Targeted Muscle Reinnervation for Control of Myoelectric Prostheses

Rory Makuch, *Biomedical Engineering, University of Rhode Island*
BME 181 Second Presentation, April 22, 2013 <rormak@my.uri.edu>

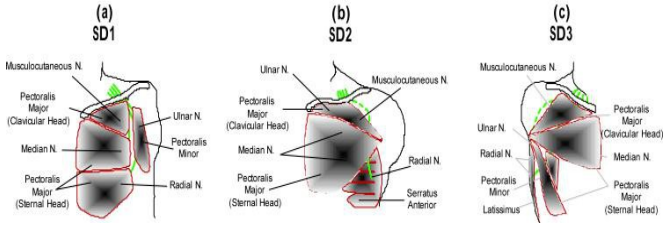
***Abstract*—The loss of an upper extremity is one of the most debilitating injuries one can sustain. Targeted muscle reinnervation surgery allows greater control of myoelectric prostheses by transferring residual arm nerves to other muscles for myoelectric signal amplification.**

I. Introduction

Many people each year lose a part or all of one or both of their upper limbs. Throughout history the development of prostheses has been slow. Starting with leg prostheses just for support, then to cosmetic upper and lower limb prostheses, and finally to body powered and myoelectric prostheses. Myoelectric prostheses seek to improve on body powered prostheses by cutting down on physical strain in the patient. This is achieved through the use of electrical power, and the ability to control the prosthesis mentally. Sometimes a patient may not have enough residual arm muscle to generate proper myoelectric signals. Targeted muscle reinnervation allows the nerves of the arm to be transferred to muscle areas in the chest and back, so that nerve impulses to the arm stimulate the new area thus amplifying myoelectric output.

II. Methods IV Discussion

An eligible candidate for targeted muscle reinnervation is given surgery from 11-70 months before work begins with the prosthesis. During surgery depending on the extent of the amputation the remaining nerves in the arm or shoulder are transferred to muscle tissue that is no longer necessary because of the injury.



Once rehabilitated the patient begins work with the prosthesis. Twelve adhesive bipolar EMG electrodes are placed on the patient. Four at clinically evaluated locations, and eight more chosen by an algorithm to result in maximum accuracy and detection of the EMG signals. The signals are then amplified and processed on a desktop computer.

III. Results

In one extensive study by the Research Institute of Chicago ten participants were studied using the methods described. Five amputees that had undergone targeted muscle reinnervation and five control participants without an amputation. The patients attempted 72 hand motions and 108 wrist and elbow motions each on a virtual arm. If the move was not completed within 5 seconds it was considered a failure. The success rate for the control participants was 97% and 88% for the TMR.

Three of the TMR patients were chosen to participate in physical myoelectric prostheses control. After one day they were able to complete simple movements, and after two weeks their ability to control the prosthesis was greatly improved.

IV. Discussion

The success rate for targeted muscle reinnervation surgery is 96%. And studies have shown great success with interfacing the newly innervated muscles with virtual and physical prostheses. Things that could be improved are the latency between thought and movement, and the ease of control of the prostheses. As well as creating more portable interfaces, and more human looking prostheses. Also in the future with this type of interfaces is tactile feedback. A tactile sensor is placed on the end of the prostheses and stimulates an area on the patients reinnervated area when moved over a surface, thus creating a feeling of sensation in the patient.

References

[1] Targeted Muscle Reinnervation: Control Your Muscle with Thought. <http://www.ric.org/conditions/po/services/bionic/>
[2] Targeted Muscle Reinnervation for Real Time Myoelectric Control of Multifunctional Artificial Arms. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3036162/>
[3] Targeted Muscle Reinnervation Yields High Success Rate in first 40 cases. <http://www.healio.com/orthotics-prosthetics/prosthetics/news/print/o-and-p-business-news/%7B99bded40-142c-48d1-90a9-d60a4521c9f0%7D/targeted-muscle-reinnervation-yields-high-success-rate-in-first-40cases >
[4] Todd Kuiken: A prosthetic arm that "Feels" <http://www.youtube.com/watch?v=MLvwTlbj1Y8 >
[5] Figure 1 <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3036162/figure/F1/ >
[6] Figure 2 <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3036162/figure/F3/ >