

EVALUATION OF THE MYOELECTRIC HAND PROSTHESIS FOR PRE-SCHOOL CHILDREN  
AS USED IN THE NETHERLANDS OVER A PERIOD OF FIVE YEARS.

M.M.L. Swart

Occupational Department of the University Hospital in Leiden.

**Summary**

The myoelectric fore-arm prosthesis for pre-school children has been issued in the Netherlands since 1979. Partly under the influence of parents who wish a myoelectric prosthesis for their children with a peromelia the development and the issuing of this appliance has been started in the Netherlands. By the development of the small Swedish hand it is possible to provide even three-years-old children with this prosthesis.

In 1979 two centres in the Netherlands have started issuing the myoelectric hand prosthesis for pre-school children and the training of these young children, viz. the University Hospital in Leiden and the Rehabilitation Centre 'Hoogstraat' in Leersum. The Rehabilitation Department and the Occupational Department of the University Hospital in Leiden are closely cooperating in this project. The treatment team that attends on the parents and children is formed by a rehabilitation doctor, an occupational therapist, a prosthetist, a social worker and a physiotherapist.

A deliberate choice has been made for two centres in the Netherlands because the number of children for which this prosthesis is suitable, is relatively small, and because the acquired specialistic knowledge and experience thus remain centralised. This facilitates the passing on of information to the parents and heightens the quality of the treatment.

The following report is mainly concerned with the children that have been attended on in the University Hospital in Leiden. As the occupational therapist of the treatment team I should like to give you an impression of the frequency, the structure and the organisation of the occupational training of children with a peromelia. I will also enumerate the most common technical problems of the myoelectric prosthesis which occur in Leiden.

## Introduction

At this moment in 1984 we can look back upon a period of five years during which experience with the myoelectric pre-school children prosthesis has been gained. As far as we know some 17 children of very young age have been provided with a prosthesis in the Netherlands. Nine of them are being attended on and trained by the team of the University Hospital in Leiden. Out of these nine children five have got the Germain  $6\frac{3}{4}$  Otto Bock hand when they were about six years old. Two out of these five had been supplied with a mechanical hook prosthesis from the age of two on. The remaining three, when they were about two and a half years old, had got the Swedish myoelectric prosthesis for pre-school children. One little girl is still in the preparatory phase in order to get the Swedish hand .(fig. 1).

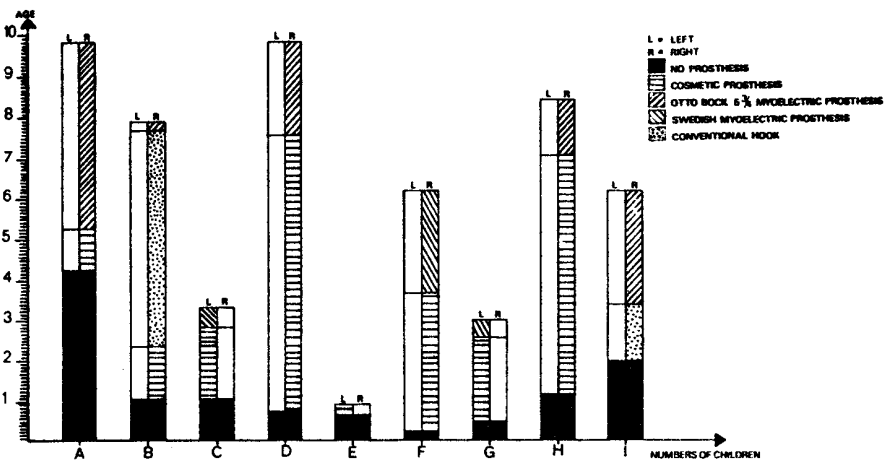


Fig.1. On what age the children have worn different types of prostheses.

A deliberately choice has been made for applying the myoelectric prosthesis from the age of  $2\frac{1}{2}$  or 3 years. This is because in the symmetrical phase of the child's development a clear need of bimanual playing arises, so that a second gripping function becomes desirable. The use of the myoelectric prosthesis in this developmental phase can lead to a better integration of the prosthesis into the body-image.

This in turn enhances the possibilities of acceptance of the prosthesis. The children, before they had been provided with the myoelectric prosthesis, had already been accustomed to a prosthesis. Already at the age of about one they had been wearing a cosmetic prosthesis. Thus they grew accustomed to an extension of the arm but not yet to the difference in weight. To make the change in weight as gradual as possible the cosmetic hand was periodically made heavier by means of lead beads.

#### Conditional aspects of supplying a prosthesis.

Our experiences of the past five years lead us to the view that a good, realistic information given to the parents about the existing different prostheses plays an important role. It is essential to distribute the information over a number of informative talks so that not too much information is given in each talk. The effect of given information seems to be greater this way. In addition to the information about the different types of prostheses (such as the conventional hook, the cosmetic and myoelectric prosthesis) the parents will also hear about the advantages and disadvantages. In choosing the type of prosthesis the cosmetic aspect plays for the parents a role not less important than the functional and the technical aspects.

It is important for the team to get by observation an impression of the degree to which parents accept their child's handicap. It is essential for the parents to accept their child as it is. Feelings of guilt often make acceptance difficult. The child will only accept itself if it knows its parents and other people accept it. Another essential point to the team to observe is whether the domestic surroundings give enough room for attention and time to be given to the child during its training phase with the myoelectric prosthesis. Support, guidance and stimulation, given by the parents are of great importance for a good result of the training. If these conditions are not fulfilled the appliance of a prosthesis, either conventional or myoelectric, is doomed to fail. That is why two children have dropped out.

The part of the occupational therapist in the myoelectric pre-school children project.

A. The observation periods.

When a general practitioner or a specialist has sent a child with a peromelia to us, the rehabilitation doctor and the occupational therapist will work closely together. At best we have known the child since it was four or five months old. Every three months the young child is seen by the doctor and the occupational therapist. The occupational therapist primarily observes the child's level of development, i.e. does the child function at the level at which it should function in view of its age? She will take into view the different areas of the child's development from its birth on such as:

- moving/ locomotion/ acting
- perception/ concentration/ learning
- playing
- communication
- becoming independent

All these areas may involve problems for a child which misses part of the fore-arm including the hand. In this respect it is important to stimulate and activate the remaining functions. It is essential for the child to make the best possible use of the functions it does have. In this way its optimal functioning with regard to mobility, muscular strength and coordination may be reached. By the repeated use of the incomplete arm e.g. in playing the child will develop the muscle groups that are still present, which in turn, is important for the ability to operate the myoelectric prosthesis.

The so-called functionless appendages, e.g. a small 'finger' at the stump of the arm is as much as possible integrated into this stimulation. In practice such appendages sometimes turn out to be functional for the child. The following example illustrates this. One of the nine children in Leiden appeared to use the little 'finger' at the end of its arm-stump in playing activities. This little 'finger' has a limited movability both in the direction of the radius and of the ulna. The Orthopaedic Workshop has constructed in the socket of the myoelectric prosthesis two micro-switches which the child could operate with its little 'finger'. Thus the myoelectric prosthesis was reconstructed to an electric prosthesis.

By means of the micro-switches the child could open and close the hand. However in the long run the skin of this little 'finger' grew over-sensitive to the switches. This problem could not be solved in a technical way. When the skin was regularly irritated we had as yet to decide to supply the child with a myoelectric prosthesis operated by electrodes.

During these periods of observation and guidance the occupational therapist has also to do his best to stimulate sufficiently the sensitivity and the tactile sense of the skin areas of the remaining arm. Indeed for the young child feeling and groping are essential means in discovering its own body and the world around.

#### B. Training periods.

The treatment and guidance are preferably given in a policlinic. The first occupational training period of the child after supplying the myoelectric prosthesis mainly aims at the child's learning to operate the prosthesis and to use it spontaneously in playing - activities. This whole process runs automatically. In this age-class there is no well defined programme of exercises as there is for adults. A little child learns spontaneously just like it has learned its other movements. During these first training periods the main stress has to be layed on :

- stimulating bimanual playing
- checking whether the two electrodes are well adjusted both individually and in relation to each other.
- checking how the socket fits to the arm
- being sure that the parents know how to handle the prosthesis, especially how to put it on and how to preserve it.
- and, last but not least, how does the child accept the prosthesis?

Good relations with the parents are essential. By involving the parents in the training it becomes possible for them to continue the greater part of the training at home, provided that they have the right instructions. This determines the length of the occupational training period. Although it is always possible to have contact by telephone, it is still necessary that the doctor and the occupational therapist should see the child once every three months. This will best guarantee that questions, uncertainties and problems are presented to the treatment team.

It regularly occurs that on occasion of questions raised by the parents a short occupational treatment takes place. These treatments are often closely linked with important developmental stages in the child's life, e.g. going to the infant school, dressing and un-dressing independently, becoming active in sports and going to the primary school. (fig.2)

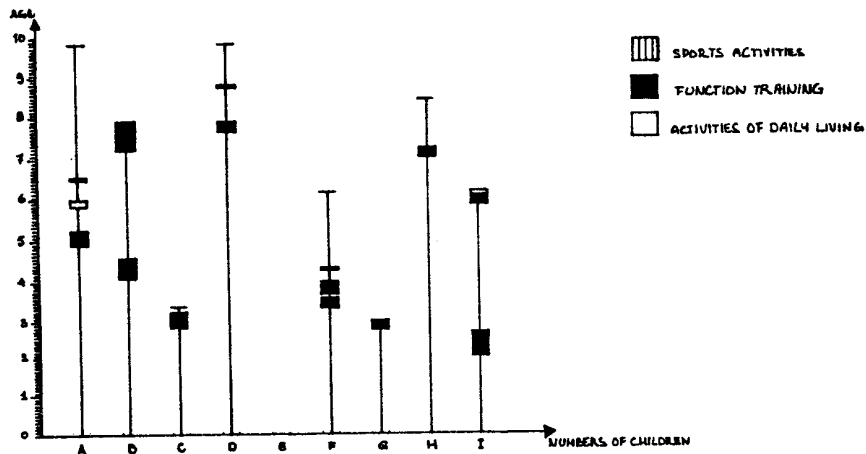


Fig.2. On what age the children have got the different kinds of occupational treatments.

Personal instruction to masters and gymnastic instructors will make many things clear. The myoelectric prosthesis is often completely new to them and they do not know what can and what can not be expected of it. It is important to visit the child at home several times if the distance allows. Indeed a significant training programme directed at the specific needs and surroundings of the child with a peromelia can not be set up until there is a good insight into his personal circumstances.

Once a year video recordings are made of all young children in the age of 2 - 6 years. Consequently the development of the pre-school children and their using the prostheses is precisely registered. As soon as the child is at the primary school the main stress is shifting from a strongly motorial development to the process of learning.

It has been proved in practice that during this period the number of checks by the team can be brought down from once every three months to twice a year.

Account of the most frequent repairs to the myoelectric prosthesis in the past five years.

In the case of pre-school children the occupational therapist of the treatment team of the University Hospital in Leiden, functions as the central person with whom the other team members are keeping in touch.

The parents contact her in case problems arise and she sees to it that the team members concerned will be called on to solve the problems. Many of the problems are of a technical and instrumental kind. Between the prosthetist and the therapist there is as a result a close cooperation. All repairs carried out to the myoelectric prosthesis by the Orthopaedic Workshop have been recorded during the past five years. This enables us to present to you the following survey:

- A. On an average the prosthesis has to be repaired at the workshop six times a year. It is not necessary that the child too should go to the workshop. If the travelling distance is great, the prosthesis is sent by mail. If the distance is short the prosthesis can be brought to the workshop the same day.
- B. The University Hospital prefers to mount the battery on the socket. So breaking of the flex is rare with children in Leiden. Though this solution is aesthetically not very pleasing, it surely is rather functional for the child.
- C. The four most frequent technical problems are :
  1. The cracking of the cosmetic glove
  2. Hand servicing because of complaints about creaking and squeaking and problems in opening and closing of the hand
  3. Distortion of the finger unit
  4. Wear and tear of the gear

(Fig.3)

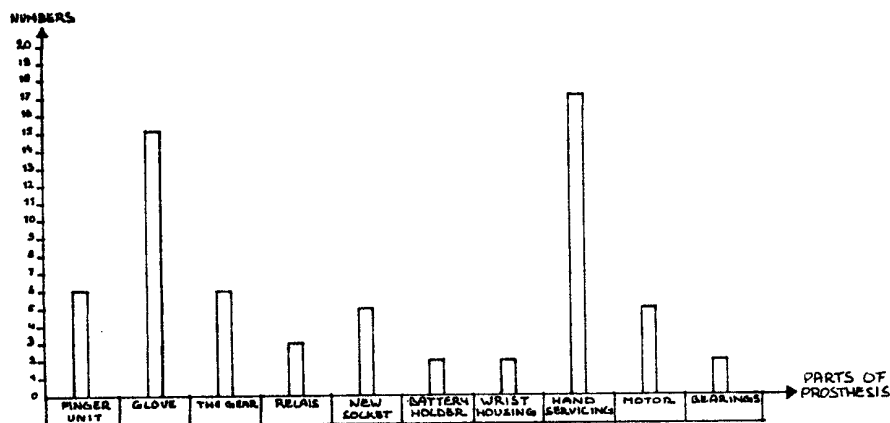


Fig.3. The most frequent repairs to the parts of the myoelectric prosthesis.

#### Conclusions.

In 1979 we started the myoelectric pre-school children project in the Netherlands. The required knowledge came from doctor Sörbye, head of the Neurophysiological Department of the Örebro Regional Hospital in Sweden. During the past years there has been a regular exchange of information with doctor Sörbye. The idea behind this early application of the myoelectric prosthesis is that at a young age this will result in a better integration than at a later age.

Now, five years after, nine children in Leiden have been supplied with a myoelectric prosthesis. Out of these nine children two have dropped out because of educational and acceptational problems of the parents. This underlines once again the fact mentioned above that for the treatment team, when giving advice about providing a myoelectric prosthesis or not, it is a matter of great importance to have a clear insight into the domestic circumstances. We can safely assume that the application of the myoelectric prosthesis to the seven remaining children has been successful until now.



The myoelectric prosthesis functions as a supporting hand of full value. The active gripping function is often brought into practice as the passive rotation of the wrist. The myoelectric prosthesis is being worn by most children practically all day long. This requires that the prosthesis should be technically reliable, preferably also in sport situations which pre-eminently need two gripping functions e.g. flying-rings, handstand, parallel bars and wall-bars.

The fact that with our children the finger unit is rather often distorted is due not only to its use during the sporting, but also to the supporting function that the prosthesis has when the child is falling. It is to be hoped that the recently started development of fingers made of carbon fibre instead of aluminium fingers will lead to better results in practice.

A still more important point remains the glove. It is actually amazing that in this time of technical progress it seems impossible to make a cosmetic glove of more durable material. But maybe these suggestions will be a stimulus for the technicians amongst you to take new initiatives in this field.

#### References

1. Sörbye, R; et al.: "Development and Improvements of a Myoelectric Controlled Hand Prosthesis for Children, Based on Clinical Experiences". Paper 2nd Europ.Conf.Of Rehabil.Intern., Brighton, England, sept. 1978. Conf. Proceedings p. 334-342.
2. Swart, M.M.L., v.d. Boongaard, G.: "Preliminary Evaluation of the Swedish Myoelectric Hand Prosthesis for Pre-school Children as used in the Netherlands". Proceedings of the seventh International Symposium on External Control of Human Extremities, Dubrovnik, Yugoslavia 1981. p. 437-440.
3. v. Wersch, A., Hartkamp, J.W.L.: "Ergotherapeutische behandeling van kinderen met congenitale defecten van de bovenste extremiteiten". Nederlands Tijdschrift voor Ergotherapie. Jaargang 10 nr 4.

#### Authors' addresses:

M.M.L. Swart, Occupational Therapie Department, Building 5,  
University Hospital, Rijnsburgerweg 10, 2333 AA Leiden,  
The Netherlands.