TODDLERS AND MYOELECTRICS — DO THEY GO TOGETHER?

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ABSTRACT

The purpose of our research was to evaluate the prosthetic acceptance of below elbow limb deficient toddlers. The prosthetist, occupational therpist and caregivers were found to play major roles in the success of prothetic use. Conclusions were drawn from prosthetic and occupational therapy clinical observations, the University of New Brunswick Test of Prosthetic Function and a subjective parent survey.

INTRODUCTION

Technological improvements over the last decade have allowed toddlers to be fit with advanced prosthetic components. The availability of this technology has produced a dilemma in the actual fitting of infants. The improved componentry has come with increased costs for which funding is not readily available. One cause may be the lack of objective literature to support the efficiency of such fittings.

POPULATION

D.O.B.	4/86	3/87	3/87	3/88	8/88	10/88	7/89	2/90
CHILD	KrisAnn	Jessica	Wesley	Bryce	Tyler	McC.	Heather	Michael
SEX	F	F	M	M	M	F	F	M
B-E LEVEL	short	short	W-D	long	short	short	short	short
B-E SIDE	R	R	L	R	L	R	L	L
PASSIVE	--	--	10mos	5mos	7mos	4mos	7mos	10mos
CABLE:								
hook	reject			reject				
hand	reject							
MYO:								
1-site	60mos	10mos	14mos	22mos	29mos	14mos	17mos	16mos
2-site		12mos	17mos	36mos				
U.N.B.:								
spont	3.8	3.8	2.6	--	3.3	4	2.1	2.5
skill	3.6	3.8	2.3	--	3.1	4	1.9	2.5

Table 1

Our intention is to contribute to the body of knowledge available to parents, third party payers and health care professionals. While our population included only eight individuals, we observed aspects of fitting these toddlers with myoelectrics that others have not mentioned. These findings have had a positive influence in working with childen at a young age. (See Table 1)

POPULATION

The individuals in our study included four females and four males with equal numbers of left and right below elbow congenital deficiencies. Six of the eight toddlers demonstrated short below elbow limbs, with an average ulnar length of two and one half to four centimeters. Two long below elbow or wrist disarticulation deficiencies were fit. Six of the eight were fit with passive prostheses at a mean age of seven months. Two of the toddlers had worn and rejected cable prostheses prior to visiting our facilities. Myoelectric hands, with one-site electrode control, were fit from ten to twenty-nine months of age (with the exception of one child who was fit at five years of age). To date, only three of the eight have recieved two-site myoelectric prostheses. Our toddlers wearing two-site electrode myoelectrics were fit from twelve to thirty-six months of age.

PROSTHETIC CLINICAL OBSERVATIONS

All eight children in our study were initially fitted with VASI 0-2 hands. Two have subsequently upgraded to the VASI 2-5 size. Three have graduated to two-site myoelectric control. The expectation is that as the others grow, physically and developmentally, they will progress to two-site, as well.

Three types of batteries were used during the study. Two of the children wore the Otto Bock 7V, which has been a standard in the field. However, it has a 14 hour recharge time and is too large to be placed in the forearm of a toddler. 9V batteries are disposable and easy but tend to offer too much power and burn out hand motors. Six of our toddlers have used 9V batteries. Two are now using the Liberty Mutual battery. This battery is small enough to fit in most forearms, thus eliminating humeral cuffs or other external placements. And, parents report preferring the half hour recharge time.

One-site electrodes permit toddlers to have immediate use due to their ease of operation. In most cases, wrist extensors contract to open the hand. When the child relaxes, the St. Anthony (Cookie Crusher) circuit automatically closes the hand. This advancement enables toddlers to operate the prostheses without extensive training. The decision to use two-site myoelectric control was based upon parental wishes, limb length, and the prosthetist's recommendations. It appears in the literature that most prosthetists wait to myoelectrically fit the toddler until three to six years of age, [1]. However, our study suggests that cognitive development is more crucial than chronological age. One of the toddlers with above average intelligence was fit at 12 months and is an excellent user.

The cable hook and hand fit to one child were "just sticks at the end of her residual limb," according to her mother. "The cable arm just lay at her side and she never figured out how to use it. She was immediately able to use the myoelectric prostheses." Two users in our population stated they rejected their body powered prostheses due, in part, to cosmesis.

One girl had nine repairs in a two year period, but was the only child to score perfect 4's on the UNB Test of Prosthetic Function. Our research suggests that the number of breakdowns did not correlate with her development.

OCCUPATIONAL THERAPY CLINICAL OBSERVATIONS

Observations by our occupational therapist have shown therapy to effect each child's development. Our myoelectric group which meets monthly with the therapist and prosthetic assistant was started in 1989. The purposes of the group are to increase socialization among peers, monitor developmental skills, improve bilateral coordination, help in activities of daily living such as dressing or feeding, and to strengthen upper extremities. Parents discuss failures and/or successes involving prosthetic use, bilateral activities, school issues and socialization. In turn, the health care providers educate the families about prosthetic care, emotional aspects of congential anomalies and provide home programming with age appropriate activities.

"Most vulernable has proven to be the outer glove that provides both protection and a cosmetic appearance to the electronic limb," [2]. According to our subjective survey, parents stated that short glove life was one of the major disadvantages of the myoelectric prostheses. A significant result of prosthetic education was increased glove life for all the children. That was probably due to a monthly application of Otto Bock cleansing cream and information concerning prehension and glove staining.

Another benefit of occupational therapy was the communication between child and therapist. According to one father, "we love her if she wears her arm or not, but feel like the bad guys when we insist she wear it." This child is eager to attend group therapy and displays precise fine motor and manipulation abilities.

ENVIRONMENT

The environment seems to have a major effect upon our population. Two of our toddlers live in rural Wyoming and are unable to particiapte in the ocupational therapy group. "Therapy has been effective if either the parent or occupational therapist complete the therapy program," [3] The Wyoming children have been successful because their daily activities provide opportunities to crawl under fences, climb up haystacks, and hold the reins of horses.

CULTURE

Each culture accepts limb deficient children differently. One of the toddlers evaluated in the study came from a Spanish heritage. Her home environment was exceptionally tidy. She played in a frilly dress, had a bow in her hair and wore patent leather shoes. In the play area toys were not noticed. Additionally, there was a language barrier as evidenced by repeated instructions concerning battery installation. The arm was sent in five times for replacement of blown battery fuses. The parents were unable to understand English instructions. Eventually, a diode was placed on the battery box, eliminating the problem.

SOCIALIZATION

Group therapy creates an atmosphere for children to play with other children who have limb deficiencies. One young toddler, often spent the first fifteen minutes just watching the children interact while using their prostheses. "Meeting other children can be helpful in learning by example," [4]. The children integrate and form special friendships based, partly, upon therealization that they are not so unusual.

SHOULDER GIRDLE STRENGTH

Strength and stability were consistently observed with a lack of proximal control and

diminshed shoulder movements. Our team recently addressed this with an infant not included in the study. At three months of age, he did not like to be in prone position to complete weight bearing activities. His parents were worried that the position would hurt him. They didn't realize that he would not transition from different developmental positions. When the infant cried, his parents gave him a pacifier which reinforced him not to tolerate the position of prone. With a home program, he has progressed and will now roll independently without fussing. The most frequent abnormal posturing noted during weight bearing were: increased elevation of the shoulder girdle; external rotation; adduction; and fixing at the shoulder. While completing functional activities, the children demonstrated limitations in shoulder flexion, elevation, external rotation, and decreased mobility around the scapula. A recent study states that children with limb deficiencies lack muscle strength bilaterally, [5].

UNIVERSITY OF NEW BRUNSWICK TEST OF PROSTHETICS FUNCTION

U.N.B. Test Of Prosthetics Function Assessment Of
SPONTANEITY

0	Prosthesis not used or used only on request
1	Use of prosthesis proximal to terminal device only
2	Very delayed, occasional or "last resort" use of the terminal device (either for active grasp or passively)
3	Slightly delayed or inconsistant use of terminal device for active grasp
4	Immediate, automatic, consistent use of terminal device for active grasp

Table 2

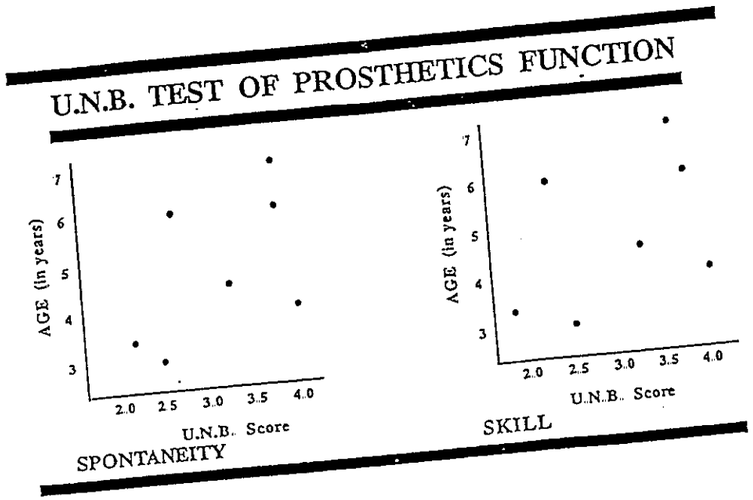
U.N.B. Test Of Prosthetics Function Assessment Of
SKILL

0	Prosthesis is not used
1	No active terminal device function, although terminal device or some other device or some other part of the prosthesis may be used passively to stabilize or support
2	Active use of terminal device is attempted, but looks very slow or awkward Grasp is frequently lost or regained with difficulty
3	Active use of terminal device, shows some degree of awkwardness, slowness or uncertainty. Grasp is readily regained when lost.
4	Active use of terminal device is quick, skilled and smooth Grasp is consistently maintained.

Table 3

Using spontaneity and strength as measurements, the UNB Test of Prosthetics Function examines the child's ability to complete age appropriate activities. (Tables 2 and 3)

Two of the four age categories were incorporated to assess upper limb prothetic use. The spontaneity index measures "the extent to which the child has incorporated the prosthesis into his or her body image." The skill index measures "the ability to open and close the terminal device, to grasp and release objects of different sizes and shapes with confidence, speed and consistency," [6]



Each of the children were given the UNB Test. (Table 4) The average scores of our population were:

Age 2-4	3.0 spontaneity	2.9 skill
Age 5-7	3.8 spontaneity	3.7 skill

The scores ranged from 1.9 to 4.0. The 5-7 year olds scored higher on spontaneity and skill than the 2-4 year olds. The older children displayed more skill which could be due to longer experience wearing their prostheses. They also demonstrated longer attention spans, increased concentration on activities and more precise fine motor abilities. Recent literature states that "early fittings in the first months of life enhance long term outcomes," [1]. The lower scores of the 2-4 year olds is influenced by the fact that they are easily distracted and spend more time exploring their environments.

PARENT SURVEY

The survey was added into the research because of the major role parents play in their child's prosthetic use. While the children were taking the UNB Test, the parents completed a questionairre concerning the types of prostheses worn, wearing and use patterns and attitudes towards myoelectic hands. They reported liking the natural appearance, increased function, increased independence, and increased self confidence. They disliked the high cost, the number of repairs, short glove life and the inability for the hand to open wider.

CONCLUSIONS

The importance of the prosthetist, occupational therapist, UNB Test of Prosthetic Function and the parents have been discussed in this paper. The prosthesis is not only for the toddler but also for the parent to help them to cope with a limb deficiency. The myoelectric hand lessens the stigma of limb deficiency by enabling the child to complete age appropriate activities.

In evaluating toddlers for two site control, our study suggests that cognitive development plays a bigger role than chronological age. The highest number of breakdowns did not impede the development of the only toddler to score 4's consistently on the UNB. The children need to be engaged in challengning activities whether supervised by a parent or therapist. The benefits of occupational therapy which have improved each child's performance are bilateral components, strengthening of the shoulder girdle, transitioning from developmental postions, encouraging social skills and addressing issues of daily living. Other outside factors that both inhibited and encouraged development were the environment and culture. The results of the UNB Test showed that 5-7 year olds scored slightly higher on spontaneity and skill than did the 2-4 year olds. The fact that those childen were fit at young ages and have been wearing their arms for a longer period of time has improved their performances.

Although, the parents mentioned some negatives about myoelectric prostheses, they all claim they would repeat the myoelectric option and, to date, 50 % have.

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