

A Novel Vertebral Numbering System Using EOS Imaging

ABSTRACT

Background

Disagreement exists on how to best report anomalous vertebra and which imaging modality is most consistent, creating discrepancies between radiologists and surgeons. Errors in vertebral numbering can have devastating implications for patients. With no consensus on a vertebral counting method that accounts for transitional anatomy of the spine, a simple and accurate vertebral numbering system that can be applied to routine imaging is needed.

Questions/Purposes

1. How common are congenital rib and vertebral anomalies and in what patterns do they most often occur in EOS (Alphatec Holdings, Inc, Carlsbad, CA, USA) full-length spine imaging?
2. What vertebral counting method best accounts for transitional anatomy of the spine and can provide the lowest error when utilizing limited imaging of the spine?

Methods

A retrospective study analyzing full-length spine x-rays in 3147 patients was performed at the University of Colorado with the aim of describing a novel and more simplified vertebral numbering system. The number of pre-sacral mobile segments were identified and recorded along with number of ribs, congenital fusions, and other anomalous findings. Results were reviewed by a committee of musculoskeletal radiologists, neurosurgeons, and orthopedic spine surgeons and verified by interobserver analysis.

Results

91.1% (2868/3147) demonstrated the conventional 24 pre-sacral mobile segments. Transitional anatomy, as defined by identifying fewer or more than 24 pre-sacral segments, was noted in 8.8% (279) of patients. Within our cohort, 5.5% (174) had 25 pre-sacral mobile segments, 3.3% (104) had 23, and 0.03% (1) had 26. The majority (94.6%; 2976) had 12 ribs (including hypoplastic ribs), 4.5% (143) had 11 ribs, 0.88% (28) had 13 ribs. Presence of both transitional anatomy and abnormal number of ribs was least prevalent, 1.8% (56). Considering the first non-ribbed vertebrae as the first lumbar vertebrae yielded the lowest probability of a numbering error.

Conclusion

Our data suggests there is a lower prevalence of ribbed vertebral body anatomic variations as compared to the prevalence of transitional lumbosacral anatomy. Given this, our institution has adopted a numbering system counting in a cranial to caudal direction, with the first ribbed vertebra labeled as thoracic (T1) and the first non-ribbed vertebra in the lumbar spine labeled as lumbar (L1). This method will improve consistency between radiologists and surgeons and decrease the risk of wrong level surgery in the setting of transitional anatomy.

Level of Evidence

IV