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Scoliosis

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Immediate correction required to expect a long-term effectiveness of a brace treatment: a biomechanical insight

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Background
Immediate in-brace correction has often been deemed as fundamental to long-term brace effectiveness but the biomechanical rational is unclear and unproven.

Objective
To biomechanically study how the immediate in-brace correction of the scoliotic curves is affecting the mechanisms involved in the long term correction of the spine.

Methods
The three-dimensional geometry of 30 patients was acquired using multi-view radiographic reconstruction and surface topography techniques. A finite element model of the trunk and a parametric brace model were created. For each case, two spinal stiffnesses (flexible, stiff) were tested. Installation of the brace was simulated. Using an experimental design framework including thirteen design factors, 768 braces were tested for each patient (total of 69120 tested braces). Immediate in-brace correction of the coronal Cobb angles and loads acting on the growth plates of the apical vertebrae were computed and analyzed.

Results
Immediate correction of coronal curves and corresponding bending loads on the apical vertebrae were linearly correlated (mean R2 = 0.86). 10% to 99% of immediate correction was necessary to nullify the asymmetric loads, with an average of 49% (flexible spine model) and 35% (stiff spine model).

Discussion
Based on the Hueter-Volkmann principle, the correlation between immediate in-brace correction and corresponding modification of the load distribution at the apical level contributes to reducing the scoliosis vicious circle. The immediate correction values corroborate the rule-of-the thumb frequently used by the orthotists.

Conclusion
This study confirms the importance of immediate in-brace correction and provides insights into the understanding of brace biomechanics.

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