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Ruth Clark
CZ BioMed

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Socketless Option for Prosthetic Care



■ Socketless technology for prosthetics may revolutionize the prosthetics industry. c/o AP

Dr. Chaz Holder developed Socketless Technology for prosthetics, a revolutionary approach to prosthetic care. In this article, his colleague describes this technology and its many applications.

by Ruth J. Clark, CZ BioMed

Every individual with a disability desires the same three things:

1. A high quality of life
2. The freedom to pursue that life, including employment opportunities
3. Free and open access to the community in which he or she lives

Amputees, regardless of the country, society or culture in which they live, are no exception. High-quality prosthetic care is especially crucial to amputees who live in agrarian, non-technological societies where tilling the fields, grinding grain and cooking meals are all done with

few or no mechanical aids.

Traditionally, artificial limbs have been constructed utilizing a socket, individually fabricated to fit the residual limb. Socketless Technology for Prosthetics challenges conventional prosthetic wisdom by bio-mechanically replicating the function of the socket without the form. This technology was conceived by the late Dr. Chaz Holder (1947–2002), himself a triple amputee, who understood all aspects of amputee care from both the academic and the wearer point of view. Dr. Holder started developing the concept of socketless prosthetic technology in the mid 1990s. During the last one-and-a-

half years of his life, he wore a socketless above-knee prosthetic, and work is continuing on the socketless below-knee and above-elbow designs.

When Socketless Technology was first created, Holder was aware of the specific needs of humanitarian prosthetic missions. The requirements of amputees around the world are the same, regardless of the political and economic conditions they live in. Key requirements to ensure successful and continued prosthetic use are:

- Comfort and light weight
- High functionality
- Minimized secondary impact (heat and friction-related skin breakdown)
- Durability

Our first release, Below-Elbow Socketless Technology, has proven to be a superb solution to these problems, par-

ticularly in pediatric care. One of the biggest problems encountered when trying to fit pediatric patients is that residual limb growth will render a traditional socket based prosthesis unwearable in a matter of a few short months. In economically sound countries, this starts a continuous cycle of frequent limb fabrication during the primary growth years. Post-conflict and economically depressed countries do not have this luxury. The cost of this frequent replacement cycle carries an emotional cost for the patient, in addition to the financial costs, reduced productivity within the family due to traveling from the country to the prosthetic clinic in the city, as well as professional time. These may be some of the reasons pediatric patients often do not receive prosthetic assistance in many post-conflict countries.

Socketless limbs can be adjusted to accommodate change due to growth or shrinkage, allowing a pediatric amputee to stay in the same limb system for many years. One patient in North Carolina received a limb at age four and has been in the same device for close to three years. With the exception of minor repairs to the cosmetic cover (caused by play and roughhousing that all three- and four-year-olds should be involved in), the system has required no major modifications or component replacements. In landmine-affected countries, the incidence of children being injured by landmines is alarmingly high. As these children grow, they will eventually need to take their place in the work force. Access to high-quality prosthetic care as children is required if they are to become productive adults.

Likewise, patients with partial hands have traditionally been difficult to fit. In the past, the choice of surgical intervention has been decided upon, and in the case of children, authorized by guardian adults and medical personnel, acting in what they feel is the best interest of the child's future. Frequently, this revision surgery is only suggested to facilitate conventional socket fitting and not due to

the health of the hand. As new surgical techniques are developed, someone whose partial hand has already been removed will not have the opportunity to benefit from these future developments. A three-year-old congenital amputee with a partial hand (proximal palm only) and hypoplastic thumb has been using a Socketless Below-Elbow system with great success for well over a year. Fitting over, but not touching or encasing, the partial hand, this socketless limb allows for fully functional, active terminal-device (hook) control.

During the formative years, a child explores and learns about his or her environment and personal capabilities in many ways. The open exposure of the wrist and thumb afforded by the socketless system has an unforeseen benefit of providing the opportunity for the child to balance the learning of fine motor skills with both organic arms and hands. Tactile and sensory perception can also be learned symmetrically as both arms have similar weight and skin exposure during the daily wearing of a socketless prosthesis. Muscle and skeletal growth will continue equally in both limbs through the retention of the wrist.

Some advantages of Socketless Technology in Below-Elbow applications are:

- Socketless Option for Prosthetic Care Removable Immediate Post Operative Prosthetic (IPOP), allowing a below-elbow amputee to leave the hospital with independent, bilateral function. Familiarizing a below-elbow amputee with prosthetic function during the immediate post-surgical healing period will assist in the decision to consider prosthetic options as a permanent part of their future.

- It can provide a non-surgical option to obtain full prosthetic function for an individual with a partial hand.

- It can provide full, body-powered prosthetic function for an individual with reduced hand function due to partial paralysis, arthritis, etc.

- There is up to a 50 percent reduction in weight compared to socket-based

systems, which reduces fatigue and discomfort and assists with prosthetic acceptance and retention.

- It substantially reduces the number of devices needed to be constructed during a child's growth years, a substantial savings in clinic time, as well as professional and financial resources. Within an existing budget, as many as four times as many patients can be fit during the first year of introduction of this system. Due to the long life of the system, during subsequent years, fewer than 10 percent of the systems need to be re-fit each year.

- It can act as a secondary/back-up limb for sport and hobby activities (e.g., summer beach time, gardening, backyard mechanic, etc.). This preserves the function and aesthetics of a cosmetic socket, body powered prosthesis or myoelectric limb.

To date, more than 350 unilateral and bilateral amputees, including many children, have been provided with Socketless Below-Elbow limbs in six countries. Dr. Holder had also initiated plans to develop a Technology Transfer model to make his work available to amputees in post-conflict or economically poor areas of the world, based initially on the Below-Elbow limb. This work will be done through either existing or new medical facilities, with the techniques for manufacturing and assembly adapted to the specific capabilities and needs of that area. As additional design work is refined, each of these will also be made available. ■

Additional information on this work can be obtained from Dr. Holder's partner, Ruth Clark.

Contact Information

Ruth Clark
CZBioMed
Tel: (250) 314-1849
(866) 366-8366 (toll free)
859 Battle Street
Kamloops, B.C. Canada V2C 2M7
E-mail: info@czbiomed.md
Website: www.czbiomed.md