Cervical sagittal alignment

- Three-dimensional gait analysis reveals differences in spinal balance and muscle activity during prolonged walking in patients with dropped head syndrome based on global spinal alignment
- Digital tomosynthesis enhances cervicothoracic sagittal alignment assessment: are cervicothoracic sagittal parameters correlated with the occurrence of cervical spondylotic myelopathy?
- Impact of anterior controllable antedisplacement and fusion (ACAF) on cervical lordosis and sagittal alignment in OPLL: A comparative radiographic analysis
- Validity and Reliability of an Artificial Intelligence-Based Posture Estimation Software for Measuring Cervical and Lower-Limb Alignment Versus Radiographic Imaging
- Does Sagittal Spinal Alignment Predict Future Fall-Related Fractures in Community-Dwelling Women with Osteoporosis?
- Impact of T1 Slope Visibility on Cervical Sagittal Alignment: A Comparative Study of Radiographic Parameters According to T1 Slope Visibility
- Modified Laminoplasty vs. Laminectomy with Fusion in different K-line status among patients with high occupation rate of cervical ossification of longitudinal ligament
- All-Level Versus Alternative-Level in Unilateral Laminoplasty: A Retrospective Comparative Study

The cervical segment is the part of the spine with the most mobility in the sagittal plane; when cervical spine suffers degenerative changes, it has compensatory mechanisms to maintain the position of the head over the feet and to keep alignment and a horizontal gaze. Understanding the behavior of the cervical spine during degenerative processes is a challenge for the spine surgeon [1].

The cervical spine has a linear chain of correlation or reciprocal relationship regionally (within the cervical spine) and globally (head to whole spine).

Numerous finite element models of the cervical spine have been proposed, with exact geometry or with symmetric approximation in the geometry. However, few researches have investigated the sensitivity of predicted motion responses to the geometry of the cervical spine. The goal of this study was to evaluate the effect of symmetric assumption on the predicted motion by finite element model of the cervical spine. We developed two finite element models of the cervical spine C2-C7. One model was based on the exact geometry of the cervical spine (asymmetric model), whereas the other was symmetric (symmetric model) about the mid-sagittal plane. The predicted range of motion of both models-main and coupled motions-was compared with published experimental data for all motion planes under a full range of loads. The maximum differences between the asymmetric model and symmetric model predictions for the principal motion were 31%, 78%, and 126% for flexion-extension, right-left lateral bending, and right-left axial rotation, respectively. For flexion-extension and lateral bending, the minimum difference was 0%, whereas it was 2% for axial rotation. The maximum coupled motions predicted by the symmetric model were 1.5° axial rotation and 3.6° lateral bending, under applied lateral bending and axial rotation, respectively. Those coupled motions predicted by the asymmetric model were 1.6° axial rotation and 4° lateral bending, under applied lateral bending and axial rotation, respectively. In general, the predicted motion response of the cervical spine by the symmetric model was in the acceptable range and nonlinearity of the moment-rotation curve for the cervical spine was properly predicted [2].

The normal cervical spine alignment can vary from lordotic to neutral to kyphotic depending on a patient's normal global spinal alignment.

The maintenance of cervical alignment is an important factor, particularly in multilevel diseases, as misalignment after spinal instrumentation can lead to pseudarthrosis, cage subsidence, and neck pain, affecting clinical outcome and quality of life [3].

Regardless, cervical spine alignment targets after cervical spine surgery are not well established [4].

A study aimed to evaluate the impact that these phenotypes have on preoperative, postoperative, and changes in Cervical spine alignment in patients undergoing anterior cervical discectomy and fusion (ACDF). Baker et al. performed a retrospective study of prospectively collected data of ACDF patients at a single institution. Preoperative magnetic resonance imagings (MRIs) were used to assess for the MC and EA. Patients were subdivided into four groups: MC-only, EA-only, the combined Modic-Endplate-Complex (MEC), and patients without either phenotype. Pre and postoperative MRIs were used to assess alignment parameters. Associations with imaging phenotypes and alignment parameters were assessed, and statistical significance was set at $p < 0.5$. A total of 512 patients were included, with 84 MC-only patients, 166 EA-only patients, and 71 patients with MEC. Preoperative MC ($p = 0.031$) and the MEC ($p = 0.039$) had significantly lower preoperative T1 slope compared to controls. Lower preoperative T1 slope was a risk factor for MC ($p = 0.020$) and MEC ($p = 0.029$) and presence of MC (Type II) and the MEC (Type III) was predictive of lower preoperative T1 slope. There were no differences in postoperative alignment measures or patient reported outcome measures. MC and endplate pathologies such as the MEC appear to be associated with worse Cervical spine alignment at baseline relative to patients without these phenotypes. Poor alignment may be an adaptive response to these degenerative findings or may be a risk factor for their development [5].

Various radiological parameters are used to evaluate cervical ossification of the posterior longitudinal ligament and to determine the surgical strategy. Factors such as the number of involved spinal segments, Cervical spine alignment or T1 slope, the relationship between OPLL and the C2–7 line (termed the "K-line"), occupying ratio of OPLL, and involvement of dural ossification need to be carefully considered before surgery [6].

Cervical spine surgery may affect sagittal alignment parameters and induce accelerated degeneration of the cervical spine.

It is correlated with myelopathy severity and used by spinal surgeons for surgical planification. Magnetic resonance imaging (MRI) is the gold standard for the evaluation of cervical myelopathy but may not be for the assessment of cervical sagittal balance compared to X-rays. The objective of a study was to assess the correlation of Cervical spine alignment between supine MRI and standing radiographs in patients with cervical spondylotic myelopathy (CSM).

Cobb, Jackson and Harrison methods were used to measure cervical sagittal alignment on supine MRI and standing radiographs of CSM adults. Cervical spine alignment was divided based on Cobb angle values on lordotic (> 4°), kyphotic (< - 4°) and rectitude (- 4° to 4°). Correlations between radiographic and MRI measurements were determined. Intra- and interobserver reliability were assessed and MRI and X-Ray-measured angles were compared.

One hundred and thirty patients with CSM were reviewed. Correlations of cervical lordosis measures between radiographs and MRI were strong using the Cobb (0.65) and Jackson (0.63) methods, and moderate using the Harrison (0.37) method. Mean cervical lordosis angle was significantly lower on supine MRI compared to standing radiographs for all methods (Cobb 11.6 Rx vs. 9.2 MRI, Jackson 14.6 vs. 11.6, Harrison 23.5 vs. 19.9). Eighteen patients (15.4%) without lordosis on supine MRI presented lordosis on standing radiographs.

A substantial proportion of patients has sagittal alignment discrepancies between supine MRI and standing radiographs. Therefore, standing radiographs of the cervical spine should always be included in surgical planning of CSM patients [7)].

Cervical sagittal alignment parameters of surgical patients will be correlated with radiological adjacent segment degeneration (ASD) and with clinical outcome parameters.

The data from previous studies are insufficient for analysis using the recently designed CSA parameters, T1 slope (T1s), and T1s minus cervical angle (T1sCA).

Similar to the thoracolumbar spine, the severity of disability increases with positive sagittal malalignment following surgical reconstruction [8)].

An evolving trend is defining cervical sagittal alignment. Evidence from a few recent studies suggests correlations between radiographic parameters in the cervical spine and HRQOL. Analysis of the cervical regional alignment with respect to overall spinal pelvic alignment is critical.

Patients were analysed from two randomized, double-blinded trials comparing anterior cervical discectomy with arthroplasty (ACDA), with intervertebral cage (ACDF) and without intervertebral cage (ACD). C2-C7 lordosis, T1 slope, C2-C7 sagittal vertical axis (SVA) and the occipito-cervical angle (OCI) were determined as cervical sagittal alignment parameters. Radiological ASD was scored by the combination of decrease in disc height and anterior osteophyte formation. Neck disability index (NDI), SF-36 PCS and MCS were evaluated as clinical outcomes.

The cervical sagittal alignment parameters were comparable between the three treatment groups, both at baseline and at 2-year follow-up. Irrespective of surgical method, C2-C7 lordosis was found to increase from 11° to 13°, but the other parameters remained stable during follow-up. Only the OCI was demonstrated to be associated with the presence and positive progression of radiological ASD, both at baseline and at 2-year follow-up. NDI, SF-36 PCS and MCS were demonstrated not to be correlated with cervical sagittal alignment. Likewise, a correlation with the value or change of the OCI was absent.

OCI, an important factor to maintain horizontal gaze, was demonstrated to be associated with radiological ASD, suggesting that the occipito-cervical angle influences accelerated cervical degeneration. Since OCI did not change after surgery, degeneration of the cervical spine may be predicted by the value of OCI [9].

Cervical sagittal balance

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Cervical kyphotic deformity

see Cervical kyphotic deformity

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