Two Good to Be Screw? The Value of Two Points of Pelvic Fixation in Adult Spinal Deformity Correction

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INTRODUCTION:

Spinopelvic fixation significantly enhances the stability of the lumbopelvic junction, a site that often experiences substantial shear stress, particularly in adult spinal deformity (ASD) surgeries requiring long fusions. Consequently, our objective is to develop a predictive index for optimal outcomes following sacroiliac fixation, to identify the practices that provide the greatest benefits to ASD patients.

METHODS:

This retrospective cohort study included 477 operative ASD patients aged 18 years and older from a single-center, prospectively enrolled database. All patients had complete baseline (BL) and two-year (2Y) follow-up data. The cohort was divided based on those who underwent at least two points of SI fixation (>TP) and those who did not (<TP). Descriptive statistics and means comparison analyses were utilized to assess differences in baseline demographics, surgical parameters, and Health-Related Quality of Life (HRQL) outcomes over time. Chi-squared tests determined differences in complication rates between groups. Logistic regression was employed to identify the predictive value of relevant medical and surgical factors in achieving optimal outcomes.

RESULTS: In this study, 447 patients met the inclusion criteria, presenting a mean age of 59.8±14.4 years, BMI of 26.9±5.5 kg/m^2, Charlson Comorbidity Index (CCI) of 1.7±1.7, and a modified Adult Spinal Deformity Frailty Index (mASD-FI) of 6.3±4.8. Surgical metrics included an average operative time of 415.6±177.5 minutes, EBL of 1598.4±1390.8 mL, and an average of 11.1±4.5 levels fused. Surgical approaches varied with 33.3% of patients undergoing a combined approach, 58.5% posterior-only, and 0.8% anterior-only. Sacroiliac fixation was performed in 284 (59.5%) patients, with 204 (42.8%) receiving an iliac screw and 98 (20.5%) other types of screw fixation. The group with more than two points of SI fixation (51.8% of patients) tended to be older (64.4 vs. 54.7 years, p<.001), with higher BMI (27.4 vs. 26.4, p<.001), more comorbidities (2.2 vs. 1.5, p<.001), and worse frailty scores (7.3 vs. 5.3, p<.001). They also experienced longer surgeries (450.5 vs. 372.0 mins, p<.001) and greater blood loss (1918 vs. 1202 mL, p<.001). This cohort showed higher rates of adverse events (17.4% vs. 9.1%, p=0.008) and musculoskeletal complications (4.0% vs. 0.9%, p=0.027), yet also noted improved GAP proportionality at 2 years (66.4% vs. 56.1%, p=0.021) and better age-adjusted PI-LL and SVA improvements (p<.001 for both). No significant differences in pseudoarthrosis rates at 2 years were observed. Higher rates of MCID via the ODI at both 1 and 2 years were seen in those with more extensive fixation. Subanalysis revealed that patients with sarcopenia and osteoporosis were significantly more likely to require extensive SI fusion (ORs 2.14 and 3.8 respectively), and frail patients exhibited higher rates of PJK at 2 years (55.6% vs. 32.5%, p=0.045). Frail and sarcopenic patients undergoing SI fusion were less likely to achieve optimal outcomes, highlighting their vulnerability.

DISCUSSION AND CONCLUSION:

Spinopelvic fixation in patients with ASD can enhance spinal alignment restoration, prevent decompensation, and reduce the risk of distal instrument instability. Biomechanically, for long-segment arthrodeses extending above L3, sacral screws should be reinforced with supplemental iliac screws or additional spinopelvic fixation to protect against mechanical stress. Additionally, the application of three-column osteotomies, such as pedicle subtraction or vertebral column resection in the lower thoracic or lumbar spine, necessitates further stabilization provided by spinopelvic fixation. This retrospective study underscores that despite its invasiveness, spinopelvic fixation is especially crucial for frail, sarcopenic, and osteoporotic patients, significantly enhancing their chances of achieving proper spinal alignment.

In our primary analysis, we observed superior clinical outcomes in our >TP cohort compared to the <TP cohort. This was despite the >TP cohort being older, having a higher BMI, a greater number of comorbidities at baseline, and worse frailty scores. The operative time for the >TP cohort was also significantly longer, and EBL was greater. Although the >TP patients experienced higher rates of adverse events and musculoskeletal complications, they showed more significant improvements in GAP proportionality at 2 years and in age-adjusted PI-LL and SVA. Additionally, there were no significant differences in the level of pseudoarthrosis at 2 years. In terms of HRQL, those with two or more points of fixation had higher rates of achieving meaningful clinical improvement, as measured by the ODI, at both 1 and 2 years. These results support the use of robust fixation strategies to achieve better alignment and overall postoperative improvement, which is aligned with previous studies that highlight the importance of adequate fixation to improve surgical outcomes in ASD patients.

In subanalyses, patients with sarcopenia were significantly more likely to require TP SI fusion, as were those with osteoporosis. Additionally, frail patients showed significantly higher rates of PJK at two years. Frail and sarcopenic patients undergoing SI fusion were also less likely to achieve optimal outcomes, highlighting their status as a particularly vulnerable group. The data implies that enhanced stabilization through multi-point fixation, despite its associated risks and increased surgical demands, is beneficial in managing more complex cases of ASD, particularly in patients with greater preoperative vulnerabilities. These insights underscore the necessity of a tailored approach in spinal deformity surgery, factoring in patient-specific characteristics and the complexity of deformity to optimize surgical strategies and enhance recovery trajectories.