

International Encyclopedia of Rehabilitation

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Center for International Rehabilitation Research Information and Exchange (CIRRIE)

515 Kimball Tower

University at Buffalo, The State University of New York

Buffalo, NY 14214

E-mail: ub-cirrie@buffalo.edu

Web: <http://cirrie.buffalo.edu>

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Prosthetics

Andrew H. Hansen, PhD

Research Health Scientist

Jesse Brown VA Medical Center

Research Associate Professor

Dept. of Physical Medicine and Rehabilitation Northwestern University

Feinberg School of Medicine Affiliated Faculty, Dept. of Biomedical

Engineering McCormick School of Engineering and Applied Science

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Prosthetics are mechanical devices that aim to replace functions of missing body parts. The term prosthetics is used to describe devices that replace limb systems and also to describe internal joint replacement parts (e.g. hip or knee replacement joints). This article focuses on replacements of entire limb systems, commonly called prosthetics, prostheses, or artificial limbs.

Prosthetics are used by persons who have experienced amputations of limb systems or by persons who are born with limb deficiencies. These devices are not life-sustaining, but can improve a person's mobility and ability to interact with their environment. Prostheses are created for both upper limb and lower limb systems. In humans, the upper and lower limbs serve different purposes and experience different loading conditions during use. However, there are certain elements that are common to both upper and lower limb prostheses:

Coupling elements

Both upper and lower limb prostheses must be connected to the person in a way that provides adequate control of the device. Part of this coupling includes suspension of the device in situations where gravity would tend to remove it from the body. Another aspect of the coupling is the ability to transfer loads between the remaining (residual) limb and the prosthesis without causing pain or tissue breakdown. Coupling between the prosthesis and the person is usually established using a custom socket that fits over the residual limb. Sockets are made by casting the general shape of the residual limb and making a positive model of the limb. Modifications are then made to the positive model and a socket is created over the positive model to provide an intimate yet comfortable interface between the person and their prosthesis. Some prostheses are connected directly to bone in the residual limb (osseointegration) and use a structure that protrudes through the skin to connect to the rest of the prosthesis. This method of prosthesis connection is rarely used at this time due to issues of infection at the skin-implant interface.

End elements

The end element is a part on the distal end of the prosthesis that serves some function for the person. For an upper limb prosthesis, the end element may be a hook, a hand, or a

spoon, as examples. For a lower limb prosthesis, the end element is usually a prosthetic ankle-foot device to facilitate walking or running.

Connection elements

The coupling and end elements of a prosthesis are connected using connection elements. For some prostheses, the connection elements can be simple rigid tubes with fastening plates on either end to accept the coupling and end elements. In prostheses for high level amputations, the connection elements may also incorporate joints. For example, a prosthesis for a person with an above-knee prosthesis may have a prosthetic knee joint that can bend in swing phase of walking but that remains straight during the stance phase of walking.

Good coupling of the prosthesis with the body allows for better control of the end element's location in space. Most end elements for lower limb prostheses are flexible passive parts that do not require control other than that achieved through coupling and movement of the residual limb. Many upper limb end elements are more complex (hands or hooks that open and close, for example) that must be controlled through other means such as mechanical control through cables and harnessing or myoelectric control.

Prostheses are much simpler than the limb systems they replace. The relative simplicity stems from the need of the person to control the device and the requirement of the device to be robust and durable. Further advances in technology and our knowledge of human movement control should lead to improved prostheses for persons with missing limb systems.

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