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THE SWING PHASE OF WALKING WITH ABOVE-KNEE PROSTHESES

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After many years of development, fluid control of the swing phase of walking now exists in commercially available above-knee prostheses, and other models soon should pass the experimental stage. The purpose of this review of historic and modern principles for control of artificial knee joints during swing phase is to assist the professions concerned with amputee rehabilitation to provide these new devices, not only for appropriate disabled veterans but also for all others who may be able to use them effectively. The two papers following this discuss principles of mechanical and fluid friction, specific mechanisms, and recent clinical application studies (1, 2).

Fluid-controlled mechanisms for the *stance* phase are also to be expected. At least one example, the Henschke-Mauch Model A "Hydraulik" Swing-and-stance Control System, is at an advanced stage of evaluation. A subsequent issue of the Bulletin will consider this portion of gait.

FLUIDS

Fluid-controlled mechanisms make use in varying degrees of several key properties of fluids. Pressure at any point in a fluid is transmitted to all other points. Pressure at any point in a fluid is transmitted to all other points. A liquid is incompressible, for all practical purposes, within the range of pressure used in prosthetics. Thus, it can transmit energy or control signals from point to point, as in hydraulic brakes on an automobile, and can return reactions, as from a spring-loaded reservoir piston. A liquid also resists shearing forces as one layer of fluid slides over another. During oozing and slow "viscous" flow, this sliding occurs in an orderly fashion like cards in a deck; during more rapid "turbulent" flow, random whirlpool-like motions result. Another key feature of fluids is that resistance to flow increases rapidly as the flow rate increases, as we all know from experience with door closers. These properties are discussed in detail in the next paper "Properties of Fluid Flow Applied to Above-Knee Prostheses" (1).

Air and other gases can be considered fluids if they are subjected to only small changes in pressure. Generally, however, a pneumatic artificial knee control may be subjected to considerable changes in air pressure so that the compressed air behaves like the air springs supporting buses, yet also to such small pressure changes that leakage of air through a control valve follows to a considerable extent the rule of rapid increase in resistance for a small increase in speed of flow.

To continue reading, please visit http://www.rehab.research.va.gov/jour/64/1/1/5.pdf.