Notice of the Final Oral Examination for the Degree of Master of Science

of

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BKin (Hons) (University of Victoria, 2015)

“Does continuous passive motion of the ankle applied with a pneumatic robot alter spinal cord excitability?”

School of Exercise Science, Physical and Health Education

Friday, September 15th, 2017
11:00 a.m.
Medical Sciences Building
Room 210

Supervisory Committee:
Dr. Paul Zehr, School of Exercise Science, Physical and Health Education, University of Victoria
(Supervisor)
Dr. Marc Klimstra, School of Exercise Science, Physical and Health Education, UVic (Member)

External Examiner:
Dr. Patrick Nahimney, Department of Biology, UVic

Chair of Oral Examination:
Dr. Lenora Marcellus, School of Nursing, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies
Abstract

Background: Spasticity of the ankle can occur in multiple sclerosis and stroke, and can significantly reduce quality of life by impeding walking and other activities of daily living. Robot driven continuous passive motion (CPM) of the ankle may be a beneficial rehabilitation strategy for lower limb spasticity management, but, objective measures of decreased spasticity and improved locomotion remains uncertain. Additionally, the acute and chronic effects of CPM on spinal cord excitability are unknown. Objectives: To evaluate: 1) the acute changes in spinal cord excitability induced by 30 min of CPM at the ankle joint, in neurologically intact individuals and in those with lower limb spasticity; and, 2) chronic training-induced effects of 6 weeks of bilateral CPM training on reflex excitability and locomotion in those with lower limb spasticity. Methods: Spinal cord excitability was assessed using Hoffmann (H-) reflex recruitment curves, collected immediately before and following 30 min of CPM of the right (neurologically intact) or more affected (clinical) ankle. A multiple baseline repeated measures study design was used to assess changes following 18 bilateral CPM training sessions. Spasticity and locomotion were assessed using the Modified Ashworth Scale, the 10 m Walk test, and the Timed Up and Go test. Results: 21 neurologically intact and 9 participants with spasticity completed the study. In the neurologically intact group, CPM produced a bi-directional modulation of H-reflex creating ‘facilitation’ (n=12) (31.4 ± 20.9% increase in H-reflex amplitude) and ‘suppression’ (n=9) (32.9 ± 21.0% decrease in H-reflex amplitude) groups. In the clinical participants, acute CPM before training significantly increased H-reflex recruitment curve variables H@Thres and H@50; but there was no significant effect of acute CPM post-training. Baseline reflex excitability following training was reduced on the MA side for H@Thres, H@50 and H@100 by 96.5 ± 7.7%, 90.9 ± 9.2%, and 62.9 ± 21.1%, respectively. On the LA side there was a significant decrease in H@Thres and H@50 by 83.4 ± 29.0% and 76.0 ± 28.3%. Time to complete the 10 m Walk Test was not different (5.2 ± 7.9% change, p = 0.06), and time to complete the Timed Up and Go was decreased (9.5 ± 12.3% change, p = 0.05). Spasticity of the ankle plantar flexor muscles, assessed by the Modified Ashworth Scale, was reduced in 4 participants. Conclusion: Acute and chronic CPM of the ankle can significantly alter spinal cord excitability. CPM training may be a useful strategy to decrease spasticity of the ankle plantar flexors.