Cervical Curvature Became More Lordotic in Flexion Post-Operatively Regardless of Type of Surgical Approach in Cervical Spondylotic Myelopathy

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Disclosures:

Introduction: Presence of an appropriate cervical curvature is gaining clinical recognition for the biomechanical reasons of better weight distribution, structural support, energy efficiency as well as shock absorption and it is becoming a significant outcome measure for patients with cervical disorders. Despite this, there are currently limited published literature available documenting the changes in the cervical spine curvature in patients undergone decompression surgery for cervical spondylotic myelopathy (CSM). Furthermore, the available literature has mostly focused on the effect of a single type of surgical approach on the associated curvature change. Given anterior and posterior surgical approaches have both been proven to be effective and equally commonly utilized in treating CSM, current study investigated the changes in the cervical spine curvature in CSM patients that had undergone either a one- or two-level instrumented anterior cervical discectomy and fusion (ACDF) and compared to those that had undergone laminoplasty. It was hypothesized that an observable increase in kyphosis will likely be seen post-operatively regardless of the type and direction of surgical approach.

Methods: The study population consisted of radiographically confirmed CSM patients who had undergone decompression surgical intervention at our institution between August 2012 and July 2013. Utilizing the Cobb method, curvature of the cervical spine (C2-7) was evaluated on preoperative and follow-up (3 months) x-rays in 30 patients (12 underwent one-level ACDF, 11 with two-level ACDF and 7 underwent laminoplasty). Digitized lateral cervical spine radiographs in neutral, flexion and extension views in the standing position were obtained for all patients, with negative and positive angles indicating cervical kyphosis and lordosis, respectively. In order to gain an overview of the trend of change post-operatively, the pre- and post-operative curvature for each of the patient was compared and classified as either unchanged, became more lordotic or kyphotic. Based on the generally accepted standard, only a change of greater than 5° is considered adequate to be classified either as a kyphotic or lordotic change respectively (Rajshekhar, Arunkumar et al. 2003). For the statistical analysis, paired t-test was firstly used to assess the overall significance of change of the cervical spine curvature pre- and post-operatively in the three positions. This was then followed by a one-way ANOVA to assess the effect and influence of the type of surgical approach on the cervical spine curvature. A p-value of <0.05 was considered significant. The study was approved by the institutional medical research ethics committee (201201053RIC).

Results: In the neutral position, the curvature remained unchanged (change < 5°) in 11 patients (36%), 6 patients (20%) became more lordotic and 13 patients (43%) became more kyphotic post-operatively. For the flexed position, curvature remained unchanged in 9 patients (30%), 20 patients (67%) became more lordotic and only 1 patient became more kyphotic (3%) post-operatively. For the extended position, curvature remained unchanged in 13 patients (43%), became more lordotic in 4 patients (14%) and 13 patients became more kyphotic (43%) post-operatively. A summary of the classifications is presented in Table 1 and a case representative of this trend is illustrated in Figure 1. Globally, the mean (SD) C2-7 curvature in the neutral position was 13.4° (13.2°) and 12.3° (11.6°) pre-operatively and post-operatively (p=0.53). For flexion, the curvature was -19.6° (13.3°) pre-operatively and -10.4° (11.6°) post-operatively (p=0.11).

Discussion: Regardless of the type and direction of surgical approach, current study identified a trend of increase in cervical spine kyphosis in the neutral and extended position, whilst a lack of physiological kyphosis in the flexed position in CSM patients post-operatively. This observed trend of change in curvature angle is somewhat a reversal of the normal physiological curvature pattern associated with cervical range of motion, i.e. increase in kyphosis into flexion and increase in lordosis into extension respectively. Such pattern may be due to the relatively small range of motion observed in the study population but this does not fully explain the lack of lordosis in the neutral position. With the recent emerging evidence of the importance of preserving cervical lordosis in order to promote and regain optimal biomechanical functioning of the cervical spine post-operatively, our result warrants serial follow-ups to ascertain whether such changes do persist when the global range of motion improves. Moreover, it is acknowledged that an increase in the sample size as well as the number per surgical group will further consolidate the results. Long-term follow up is currently underway in order to better determine the long-term effect of surgery on cervical spine curvature and its associated secondary implications such as cervical instability, progression of kyphosis and the
recurrence of cord compression.

**Significance:** The preliminary results of the current study serve as an important stepping-stone to better understand the impact of decompression surgery on spinal alignment and contribute to explain the development of adjacent segment disease post-operatively.

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<table>
<thead>
<tr>
<th>Position</th>
<th>Unchanged</th>
<th>More Lordotic</th>
<th>More Kyphotic</th>
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<tbody>
<tr>
<td>Neutral</td>
<td>11 (36%)</td>
<td>6 (20%)</td>
<td>13 (43%)</td>
</tr>
<tr>
<td>Flexion</td>
<td>9 (30%)</td>
<td>20 (67%)</td>
<td>1 (3%)</td>
</tr>
<tr>
<td>Extension</td>
<td>13 (43%)</td>
<td>4 (14%)</td>
<td>13 (43%)</td>
</tr>
</tbody>
</table>
Figure 1. Pre-operative (A) and Post-operative (B) Flexion-Neutral-Extension lateral radiographs of a patient undergone C3-4 anterior cervical discectomy and interbody fusion with PEEK cage showing C2-7 Cobb angle. Post-operatively, the curvature became more kyphotic in the neutral and extended position and less kyphotic in the flexed position.
Fig 2. Comparison of the change in cervical spine curvature pre- and post-operatively in neutral, flexion and extension positions (Mean ± SE). The change in curvature in flexion (lack of kyphosis) showed statistically significant difference (* p < 0.01).