

Title: The Learning Curve in Robotic-Assisted Pediatric Spine Deformity Surgery

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Introduction: Pedicle screw malposition is a leading cause of morbidity in pediatric spine deformity surgery. The introduction of robotics paired with navigation has increased the accuracy of pedicle screw placement up to 98.8%, compared to 90% using the free-hand technique.

Purpose: Quantify a typical learning curve when implementing robotics in pediatric spine deformity surgery and identify experience-related changes in surgical outcome measures.

Methods: The first 300 patients who underwent robotic-assisted posterior spine fusion by a single surgeon at a single institution were retrospectively reviewed. Cases were split into three surgeon experience groups: Early (cases 1-50), Middle (cases 51-100), and Late (cases 101-300). Demographics, risk designation, curve parameters, operative data, and outcome measures were recorded and compared across all groups.

Results: Preliminary results include the first 150 patients (58 male, 92 female) with an average age of 14.5 years (range 4 to 22 years) and an average primary curve of 53.22 degrees. The most common diagnosis was adolescent idiopathic scoliosis (n=52). There was no significant difference in the incidence of post-operative complications, average length of stay, average percent correction, or neuromonitoring changes across the three experience groups. The need for perioperative allogenic transfusion decreased significantly in the late group relative to the early group (OR 2.31, 95% CI: 1.12-4.74, p=0.0227). There was a significant improvement in overall operative time in the early group relative to the late group (mean % difference: 16.4% increase, p=0.0065) and the early group relative to the middle group (mean % difference: 14.2% increase, p=0.0194).

Discussion: Despite an initial learning curve resulting in significant improvements in blood loss and operative time, there is no decrease in safety or increase in post-operative complications when implementing robotics in pediatric spine deformity surgery. Anticipated outcomes: support the informed implementation of robotic-assisted spine surgery.

Conclusion: Robotics can be implemented safely in a pediatric population, and as surgeon proficiency improves, the adoption of robotics may offer long-term benefits for surgeons and patients alike. Future steps include analyzing the remaining 150 patients to better understand the overall learning curve associated with the implementation of robotics paired with navigation in pediatric spine deformity surgery.