



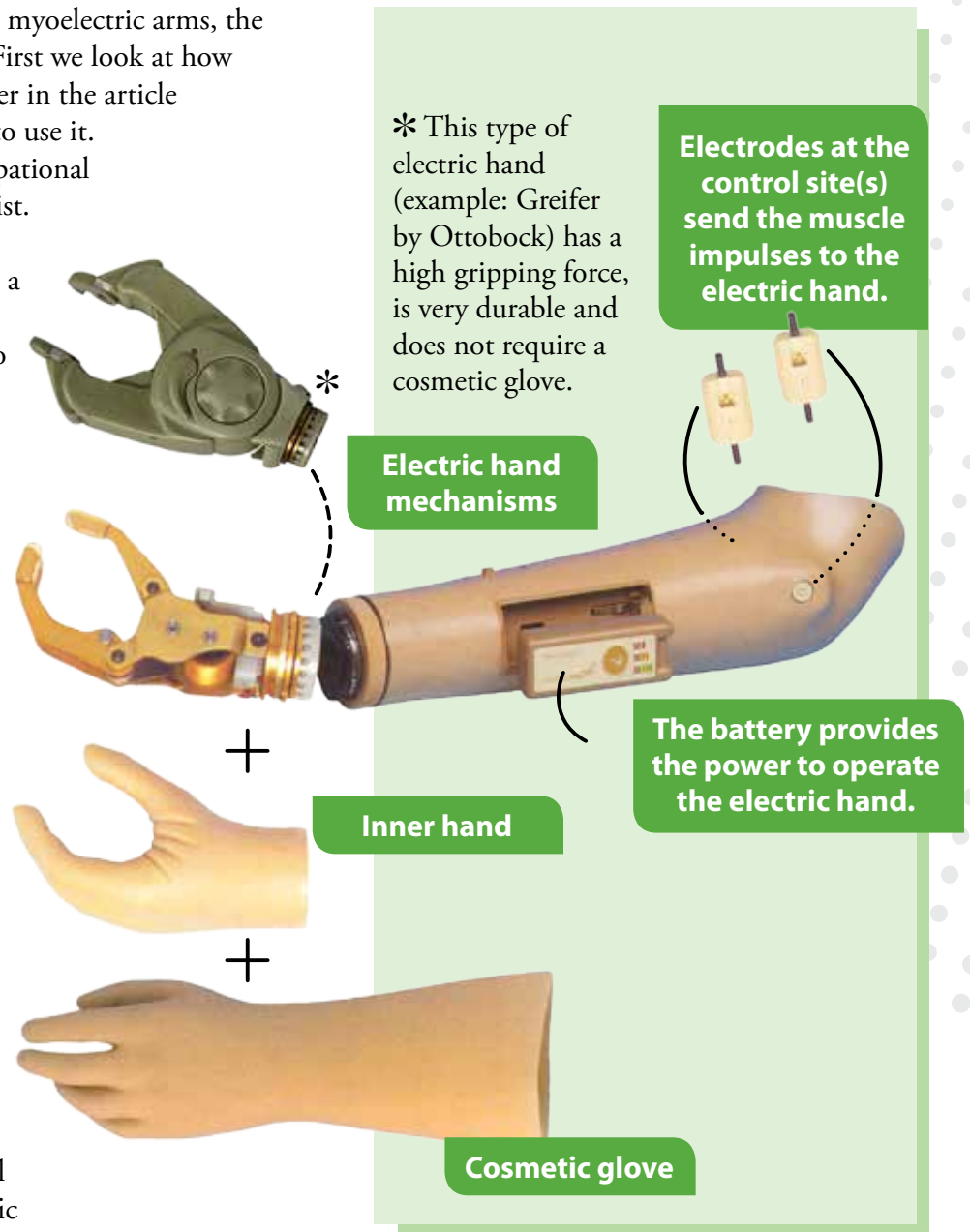
## Myoelectric Arms

When it comes to fittings that provide “function” for arm amputees, there are choices for body-powered prostheses (which provide great function and are lightweight) and electric prostheses. We have information on body-powered options should you require it.

In this article we concentrate on myoelectric arms, the most common electric fittings. First we look at how a myoelectric arm works and later in the article explain how an amputee learns to use it. Training is provided by an occupational therapist and/or by the prosthetist.

Children can now be fitted with a myoelectric arm at a very young age, even around age one, due to advancements with lightweight components and socket design. When children are fitted at a young age the artificial limb becomes a part of their natural body movements and body image. For children, components have been uniquely designed to allow for their size and strength. A myoelectric arm needs to change both physically and functionally as the child grows.

A “myoelectric” arm is operated when electrodes pick up muscle (myo is from the Greek word for muscle) impulses from the residual limb. These muscle impulses (signals) are then translated into electrical signals that are sent to the electric hand to open or close it. A battery in the prosthesis provides the power.



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## How does it move?

### Muscle signals

Where an electrode is placed on the muscle is referred to as a “control site.” A simple myoelectric arm with one control site, called a ‘Cookie Crusher,’ (which has only one speed for grip force) is often a child’s first myoelectric fitting. Later on, when the clinic team decides the child is ready to handle a more sophisticated fitting or when an adult is fitted, two control sites are usually used (there are situations when an amputee only has one viable control site – for example in the case of a residual limb covered in scar tissue; if a control site is not viable, alternative controls, such as simple switches, are used). When two control sites are used, one control site opens the hand and the other control site closes it.

### Proportional Control

Myoelectrics with “proportional control” means the amputee, by the length or strength of muscle contraction, can control how quickly the hand opens or closes and the grip force once the fingers make contact with an object so that the amputee can hold objects lightly or firmly as needed. For example, the amputee has the ability to gently hold a delicate object like an egg or more force can be applied to hold heavier objects like a book. The amputee can also control the speed that the hand opens and closes, depending on the required task.

### Electric hands

The electric hand (or another terminal device such as an electric hook) receives the signals sent from the control site(s).

### Battery Power

The power to operate a myoelectric arm is provided by a battery. The battery will either be built into the prosthesis, and the arm itself is plugged in to recharge it, or alternatively, a removable, rechargeable battery is used, and can be replaced as needed. Lithium batteries more and more are being used instead of nickel cadmium ones. Nickel cadmium batteries need to be fully discharged before being recharged otherwise memory problems can result – also more than one

battery a day is usually required. Lithium batteries are lighter in weight and can be charged at any time without concerns about how much power has been discharged. They charge more quickly (four hours or less) and last considerably longer before they need recharging (cutting down the number of batteries an amputee needs to keep on hand).

## Three phases of training

Training is an important factor when an amputee has been fitted with a myoelectric arm, it helps the amputee incorporate the artificial limb into his/her life as the amputee learns what the prosthesis can actually “do” for him/her. Training consists of three main stages:

### Signal Training

This first phase of training teaches the amputee to control the muscle(s) required to operate the myoelectric arm. The amputee learns to produce signals at will and to inhibit signals when movement of the arm is not required. Electrodes are placed over the selected muscle(s) and connected to a trainer which provides feedback as the amputee contracts the muscle(s).

### Control Training

The second phase is control training at which time an amputee learns to control the muscle(s) appropriately to perform a required function. The training may include using computer games or an actual artificial limb – again, providing feedback to the amputee. A trainer could either be a myoelectric hand or even something

fun. For young children this could be modified toys like a toy train, where the muscle impulses, when correctly made, will cause the train to move. A variety of objects of different sizes, shapes and textures may be used to practise grasp and release when the amputee is learning to control the hand.

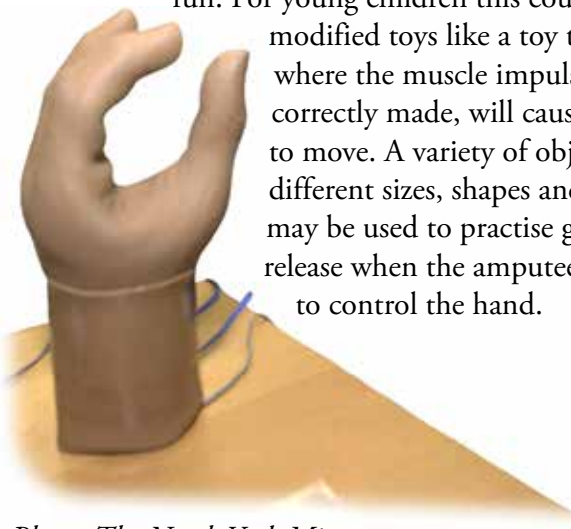


Photo: The North York Mirror

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## Functional Training

The third phase is functional training and it is important that the artificial limb fits correctly before beginning this phase of training. Functional training is the most intensive phase of training and can take between two weeks to two months (it may vary for children).

This phase of training helps the amputee to become accustomed to wearing the artificial limb, to become a proficient myoelectric user and to view the artificial limb as part of their body image. The occupational therapist and prosthetist will also work together to teach the amputee tasks that can be performed on a daily basis at home.



*Photo: Bloorview MacMillan*

Training begins with simple tasks which are repeated to allow each pattern to be learned. Gradually more complex, real-life activities are introduced suitable to the amputee's age. A problem-solving approach is also taught so the amputee will be able to use the myoelectric in new situations once the training is complete. For children it is important to encourage the child to wear the myoelectric arm consistently and this may mean a gradual increasing of wearing time. Have the child participate in fun activities while wearing the myoelectric arm to provide encouragement. Frequent review and "booster" training sessions with an occupational therapist may be required to help an amputee get the maximum function from their myoelectric arm.

A child, or any amputee, needs to learn that the prosthesis will provide *function* if he/she is to be expected to want to wear it.