

Accuracy of IS-GROWTH predictions of the risk of reaching the clinically significant thresholds of 30°, 45° and 50° in idiopathic scoliosis patients

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Introduction

IS-GROWTH has recently been developed to predict the progression of Idiopathic Scoliosis (IS) at all ages, with curves up to 70° at start. While it provides a graphical representation of the wide range of possible evolutions, IS-GROWTH does not offer risk thresholds, unlike the previously developed BrAISTCalc (applicable only to adolescents IS curves 20-40°, Risser 0-2). The objective is to develop IS-GROWTH predictive formulae for the risk of reaching significant clinical thresholds at the end of growth: 30° for probable stability in adulthood; 45° and 50° for surgical indications.

Materials and Methods

We considered the two groups (development and temporal validation) from the previously published ISGROWTH paper, which included all available IS children who presented to our institute with prior X-ray taken before any treatment. We examined the distribution within the individually predicted ranges in the validation group. We applied a mathematical transformation to approximate a normal distribution and assessed normality using the Asymmetry and Kurtosis tests. We developed prediction models for the 30°, 45°, and 50° thresholds. We performed temporal validation on all radiograph pairs. We assessed performance using the Area Under the Curve (AUC) for discrimination, the accuracy of risk estimates through Brier Scores (BS) with 95% Confidence Intervals (95CI), and calibration analysis using risk deciles to compare predicted probabilities with observed outcomes.

Results

We evaluated the distribution of IS-GROWTH predictions for 552 patients (74% female, 12.4±2.0 and 14.7±1.7 years, 19±9° and 26±11° at start and end, respectively). A square-root transformation provided the best approximation to a normal distribution (asymmetry 0.01, kurtosis 0.72). To temporally validate the prediction model, we had 270 pairs of radiographs (187 patients; 87% female; first radiograph below age 10 for 17, and above age 10 at Risser 0, 1, 2, and 3 for 80, 31, 56, and 86, respectively). At the end of growth, we had 109 radiographs <30°, and 53 and 37 >45° and 50°, respectively. The AUC (95CI) were 0.91 (0.87-0.95), 0.86 (0.80-0.93) and 0.81 (0.72-0.90) for the 30°, 45° and 50° thresholds, respectively. Overall predictive accuracy was high, with Brier Scores of 0.19 (0.15-0.22) for 30°, 0.15 (0.12-0.18) for 45°, and 0.14 (0.11-0.17) for 50°. Calibration analysis showed a strong correlation between predicted and observed risks across all thresholds, with high reliability even at the probability extremes for surgical indications.

Conclusion

IS-GROWTH provides accurate, validated probabilities for reaching clinically significant thresholds. Complementing graphical trajectories with quantitative risk estimates offers a more comprehensive prognostic tool than existing models, applicable to a wider clinical population. These validated risk percentages allow for personalised counselling and shared decision-making.

