Cervical Deformity Patients with Baseline Hyperkyphosis and Hyperlordosis Differ in Surgical Treatment and Radiographic Outcomes

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Disclosures

Dr. Peter G. Passias reports: consulting from Aesculap, Globus Medical, Medicrea, SpineWave and Zimmer Biomet; scientific advisory board membership from Allosource and Terumo BCT; publishing copyright from Jaypee Brothers Publishers, all outside the submitted work.

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Introduction

• The most common method to assess cervical lordosis is with the Cobb angle (C2 to C7)
• Cervical kyphosis or hyperkyphosis is the most common presentation of sagittal cervical deformity (CD) and may arise secondary to degenerative causes, autoimmune phenomena, or previous spine surgery
• **Hyperlordosis**, though more rare, can also manifest itself into a form of CD separate from its kyphotic counterpart
• No consensus currently exists for optimal correction of CD, and there is a dearth of literature comparing **hyperlordotic versus hyperkyphotic** types with respect to post-operative alignment and outcomes

**Objective**

Identify differences in 1.) surgical treatment, 2.) radiographic alignment, and 3.) clinical outcomes between two extremes of cervical spinal curvature – hyperlordosis and hyperkyphosis – measured via the Cobb method
Materials & Methods

- **Design:** Retrospective review of a prospectively collected multicenter database

- **Inclusion Criteria:**
  - Surgical CD patients >18 y/o with complete baseline and 1-year follow
  - Patient demographics, comorbidities, self-reported disability index, and radiographic data were obtained with standardized patient questionnaires at the preoperative interval
  - Procedural, peri-operative, and post-operative radiographic data were collected following surgery at 1-year follow-up
  - Standardized health-related quality of life (HRQL) measures were administered at baseline and 1Y study intervals, and included the Neck Disability Index (NDI), Numeric Rating Scale (NRS) for both neck and back pain, the modified Japanese Orthopedics Association (mJOA) outcomes questionnaire, and the EuroQol 5-dimensions 3-severity-level (EQ-5D) questionnaire
  - Cervical alignment was assessed based on sagittal parameters (Cobb method, SVA, TS-CL, C0-C2)
  - Global alignment was assessed based on sagittal vertical axis (SVA, C7 to S1, PT, and PI-LL)
Results: Overview

- 102 surgical CD patients
- **Average age:** 61 years
- 65% Female
- **Mean BMI:** 30 kg/m²

Hyperkyphosis: 20 Patients
Hyperlordosis: 21 Patients
Results: Differences

- HK had higher EBL with anterior approaches than HL but similar EBL with posterior approach.
- Control, HL, and HK groups differed in BL TS-CL and BL SVA.
- HL pts had significantly less index discectomies, trended less corpectomies, and similar osteotomy rates to HK. HL had 3x the revision rate of HK and controls.
- At 1Y, HL pts had significantly higher cSVA, and trended higher SVA and SS than HK.
- In terms of BL upper cervical alignment, HK pts had significantly higher McGregor’s slope and C0-C2 Cobb however postop differences in MGS and C0-C2 were not significant.
- HK drivers of deformity were primarily C (90%), whereas HL had primary CT (38.1%), UT (23.8%), and C (14.3%) drivers.
## Results: Pre to Post Op Changes in Sagittal Alignment

<table>
<thead>
<tr>
<th>Overall CD Cohort Correction</th>
<th>Sagittal Alignment Parameters</th>
<th>Pre-Op</th>
<th>Post-Op</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C2-C7 Cobb angle (°)</td>
<td>-7.13</td>
<td>6.84</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td></td>
<td>C2-C7 SVA (mm)</td>
<td>46.7</td>
<td>40.5</td>
<td>0.002*</td>
</tr>
<tr>
<td></td>
<td>TS-CL (°)</td>
<td>37.5</td>
<td>28.5</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td></td>
<td>C7-S1 SVA (mm)</td>
<td>-0.96</td>
<td>23.0</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td></td>
<td>Pelvic Tilt (°)</td>
<td>19.6</td>
<td>19.7</td>
<td>0.910</td>
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<tr>
<td></td>
<td>PI-LL (°)</td>
<td>0.77</td>
<td>2.31</td>
<td>0.167</td>
</tr>
<tr>
<td></td>
<td>Sacral Slope (°)</td>
<td>34.2</td>
<td>34.0</td>
<td>0.872</td>
</tr>
</tbody>
</table>
Results: Patient-Reported Outcome Measures

<table>
<thead>
<tr>
<th>Patient-Reported Outcome Measures (PROMs)</th>
<th>Control</th>
<th>HL</th>
<th>HK</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Baseline</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mJOA</td>
<td>13.48</td>
<td>14.78*</td>
<td>12.56*</td>
<td>0.048*</td>
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<tr>
<td>NDI</td>
<td>49.78</td>
<td>46.15</td>
<td>50.86</td>
<td>0.666</td>
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<tr>
<td>EQ5D</td>
<td>0.726*</td>
<td>0.766*</td>
<td>0.731</td>
<td>0.037*</td>
</tr>
<tr>
<td>NRS Neck Pain</td>
<td>6.88</td>
<td>6.67</td>
<td>6.79</td>
<td>0.938</td>
</tr>
<tr>
<td><strong>1-Year Post-Op</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mJOA</td>
<td>14.10</td>
<td>15.24</td>
<td>14.14</td>
<td>0.371</td>
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<tr>
<td>NDI</td>
<td>37.50</td>
<td>34.68</td>
<td>37.84</td>
<td>0.877</td>
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<tr>
<td>EQ5D</td>
<td>0.774</td>
<td>0.818</td>
<td>0.790</td>
<td>0.139</td>
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<tr>
<td>NRS Neck Pain</td>
<td>4.10</td>
<td>4.29</td>
<td>4.79</td>
<td>0.740</td>
</tr>
</tbody>
</table>
Conclusions

• Patients with a baseline hyperlordotic deformity may be undertreated and inadequately realigned in the context of their unique presentation

• Hyperkyphotic CD patients had lower cSVA and SVA at 1-year, hyperlordotic cervical deformities proved more resistant to proper sagittal realignment

• Special consideration in this patient population should be encouraged, and clinicians should be aware of a potentially increased risk for persistent cervical malalignment following surgical correction
References