

HOW FOOT ORTHOSES WORK – THERAPEUTIC EFFECTS

In the next series of ProLab newsletters, the biomechanical and therapeutic basis for the function of foot orthoses will be explored, or, in other words, the question of how foot orthoses work will be discussed in detail. Before covering the biomechanics behind how foot orthoses work, it will be helpful to review the research studies that have been published over the past 35 years that describe the therapeutic effectiveness of foot orthoses in treating various mechanically-related foot and lower extremity pathologies.

Beginning in the 1980s, many clinical studies were published which reported on the therapeutic effectiveness of foot orthoses. In a study of 81 patients in 1988, 91% were “satisfied with orthoses” and 52% “wouldn’t leave home without them” (Donnatelli R et al: Biomechanical foot orthotics: A retrospective study JOSP, 10:205-212, 1988). A 1991 study on 500 distance runners found that 76% of the runners reported complete resolution or great improvement of symptoms wearing foot orthoses (Gross ML et al: Effectiveness of orthotic shoe inserts in the long-distance runner. Am. J. Sports Med., 19:409-412, 1991). A 1993 study of 520 patients demonstrated that 83% were satisfied and 95% reported their problem had partially or completely resolved with orthoses (Moraros J, Hodge W: Orthotic survey: Preliminary results. JAPMA, 83:139-148, 1993). A study from 2003 showed that in 102 patients with patellofemoral pain syndrome (PFPS) 76.5% of patients improved and 2% were asymptomatic after 2-4 weeks of orthosis therapy (Saxena A, Haddad J: The effect of foot orthoses on patellofemoral pain syndrome. JAPMA, 93:264-271, 2003). In addition, in research from 2004 on 275 patients that wore orthoses for over a year, the majority of subjects obtained between 60-100% relief of symptoms, with only 9% reporting no relief of symptoms (Walter JH et al: A patient satisfaction survey on prescription custom-molded foot orthoses. JAPMA, 94:363-367, 2004).

Larger prospective studies have also been published which confirm the therapeutic effectiveness of orthoses. In 2009, a study of 179 subjects with PFPS were treated with either orthoses, flat inserts or physiotherapy and found that foot orthoses produced significant improvement in treatment success (85%) versus flat inserts (58%), with orthoses showing the same amount of improvement as physiotherapy (Collins N, Crossley K et al: Foot orthoses and physiotherapy in the treatment of patellofemoral pain syndrome: randomized clinical trial. Br J Sports Med 43:169-171, 2009). In 2011, 400 military officer trainees were followed prospectively over a 7-week period of basic training, and were divided into an orthosis group and a no-orthosis group. There were 61 injuries in the no-orthosis group and only 21 injuries in the orthosis group, including a 10-fold reduction in

medial tibial stress syndrome with orthoses (Franklyn-Miller A et al: Foot orthoses in the prevention of injury in initial military training. A randomized controlled trial. Am J Sp Med, 39:30-37, 2011).

Foot orthoses have also been found to reduce the painful effects of high plantar pressures. In 1999, custom orthoses were found to be effective at reducing plantar pain under the metatarsal heads in subjects with rheumatoid arthritis (Hodge MC et al: Orthotic management of plantar pressure ad pain in rheumatoid arthritis. Clin Biom, 14:567-575, 1999). In 2006, a prospective study of 151 subjects with cavus foot who wore custom foot orthoses for 3 months (Fig. 1) showed significant decreases in foot pain, increases in quality of life and three times greater plantar forefoot pressure reduction when compared to sham insoles (Burns J et al: Effective orthotic therapy for the painful cavus foot. JAPMA, 96:205-211, 2006). In addition, in 2006, Dr. Paul Scherer and coworkers found that

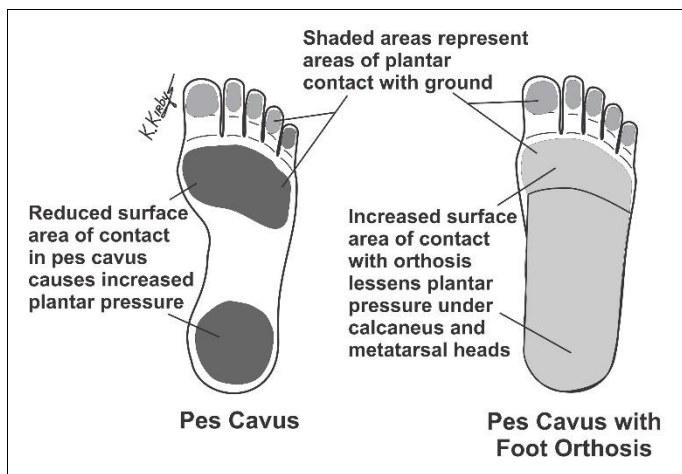


Figure 1. In a foot with a pes cavus deformity, there will be increased plantar pressure under the calcaneus and metatarsal heads due to the reduced surface area of ground contact in this high-arched foot (left). Research has shown that plantar pressures may be reduced with foot orthoses in these feet, possibly due to the increased surface area of contact that orthoses provide (right).

orthoses reduced sub-hallux pressure during walking gait (Scherer PR et al: Effect of functional foot orthoses on first metatarsophalangeal joint dorsiflexion in stance and gait. JAPMA, 96:474-281, 2006).

The effects of plantar pressure reduction in the orthosis treatment of diabetic foot ulcers have also been researched. In 8 patients with plantar neuropathic ulcers that healed with custom orthoses, orthoses significantly reduced peak pressure, reduced pressure/time integral and increased contact area versus the no-insole condition (Raspovic A, et al: Effect of customized insoles on vertical plantar pressures in sites of previous neuropathic ulceration in the diabetic foot. Foot, 10:133-138, 2000). Also, in 81 type II diabetic patients, orthoses were found to cause a 30% reduction in maximum peak plantar pressure (Lobmann R, et al: Effects of preventative footwear on foot pressure as determined by pedobarography in diabetic patients: a prospective study. Diab Med, 18:314-319, 2001). Likewise, in a study of 34 adolescent Type I diabetic patients, peak plantar pressure and pressure-time integral were found to be reduced (Duffin AC et al: High plantar pressure and callus in diabetic adolescents. Incidence and treatment. JAPMA, 93:214-220, 2003).

Foot orthoses have also been found to reduce the incidence of foot and lower extremity stress fractures. In a prospective study of 295 military recruits, orthoses reduced the incidence of femoral stress fractures in recruits with pes cavus and reduced the incidence of metatarsal fractures in recruits with pes planus (Simkin A et al: Combined effect of foot arch structure and an orthotic device on stress fractures. Foot Ankle, 10:25-29, 1989). Furthermore, in a prospective study of 404 infantry recruits, orthoses were found to reduce the incidence of stress fractures by 11.3-16.3% compared to the non-orthosis group (Finestone A et al: Prevention of stress fractures using custom biomechanical shoe orthoses. Clin Or Rel Res, 360:182-190, 1999).

Special valgus-wedged foot orthoses have also been shown to reduce the symptoms seen in individuals with medial knee osteoarthritis (OA). In 2004, in a 24-month prospective trial on 156 patients with medial knee OA, significant reductions in NSAID usage were found in patients wearing valgus-wedged orthoses (Pham T, et al: Laterally elevated wedged insoles in the treatment of medial knee OA: a two-year prospective randomized controlled study. Osteo Cartilage 12: 46-55, 2004). In addition, in another study using 30 subjects with medial knee OA treated with valgus-wedged orthoses, it was found that their pain levels had significantly reduced at 3 and 9 weeks after receiving foot orthoses for their knee pain (Rubin R, Menz HB: Use of laterally wedged custom foot orthoses to reduce pain associated with medial knee osteoarthritis: A prelim. investigation. JAPMA, 95:347-352, 2005).

Research has also demonstrated that foot orthoses can improve balance during both unipedal and bipedal standing. In a 1996 study, orthoses were shown to significantly reduce postural sway in medial/lateral and in inversion/eversion platform movements in 13 injured versus 12 uninjured subjects (Guskiewicz KM, Perrin DH: Effects of orthotics on postural sway following inversion ankle sprain. JOSPT, 23:326-331, 1996). In 2001, Hertel et al found a decrease in frontal plane center of pressure length and velocity with medially-posted orthoses in 15 healthy subjects during unipedal standing on orthoses (Hertel J, Denegar CR, et al: Effect of rearfoot orthotics on postural control in healthy subjects. J Sport Rehabil, 10:36-47, 2001). In addition, in 50 subjects with pronated feet, wearing orthoses was found to improve balance during bipedal standing via reductions in medial-lateral sway (Rome K, Brown C: Randomized clinical trial into the impact of orthoses on balance parameters in excessively pronated feet. Clin Rehab, 18:624-630, 2004).

Overall, scientific research clearly confirms that foot orthoses are very effective at treating a multitude of mechanically-related conditions of the foot and lower extremity. From treating running-related injuries and medial knee OA, preventing stress fractures, reducing plantar pressure and pain, and improving balance, orthoses have been repeatedly shown to be an effective medical treatment. The next few newsletters will describe, in detail, the biomechanics behind how foot orthoses achieve these amazing therapeutic results.



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