Evidence of a Decreased Cervical Multifidus Contractility in Patients Undergone Decompression Surgery for Cervical Spondylotic Myelopathy


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Disclosures:

Introduction: Cervical Spondylotic Myelopathy (CSM) is becoming one of the most common cervical disorders implicating the spinal cord. Patients with progressive neurologic changes or severe disabling pain will usually require decompression surgery. With the well accepted modern model of spinal stability emphasizing the importance of the deep spinal muscles such as the multifidus, recent decompression surgeries for CSM have evolved with a greater effort in preserving the deep tissues during surgery. Despite this, the impact of spinal decompression surgery on the contractility of the deep core muscles have not yet been investigated. In order to address this important gap in the clinical knowledge which would have great implications on the selection of the post-operative rehabilitation program, current study aims to utilize clinical ultrasound imaging to investigate the impact of surgery on the contractility of the multifidus muscle. The contractility of the muscles will be determined by measuring the changes in the thickness of the muscle belly whilst performing an isometric contraction maneuver and comparing it pre- and post-surgery. Furthermore, the influence of different surgical approaches will also be investigated.

Methods: Twenty-four MRI confirmed CSM patients attending our institution between August 2012 and July 2013 were included in the study. Basic demographic details as well as their pain (VAS) and disability (Neck Disability Index) levels were firstly recorded. Patients were then briefed about the use and purpose of the Ultrasound assessment with the therapist ensuring no contraindications with the use of Ultrasound were identified and formal consent received. Whilst comfortably seated in a wooden chair with high-back support, the patients were asked to perform an upper cervical extension whilst the therapist provided a manual resistance at the back of the head and thus producing an isometric contraction of the multifidus muscle. Whilst performing the described maneuver, an imaging Ultrasound (GE, USA) was used to record the muscle contraction with a special focus on the multifidus muscle at C7, C6, C5 and C4 levels respectively. Two repeated recordings were taken at each level and with left and right side taken separately to ensure better consistency for the analysis. After the images have been taken, the resting thickness and the thickness at patient’s maximum contraction were measured manually using the in-built tool and then the average thickness change and normalised change were calculated and entered for analysis. An example of the recorded images and marking is illustrated in Figure 1. For the statistical analysis, Mann-Whitney test was firstly employed to determine any significant side differences and then a Multivariate Analysis of Covariance (MANCOVA) with the type and direction of the surgical approach as well as other demographic data entered as the covariate was conducted to investigate for significant differences in contractility pre- vs post-surgery. A p-value of <0.05 was considered significant. The study was approved by the institutional medical research ethics committee (201201053RIC).

Results: Of the 24 patients, 16 were male (55(13.9) yrs) and 8 females (64(9.1) yrs). The overall NDI score for this group pre-surgery was 14.4(10.8) and with an average resting pain (VAS) of 5.8(2.5). At 3 months post-surgery, the average NDI score was 9.9(13.8) with resting pain (VAS) of 3.1(2.1). For the patients receiving laminoplasty, no significant difference was found (p>0.165) between the operated (incision) side vs non-operated side, for any of the levels and both pre- and post-surgery. For patients receiving the anterior approach, no significant difference for any of the levels for both pre- and post-surgery was identified (p=0.105). With no significant side differences identified, the average of the left and right side were calculated and used for further analysis. For anterior vs posterior approaches, Mann-Whitney test revealed that most of the levels were not significant, however, for Pre-surgery: thickness change at C4, and for 3 months Post-surgery: thickness change at C6 and C5 as well as normalized thickness change at C5 were found to have significant difference (Figure 2). MANCOVA showed no significant difference pre- vs post-surgery based on Pillai’s Trace with a p-value of 0.469 and observed power of 0.497 and operating approach (anterior vs posterior) did not reach statistical significance based on the covariant analysis.

Discussion: Current prospective study investigated the influence of different surgical approaches on the contractility of the multifidus muscle has identified a number of interesting points for discussion. Despite the general perception that surgery utilizing posterior approach and especially on the side of incision, are more likely to lead to gross muscle trauma and dysfunction, this was not evident in our data to date. This could be an indication of the adaption of advances in surgical
techniques in preserving the deep tissues and especially when performed by an experienced neurosurgeon. However, it is noted that the relative small sample size and large variance may have also lead to the insignificant findings. Nevertheless, it is a positive sign for patients requiring posterior decompression approach. Although the side of incision did not appear to lead to a significant difference, it must be noted that overall, the posterior approach appeared to have a greater influence on the contractility of the multifidus muscle. Albeit it failed to reach a significant difference based on the covariant analysis, an observable trend of a marked decrease in thickness change was identified. A larger sample size will be required to further ascertain such findings. Given the known direct influence of spinal disuse and resultant muscle atrophy and activation, it was hypothesised that marked atrophy of the multifidus will be observed at three months post-surgery, this was especially so given our patients were instructed to wear collar support for three months as part of the post-surgery protocol. However, our results did not identify any significant differences in muscle contractility pre- and post-surgery. Such contrasting finding may be due to the fact that most of the patients in this sample have had their symptoms for greater than six months prior to their surgery. It is plausible that the chronicity of the condition may have already caused a marked dysfunction in the deep muscles pre-surgery and subsequently leading to a lack of difference post-operatively. It is acknowledged that given the longitudinal design of the study, data to date should only be considered as preliminary as the sample will be reviewed again at 6 months and 12 months post-surgery. It certainly will be of interest to investigate whether the identified decrease in contractility will be reversible at 6 months through Physical Therapy management which was designed to restore functional capacity as well as the deep muscle functions.

**Significance:** Despite the lack of statistically significant contractility change pre- vs post-surgery, an observable decrease in muscle contractility was identified and more specifically, patients undergone posterior approach appears to be more greatly influenced than those undergone anterior approach. This finding will have great implications in the determination and selection of post-surgery rehabilitation program.

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**References:**
Figure 1. Ultrasound imaging obtained at C5 level at rest (A) and at the maximum isometric head extension maneuver (B).

The arrow indicates the recorded muscle thickness. M = Multifidus; SSC = Semispinalis Cervicis; SP = Spinous Process; AP = Articular Process.
Figure 2: Mann-Whitney test comparing Anterior and Posterior approach on the thickness change of the different levels, pre- and post-surgery. Delta=Change of thickness, Pre=Pre-surgery; 3M= 3 months post-surgery.