Title: Can Brain Activity Predict Manual Dexterity Improvement after Surgery in Cervical Myelopathy?

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Structured Abstract:

Introduction: Cervical spondylotic myelopathy (CSM) is a degenerative disease of the spine that causes compression of the spinal cord. There are a variety of symptoms CSM patients experience, including gait dysfunction, disturbances in overall hand function and bowel/bladder dysfunction. CSM is potentially reversible following surgery, with 35% of patients improving [1]. However, there are few predictors to determine which patients will exhibit neurological improvement following surgical treatment. Introducing rehabilitation to improve manual dexterity after surgical intervention could also potentially improve patient quality of life, which is the primary goal. The objective of the current study is to determine whether changes in manual dexterity following spinal decompression surgery and following rehabilitation correlate with brain function measured by functional MRI (fMRI). Preliminary data is presented for this ongoing study.

Methods: Ten patients (8 men, mean age (±SD) 63 ± 11.2 years, 10 right-handed) with a clinical history of CSM were scanned on the 3.0 Tesla Siemens MRI scanner at Robarts Research Institute at prior to and six weeks after spinal decompression surgery. Each time-point included the acquisition of sagittal T1-weighted 3D images and blood oxygen level-dependent (BOLD) images (echo planar sequence, TR/TE = 1000/30 ms) during the functional task. The motor pathway was activated during the functional imaging using a block paradigm task, where subjects were instructed to perform a finger-to-thumb motion using a button box. The block paradigm consisted of 30 seconds of rest, followed by 30 seconds of controlled tapping, repeated for 5 minutes and 30 seconds (with a total of 6 rest and 5 active periods). All subjects also completed a validated dexterity measurement for myelopathy patients called Graded Redefined Assessment of Strength, Sensation and Prehension (GRASSP) at both time-points.

Results: One patient was excluded from analysis due to the presence of large changes in global activation patterns caused by breath holding. A preliminary analysis showed that the volume of activation prior to surgery trended towards more activation when a patient performed better on the GRASSP dexterity device. After surgical intervention, the volume of activation and BOLD signal in the contralateral motor region, both decreased.

Discussion: These preliminary results suggest that pre-surgery patients who demonstrate a better dexterity score are activating more of the motor region; however, the sample size used does not provide sufficient power for analysis. Recruitment of more patients is presently ongoing. Currently, rehabilitation has been introduced to half of the patients at the 6 week post surgery time point and is performed 3 times a week for a duration of 6 weeks. Another follow-up scan is planned at the 12 week post-surgery time point to examine the effects of dexterity rehabilitation.

References: [1] Bernhardt et al., 1993