



US DEPARTMENT OF DEFENSE  
**BLAST INJURY RESEARCH PROGRAM**  
**COORDINATING OFFICE**

## Orthotics and Prosthetics

### The Influence of Ankle-foot Orthosis Stiffness on Walking Performance in Individuals with Lower-limb Impairments

Researchers at the CRSR at USUHS studied the influence of the stiffness of ankle-foot orthoses (AFOs) on gait performance improvement in patients with unilateral lower-limb neuromuscular and musculoskeletal impairments. Passive-dynamic AFOs utilize stiffness to improve gait performance through elastic energy storage and return. However, the influence of AFO stiffness on gait performance has not been systematically investigated, largely due to the difficulty of manufacturing devices with precisely controlled stiffness levels. Additive manufacturing techniques, such as selective laser sintering (SLS), were used to manufacture AFOs with controlled stiffness levels. Three-dimensional and electromyographic data were collected from each participant while walking overground with each of three orthoses of varying stiffness. As the AFO stiffness decreased, ankle range of motion and medial gastrocnemius activity increased while the knee became more extended throughout stance. Individuals effectively compensated for changes in AFO stiffness with altered activity of the gastrocnemius muscle, and the stiffness levels analyzed in this study had a minimal effect on overall walking performance. The study, published in *Clinical Biomechanics*, suggests that orthotists do not need to focus on identifying optimal orthotic stiffness for individuals who will primarily be using it for low-impact activities such as walking.