes—designed for anything from rock climbing to dance—often don’t allow for a full-length solution. So, practitioners working with such cases have to get creative—using tape, felt, or super-thin rigid inserts—to find ways to support feet and align joints.

The challenges differ from one type of shoe to the next.

Cleated sports



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On the face of it, cleats may seem an easy fit for foot orthoses. Roomier than many other athletic footwear (ie, cycling shoes, figure skates, or dance shoes), cleats present their own unique challenges, particularly when athletes have a preference for cleats that are too small. It is well known among clinicians that both soccer players and football kickers, for example, wear their cleats extra-tight to improve feel on the ball.

Multiple studies¹⁻³ have shown cleats are associated with increased pressure on the heel, lateral midfoot, and fifth metatarsal when athletes are running or turning. San Diego-based pedorthist and physical therapist Patricia Pande, PT, MCLSc, CPed, CSCS, has found tight cleats can also be associated with forefoot injuries. The range of potential injuries associated with cleats is wide, and includes plantar issues, ankle sprains, and other soft tissue or bone injuries.

Pande, formerly of Kinetic Physical Therapy in North Carolina and a faculty member at the University of North Carolina Physical Therapy Faculty Clinic in Hillsborough, recently relocated to Southern California to focus on research, writing, and her consulting firm, FootCentric.

For cleated sports, Pande favors carbon fiber inserts, which she said can be semicustomized for each athlete. Pande said the carbon fiber allows practitioners to increase the rigidity of cleats to make the foot and shoe more stable, and fits well into low-profile shoes. The material can be heated and shaped, allowing for tweaks. However, while carbon fiber lasts longer than the felt or foam favored for dance-shoe inserts, Pande said its life span is about a year or two—which is shorter than the polypropylene used for other specialty insoles.

Since soccer shoes are, overall, bigger than many other athletic shoes, practitioners are able to fit a full insert into the shoes.

“When I do injury profiling, I try very, very hard to put in a full-length insert,” Pande said. “Think about the excursion of the orthotic in the shoe. The shearing plays such a role in plantar fasciitis⁴ and can cause skin issues.”

As with other athletic shoes, the goal is to alleviate pain, redistribute pressure, and reduce the risk of injury. However, Pande is quick to point out that if the cleat is the “culprit,” she recommends orthoses for the cleat only, but if there is a more pervasive issue, the athlete should have inserts made for each pair of shoes he or she wears.

Regardless of how much room is available in a shoe, lower extremity clinicians say, the goals of orthotic management remain focused on alignment and biomechanics.

Cycling



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Few studies exist to test the use of orthotic devices in cycling shoes, which are typically made of rigid materials and are often attached directly to the pedal of a bike with toe clips. These shoes are not made for walking.

A March 2012 investigation in the German publication *Sportsverletz Sportschaden*⁵ found that, compared with the standard insoles that come with cycling shoes, carbon fiber insoles for cycling shoes were associated with lower plantar pressures in all foot regions except the toes. In an Australian study of 12 cyclists published in January 2013 by the *Journal of Science and Medicine in Sport (JSMS)*,⁶ contoured prefabricated orthoses were associated with greater foot contact area and greater perceived midfoot support than flat inserts of similar hardness. In a November 2011 JSMS study,⁷ a different group of Australian researchers found no overall kinematic effects of custom foot orthoses in a group of 12 cyclists, but did find subject-specific effects.

Such studies tend to have small numbers of participants and other methodological limitations, making it difficult to identify the clinical implications. A May 2014 systematic review in the *Journal of Foot and Ankle Research*⁸ concluded there is limited evidence supporting the use of insoles in cycling. In the August 2016 issue of the *International Journal of Sports Physical Therapy*, a review of interventions at the foot-shoe-pedal interface in cyclists reached a similar conclusion.⁹

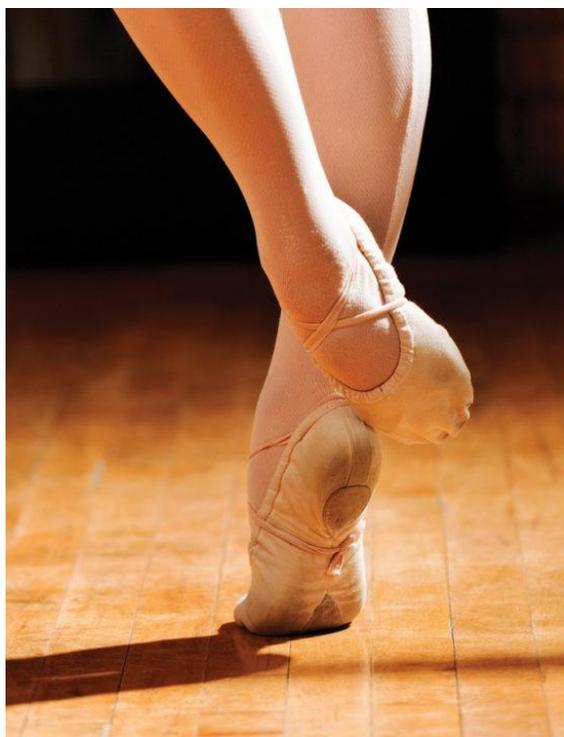
The goal in using an orthotic device in cycling shoes typically is to better distribute plantar pressure while the cyclist's shoes are clipped to the pedals. Results of the German study showed a decrease in pressure using custom carbon fiber insoles.

The most common injuries in cycling often relate to overuse, according to the American Academy of Podiatric Sports Medicine.¹⁰ Knee pain, shin splints, Achilles tendonitis, sesamoiditis, and numbness can often be traced back to the fit of the cycling shoe. A custom insert may help to solve these problems.

Custom orthoses for cyclists may be stiff (eg, carbon fiber or polypropylene) or more forgiving (eg, ethylene vinyl acetate [EVA]) depending on the nature of the injury or pain being treated. The only consistency in cycling inserts is size. Similar to dance shoes, the inserts are small and the focus is on the ball of the foot due to the limited amount of space inside the shoe.

An April 2014 *LER* article¹¹ explored in more detail the contradictions that arise when prescribing orthotic devices for cyclists and the lack of meaningful research on which to base this aspect of clinical practice. Experts interviewed in that article suggested that high-performance road cyclists may benefit from rigid inserts, while recreational cyclists may get relief from more flexible options.

Dance shoes



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Of all the challenges involved in getting foot orthoses into specialty shoes, dance shoes may present the toughest. Putting aside the fact that modern dancers go barefoot, leaving taping as the only real alternative, dance shoes often don't allow for a full-sized insole, according to Jeffery A. Russell, PhD, AT, FIADMS, an assistant professor of athletic training and director of science and health in artistic performance (SHAPE) at Ohio University in Athens. He noted a modified, smaller insert is usually the solution.

Like many other athletes, dancers often experience pain in other areas—such as the ankle, knee, or Achilles tendon—that can be related to foot issues. Pain associated with hyperpronation, according to a 2013 *Journal of Dance Medicine & Science* study,¹² is a common issue in dancers that can be alleviated with foot orthoses. The study found orthosis use was associated with a decrease in pain, as well as in the static medial longitudinal arch angle.

According to Russell, dancers often present with pes planus or pes cavus, both easily managed conditions. High arches can be treated with a simple D-shaped support in the center of the shoe/foot. A donut-shaped orthosis can be used to alleviate pain from a heel spur or a teardrop-shaped pad can be inserted behind the metatarsal arch to absorb some of the shock to the metatarsal bones.

Unlike athletes wearing more rigid shoes, insoles for dance shoes are usually made of orthopedic felt (a thicker, more durable cousin of art felt), closed-cell rubber foam, leather, cork, or a variety of soft and firm plastics. In Russell's experience, he has found that some of these orthoses require regular replacement (every few weeks) versus the longevity of a more rigid insert.

Among the biggest challenges is the ability of the dancer to become comfortable with the insole, which may require alterations to movement, Russell said.

“We’re not using a full orthotic, so we’ll often craft them ourselves,” he said. “If you’ve been a dancer for years and years, it’s going to change the sensation of the entire foot and that can throw them off quite a bit. ... The biggest thing is them getting used to it.”

Rock climbing



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Like athletes who wear cleats, rock climbers tend toward wearing specialty shoes that are smaller than their regular shoe size to get better feel. Perhaps not surprisingly, rock climbers are prone to neuromas, bunions, and other foot issues caused by shoe pressure and rubbing.

A March 2013 *Journal of the American Podiatric Medical Association (JAPMA)* article¹³ reported 86% of rock climbers sustain sport-specific foot injuries, ranging from nail disease to Achilles tendinitis. Anecdotally, experts say, the most common chronic injury is toe pain.

Jenny Sanders, DPM, principal podiatric physician at the Financial District Foot & Ankle Center in San Francisco, specializes in hiking and running issues. Sanders said her goal is to stabilize the big toe, though she often sees tendinitis (anterior tibial, posterior tibial, and Achilles) as well as plantar fasciitis. Climbing only once a week is enough to create foot issues, she said.

Rock-climbing shoes are made for a snug fit to allow the climber to better feel the surface he or she is climbing. Soles are generally stiff and may be thin, and the shoe can be downturned, forcing the foot into a plantar flexed position that is more conducive to climbing. Sanders said fit is critical to the sport, but suggests her patients go for a wider, if not longer, shoe to alleviate some issues.

Although the authors of the *JAPMA* article listed foot orthoses among the potential options for preventing and treating foot issues in rock climbers, Sanders said she prefers to tape her patients.

“There’s not a lot to talk about that because climbing shoes are incompatible with orthotics. They’re even incompatible with socks,” Sanders said. “Taping is great for climbing shoes and really the only option.”

Skates



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Weil has decades of experience with foot orthoses and has worked with some of America’s top figure skaters. When it comes to putting orthoses into any kind of skates, Weil said, there really is no downside.

“Balance, edging, propulsion, and stability are all enhanced with proper orthotics,” he said, noting joint malalignment can cause skaters to experience back pain, knee pain, or foot pain. “Alignment becomes a very, very big deal, especially when you are really starting to jump.”

Weil says there is little that is unique to fitting orthoses in skates, even tight-fitting figure skates. The boot of a figure skate is rigid—it may have up to three layers of leather—to provide ankle support, and the result is that other parts of the foot don’t conform to the pattern of the leather. Most often, Weil said, the skater experiences foot problems before the skate itself wears out.

The durable materials most often used in making orthoses for skaters—polypropylene and sometimes graphite—are the same materials often used in other sports and for nonathletes. Unlike his counterparts in other sports, Weil said he rarely uses topcovers with orthoses for skates.

“Polypropylene is great because you’re never going to break it,” Weil said. “And there are different kinds of graphite that can be made razor thin.”

Weil's anecdotal experiences are backed up by an August 2016 *Journal of Sport Rehabilitation* study,¹⁴ which reported notable improvement in postural stability after skaters used custom insoles for six weeks. The study found center of mass sway and ankle sway were reduced, leading to improved balance.

Dress shoes



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High-heeled shoes can put exceptional pressure on the ball of the foot, causing capsulitis, calluses, Morton's neuroma, or sesamoiditis, according to Larry Huppin, DPM, clinical professor of podiatric medicine and surgery at Western University of Health Sciences' College of Podiatric Medicine in Pomona, CA.

While the height and tightness of the shoe often contribute to pain or injury risk, experts say a shoe's elevation is not critical when developing an insert. Rather, as with other low-volume footwear, it is space.

To that end, Huppin, who practices in Seattle, favors a cobra-shaped insole, which helps relieve pain in the ball of the foot but nearly eliminates the heel cup of a conventional foot orthosis. The cobra design provides support for the ball of the foot and the arch, but the heel cup is replaced by a piece that looks like a curved tail.

"The goal is to make or get [patients] into a prefabricated orthotic to grab the arch and transfer pain off the ball of the foot," Huppin said. "You're very limited in what you can fit into a dress shoe ... so if I can get a cobra device that attaches really well to the arch of the foot, then I think I am doing the best I can do."

Huppin noted that women may experience pain in the forefoot, as well as overall foot fatigue, when wearing heels.¹⁵⁻¹⁷ Such issues can be prevented by fitting an orthoses before pain arises, but Huppin also said that insoles, possibly in concert with other treatments, often resolve the issue. He is quick to point out that inserts "can take pressure off, but won't get rid of inflammation."

Whether custom or prefabricated, Huppin said foot orthoses for dress shoes are often made of long-lasting polypropylene with an EVA filler and a light topcover of either vinyl or leather. Overall, the device is rigid, but

the cobra style allows for some flexibility in the heel. Because the orthoses are not truly full-sized, Huppín said, they won't last as long as a polypropylene version made for roomier shoes, but should last several years.

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