A Terminal Device for Every Patient Need

(Continued from page 2)

Depending on the amputation level, an elbow component may be necessary even when the elbow joint remains intact. Patients with high forearm amputation may not have the residual strength to perform the pronation, supination and flexion movements necessary to support a terminal device; thus, body-powered systems incorporate various types of elbow hinges to help support the prosthesis and allow for the rotation necessary to power it. Electric-powered elbows, such as the Utah Arm, Boston Arm and the Hosmer Electric Elbow, include a friction or alternative turning mechanism to permit rotation of the humerus, as well as a locking feature to assist in positioning the terminal device. The ability to lift objects of some weight is critical, thus elbow component design is focused on providing reasonable lift capacity for functional use.

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Regardless of the type and mechanism of an upper-limb prosthesis system, most are designed to replace the intricate manipulation and grasping functions of the normal hand. A hand substitute or terminal device (hands, hooks and work or recreational tools) is adapted to the prosthetic system as needed by the patient.

Passive Devices — Passive, lifelike hands are appropriate for some patients. Some have bendable or spring-loaded fingers, allowing patients the ability to grip objects. Others are specially fitted with a wide array of options to allow for the performance of household chores, gardening, sports or manual work.

Active Prehensile Devices — Active components incorporating the ability to voluntarily open or close by means of a cable deliver a much higher level of function than more passive devices. Voluntary opening and closing hands provide a more acceptable cosmetic solution for some patients, while affording a mild to moderate degree of grip and movement.

Externally Powered Hands and Prehensors — Fulfilling the need for ever more precise replacement in matching the powerful force of the natural hand, researchers have developed a wide range of electric hands, hooks and grippers (or “greifers”) to enhance grip and functional capabilities.

Cosmetic gloves and sleeves are available with some hands to give a more natural appearance for patients who express that preference. The use of silicone-based gloves and sleeves has made them more lightweight and thus more acceptable for use by patients of all ages.

The march of technology continues to improve prospects and outcomes for upper-limb amputees.

We welcome your inquiries about possible Prosthetics Today

Building Blocks to Upper-Limb Restoration

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Patients referred to our practice for evaluation and restoration of an upper-limb deficiency, whether congenital or acquired, undergo a detailed process designed to provide the most practical and functional prosthesis for their individual needs, preferences and capabilities.

Definitive upper-limb prostheses cannot be pulled complete from a box but are unique combinations of socket type, suspension method, control scheme, perhaps wrist and/or elbow units, and a terminal (hand substitute) device. The management process is as much art as science.

Early intervention is key to a successful prosthetic upper-limb solution for patients undergoing amputation. Long-range success is normally best achieved with the patient at the center of therapeutic decision-making by a rehabilitative team including the amputating surgeon or rehabilitative specialist as team leader; a certified prosthetist for component selection, fabrication and fitting; physical therapist for residual limb care; occupational therapist for functional training; other professionals as needed, and the patient’s family.

Patients may be fitted with a preparatory prosthetic system to aid in their adjustment to the replacement limb. The preparatory system can be used to mold the residual limb in readiness for fitting of a more permanent device.

Componentry

Aside from simple cosmetic solutions, the ultimate goal of upper-limb prosthetics is restoration of manipulation and grasping functions lost to amputation or congenital deficiency.

(Continued on page 2)
The challenge with body-powered system sockets, with their associated harness and cables, is to sufficiently convey the biologi- cal movements needed to power the prosthesis. For myoelectric systems, the task is to secure electrodes against the skin covering muscle areas to convey signals and allow muscle con- version at the same time.

Newer systems incorporate self-suspending sockets with roll-on liners made of silicone or similar material. These liners provide the high levels of friction necessary to increase suspen- sion strength while maintaining secure skin contact.

Wrist and Elbow

A prosthetic wrist allows an amputee to ad- just a terminal device for optimal functioning. Both manual and myoelectric models are avail- able. The simplest are friction units that main- tain the terminal device in position under load while preventing undesired rotation; however, the amputee can still rotate the terminal device manually. Constant friction wrist units prevent rotation throughout the entire range of motion.

Quick-release wrist units, which allow the amputee to snap various terminal devices on and off quickly and lock them down firmly, are useful for frequent changes of implements for work or hobby activities.

Will Amputees Use Their Prosthesis?

Observations over the years have revealed adult amputees’ acceptance of upper-limb prostheses to be relatively low. On the other hand, practitioners have noted that children fitted with a prosthesis at an early age exhibit great potential for acceptance and success.

Optimal acceptance by adults seems to occur when the initial fittings are performed in the first week to 30 days after amputation. Adults seem to respond best to a comprehensive program wherein they are thoroughly introduced to the prosth- etic options with the ability to touch and feel the devices and understand their capabilities.

Therapists on the team are instrumental in evaluating how the patient works, uses his/her hands and arms, learns, and applies new knowledge. When these findings are integrated into an overall therapeutic plan, adult upper-limb amputees can claim a stronger ownership of their prosthetic system and its use.

For the best prosthetic outcome, patients should undergo careful and test socket fittings as soon as feasible after their full evaluation and receive and begin training in their prosthesis in the shortest time possible, with regular follow-up and adjust- ments along the way.

The Otto Bock Sensor-Hand SPEED electric ter- minal device adds a quieter motor and unprecedented opening and closing speed to its SensorHand “Auto- grasp” technology, which senses when an object is held in the hand and releases a grip force, then automati- cally adjusts tension, such as when filling a glass with water.

Motion Control’s powered terminal devices for the Utah Arm system include several hand components and a water-resistant hook-type component known as the ETD or Electric Terminal Device (see photo page 1). The ETD’s hook “fingers” generally permit finer functioning than hand-type fingers. Moreover, it’s ability to resist liquids allows wearers to engage in “wet” activities of daily living, such as showering, with the device in place.

Motion Control hands and the ETD all can be equipped with a new option called the Flexon Wrist, which can be set to one of three positions, allowing the wearer to flex or extend the wrist thus placing the hand in a more natural position for performing specific tasks.

What’s New

Note to Our Readers

Mention of specific products in our newsletter neither consti- tutes endorsement nor implies that we will recommend selection of those particular products for use with any particular patient or application. We offer this information to enhance professional and individual understanding of the orthotic and prosthetic disciplines and the experience and capabilities of our practice. We gratefully acknowledge the assistance of the following resources used in compiling this issue: Homser Dorrance Corp. • Liberating Technologies Inc. • Motion Control Inc. • Otto Bock Health Care • TRS Inc.
Upper-Limb Prosthetics—Both Art and Science

(Continued from page 1)

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areas to convey signals and allow muscle control concomitantly. As time-consuming maintenance or adjustments.

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Body-Powered Components

Conventional body-powered systems use movement
of the residual limb and shoulders to power a terminal device, prosthetic joint or locking mechanism. The force and motion necessary for movement are delivered by a cable and harness, which crosses the chest or shoulders. Each level of limb absence presents different prosthetic challenges. In general, the higher the level, the greater the challenge.

Advantages of body-powered systems are their relatively light weight, lower cost and high reliability. Disadvantages include the sometimes-exaggerated movements and high energy needed to operate the system. Nevertheless, body-powered systems have been the mainstay of upper-limb prosthetic solutions for decades.

externally Powered Components

Components whose function is provided by a dedicated power source, typically a battery, are most often controlled by electromyographic signals generated by muscle contraction in the residual limb and sensed by electrodes in the socket.

An alternate method of actuating externally powered components involves one or more touch pads strategically built into the socket for actuation by residual limb musculature. Like myoelectric sensors, touch pads are available with proportional speed control: the greater the input signal, the higher the speed of actuation. Advantages of externally powered components are their more automatic function, which does not require a cable or action of the amputee to generate movement. Disadvantages include higher cost and sometimes the need for a more complicated and time-consuming maintenance or adjustments.

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First Step

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