C1-2 Compensatory Hyperlordosis Associated with Increased Post-operative Neck Pain after Long Segment Cervical Fusion

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INTRODUCTION

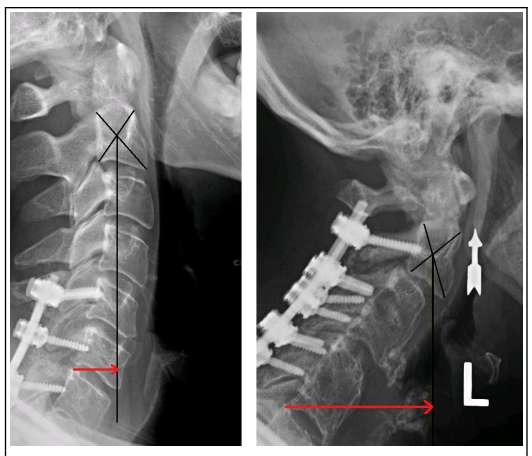
- Positive spinal sagittal malalignment shown to correlate with pain and disability in thoracolumbar fusion
- Impact of cervical sagittal balance on outcomes of cervical fusion not reported
- STUDY AIM: Evaluate relationship between cervical sagittal alignment and postoperative outcomes for patients receiving multi-level cervical fusion

METHODS

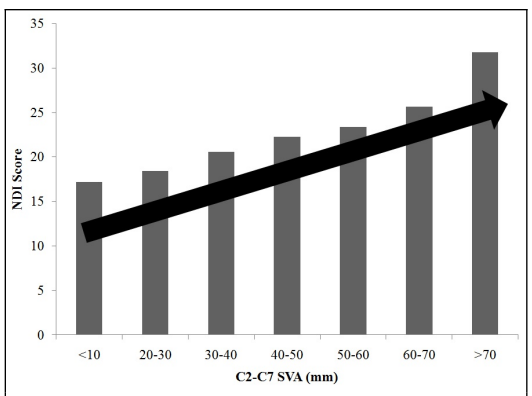
- 113 patients (M/F=61/52; 59±12y.o.) received multi-level cervical fusion
- Radiographic measurements: (1) C1-C2 lordosis, (2) C2-C7 lordosis, (3) C2-C7 sagittal vertical axis (C2-C7 SVA; distance between C2 plumb line and C7), and (4) Center of gravity of head SVA (CGH-C7 SVA; distance between external auditory canal plumb line and C7)
- Health related quality of life (HRQOL) measures: neck disability index (NDI), visual analog pain scale (VAS), and SF-36 physical component scores (PCS)
- Pearson product-moment correlation coefficients calculated between radiographic measures and HRQOL scores (significance = $p<0.05$)
- Improvement in NDI scores following surgery evaluated by categorizing scores into standard intervals: no disability(0-4), mild(5-14), moderate(15-24), severe(35-34), and complete(>34)

RESULTS

- 80% of patients experienced improvement of NDI scores or remained the same compared to preop
- Both C2-C7 SVA and CGH-C7 SVA negatively correlated with PCS ($r=-0.43$, $p<0.001$ and $r=-0.36$, $p=0.005$, respectively)
- C2-C7 SVA positively correlated with NDI scores ($r=0.20$, $p=0.036$)
- C2-C7 SVA positively correlated with C1-C2 lordosis angles ($r=0.33$, $p=0.0003$)
- Both logistic and linear regressions used to determine possible C2-C7 SVA threshold at which onset of disability can be defined by NDI scores
- Logistic regression model predicted threshold value of 41 mm for C2-C7 SVA
- Linear regression predicted threshold C2-C7 SVA value of 37 mm for raw NDI score of 25



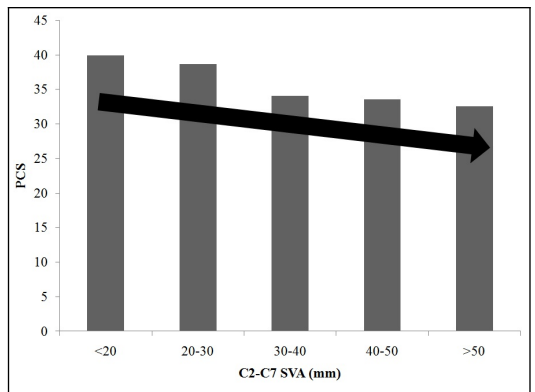
(Left) Patient with C2-C7 SVA of 20.9 mm exhibiting PCS score of 55.1 and NDI score of 3 (no disability). (Right) Patient with C2-C7 SVA of 59.2 mm exhibiting PCS score of 28 and NDI score of 37 (complete disability).



Correlation between C2-C7 SVA and NDI Scores

CONCLUSIONS

- Positive cervical sagittal malalignment, measured by C2-C7 SVA, negatively affects HRQOL scores following multi-level cervical fusion
- Study proposes a C2 plumb line > 40 mm from posterior superior aspect of C7 suggests clinical concern of cervical sagittal malalignment
- Correlations between cervical SVA and C1-C2 lordosis suggest that these parameters linked as patients attempt to optimize craniocervical alignment
- C1-C2 alignment may be terminal link between cranium and cervical spine to regulate angle of gaze
- High positive correlation ($r=0.88$, $p<0.0001$) between C2-C7 SVA and CGH-C7 SVA indicates that C2 segment plays critical role in determining location of head center of gravity
- This is the first study to examine impact that regional SVA in cervical spine has upon HRQOL following multi-level cervical fusion
- Similar to the thoracolumbar spine, severity of disability increases with positive sagittal malalignment following surgical reconstruction



Correlation between C2-C7 SVA and PCS