Orthotics and Prosthetics

Running-specific Leg Prostheses

A multi-disciplinary collaborative team of researchers from the University of Colorado-Boulder (Boulder, CO), the Veterans Affairs (VA) Eastern Colorado Healthcare System, and VA Jewell Clinic Regional Amputation Center studied the effects of running specific prosthetic (RSP) model stiffness and heights on running and sprinting in Service members and Veterans with amputations. Participants in the study had unilateral (one side) or bilateral (both sides) transtibial (below the knee) amputations (TTAs). Their overall goal is to optimize the clinical prescription of RSPs, which will ultimately maximize recovery, restore function, and improve and expedite orthopedic rehabilitation for people with amputations, while simultaneously saving time, money, and resources.

The researchers analyzed the biomechanical and metabolic effects of 30 people with TTAs (20 with unilateral and 10 with bilateral TTAs) using 15 different RSP configurations during running and sprinting. Each athlete used three RSP models (Össur, Freedom Innovations, and Ottobock) with three stiffness categories per model (manufacturer recommended, and ±1 stiffness category) at three different heights (prosthetist recommended, and ±2 cm). They determined the optimal configuration for running as the RSP that minimized metabolic demand while the optimal configuration for sprinting was the RSP that maximized speed.

Runners with unilateral and bilateral TTAs minimized metabolic cost during running by using the least stiff J-shaped Ottobock 1E90 Sprinter RSPs. For individuals with bilateral TTAs, stiffness reduction improved metabolic cost by 3.7 percent. Sprinters with unilateral and bilateral TTAs achieved faster maximum speeds by using the J-shaped Össur Cheetah Xtend and Ottobock 1E90 Sprinter RSPs and did so by increasing peak vertical ground reaction force and decreasing leg stiffness. Sprinters with bilateral amputations did so by decreasing ground contact time and increasing peak vertical ground reaction force.

These findings suggest that athletes with TTAs can best optimize distance-running and sprinting performance by using a specific RSP model and stiffness.

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