Clinical Evidence for the use of Carbon Fiber Prostheses for Running

Overview

• The introduction of the carbon fiber flexible foot allows for the storage and release of mechanical energy, which previously was incapable with the use of a “SACH” type foot.1
• The evolution and use of the carbon fiber prosthesis has dramatically changed the capabilities of runners/sprinters, enabling amputees to achieve similar levels of athletic performance to the able-bodied athlete.1

Clinical Evidence

Power Output and Energy Return

• While carbon fiber prostheses exhibit improved energy efficiency compared to other prostheses, they do not come near the capabilities of the intact human foot.1,2
• Sprint feet while demonstrating improvement upon other carbon fiber flex type prostheses, they cannot produce the same power or work as a human foot.2,3

Energetics

• Energy cost increases with increasing amputation level and can be affected by prosthesis type during running.4
• Amputees running on carbon fiber running prostheses exhibit lower heart rates and lower VO2 levels than running on a prosthetic foot not intended for running.1

The Effect of Sprint Foot Shape and Stiffness

• Stiffness of the carbon fiber running prosthesis is associated with faster running speeds and increased running symmetry.1
• Wider C-shaped curves for sprinting prostheses have been found to improve speed and symmetry.1
• Varying degrees of stiffness and shape of the prosthetic foot can affect the speed and functionality of the runner.1

The Effect of Alignment, Mass, Position of the Center of Mass, and Inertia

• Shifting the load line of the limb posteriorly increases plantar flexion and puts a greater load on the toe, improving symmetry.5
• The prosthesis is made lighter than the residual limb to try to reduce the high metabolic cost exhibited by amputees during activity, as a decrease in prosthetic mass decreases the demand on the muscles to move the leg during the swing phase.1
• A running prosthesis needs to be lighter than the intact limb for an amputee to have similar energy costs as able-bodied persons.1
• Adjustments in the center of mass and inertia have been to alter gait kinetics.6,7


