Electromyography, Myoelectric signals and their use in Controlling Prosthetic Limbs

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Electromyography (EMG) involves the testing of muscles for electric activity. All muscle activity is performed due to small electric signals. Diseases such as muscular dystrophy may create abnormal electric signals. These signals can be tested and the information gathered can be used to diagnose a patient.

Myoelectric signals, also called action potentials, are the electric signals that are sent to muscles to make them contract. These signals are present throughout the whole body and are still produced when a limb is damaged or severed.

Patients who have a severed hand, for instance, may have feelings of a “phantom hand”. This sensation may be from the myoelectric signals being sent to the stub where the patient’s hand previously was. Patients feel like their hand is still attached to their arm. This feeling has led scientists to wonder if a bionic hand can be created that receives these exact signals and functions like an organic hand would.

Traditional electric switch prosthetics use straps or cables that are actuated by body movement to control the movement of the prostheses. Fully myoelectric control gives information to the prostheses purely based on the electric signals produced by the body.

A disadvantage of myoelectric signals is the difficulty of determining strength. It is extremely difficult to correctly gauge the strength of a patient squeezing a ball using just myoelectric signals. In many cases it is near impossible to accurately gauge strength. Non-invasive methods of receiving myoelectric signals is just not sufficient. Other functions and factors of muscle movement determine the strength of grip, for example. These factors are not limited to myoelectric signals, therefore they will not be detected in the myoelectric data.

One example of a successful myoelectric control scheme in prosthetics is the Touch Bionics™ i-LIMB®. The i-LIMB® uses myoelectric controls to power all fingers in the hand separately instead of the traditional open or close motion. The i-LIMB® also has a thumb which can be rotated, just like a natural human thumb, into multiple positions to improve grip and functionality.

The i-LIMB® solves the problem of detecting grip strength by including sensors that detect when an object has a correct amount of pressure applied for grip. Individual fingers will lock into position until the patient uses muscle movement to unlock them. The multiple grip possibilities of the i-LIMB® prosthetic allows patients to use the index finger to type on a keyboard, grasp a key and unlock a door and hold a fork and knife.

The i-LIMB® hand also rests in an anatomically correct position. This makes the prostheses much less noticeable, especially when LIVINGSKIN® technology is applied. Touch Bionics™ has developed an extremely lifelike outer skin for the prostheses. This outer skin looks almost identical to human skin, allowing the patient to truly blend back into society.

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