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Spinal Coronal and Sagittal Balance in 584 Healthy Individuals During Growth: Normal Plumb Line Values and Their Correlation With Radiographic Measurements.

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Abstract

BACKGROUND: Plumb line distances (PDs) are widely used in conservative clinical practice to evaluate the sagittal shape of the spine.

OBJECTIVE: The objective was to assess the normative values of PDs in a large, healthy population in an age range representative of the adolescent population with spinal deformities, and to correlate it with x-ray measurements.

DESIGN: This was a cross-sectional study.

METHODS: Participants were 584 healthy individuals (341 females) with x-rays showing no spine deformities. The whole sample (OVERALL) was divided into 5 groups: 6 to 9 years old ($n = 106$); >10 years, Risser 0 with triradiate cartilage open ($n = 129$) or closed ($n = 104$); Risser 1 to 2 ($n = 126$); and Risser 3 to 5 ($n = 119$). PDs were taken by maintaining a tangent to the thoracic kyphosis apex at C7, T12, L3, and S2. Sagittal index (C7 + L3), and sagittal and coronal balances (C7 related to S2) were calculated.

RESULTS: In OVERALL, PDs at C7, T12, L3, and S2 were 39.9 ± 16.7 , 21.4 ± 15.3 , 39.9 ± 15 , 20.6 ± 17.0 mm, respectively. Sagittal index was 79.8 ± 26.8 , sagittal balance was 19.3 ± 17 mm anterior to S2 plumb line; 13.5% had a coronal imbalance of 11.4 ± 5.4 mm to the right and 24.7% of 13.2 ± 6.0 mm to the left. C7 and L3 PDs, sagittal index, and sagittal balance were significantly lower in ages 6 to 9 compared to older patients in Risser 1 to 2 group. C7 and S2 PDs and sagittal index were significantly larger in males. Sagittal index correlated with thoracic kyphosis Cobb degrees ($r = 0.47$).

LIMITATIONS: The participants were not randomly chosen from the general population; and they had an x-ray because of spine pathology suspicion.

CONCLUSIONS: This study shows normative data to be used in clinical practice. Sagittal spinopelvic alignment has gained more and more importance in the last decades because of its high correlation to Health-Related Quality of Life scores in adults. 1.

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