Orthotics and Prosthetics

Design and Prescription of Advanced Orthotics

Researchers at Extremity Trauma and Amputation Center of Excellence (EACE; Center for the Intrepid [CFI], San Antonio, Texas) are continually striving to improve the design and prescription criteria for advanced orthotic devices. Subtle modifications to factors such as the alignment, bending axis, or heel wedge properties of a dynamic ankle-foot orthosis can have important implications for walking and running performance (*Brown, Russell Esposito, and Wilken 2017, Ikeda, Fergason, and Wilken 2017, Russell Esposito, Ranz, et al. 2017*). For example, little is understood about how foam heel wedge properties affect an individual's gait, despite the integral part these wedges play in the ankle-foot-orthosis system. Researchers at EACE (CFI, San Antonio, Texas) evaluated the biomechanical effects of altering heel wedge properties when walking with the Intrepid Dynamic Exoskeleton Orthosis (IDEO) and found that both the height and durometer of the wedge systematically affected gait. The results led to new developments in wedge design to include a style contoured to a greater length of the plantar surface of the ankle-foot orthosis (Figure 1). The clinical translation of the research findings had an immediate positive impact on patient care both within and outside of CFI.

The advancement of dynamic ankle-foot orthosis, such as the IDEO, has led to improved outcomes for Service members with lower limb reconstruction. These are often patients who may have otherwise undergone limb amputation and comparisons between the two procedures are critical, particularly when considering the advanced prosthetic and orthotic devices now available. Researchers at EACE (CFI, San Antonio, Texas) conducted a study to compare lower extremity biomechanics during walking in 72 individuals with lower limb reconstruction with IDEO use, transtibial amputation with passive prosthesis use, or no injuries (able-bodied controls) (*Russell Esposito, Stinner, et al. 2017*). The gait deviations that were present were most apparent in the knee in individuals with transtibial amputation and at the ankle in patients with lower limb reconstruction wearing the semi-rigid IDEO, but both groups were able to replicate many aspects of normative gait mechanics. The clinical decision leading to amputation or lower limb reconstruction is complex and multifactorial. The more comprehensive the understanding of outcomes associated with each procedure, the more information clinicians have for counseling patients who have sustained severe extremity injuries.

These studies were funded by EACE and the Center for Rehabilitation Sciences Research, Brooke Army Medical Center.

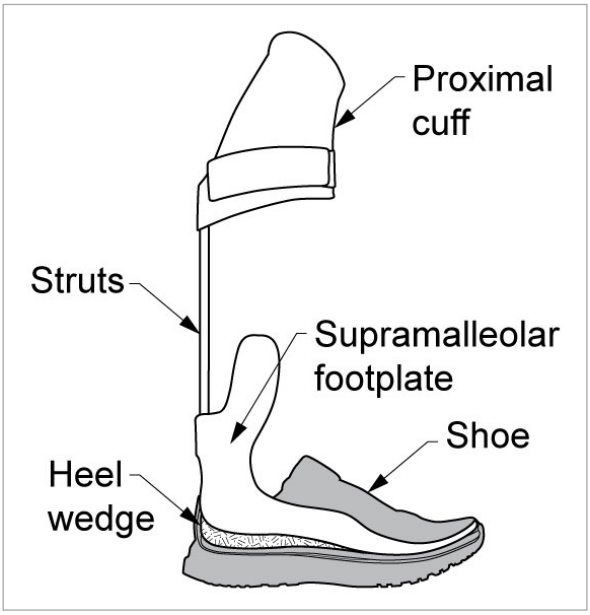

FIGURE 1: IDEO–heel wedge–shoe system. The new style heel wedge, shown in hash mark fill, sits in the shoe under the IDEO. (Figure 1 from Ikeda, Fergason, and Wilken (2017) used with permission from the authors)

REFERENCES:

Brown, S. E., Russell Esposito, E., and Wilken, J. M. 2017. "The Effect of Ankle Foot Orthosis Alignment on Walking in Individuals Treated for Traumatic Lower Extremity Injuries." J Biomech 61:51-57. doi: 10.1016/j.jbiomech.2017.06.037.

Ikeda, A. J., Fergason, J. R., and Wilken, J. M. 2017. "Effects of Altering Heel Wedge Properties on Gait with the Intrepid Dynamic Exoskeletal Orthosis." Prosthet Orthot Int:309364617728116. doi: 10.1177/0309364617728116.

Russell Esposito, E., Ranz, E. C., Schmidtbauer, K. A., Neptune, R. R., and Wilken, J. M. 2017. "Ankle-Foot Orthosis Bending Axis Influences Running Mechanics." Gait Posture 56 (147-152):147-152. doi: 10.1016/j.gaitpost.2017.04.023.

Russell Esposito, E., Stinner, D. J., Fergason, J. R., and Wilken, J. M. 2017. "Gait Biomechanics Following Lower Extremity Trauma: Amputation vs. Reconstruction." Gait Posture 54:167-173. doi: 10.1016/j.gaitpost.2017.02.016.