

REVIEW OF INFANT FITTINGS AT THE INSTITUTE OF BIOMEDICAL ENGINEERING 13 YEARS OF SERVICE

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The Institute of Biomedical Engineering at UNB opened its myoelectric fitting centre called the Prosthetics Research Centre in the fall of 1981 with the first patient fitting in January of 1982. This paper only reports on the infant fitting program of the Centre since the beginning, a total of 13 years.

The Prosthetics Research Centre was established as a clinical research and development facility for myoelectric prostheses. The clientele come from a geographically large area but small population base of the Atlantic Provinces. The provinces cover 501,703 square km with a population of 2,322,081 people.

This report reflects the growth and evolution of our program, rather than a statistically based study. What is important to note in this talk is that the review looks at two very distinct groups. These groups were not so different because of their demographics or disabilities but are different because of two very distinct technologies which were available.

TECHNOLOGY

When describing our program we have chosen to describe our population based on changing technology we have used. It is technology that has allowed us to fit smaller and younger children with cosmetic and effective results. Within the thirteen years we have seen the introduction of smaller, light weight hands, thanks to the work of our colleagues in Toronto, the UK and Germany. The use and availability of one site two state control systems has become popular only within the last seven years. Smaller and more compact battery systems are also available within the last 5 years. What we have available today for our infants does not compare to what we had available 13 years ago. At our clinic the fitting process and principles have been guided to a strong extent by technology as you will see.

PASSIVE PROGRAM

In 1982 we began an infant fitting program with this young boy. Our infant fitting program begins with fitting a passive prosthesis at about four to six months of age. Selection of a child into our passive fitting program has been through a clinic interview process. The ultimate decision rests with the parents. To date only one family has chosen not to have their child fit with a passive prosthesis, yet have later gone on to myoelectric fittings with good success. Funding is not an issue as all children in our area of

Canada are eligible to receive ongoing funding from the War Amputations of Canada, Child Amputee Program (CHAMPS).

The passive prostheses have generally consisted of a moulded total contact socket, cast in the same fashion as the myoelectric socket. A passive Centri hand is then fastened to the end of the socket. All these passive prostheses are donned by the use of a nylon stocking through a pull in tube and baby powder. They are doffed by gradual release of the tissue at the socket brim. The initial passive prosthesis has a mean weight of 152 grams. A home program to encourage use of the prosthesis in sitting, prone and supine is given as well as care of the prosthesis.

Over the next few months weight is added in two to three steps until the prosthesis becomes the weight of the myoelectric. This weight has varied over the past 13 years as technology has changed and the final overall weight of the myoelectric prosthesis has decreased.

PASSIVE PROGRAM TECHNOLOGY ADVANCES

Even within the passive fitting program, we have used three new technological advances. First is a Crawling hand which is available in three sizes. The smallest appears to accommodate a petite four month old. We have also used a Steeper passive hand which also can accommodate a child who is particularly small in stature. For the child without an elbow Steeper manufactures a passive elbow which allows for flexion/extension and internal and external rotation which is adjustable by the parents. Prior to that the first child with an above elbow amputation we fit we made a banana style of arm with a rigidly fixed elbow.

THE FIRST SIX YEARS (1982-1987) - PASSIVE TO MYO

From 1982 to 1987 the smallest hand available was the Systemtechnik (or Systek) 2" hand. We fit 12 children at an average age of 21 months with this hand as the first hand. All of these children were fit with a below elbow style of total contact socket. All have unilateral limb loss only. The average weight of the initial passive prostheses was 160 grams and the myoelectric was 450 grams. The Systek hand was used in combination with a UNB one muscle three state control with built in battery or a battery mounted on a pant clip, or the Systek hand was used with an Otto Bock or Steeper two muscle-two state electrodes and battery on a cable which was clipped to the child's pants. All systems use a UNB battery saver circuit in open and close movements.

These children today are 9 years 9 months to 14 years old, the mean age is 11 years three months. Of the 12 children initially enrolled in the program, 8 are still members of the program. Of the four who have dropped out, two went to another fitting centre. We have lost contact with the remaining two. Of the eight remaining, 1 returned to the program after being followed by an other Centre while out of this province. This child was fit with a passive prosthesis only. The other 7 use their prosthesis on average 5-6 hours a day, primarily during school hours with occasional use on weekends, usually when going out. Four children have additional prostheses which are used for specific activities such as sports.

The First Six Years (1982-1987)

Hand-Systemtechnik

Controls-one muscle three state or
two muscle two state

Weight (passive) - 160 grams

Weight (myo) - 450 grams Fitting age - 21 months

Age at Present - 11 years 3 months

7 using and wearing
1 wearing passive only
2 discharged to other centre
2 not followed
Total 12

TRANSITIONS

Our first technological change came with introduction of the Variety Village 0-3 hand. In February and April of 1987 we were able to use two of these hands which were just becoming available on the market to fit a young girl who was the first child we had seen with multiple limb loss.

We proceeded with the same program for her upper extremity fittings, using passive hands initially then switching to myoelectrics. This was the only child we used a three state control with VV hand. Today she uses VV5-9 hands, one Omni wrist and Otto Bock two site controls and is a skilled prosthetic user.

In 1986 and 1987 we had no referrals of infants to our program. This occurrence is unexplained. As far as we know there were no children from the Atlantic admitted during those years to the CHAMP Program, a program of the War Amputations of Canada which provided support to the children born with limb loss and their families.

THE FOLLOWING SEVEN YEARS (1988-1995) - PASSIVE TO MYO

In February of 1989, with the introduction and wider acceptance of a "cookie cruncher" system and the availability of the Variety Village 0-3 hand, we began fitting children who had worn a passive prosthesis with a prosthesis with one muscle two state systems as early as 12 months of age. The first young boy fitted in this program at 12 months is now four years old. We initially fit 23 children with passive prostheses. Of these, one child dropped out of the program just after being fit with the passive prosthesis, one child is deceased, and a third child was fit with a passive prosthesis, lost to followup then eventually returned for a myoelectric fitting at age 5. Of the 20 children who followed the program, all were given a powered prosthesis at an average age of 15.9 months with one muscle two state systems. The youngest age of fitting was 12 months with the oldest being 25 months. At this time these children range in age from 7 years 6 months to one year three months, a mean age of 4 years 6 months. 19 of these children are followed by our Centre, one moved and is followed at a different Centre. Of the 19 in our program 18 are full time wearers of their prostheses. Their prostheses are worn at school, daycare or during their waking hours with their use and abilities varying depending upon their developmental abilities. Only one child does not wear or use a prosthesis at this time and is the only child within this group with multiple limb losses. This child is a foot user for most activities except feeding where a specialized adapted cuff is used on the residual above elbow side.

Present technology has allowed us to fit these one year old children with myoelectric prostheses which are as light as 264 grams, batteries included. The batteries used with these children have varied from built in batteries as part of the UNB system, batteries mounted on a pant clip cable, and custom batteries mounted in the forearm or Liberty half size batteries mounted on the side of the forearm. Small, lightweight hands which can be activated with a single site "cookie crusher system" are now available from three different companies including Variety Ability Systems Inc., Hugh Steeper and Otto Bock.

The Following Seven Years (1988-1995)

Hand - VASI VV 0-3, Steeper Scamp Hand, Otto Bock 2000
Control - 1 muscle 2 state
Weight (passive) - 145 grams
Weight (myo) - 300 grams
Fitting age - 15.9 months
Age Now - 4 years 6 months

1 dropped out of program after passive fitting
1 deceased before myoelectric fitting
1 lost to followup after passive fitting-returned 4 years later
18 using and wearing prosthesis full time
1 moved and followed by another Centre
1 with multiple limb deficiencies not using or wearing prosthesis
TOTAL 23

SUMMARY OF TECHNOLOGICAL CHANGES

Hands
Controls
Batteries
Elbows
Weight

Technology has allowed us to change our approach to fitting children at younger ages and with better cosmetic effects. Hands, controls, batteries and elbows have all become smaller allowing us to produce lighter prostheses which can be fit on younger children. Perhaps the most significant change is that the children now only have to learn a simple cause and effect relationship with a cookie crusher system. "I wiggle my arm the hand opens, I don't wiggle the hand closes" rather than "I wiggle one way my hand opens, I wiggle a different way my hand closes and I relax my hand doesn't move" In addition to this with experience gained we are also able to change our approaches and perhaps provide a better product as we became used to working with children.

POSSIBLE FACTORS INFLUENCING FITTING

Let's ponder a minute on why perhaps our program appears successful. First we have seen technology change to our advantages as described.

Secondly we have had only a few changes at our Centre. Our staff changes are minimal. We began with a staff complement of 4 people, a manager, a prosthetist, an occupational therapist and a technician. Our manager who becomes quite involved with the clients has been with the Institute before the clinic service began. We have had the same prosthetist since opening. In 1985 the therapist changed. In 1991 we had a change in a technical staff member. It is perhaps the consistency of staff which encourages people to return to a centre where they know they will see familiar faces.

Thirdly there may be a factor of the way our Centre functions in typical Maritime fashion- layed back, social, and familiar, with lots of time for clients to meet, chat and have individual attention. Our Centre is small with only one prosthetist and until recently we have provided only upper extremity prosthetics. This allows us to spend a lot of this type of individual time with each person.

A fourth factor may be the complete team approach with a skilled prosthetist who can not only produce a cosmetic looking prosthesis but also one that fits comfortable. This combined with the assurance that the prosthesis is working well for a variety of functional activities may lead to our successes.

Other factors may influence people's decisions to come to our Centre. We are a University and an Internationally known leader in myoelectric control. People may be influenced by knowing they are coming to "the best" place. Another factor could be that perhaps people expect the latest technology, wanting to be like the bionic man or woman and coming as close to that as they possibly can by being fit with a myoelectric prosthesis.

The other factors which influence the success of fitting are the clientele themselves. We still struggle with the question "Who is an ideal candidate for a myoelectric prosthesis?" So many factors come into play, which are the most important?

- the family commitment to the prosthetic fitting
- absence of serious family problems
- the length of the residual limb
- the age of these children

At our Centre, however, we have fit all children whose parents want their child to have a prosthesis.

It appears that it is a combination between new technology, the skill of the fitting team and cooperative and committed parents when we see true successes of myoelectric fit.

Possible Factors Influencing Fitting

Consistent socket design
Treatment and training
Parental commitment
Ages of children
Clinic Atmosphere

CONCLUSION

Over the past 13 years the Institute of Biomedical Engineering has enrolled into a passive to myo fitting program, 34 children with unilateral deficiencies of the upper extremity and two children with multiple limb deficiencies.

With such a small and varied patient population it is difficult to conduct research which provides any statistically significant results. It is perhaps in our best interests to develop well designed, repeatable single subject studies which would provide some beneficial results for any of our questions about the success of myoelectric prosthetic fittings.