IMPACT OF UPPER LIMB PROSTHESIS SIMULATORS IN PROSTHETIC REHABILITATION

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ABSTRACT

Simulation technology is used in a number of health care arenas and has been utilized in the past with non-amputees as well as on the intact side of individuals with unilateral upper limb loss. This paper explores the impact of a body-powered simulator with interface to accommodate voluntary-opening and voluntary-closing terminal devices. It was used in education of occupational therapy students; in client consultation and in active therapeutic intervention.

INTRODUCTION

Evidence has been published regarding the beneficial impact of prosthesis-simulators. Bittermann (1968) cites use of such simulators with the non-amputee. This concept has been utilized for decades to impart empathy and to facilitate understanding operation of the body-powered technology. Weeks et al (2003) discusses the use of a simulator with uninvolved upper limb to successfully transfer skill of prosthesis use to the involved upper limb. Teaching individuals with upper limb deficiency to become adept with the prosthesis, its use and integration of it into acquisition of skills related to activities of daily living, work, recreation and social interactions can be challenging. As any practitioner of occupational therapy services knows, it is integral for beneficial outcomes that caregivers and other family members be involved in the process. Carryover of recommendations for all aspects of wear schedule of the prosthesis, skills-drills activities and adaptive strategies and techniques is essential for the successful outcomes of functional independence and positive perceived quality of life. Family members and other caregivers may be present during the prescriptive and therapeutic phases of the prosthetic program, but often lack first-hand experience of wearing/utilizing an actual prosthesis. Simulators of limited technology, such as a voluntary-opening device may be available to provide limited experience, but not readily accessible on an ongoing basis. This technology is typically used to provide a forecast to the consumer relative to expectations. Such simulators have also been used with clinicians and peer groups to advocate empathy and respect for individuals with UL differences and to enhance understanding of what is involved to strategically utilize body-powered prosthetic technology.

METHOD

Subjects: Subjects included distinct groups of occupational therapy students; clients, family members; and case managers. Apparatus: The VC-VO prosthesis simulators were used with each subject group for education, experience, impacting realistic expectations, providing evidence and inciting empathy. Method: Subjects were given initial training to skills drills followed by the opportunity to complete functional tasks. Sessions were recorded by video and responses were organized according to themes. Informed consent was received from human subjects. In a particular situation, a 45 year-old male who presents with acquired loss of both feet and both hands due to illness at the age of 11 months was offered the opportunity to use the simulators as pre-prosthetic preparation. His prior prosthetic experience is limited to 3 months as a child. His adaptive strategy of using both residual limbs at midline to accomplish tasks requires more time; overt posturing has appeared to cause mid and low back pain. The case study details use of the VC-VO prosthesis simulators at the time of evaluation and then weekly in pre-prosthetic training for a period of six weeks. Since delivery of the definitive prostheses the subject has engaged in prosthetic rehabilitation for additional functional skills during B-ADLs and I-ADLs. The subject was assessed using outcomes measures including the Quick DASH, Box and Blocks Test and the UNB Test of Prosthetic Function.

RESULTS

Simulators were used in the education of occupational therapy students who will likely be providers of prosthetic rehabilitation; with consumers, their caregivers/families and case managers. 100% of the individuals offered this experience stated that they better understood the demands/requirements of the technology which related to more realistic expectations of the devices. These opportunities with the simulator appear to enhance carryover of strategies to facilitate skill acquisition and appropriation of prosthetic satisfaction. Case presentations of these groups will be described during this presentation.

During pre-prosthetic phase, the client met all of his preliminary goals that included skills drills and beginning
functional tasks using bilateral prostheses. At the time of delivery of his definitive prostheses, the client was able to complete many self-care tasks independently using his technology. He has since engaged in prosthetic training to refine skills toward instrumental activities of daily living including care of his young children, management of his home and property and eventual return to work. Preliminary data reflects overall satisfaction and functional ability using the definitive prostheses, and greater initial ability upon delivery due to the simulator experiences. Final outcomes will be reported at this event as the subject continues to participate in prosthetic rehabilitation.

**DISCUSSION**

It appears that the concept of utilizing simulators is underutilized. The body-powered prosthesis simulator described accesses both voluntary-opening and voluntary-closing terminal devices. As described in this presentation, the prosthesis simulator can be used in multiple stages of prosthetic training. At initial evaluation, it can be used to compare function and access of the technologies for successful prescription and actual client trial. This evidence can be video-taped and photographed to provide compelling evidence justifying medical necessity to the funding stakeholder(s). The caregiver can experience the diverse technologies in order to better understand the requirements of use and application to functional/bimanual manipulative tasks and case manager experience can speak to the acquisition of technology and to access to skilled therapy. During the preparatory phase, the user can adjust to the demands of suspension and practice pre-prosthetic skills drills and activities. Upon delivery of the definitive prosthesis, the simulator can be utilized to educate the family members and caregivers to various strategies in order to complete bimanual tasks. These opportunities with the simulator appear to enhance carry-over of strategies to facilitate skill acquisition and appropriation of prosthetic satisfaction.

The VC/VO prosthesis simulator was used during the pre-prosthetic delivery phase of intervention to address skills drills of grasp and release in diverse planes, functional splinter skills and bi-manual functional tasks; accompanied by work with the mirror box to occlude vision and address position in space, surface/ object feature identification and object identification. It is thought that such emphasis may help to improve functional outcomes and consumer satisfaction with the definitive prosthesis, impact user acceptance and minimize rejection of the prosthesis. This case study of the client with bilateral UL limb loss details the interventions used, reports functional outcomes, perception of ability/disability and client satisfaction of the prosthetic technology provided to him.

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Informed consent was obtained from all participants.

**REFERENCES**