

Factors associated with construct failures in Adult Spine Deformity patients matching ideal Roussouly type

Tobi Onafowokan¹, Ankita Das¹, Jamshaid Mir, Anthony Yung², Max Ray Fisher, Ethan Cottrill², Tyler Kade Williamson, Nathan August Lorentz, Lauren Seo³, Matthew Galetta, Jordan Lebovic⁴, Aaron Hockley, Bassel Diebo, Shaleen Vira⁵, Alan H Daniels⁶, Peter Gust Passias²

¹Spine, ²Duke University, ³NYULI, ⁴NYU Orthopedics, ⁵University of Texas Southwestern Medical Center, ⁶University Orthopedics, Inc.

INTRODUCTION:

Restoring the ideal Roussouly type in ASD patients is believed to prevent mechanical complications. However, some patients still experience these issues despite restoration. The factors contributing to this are not fully understood. Our study aims to investigate the factors associated with mechanical complications in patients with restored ideal Roussouly type.

METHODS: ASD patients with baseline to 2-year clinical and radiographic data were grouped by ideal Roussouly types as defined by Latouissat: type 1 and 2 for pelvic incidence (PI) < 45°, type 3 for PI 45°–60°, and type 4 for PI > 60°. Those who matched their ideal Roussouly types postoperatively but experienced mechanical complications (Rouss+Mech+) were specifically analyzed. Means comparison tests evaluated differences between these groups, and logistic regression was used to explore associations between Roussouly conformity and various outcomes.

RESULTS: The study included 464 patients (average age 60.4 ± 14.9 years, BMI 27.5 ± 5.8 kg/m², CCI 1.67 ± 1.66) with 74% being female. Baseline Roussouly type distribution was 8.2% type 1, 51.8% type 2, 26.6% type 3, and 13.2% type 4. At baseline, 41.5% of patients matched their ideal Roussouly type, increasing to 50.7% post-operatively (p<0.001), with improvements across all types. After 2 years, those matching their ideal Roussouly type had significantly fewer mechanical complications (13% vs. 86%, p<0.001). The rates of mechanical complications for those matching the ideal type (Rouss+Mech+) were 11.1% for type 1, 13.9% for type 2, 12.7% for type 3, and 15.3% for type 4 (p=0.930). Factors linked to mechanical complications in Rouss+Mech+ included under-correction of pelvic incidence-lumbar lordosis mismatch (OR 1.1, p<0.001) and lower limb arthritis (OR 2.4, p=0.024). Additionally, Rouss+Mech+ patients had consistently lower sagittal age-adjusted scores compared to those without mechanical complications (Rouss+Mech-) at all measured points up to 2 years. Reoperation rates were also higher in the Rouss+Mech+ group at 2 years (58.3% vs. 16.7%, p<0.001).

DISCUSSION AND CONCLUSION:

Discussion: This study rigorously examined the outcomes of 464 patients undergoing spine surgery, revealing critical insights into the relationship between Roussouly spinal alignment types and postoperative mechanical complications. Notably, achieving an ideal Roussouly type postoperatively was associated with a significant reduction in mechanical complications. This underscores the importance of meticulous preoperative planning and intraoperative execution to align patients' spines according to their ideal Roussouly curvature. Despite improvements in alignment, a significant proportion of patients still experienced mechanical complications, particularly those who were under-corrected or had comorbid conditions like lower limb arthritis. These findings suggest that simply achieving the ideal Roussouly type is not sufficient; the quality of the correction and the overall health of the patient play crucial roles in the outcome. The consistent under-correction of pelvic incidence-lumbar lordosis mismatch points towards the need for better surgical techniques or technologies that can more reliably achieve and maintain the desired spinal alignment. Furthermore, the study highlighted that even with optimal alignment, some patients are still prone to complications, as evidenced by the varying rates of complications across different Roussouly types. This variability indicates that individual patient factors, possibly genetic or related to lifestyle, could influence outcomes and should be considered in preoperative assessments.

Conclusion: The results of this study affirm the clinical importance of adhering to the Roussouly classification for planning and executing spine surgeries to minimize postoperative mechanical complications. However, they also highlight that achieving an ideal Roussouly type is not a panacea. Surgeons must consider the individual characteristics of each patient, including potential comorbidities and the precise execution of spinal corrections, to truly optimize outcomes. Our findings advocate for the integration of comprehensive preoperative evaluations that go beyond mere radiographic measurements to include an assessment of comorbid conditions that may affect surgery outcomes. Moreover, continual refinement of surgical techniques to ensure precise correction according to the Roussouly types is essential. Future studies should focus on longitudinal outcomes and the development of enhanced surgical protocols that incorporate these broader assessment and correction strategies. This will help in further reducing the rates of mechanical complications and reoperations, ultimately enhancing patient satisfaction and quality of life post-surgery.