Editorial Commentary

Compensatory or pathologic?—cervical spine sagittal alignment in adolescent idiopathic scoliosis

Kenneth Aaron Shaw[1], Joshua S. Murphy[2]

[1]Department of Orthopaedic Surgery, Dwight D. Eisenhower Army Medical Center, Fort Gordon, GA, USA; [2]Children's Healthcare of Atlanta, Atlanta, GA, USA

Correspondence to: Kenneth Aaron Shaw. Department of Orthopaedic Surgery, Dwight D. Eisenhower Army Medical Center, 300 E Hospital Road, Fort Gordon, GA, USA. Email: shaw.aaron82@gmail.com.

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Akbar *et al.* (1) provide a timely study to further characterize and quantify the sagittal alignment of the cervical spine in children with adolescent idiopathic scoliosis (AIS). Sagittal spinal alignment has been a been a growing area of interest in the field of adolescent spinal deformity. Not only has it been shown to affect clinical outcomes in various populations of adult spinal deformity patients (2,3), it also affects the rate of postoperative complications, including proximal junctional kyphosis and adjacent segment disease (4,5). However, these studies focus largely on the spinopelvic alignment, with the cervical sagittal alignment gaining less attention. Although not a novel investigation, previous studies evaluating cervical sagittal alignment have focused on global parameters and the segmental effects of deformity on the cephalad and caudad alignment of the cervical spine has not been previously assessed. The authors sought to remedy this oversight in the setting of untreated AIS patients.

The authors performed a retrospective review of 81 AIS patients (26% male, average 15.5 years) with a coronal curve magnitude >40°, applying a comprehensive radiographic analysis of global, regional, and segmental sagittal alignment in and of the cervical, thoracic, and lumbar spinal regions. Although measurements were performed by two authors, no information is provided as to whether these were collaborative or independent measurements. Additionally, intra- and inter-observer comparisons were not provided for the evaluation of individual measurement reproducibility. The authors proceeded to subdivide the patients into three subgroups based on thoracic and lumbar sagittal spinal alignment (hyper-, normo-, and hypo-) according to previously reported normative data (6), investigating the effects of these stratified groups on cervical sagittal alignment. However, at the conclusion of this study readers are left wanting further characterization of the scoliotic deformity including Lenke classification, coronal curve magnitude, location of curve apex, variable that are likely driving the underlying segmental sagittal alignment.

From their sub-analysis, lumbar alignment was found to have no effect on cervical alignment, influencing only the adjacent thoracic and spinopelvic parameters. However, differences were present in the thoracic spine, with hypokyphotic patients showing reciprocal subaxial cervical kyphotic alignment. The authors are congratulated in their nuanced segmental analysis, bridging a gap in the previous literature. Through this nuanced analysis they found that cervical kyphotic changes all occurred below the level of the C4 vertebral body with no changes occurring in occipito-cervical alignment. This kyphotic alignment was also associated with posteriorly aligned cervical sagittal alignment, suggesting that the cervical sagittal alignment is a necessity to maintain horizontal gaze. In support of this finding, T1 slope was also decreased in the hypokyphotic thoracic spine cohort which has been shown to be a key

player in predicting lower cervical alignment (7).

The authors proceed to focus on the association between thoracic hypokyphosis and cervical kyphosis through their discussion, raising the question as to whether this kyphotic alignment is pathologic or rather a compensatory change driven by the primary thoracic spine deformity in order to maintain horizontal gaze. This debate that can only be settled with post-operative imaging comparison. Unfortunately, this comparison was beyond the scope of the current study, however, a recent article has taken this next step, showing that cervical lordosis was restored following posterior spinal fusion in patients with preoperative kyphotic alignment (8). Combining this study with the growing body of evidence, we are slowing gaining a heightened appreciation of the compensatory cervical sagittal alignment in children with AIS and the influence our surgeries exert.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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