

## THE EVOLUTION OF OTTO BOCK MYO-ELECTRIC SYSTEMS FOR THE PEDIATRIC PATIENT

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### INTRODUCTION

There has in the past, and there continues to be controversy over pediatric prosthetic fittings with myo-electric systems. Who are we fitting, the parent or the patient? At what age should we fit, and what components should we fit the patient with? Independent studies have shown positive results with early management of myoelectric fittings.

In keeping with the past, present and future theme of the Symposium, this paper will present Otto Bock's approach to myo-electric systems for the pediatric amputee. Topics to be discussed will include previous designs and components, as well as current systems. The focus will be the unique design and manufacture of the System 2000. In the years to come, what developments can the patient look forward to from Otto Bock? What does the future hold for the System 2000 design; larger sizes, changes in electronics, new battery options?

### PAST

Throughout the development of Otto Bock's myo-electric systems, a variety of hand sizes have been available. The early 12 volt system offered 7 3/4, 7 1/4 and 6 3/4 sizes.

The 6 3/4 was developed for ages 8 to 12 years. As technology evolved into the 6 volt system, the 6 3/4 size was made available in various configurations, quick disconnect, wrist disarticulation, and the threaded stud design. This size offered a small size and a good cosmesis, with 18 cosmetic glove colours to choose from. The hand however has a slower speed due to a smaller drive unit and different gearing system. Grip force was also reduced, as a transmission assembly did not fit this size of hand.

Further development led to the first Electrohand 2000 design. This design featured a new thumb/finger relationship. The fingers and thumb rotate around the same axis, thus stimulating a more natural grasping motion. The earliest design of the system consisted of a single size only, this being a 5 1/2. This size is suitable for ages 3 to 6. The system was connected by threading the hand into the wrist unit. The electrical connection was made by inserting the battery cables and electrode into the switching circuit. The circuit has a coaxial plug that is inserted into the wrist of the hand thus completing the connection. The power source was reduced from a 6 volt nickle - cadmium battery to a 4.8 volt battery. The development of the rectangular electrodes provided a reduced profile and dimension ideal for children's socket designs.

## PRESENT

Advancement in materials, design, and manufacturing has allowed the System 2000 hand to be made available in four sizes, thus fitting patients in age from 1 1/2 years to 13. The newer design still maintains its unique prehensile characteristic, as well as some mechanical and electrical changes.

The manufacturing process of the hand mechanism is different from other myo-electric hands currently available. A cylindrical length of special grade aluminum is used for the finger and thumb segments. These pieces are heated then pressed in a mold to form the shape. They are then machined and milled to further define the shape and mechanical component. A special plastic coating covers the fingers and thumb thus providing minimal weight and avoiding the need for an inner hand.

The drive mechanism for sizes 5 1/2, 6, 6 1/2 operates on a two motor system. These motors are at either end of the housing assembly. One motor provides speed in opening and closing, and the second motor provides power for grip force upon closing. A combination of reduction units, and gearing completes the drive mechanism. Electrical signal transfer has been changed as well. A series of rings on the switching circuit make contact with wires that are integrated into the wrist of the hand. This eliminates the coaxial plug of the earlier design, and also its overall length.

Electronics of the switching circuit use a microprocessor which has improved function in the following ways: (a) reduced power consumption, (b) automatic adjustment of the switching level between speed and grip force in relationship to the hand and glove condition and, (c) wear of the gears is reduced because of the switch level in the opening direction. Power is provided by the same smaller size 4.8 volt battery. The battery has an on/off switch that assists in preventing unnecessary power from being drained from the battery.

The size 5 hand operates with a single motor only. The prosthetist has the option of single or dual electrode sites. If a single site is selected, the hand is myo-electrically opened, and a spring mechanism closes the hand. The hand may also be manually opened by the patient or caregiver. Separate switching circuits are required for single or dual electrode sites. Also separate circuits are required for left or right hands.

## FUTURE

In summary, the basic idea of preserving the unique relationship of the finger/thumb axis has been maintained. Manufacturing techniques and specific parts have been improved providing the patient with a more cosmetic, smoother functioning prosthesis. What does the future hold for this system or design? Will other options or components be available, such as a wrist rotator, or is a proportional speed hand feasible? Are larger sizes a possibility while maintaining the unique finger/thumb axis feature? If so, does this mean the death of the 6 3/4 size?