Cervical Balance is Irrelevant in MOST Cervical Surgery

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Disclosures

- Stock ownership: Amedica, Paradigm Spine, and Spineology
- Consultant: Nutech, LDR Spine
- Speaker’s Bureau: LDR and K2M

Dear Sig...
What are we treating?

Dazzle them with Data

- Current literature on alignment is mostly focused on deformity cases --- NOT the majority of cervical surgery performed nationwide
- Paucity of quality literature looking at alignment in our simple one and two level cases.

History

Contemporary Spine Surgery

Cervical Sagittal Balance: A Review

What is normal cervical sagittal balance?
History

Gore, 1986
“Roentgenographic findings of the cervical spine in asymptomatic people”

• Mean C2-C7 lordosis in asymptomatic individuals was 16 ± 16 (men 15 ± 10 (women) between 20-25 years. This increases to 22 ± 13 (men) and 25 ± 16 (women) between 60-65 years.

Mean ± 1 SD, these measures are highly variable.

History

Hardacker, 1997
“Radiographic standing cervical segmental alignment in adult volunteers without neck symptoms”

• Mean C1-C7 lordosis in asymptomatic individuals was -40 ± 9.7, with -31.9 ± 7 contributed from C1-C2.

History

Kuntz, 2007
“Neutral upright sagittal spinal alignment from the occiput to the pelvis in asymptomatic adults: a review and resynthesis of the literature”

• Literature review of spine sagittal balance

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Gore et al., 1986</th>
<th>Hardacker et al., 1997</th>
<th>Kuntz et al., 2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>no of cases</td>
<td>100 (100%)</td>
<td>90 (90%)</td>
<td>264 (98%)</td>
</tr>
<tr>
<td>mean age (yrs)</td>
<td>42 (19-65)</td>
<td>35.6 (14-43)</td>
<td>39 (20-73)</td>
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<tr>
<td>C1-C2 lordosis</td>
<td>-15 ± 7.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C2-C7 lordosis</td>
<td>-22 ± 14</td>
<td>-12.2 ± 7.0</td>
<td>-26 ± 6.5</td>
</tr>
<tr>
<td>T1-T12 lordosis</td>
<td>-35 ± 14.7</td>
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“The greatest variation in the regional spinal curves occurred in the cervical spine from C-2 to C-7.”
History

Grob, 2007
“The association between cervical spine curvature and neck pain”

“As no standard values for “normal” curvature could be found in the literature, we defined the curvatures as follows (negative = lordotic; positive = kyphotic)…”

So, what is normal cervical sagittal balance, and does it impact outcomes?

Cervical Sagittal Balance

Gore, 1986
“Roentgenographic findings of the cervical spine in asymptomatic people”

• “It is important to realize that although roentgenographic abnormalities represent structural changes in the spine, they do not necessarily cause symptoms.”
Cervical Sagittal Balance

Harrison, 2004
“Modeling of the Sagittal Cervical Spine as a Method to Discriminate Hypolordosis”
- Modeling of the sagittal cervical spine showed that the chronic pain group had the least lordosis, followed by acute pain, and then normal with greatest lordosis.
- The study excluded patients with any kyphotic segment.

Cervical Sagittal Balance

Anakwenze, 2009
“Sagittal cervical alignment after cervical disc arthroplasty and anterior cervical discectomy and fusion”
- Cervical alignment (C2-C6) after CDA and ACDF
- Although ACDF facilitated a greater increase in device level lordosis (1.25°) and less loss of lordosis at the caudal adjacent level compared with TDR-C (0.39°), the clinical relevance of the small differences remain unknown.

Cervical Sagittal Balance

Guerin, 2012
“Sagittal Alignment After Single Cervical Disc Arthroplasty”
- Prospective study
- There was a significant correlation between postoperative C2-C7 alignment and preoperative C2-C7 alignment
- There was no correlation found between clinical outcomes and post-operative C2-C7 alignment
Cervical Sagittal Balance

Hisey, Nunley, 2014
“Sagittal Alignment of One-level TDR and ACDF Patients: An Analysis of Patient Outcomes from a Randomized, Prospective, Clinical Trial”

- Prospective study
- Comparison of ACDF and TDR treatments
- TDR patient outcomes did not differ between kyphotic and lordotic groups
- ACDF patient outcomes were worse for the kyphotic group

Cervical Sagittal Balance

Davis, Nunley 2014
“Sagittal Alignment of Two-level TDR Patients: An Analysis of Patient Outcomes from an FDA IDE Randomized, Prospective, Clinical Trial”

- Prospective study
- Two level TDR and ACDF patients were pooled to compare sagittal balance and clinical outcomes
- No significant differences were found between the outcomes of the lordotic and kyphotic patients.

Cervical Sagittal Balance

Park, 2014
“Sagittal Alignment As a Predictor of Clinical Adjacent Segment Pathology requiring Surgery after Anterior Cervical Arthrodesis”

- Results suggest that malalignment of the cervical spine following an ACF at C5/6 has an effect on the development of CASP requiring surgery.
- Study limitations: Retrospective study, no pre-operative radiographs, other contributing factors to the CASP, no clinical outcomes were reviewed
Cervical Sagittal Balance

Wang, 2015
“Analysis of Cervical Sagittal Balance Parameters in MRIs of Patients with Disc-Degenerative Disease”

• The aim of this study was to “explore the correlations between the different parameters of the cervical sagittal balance in magnetic resonance images (MRI) and evaluate the criteria for their clinical application in disc-degenerative diseases.”

A limitation of the study was the focus on only imaging, with no assessment of the treatment outcome or clinical symptoms.

Cervical Sagittal Balance

Di Martino, 2015
“Cervical spine alignment in disc arthroplasty: should we change our perspective?”

• Systematic literature review
• “We understand that the overall cervical alignment after TDR tends towards the loss of lordosis, but only longer follow-up can determine its influence on the clinical results.”

Cervical Sagittal Balance

Lee, 2016
“Correlation between cervical spine sagittal alignment and clinical outcome after cervical laminoplasty for ossification of the posterior longitudinal ligament”

• Prospective study
• “Cervical laminoplasty for OPLL improved radiculomyelopathy. Cervical laminoplasty increased the probability of cervical kyphotic alignment. However, cervical sagittal alignment and clinical outcomes were not clearly related.”
Sagittal Alignment As a Predictor of Clinical Adjacent Segment Pathology requiring Surgery after Anterior Cervical Arthrodesis

Moon Soo Park, MD, PhD, Michael P. Kelly, MD, Dong-Ho Lee, MD, PhD, Woo-Kie Min, MD, PhD, Ra’Kerry K. Raheman, MD, PhD, and K. Daniel Riew, MD

- N=120
- F/U = minimum ONE year
- Multiple parameters measured

CONCLUSIONS—Our results suggest that malalignment of the cervical spine following an ACF at C5/6 has an effect on the development of clinical adjacent segment pathology requiring surgery.

Although the authors report some relationships between CASP and loss of lordosis, the significance of these should be viewed with caution. First, the authors have measured a large number of parameters for comparison between the two groups, yet have not made a Bonferroni adjustment in their calculation of statistical significance. With more than 20 comparisons being made, there is a high likelihood that at least one comparison will have a p value between .01 and .05 purely by chance. The authors do not report any statistically significant relationships on the order of p<.001, which would provide more convincing evidence of a true relationship.

- Normal cervical sagittal balance is not clearly defined.
- Recent literature still lacks a correlation of cervical sagittal balance to clinical outcomes.

Pierce: What can I say? Once again I stand corrected!
Bibliography


Thank You!