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Orthotics and Prosthetics

Novel Crossover Prosthetic Foot Enhances Health Outcomes for Service Members, Veterans, and Civilians with Lower Limb Amputation

Service members, Veterans, and civilians with lower limb amputation often require multiple prostheses to engage in a variety of vocational and recreational activities. Although specialized or activity-specific prostheses can allow users to perform at a high level, they also require additional expense, maintenance, and effort to use. There is therefore a need for prosthetic components capable of functioning across a range of activities. Crossover feet, which integrate the extended carbon fiber keel and posterior socket attachment of a running-specific foot with the carbon fiber heel and foot shell of traditional energy-storing feet, have been designed by Davidson Prosthetics (Puyallup, Washington) and Össur (Reykjavik, Iceland) to fulfill this purpose (*Hafner et al. 2017*; Figure 1). In principle, crossover feet should allow lower limb prosthesis users to effectively perform both low-level activities like walking indoors and high-level activities like jogging, running, or playing sports. However, research is needed to determine whether crossover feet can match or exceed the performance of energy-storing feet generally provided to Service members, Veterans, and civilians with lower limb amputation as part of their standard of care.

Crossover feet can fulfill injured Service members' need for a robust, multi-purpose prosthetic foot. They provide low-level performance equal to modern energy-storing feet, but enhance users' abilities to engage in a range of high-level activities.

Researchers at the University of Washington (Seattle, Washington) conducted a randomized crossover study to compare laboratory-based and community-based outcomes associated with use of crossover feet (Össur Cheetah Xplore) to standardized energy-storing feet (Össur Vari-flex). Participants with transtibial amputation received duplicate prostheses with each type of foot, and wore each for a minimum of one month prior to testing. Laboratory-based outcomes included walking endurance, perceived exertion, and walking performance (e.g., speed and step length, width, and time). Community-based outcomes included step activity and reported mobility, fatigue, activity restrictions, balance confidence, and satisfaction. Participants were also interviewed regarding activities in which performance of the feet differed.

Results from unilateral prosthesis users (n=26) who participated in the study indicated crossover and energy-storing feet offer generally equivalent laboratory-based performance (i.e., while walking at normal speeds). However, participants took significantly longer sound-side steps in the crossover foot. The crossover foot may therefore have the potential to mitigate secondary conditions and long-term impairment associated with asymmetrical gait. Although activity levels (i.e., daily step count) were not significantly affected, participants reported significant improvements in all community-based health





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outcomes when using the crossover foot. Interviews confirmed that participants preferred the crossover foot to the energy-storing foot for a number of activities, including walking over uneven terrain, walking on inclines, ascending stairs, playing sports, and running. Results indicate that crossover feet may be a promising prosthetic alternative to traditional energy-storing for Service members, Veterans, and civilians with transtibial amputation who engage in a range of mobility activities.

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Running-specific foot

Crossover foot

Energy-storing foot

FIGURE 1: Crossover feet (center) combine features of running-specific feet (extended carbon fiber keel and posterior socket attachment) and energy-storing feet (carbon fiber heel and foot shell). (Figure used with permission from the authors)

REFERENCES:

Hafner, B. J., Halsne, E. G., Morgan, S. J., and Davidson, G. 2017. "Functional Outcomes in People with Transtibial Amputation Using Crossover and Energy-Storing Prosthetic Feet: A Pilot Study." JPO: Journal of Prosthetics and Orthotics Published Ahead of Print. doi: 10.1097/jpo.000000000000163.

