INFLUENCE OF A TRANSRADIAL AMPUTATION ON NEUROMUSCULAR CONTROL OF FOREARM MUSCLES

[1]Morten Bak Kristoffersen, [1]Andreas Franzke, [2]Alessio Murgia, [2]Raoul Bongers and [1]Corry van der Sluis

[1]University of Groningen, University Medical Center Groningen, Department of Rehabilitation Medicine, Groningen, the Netherlands
[2]University of Groningen, University Medical Center Groningen, Center for Human Movement Sciences, Groningen, the Netherlands

ABSTRACT

Following an upper-limb amputation the muscles and tendons in the amputation stump are often rearranged by a surgical procedure. One of the purposes of this rearrangement is to shape the stump as to optimally support the prosthesis socket, and to create good control sites for a myoelectric prosthesis using direct control. For the transradial level the main wrist flexors and extensors are used for the latter purpose and the remaining muscles are mainly used for reshaping the stump. This is an interesting phenomenon from a motor control perspective and questions arise to how the control strategy of the neuromotor system changes after amputation when muscles and other tissues are rearranged and subsequently degenerate. Moreover, the feedback loop is heavily altered due to absence of a moving limb. This also appears to have an effect on the electromyogram (EMG) as demonstrated in several studies in which motion intent was classified using features of the EMG measured at the forearm. When comparing classification accuracy between able-bodied subjects and amputee subjects the accuracy was lower for the amputees. However, the relative accuracy between able-bodied participants and amputees is fairly consistent among a range of classification algorithms. Therefore, many studies recruit able-bodied subjects and extrapolate their results to the amputee population.

In this study we aim to investigate how transradial amputation influences the EMG in an effort to improve the transferability of results from able-bodied participants to amputee users. In our study protocol, we simultaneously measure the EMG at the forearm of both the unaffected and the affected side of transradial amputees. Participants will perform bimanual (phantom) movements in two different conditions. In the 'restricted-hand condition', the hand of the able side is restricted by a brace so the movement contractions become isometric. In the 'free-hand condition', the hand of the able side is not restricted. The purpose of restricting the able hand is to simulate the loss of hand movements while contracting wrist muscles and determine how this influences the EMG. We hypothesize that the EMG measured at the able-side in the 'restricted-hand condition' is more similar to the EMG at the affected side than it is in the 'free-hand condition'. To quantify this, we use a pattern-recognition algorithm to classify the motion intent from both sides and analyse the resulting classification clusters using the separability index, repeatability index and the semi-principal axes as described in the literature.