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Visualization and evaluation of spinal 3D geometry in scoliosis using EOS 2D/3D imaging : first-year clinical data prove the significance of the horizontal plane view

Background

Traditional Xray diagnosis, pre-operative classification and post-operative evaluation of surgical correction of scoliosis are based on 2D images that lack the ability to visualize and truly evaluate the spatial geometry of this three-dimensional deformity. CT scan with 3D reconstruction is rarely used in orthopedic clinical practice due to high-dose radiation and post-operative artefacts. EOS, a new 2D/3D digital imaging system based on Nobel prize- winning ultra low-dose Xray detection and precise 3D reconstruction of the spine offers a new option in this field. We present the results obtained during the first year of clinical use of our EOS system.

Method

30 patients with idiopathic adolescent or degenerative scoliosis treated according to Cotrel-Dubousset technique using multi-anchors and rods system were included in this clinical study. Patients were examined with EOS before and after operation, followed by semi-automatic 3D reconstruction of the spinal column strictly following the manufacturers' guidelines. Parametric values were automatically calculated for apical RVA and Cobb 3D angle, kyphosis and lordosis, pelvic positional parameters, vertebral orientation and intervertebral rotation. Corresponding pre- and post-operative parametric values for the same patient were compared. Vector

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points for apical vertebrae of the scoliotic curves were determined manually based on available landmarks in individual 3D reconstructions. Precise coordinates of apical vertebra vectors were obtained after normalization based on EOS built-in 3D calibration. Numerical values of vectors were calculated using standard vector algebra. Corresponding pre- and post-operative vector parameters were compared.

Results

Artefact-free imaging of the whole spinal column was obtained for each patient with the possibility of obtaining interactive 3D visualization in sagittal, coronal and horizontal plane view. Simple and objective evaluation of effects from surgical correction could be assessed by changes in automatically computed parametric values for Cobb's angle, kyphosis, lordosis and vertebral rotations. Detectable changes in orientation and position of each vertebra

were strikingly revealing in horizontal plane view. Numerical evaluation of correction was significantly enhanced by comparing pre- and post-operative apical vertebra vectors.

Conclusion

First-year clinical practice with EOS proved to be of high value in 3D visualization of pre- and post-operative spinal geometry in scoliosis. Precise documentation of 3D geometry of deformities, determination and comparison of pre- and post-operative clinical parameters was routinely possible. Evaluation of the horizontal plane view, coupled with the measurement of the apical vertebra vector appears to be a solid starting point on the way towards a new 3D classification in scoliosis. (•)