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# A New Myoelectric Below Elbow Prosthesis for Infants

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In the early 1980's it became evident, from the experiences of Rolf Sorbye's group in Sweden, that it was possible to fit very young children with myoelectrically controlled prostheses using existing adult controls and hands. Sorbye also showed that these young children could effectively control their prostheses at the young age of 18 months, and that in later years their use was very spontaneous and natural compared to children fitted at older ages.

At the Bio-Engineering Institute's Prosthetics Research Centre we have a similar program of fitting young infants using adult sized myocontrol units from Otto Bock and UNB, and the Systemteknik hand developed in Sweden for Rolf Sorbye's patients. Similarly, we are seeing the same spontaneous and natural use of myoelectric prostheses at these young ages. From this experience, it became evident that existing controls used on these infants and young children were not appropriate in size or function (Figure 1).

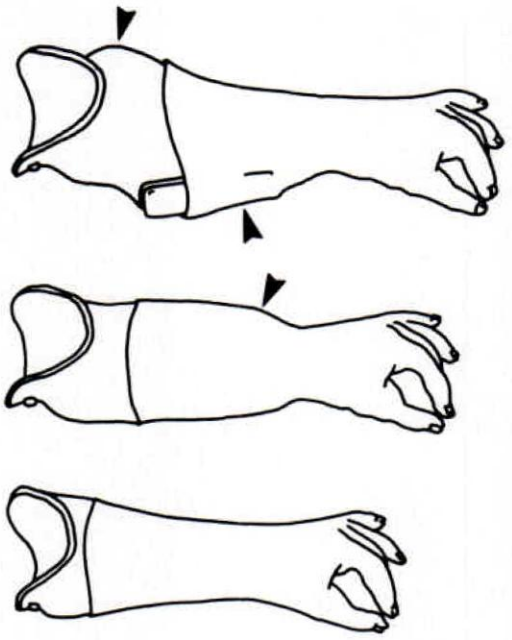

**Figure 1. (top to bottom) Progression towards more cosmesis in myoelectric below elbow prostheses.**

Under a research grant funded by private enterprise, the Institute has been developing child size controls to fit both short and long below-elbow amputees. The control modules not only are sized according to the patient to whom they will be fitted, but

also have electronic circuitry which is more adapted to children's use of a myoelectric control.

The objectives of this project included:

A. Improved cosmesis
B. Reduced weight
C. Choice between two state (two muscle) or three state (one muscle) control
D. Choice between built in or external battery (fast charge option for built-in battery)
E. Battery saver feature in both opening and closing
F. Ease of fitting (small electrode disks in the socket with electronic circuitry located below forearm laminating ring)

The first prototype of these systems was fitted in February 1983, but showed several design deficiencies, which led to a redesign of this prototype.

In conjunction with this prototype evaluation, the individual features of this design were integrated with existing controls of other adult patients to evaluate their usefulness in a field environment. These features include a battery saver and battery fast charge options.

All UNB controls manufactured today have a built-in battery saver feature which has proven to save up to ½ of the battery capacity used by an active child. This feature is further expanded upon in our infant design to save power on opening as well as closing for use in a two muscle system.

A fast charge option for the built-in batteries has been evaluated in extensive lab tests and on patients already using UNB adult myoelectric control units. This feature allows the patient to fast charge the battery in 30 minutes or less during the day, while normal slow charge is used at night.

During the period February 1983 to April 1984, we also saw the children's hand sizes developed by Hugh Steeper of Roehampton, England, becoming available for use in North America. This led our design team to add additional models of the infant designed components for use with these larger child size hands (Figure 2).

All of the electronic modules of these child size controls feature circuitry miniaturized by thick film hybrid technologies (Figure 3).

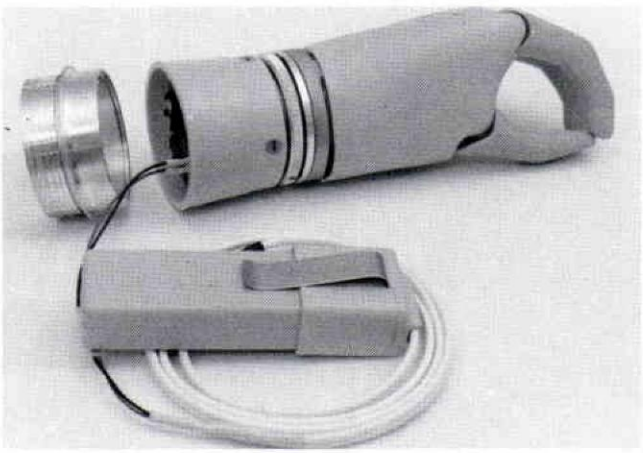

**Figure 2. (left) Note new polypropylene section at base of hand, as well as at wrist connection unit.**

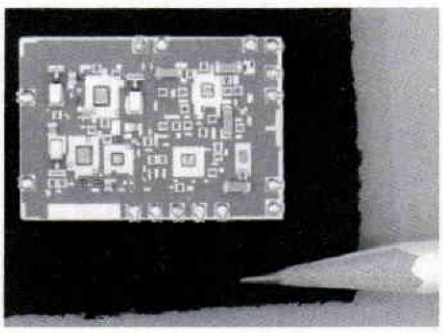

**Figure 3. (right) Miniaturized components allow for improved cosmesis.**

| Type of Control | Systemteknik Hand | Steeper Hand |
|---|---|---|
| One muscle | 1. Built-in Battery<br>2. External Battery | 3. Built-in Battery<br>4. External Battery |
| Two muscle | 5. Built-in Battery<br>6. External Battery | 7. Built-in Battery<br>8. External Battery |

**Table 1.**

These circuits are housed in an integrated molded polypropylene case that makes up a portion of the forearm of the prosthesis. The prosthetist must laminate a short forearm section to a laminating ring which attaches to this polypropylene forearm. All modules are attached directly to the different sized hands at the wrist, as illustrated in Figure 2.

# CONCLUSION

Eight control unit modules were designed to work with short to long below elbow, young amputees using the existing Systemteknik and Steeper hand sizes as seen in Table 1.

These units, in conjunction with limb banking of hands and components, should realize a definite improvement in the ability of a clinic to fit numerous young patients with the best suited control system for their age and size.

**AUTHOR**

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