Dynamic Chiropractic

ORTHOTICS & ORTHOPEADICS

# Surprising Reasons for Orthotic Efficacy

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Clinical outcome studies show orthotics are effective in the management of a wide range of injuries, including plantar fasciitis, Achilles tendinitis and patellofemoral pain syndrome. In addition to treating acute injuries, orthotics also may play a role in preventing injuries. In a randomized, controlled trial published in *American Journal of Sports Medicine*, 400 military recruits treated with orthotics were 50 percent less likely to suffer overuse injury.[1]

The exceptional clinical efficacy of orthotic intervention explains why 80 percent of chiropractors prescribe orthotics for 20 percent of their patients. However, in spite of their clinical popularity, there continues to be considerable controversy regarding their exact mechanism of action.

It has been a long-held belief that the main reason orthotics work is because they improve skeletal alignment. In fact, the origin of the word *orthotic* stems from the Greek word *ortho*, meaning straight. It seems intuitive that if you support a pronated foot with an orthotic, the calcaneus will become more vertical (i.e., straighter), causing the lower extremity to rotate externally, thereby improving alignment at the knee. These coupled movements have been theorized to continue along the entire kinetic chain, with some research suggesting foot orthoses may help reduce low back pain.[2]

Surprisingly, a significant body of information suggests this may not be the case, as most three-dimensional research suggests orthotic intervention produces little change in frontal-plane rearfoot motion during the gait cycle.[3-6] In an exceptionally detailed study, Stacoff, et al.,[5] surgically implanted intracortical pins into various bones of the lower extremity (the gold standard for studying 3-D motion) and concluded orthotics produce little to no change in rearfoot eversion during the gait cycle. More recently, Nowaczenski, et al.,[6] performed an interesting three-dimensional analysis and determined individuals with low arches actually have increased ranges of rearfoot eversion while wearing orthotics.

The inability of orthotics to modify frontal-plane movement of the rearfoot caused investigators to come up with alternative theories to explain the mechanisms responsible for the beneficial clinical outcomes associated with their use. Messier and Pittala[7] suggest orthotics work because they alter the velocity of pronation, while others claim orthotics work because they decrease tibial rotation and/or delay impact and loading rates of vertical ground-reactive forces. It is also suggested that orthotics work because they improve proprioception, decrease ankle inversion moments, decrease genu valgum and/or decrease external rotation moments at the knee.

In an interesting evaluation of 3-D motion with custom orthotics, Williams, et al.,[8] studied the effect of standard foot orthoses and inverted orthoses on lower extremity function. The standard foot orthotics were made from graphite shells with 4 degree varus posts, while the inverted orthotics were made

from the same materials, but possessed extremely high post angles; i.e., the rearfoot of the orthotic shell was inverted as much as 25 degrees. Despite the extremely high post angles, subsequent 3-D gait analysis revealed absolutely no differences in frontal-plane movements of the rearfoot, as the maximum degree of calcaneal eversion was unchanged. In fact, almost half of the subjects in both orthotic groups actually everted farther than the controls.

Even though they had no effect on rearfoot motion, the inverted orthotic devices significantly decreased the inversion moment at the ankle (54 percent in 10 of 11 subjects), while the standard orthotic decreased the inversion moment by 27 percent (eight of 11 subjects). This translates into a considerable reduction in muscle strain placed on the medial leg musculature with both devices.

In perhaps the most detailed three-dimensional study performed to date, McLean, et al.,[9] evaluated lower extremity biomechanics in 15 runners fitted with custom orthotics. Each orthotic was posted to 5 degrees varus and was manufactured by an accredited orthotic laboratory. After recording joint and kinematic data, the authors calculated the rearfoot eversion angle, rearfoot eversion velocity and ankle inversion moment at discrete points during stance for the orthotic group and the control group.

Using this detailed approach, the investigators demonstrated that orthotic intervention significantly decreased maximum rearfoot eversion from 15-50 percent of stance phase; and that rearfoot eversion velocity was significantly decreased both immediately following heel strike, and at 10 percent and 15 percent of stance phase. In addition, the orthotic group exhibited a reduced ankle inversion moment from 15 percent through 70 percent of stance, which the researchers claim lessens strain on the tibialis posterior muscle as it decelerates subtalar joint pronation. Although the overall range of eversion was unchanged, orthotic intervention significantly reduced the velocity of pronation and improved mechanical efficiency at the ankle.

In addition to altering the velocity of lower extremity motion, other researchers suggest orthotics work because they improve proprioception. In 2005, Hertel, et al.,[10] performed an interesting study in which they evaluated vastus medialis and gluteus medius muscle function while subjects performed single-leg squats and lateral step downs while wearing orthotics and again without orthotics. These researchers confirmed that orthotic intervention significantly increased activity in these muscles, perhaps explaining their efficacy in the management of patellofemoral pain syndromes.

Of note, the researchers determined improved muscle activity was present whether the subjects wore valgus posts to increase pronation or varus posts to decrease pronation. Apparently, orthotic intervention increased muscle activity not because the orthotics altered motion, but because they improved sensory input to the plantar surface of the foot, thereby enhancing proprioception.

As it turns out, orthotics are able to effectively manage a wide range of musculoskeletal disorders not because they alter the overall range of pronation, but because they decelerate the velocity of pronation, improve moment arms, distribute force over a broader surface area and enhance proprioception. While the concept of an orthotic tilting the calcaneus into a vertical position, thereby altering alignment of the entire lower extremity and pelvis, is appealing, it just doesn't happen. The 19th century British biologist T.H. Huxley had a great line: "Nothing kills a beautiful hypothesis more than an ugly fact." This statement is particularly true when it comes to understanding the real reasons for successful orthotic intervention.

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