Association between trunk aesthetics and underling scoliosis severity and curve type in adolescents: evaluation of traditional clinical scores and novel automated indices from rasterstereographic imaging

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Abstract

Background: Trunk aesthetics is an important aim in treating adolescent idiopathic scoliosis (AIS). While subjective measures like the Scoliosis Research Society-22 questionnaire are commonly used, objective methods, such as the Trunk Aesthetic Clinical Evaluation (TRACE) index, are less explored. Non-invasive imaging techniques like rasterstereography (RST) have been studied to reduce radiographic exposure in AIS, though their correlation with Cobb angles remains weak. Notwithstanding, RST provides detailed trunk shape information that could enhance aesthetic evaluations.

Aim: To evaluate the correlation between aesthetic indices (TRACE and novel automated RST-based) and radiographic characteristics.

Design: Cross-sectional observational controlled diagnostic study.

Setting: Outpatient rehabilitation center for conservative treatment of spinal deformities.

Population: 675 AIS subjects (age 13±2 years; Cobb angles 10-45°) with trunk photographs, RST scans, and standing radiographs within three months.

Methods: Two automated RST aesthetic evaluations (I_match and I_dist) were developed based on TRACE principles, providing total and sub-scores for shoulders, scapulae, hemithorax, and waist. TRACE assessments on RST images and photographs were conducted by two raters, with intra- and inter-rater reliability tested in a subset of 28 participants. Correlations among TRACE (photographic and RST), automated RST evaluations, scoliosis severity, and curve type were analyzed.

Results: TRACE confirmed strong intra-rater (0.73-0.96) and moderate inter-rater (0.61-0.74) reliability. Correlations between aesthetic measures were weak: RST and photographic TRACE (0.3 overall, 0.02-0.4 sub-scores), and RST TRACE with automated evaluations (0.27-0.28 overall, 0.06-0.29 sub-scores). Correlations between Cobb angles and aesthetic evaluations ranged from weak to moderate: RST TRACE (0.35-0.42), photographic TRACE (0.13-0.53), I_match (-0.05 to -0.44), and I_dist (0.03-0.49). Waist sub-scores showed strongest correlations in thoracic and thoracolumbar curves, with thoracic curves yielding best results for automated RST evaluations.

Conclusions: The new automated RST-based aesthetic evaluation did not show clear superiority on TRACE. In the current absence of a gold standard, choices should prioritize reliability, validity, and clinical utility. Aesthetic and radiographic evaluations were weakly correlated but showed consistent patterns across trunk areas and curve types, highlighting the multifactorial nature of scoliosis-related aesthetics warranting further exploration.

Clinical rehabilitation impact: While the development of robust tools to assess aesthetics beyond radiography is ongoing, TRACE remains a reliable and cost-effective instrument for routine clinical use.

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