

A Handy Solution

A myoelectric prosthesis proved a functional choice for 6-year-old Lucas Wexler.

By Roberta T. Ciocco, O.T.R./L., Karen M. Stumpo, O.T.R./L.,
and Carl A. Rebeck, C.O.

Lucas actively incorporates using the myoelectric prosthesis into bimanual activities. Here he works with Roberta Ciocco, O.T.R./L., looks on.



Lucas Wexler has worn a prosthesis since he was 4 months old. A determined, personable 6-year-old, Lucas was born with a congenital absence of his right upper extremity below his elbow. At age 2, he entered our prosthetic program at Shriners Hospitals for Crippled Children, Philadelphia Unit, and was fitted with a self-suspending below-elbow prosthesis with a voluntary closing mechanical hand terminal device'. Team members who evaluated Lucas initially and continued to monitor him regularly included an occupational therapist, a certified prosthetist and a physician.

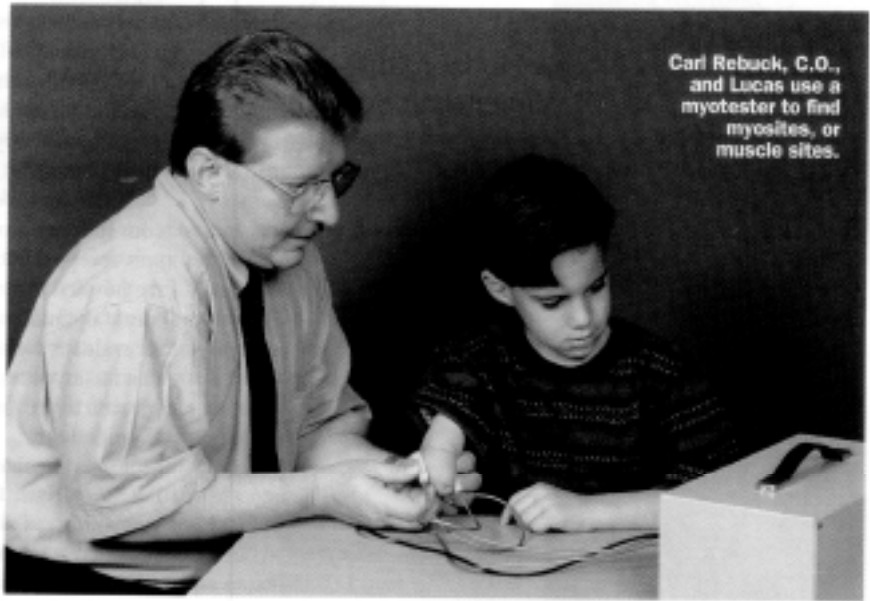
Lucas came to occupational therapy on a weekly outpatient basis for about one year. He was a very functional user of the mechanical hand and wore it consistently at least six hours a day.

Typically, mechanical hands are much more difficult to control and operate than other terminal device options such as the split hook and voluntary closing types. Lucas exceeded all our expectations with his prosthesis, spontaneously incorporating its

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use into most two-handed play activities. He continued to use the mechanical hand until the age of 5, when he was screened for participation in the Shriners myoelectric program.

Screening for this program is offered annually to all below-elbow and unilateral above-elbow clients ages 5 and older who have been regular participants in our prosthetic clinic. Generally, 10 to 15 candidates per year respond. Children above the age of 10 are considered and treated on an individual basis. The actual screening involves team members from the orthotic and pros-



Carl Rebeck, C.O., and Lucas use a myotester to find myosites, or muscle sites.

UNDERSTANDING MYOELECTRICS

A myoelectric prosthesis uses an electrical signal from a muscle to control the flow of energy from a battery to a motor. The control signal is emitted from a residual muscle remnant in the affected limb that has adequate innervation and voluntary control. This electrical signal is detected by an electrode that is strategically placed inside the prosthetic socket.

Lucas, the subject of this article, is a below-elbow amputee; therefore, the muscles targeted for use in his case were the remaining wrist flexors and extensors.

The muscles are tested with a meter that records the amplitude of the contractions and gives feedback regarding the muscles' ability to isolate contractions. In the congenital population it is not always possible to locate these muscles, in which case any two muscles that can be isolated and allow for feasible electrode placement in the socket are utilized.

When only one muscle is identified, a single-site dual-function electrode may be used. This often is the case with very short below-elbow amputees. For a single site, the user must be able to control the speed and force of the muscle contraction to elicit different control actions.

Another option for younger children who lack the coordination to isolate muscle contractions is a single-site "cookie crusher" electrode. This system allows the user to trigger a control motion, such as opening of the hand, with a muscle contraction; when the muscle relaxes, the hand automatically closes.

Once the muscles have tested successfully, the electrode is strategically located in the intimately fitting prosthetic socket. The power source is a rechargeable nickel cadmium battery that is laminated into the forearm portion of the prosthesis. The battery usually lasts a minimum of four hours.

Recently there has been much debate over the appropriate age for myoelectric fittings. Initially, myoelectric limbs were thought to be appropriate only for adolescents and adults, primarily because the components were rather large. However, since the inception of myoelectrics in the early 1970s significant biomechanical advances, such as the development of smaller, lighter and less complicated systems, now allow this technology to be applied to younger children.

-R.T.C., K.M.S., C.A.R.

Handy Solution

thetic, social service, and occupational and recreational therapy departments. Areas covered include:

- *Prosthetic history
- *University of New Brunswick (UNB)
- *Test of Prosthetic Function
- *Muscle site location (myosites)
- *Social history
- *Group skills

Based on his excellent wearing time and functional use of his conventional prosthesis, Lucas passed the initial screening and was accepted into the Shriners Myoelectric Camp. He returned to the hospital for two outpatient visits with the prosthetist—first to locate optimal myosites and casting for the prosthesis, and then to evaluate a check socket. A check socket helps to determine that the myosites are optimally placed, that there is adequate suspension to prevent the socket from sliding off and that the socket is properly fit.

Lucas received his myoelectric prosthesis on the first day of the Myoelectric Camp, an annual program developed to meet the growing needs of our juvenile prosthetic population utilizing limited resources. Accepted candidates are admitted to the hospital for two weeks of intensive training and client/parent education. The group size ranges from four to eight children, ranging in age from 5 to 10 years. Each family is encouraged to have one

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parent attend all camp programs and receive a special myoelectric training session.

The camp featured two daily sessions of occupational therapy, one to two sessions of recreational therapy with an early childhood education/child life specialist, and ongoing sessions with a social worker. Every attempt was made to foster a fun, camp-like atmosphere by incorporating the children's

myoelectric prostheses into age-level play, self-care and school-related activities. Group outings included miniature golf, bowling and a gross motor play center. Participants and their families also benefitted from socialization and emotional support.

Initially, Lucas's prosthesis was composed of a 2 1/4-inch myoelectric Liberty Mutual Steeper hand, Otto Bock electrodes and a half-size Liberty Mutual battery. It was the first time we had tried this particular combination. Unfortunately, the components were not compatible; the hand required more power than the battery could supply. As a result, the batteries were losing charge very quickly and the hand was responding inconsistently.

Several other children in the group had the same components and were all experiencing similar problems. Once the problem was identified, a decision was made to switch to componentry from one manufacturer. The Otto Bock System 2000 hand, elec-



Because the myoelectric prosthesis has no harness and his residual limb is short, Lucas does not wear the device for gross motor play and sports because there is a risk of it falling off during these activities.

trodes and battery were chosen to replace the initial components. This system also had the added benefit of being lighter in weight.

The cost of the componentry alone for this prosthesis was \$4,900. Fortunately we have an on-site prosthetic lab, which facilitated making changes. Funding for the prosthesis and all of the training was provided by Shriners Hospitals, a non-profit organization that provides orthopedic and bum care to eligible clients at no cost to the family.

Results

Lucas has been wearing his myoelectric prosthesis for almost a year. During this time, there have been no major repair issues. He wears the device eight hours a day on school days and as needed at other times. As there is no harness and his residual limb is short, he does not wear the prosthesis for gross motor play and sports because there is a risk of it falling off during these activities.

The past year has been one of many changes. Lucas began kindergarten three full days a week, and he has been actively involved in organized sports (soccer and

T-ball). A very proficient prosthetic user, Lucas is more likely to actively incorporate the device into two-handed activities. With the mechanical hand he would sometimes use the prosthesis passively by stabilizing objects without opening the terminal device. Or he would use other methods, such as holding an object between his legs.

Some of the activities in which he uses the myoelectric prosthesis as an assist include playing with construction toys such as Lego, cutting paper and drawing. Clients with unilateral amputations tend to perform activities such as eating and writing with their dominant hand.

In addition, the myoelectric prosthesis has several advantages over the conventional device. It has a stronger, more easily activated grip and is more comfortable to wear because there is no harness.

As a result of this experience, Lucas has also become more self-confident and helped to educate his kindergarten class about amputees and prosthetics. His family donated a copy of *Harry and Willy and Carrothead*, by Judith Casely, to his school. This book helps children understand that everyone has differences and that our differences are what make us unique.

Lucas Wexler is proof that with determination and a supportive environment, what might be considered a significant physical disability to some is simply what makes him unique. ■

FOOTNOTE

A terminal device is the prosthetic component that replaces hand function. This may be either voluntary opening, such as the split hook, or voluntary closing.

The authors work at Shriners Hospital, Philadelphia Unit, and recently participated in a pilot study on the effectiveness of myoelectrics with pre-schoolers.

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