

Pre-Conference Workshop 2

Hand Function Therapies: Made in Canada

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Scope

About 400,000 people in North America who survived spinal cord injury (SCI) or stroke have weak or paralyzed hands, making activities of daily life difficult or impossible. In the last decade clinical trials have shown that daily exercise therapy over several weeks and months, especially when augmented with functional electrical stimulation (FES), can improve voluntary hand function by clinically significant amounts. The purpose of this workshop is to present various hand function therapies and interventions developed for stroke and SCI patients that involve FES.

Session 1: In-Home Tele-Rehabilitation

An in-home tele-rehabilitation (IHT) system for the upper extremity will be discussed. The system comprises three elements:

- An FES cuff that elicits hand opening and closing, triggered by the user with small tooth-clicks sensed by a wireless device like a hearing aid.
- An exercise workstation with an extensible arm that presents the user with spring-loaded manipulanda equipped with force and displacement sensors. Audiovisual software guides the user through a hand function test and a variety of computer games based on ADL.
- An Internet-based IHT system allowing a therapist to supervise workstation users in their homes and to download their performance data.

This part of the workshop will discuss how the first IHT systems were deployed in patients' homes, as well as the preliminary results of a randomized controlled study conducted with the IHT system.

Session 2: The Stimulus Router System

A new type of neuroprosthesis, the stimulus router system (SRS) will be discussed. In the SRS some of the current flowing subcutaneously between a pair of surface electrodes is routed to a target nerve by a passive implanted conductive lead. The implanted lead has a pick-up terminal located under a cathodal surface electrode and a delivery terminal in contact with the target nerve. An external stimulator is connected to the surface electrodes to deliver current pulses. Recently the SRS was tested intra-operatively in a human subject undergoing nerve transfer surgery and the first permanent SRS implant to restore hand opening and grasp in a quadriplegic man took place in June 2008. This part of the workshop will discuss first results achieved with the SRS system.

Session 3: Improving Grasp in Stroke and SCI Patients

The third and the final part of the workshop will discuss the implementation of FES therapy for improving reaching and grasping functions in stroke and SCI patients. This part of the workshop will present the results of two randomized controlled trials involving:

- *Severe stroke patients* who were unable to reach and grasp prior to joining the study. These individuals underwent 12 to 16 weeks of intensive trice-weekly therapy for restoring reaching and grasping functions. One group received conventional occupational therapy (controls) and the other group received FES therapy (treatment). At the end of the study all participants in the treatment group improved either reaching or both reaching and grasping functions. The patients in treatment group on average exhibited 41% improvement in the Fugl-Meyer Assessment score, while the participants in the control group experienced improvements of only 8%.
- *Acute complete and incomplete C4 to C7 SCI patients* who were unable to grasp prior to joining the study. These individuals underwent 8 weeks of intensive five-times-weekly therapy. One group received conventional occupational therapy (controls) and the other group received FES therapy (treatment) for restoring grasping function. The preliminary results of this study suggest that the FES therapy is able to improve hand function in both incomplete and complete SCI individuals. In incomplete SCI individuals the FES therapy resulted in an improvement in the Functional Independence Measure (FIM) score of 43%, while the conventional therapy arm showed an 18% improvement. Another finding that was unexpected was that the complete SCI individuals also improved as a result of the FES therapy. In complete SCI individuals the FES therapy resulted in a 25% improvement in the FIM score, while the conventional therapy resulted in a 10% improvement. Furthermore, we observed that the complete SCI individuals, who were unable to generate any torque or force voluntarily with their hands prior to the study, were able to do so after the study if they were assigned to the FES therapy group.