

A NEW ACTIVE PART-HAND PROSTHESIS

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When the stump of a below elbow amputee includes no fingers but more than the carpal bones, the application of hooks or myoelectric prostheses involves difficulties, and the need of a prosthesis most often concerns the cosmetic appearance. However, in addition to the cosmetic look one sometimes feels the need of an active grip.

At the Regional Hospital, Örebro, Sweden, we have during the last years developed a wrist controlled part hand prosthesis that has an acceptable cosmesis and a relatively strong grip force. With this prosthesis we have supplied some children in the ages 4 - 12 years who because of a too long hand stump could not be fitted with a myoelectric prosthetic hand or were not sufficiently motivated for the training with such a prosthesis. Based on the gained experiences some modifications of the design have successively been made. The results of the clinical testing are encouraging, the patients accept the prosthesis well and find it very useful.

Constructing the wrist controlled hand prosthesis, our aim has been to find a method of using standard components to as great an extent as possible and to the highest possible efficiency. With easily available components all orthopedic departments should be able to supply patients with this prosthesis.

We have constructed the wrist controlled hand prosthesis in the following way:

A plastic socket is made for the partial hand, being strengthened by means of a flat splint of stainless steel on the radial side. This socket is cut off 1 - 2 cm distal of the wrist (fig. 1-2). At the distal end of the socket a transversal vertical metal splint is moulded in. To this splint are screwed 4 separate finger pins of stainless steel, forming the basis of a cosmetic inner hand of a suitable size. The thumb is represented in a similar way, being put on a long cylindric metal splint which is fastened to the patient's forearm by means of a small partial plastic or lined metal socket, with or without a Velcro (fig. 1-4). As a rule the Velcro is not needed, and this also means that the completed prosthesis is easily put on and off. The partial proximal socket is connected to the before mentioned radial splint of the distal one by a strong joint bolt (fig. 3). This is the main prerequisite for the good opportunity to obtain a strong grip force.

The prosthetic device described above is covered by a standard cosmetic glove of a suitable size. The glove has its "axle" at a point corresponding to the falangeal-metacarpal joint of the thumb, while the axle of the prosthetic device itself is located at the wrist point (fig. 3). The disproportion will result in a strong limitation of the grip width and in the necessity of a considerable dorsal flexion force to open the hand. This disadvantage we have overcome by extending the thumb-finger portion of the glove by means of thorough and careful stretching during alternating warming/cooling of the glove while mounted on the prosthesis, the grip of which being successively enlarged (fig. 4).

The possible opening width of the actual prosthesis as well as the grip force depend to a great extent on the stump length distal of the wrist,

the age and the general muscular strength of the patient and the degree of possible volar and dorsal flexion. By daily use and training the actual hand parameters will increase.

As an example can be mentioned that a 10 year old boy (fig. 4-7) after using this type of prosthesis during 1 1/2 years now has obtained an opening width of 6 - 7 cm without too strong dorsal flexioning effort, and his grip force exceeds 45 Newton (corresponding grip force of his normal hand is 60 Newton). This boy uses his prosthesis all day, both at school and at home, as well as while playing ice hockey etc.

Even small children have accepted this type of prosthesis at once and have been enthusiastic about all things they can do with the active grip on both sides.

This hand prosthesis can be built for adult patients as well. Since many industrial accidents result in partial hand amputees there certainly is a need for a prosthetic device like this. While the prosthesis is based mainly on standard components and therefore is not expensive, it should also be actual for partial hand amputees in developing countries.

We think this solution should be tried in children and adults with partial hands, when they in addition to a cosmetic appearance even feel the need of a relatively strong active grip.

LEGENDS

Fig. 1-2

The wrist controlled part hand prosthesis for a 4 year old girl, with the standard glove aimed for the Swedish small children's myoelectric prosthesis. After preliminary testing on the patient the screw nut is changed into a stronger joint bolt.

Fig. 3

The joint bolt is the prerequisite for a strong grip force. A textile band will prevent the glove from being damaged at the thumb-finger angle by overstretching.

Fig. 4

The prosthesis is maximally opened by a strong dorsal flexion of the hand stump. The Velcro has shown to be of no need.

Fig. 5-7

With the prosthesis many activities are more easily performed.









