

Evolution of Osteotomy Techniques over Time in Adult Cervical Deformity Surgery: Impact of New Technologies and Techniques on Patient Outcomes

Pooja R Dave, Jamshaid Mir, Peter Sergeevich Tretiakov¹, Jordan Lebovic², Shaleen Vira³, Andrew J Schoenfeld, Peter Gust Passias⁴

¹NYU Langone Orthopedic Hospital, ²NYU Orthopedics, ³University of Texas Southwestern Medical Center, ⁴NY Spine Institute / NYU Medical Center-Hjd

INTRODUCTION:

The field of corrective spine surgery, specifically cervical deformity (CD), is ever-evolving. Although new technologies and methods of measuring malalignment contribute to increase in surgical corrective procedures, the impact on postoperative impact remains unclear. The goal of this study was to examine whether surgical advancements over the years have changed outcomes and the overall way we approach CD surgery. This study sought to investigate how deformity type influences recovery pattern and outcomes in ASD corrective surgery.

METHODS: CD patients (≥ 18 yrs) with complete BL and 2Y HRQL data were included. Descriptive analysis included demographics, radiographic, and surgical details. Patients were stratified into 3 groups based on Ames ISSG Osteotomy Classification System: Grade 1 and 2 classified as Low Grade Osteotomies (LGO); Grades 3 through 5 considered Mid Grade Osteotomies (MGO); Grade 6 and 7, considered major osteotomies by Ames et al., were classified as High Grade Osteotomies (HGO). For any combination procedure where two different grades of osteotomies were done, the highest grade was taken for classification into our stratification system. Patient outcomes were measured by surgical complication rates, HRQL score difference across 2 years, and postoperative length of stay. ANCOVA and multivariable logistic regression analyses were used to evaluate the clinical, radiographic, and complications outcomes between the three cohorts.

RESULTS: A total of 136 CD patients met inclusion (57.1 ± 9.5 yrs, 60%F, BMI 28.6 ± 6.7 kg/m², CCI: $.58 \pm 1.0$). Twenty-two patients (16.2%) received MGO, while 9 patients (6.6%) had HGO and 74 patients (54.4%) received LGO. At baseline, graded osteotomies showed no statistically significant differences in age, Charlson Comorbidity Index, degree of deformity, or radiographic parameters. Surgically, osteotomies had comparable levels fused, estimated blood loss, operative time, and surgical approach. Overall complication rate was the lowest for patients undergoing HGO compared to LGO and MGO, with the greatest being for LGO (22% vs. 11% vs. 0%, $p = .16$). Two-year difference in HRQL mJOA was highest for HGO as compared to LGO and MGO, with only HGO experiencing a negative difference (.29 vs. .63 vs. -1, $p = .55$). However, EQ5D difference over the same years showed significant rates of changes in LGO compared to MGO and HGO (-.61 vs. .14 vs. -.11, $p < .001$). LGO had the greatest degree of improvement in 1 year difference in ODI, followed by HGO, compared to the other two groups (-13.6 vs. -8.5 vs. -10.4, $p = .2$), indicating short term improvement with lower invasive surgeries despite no significant long term benefit compared to surgery with greater complexity. The longest length of stay postoperatively was seen by HGO (4.4 vs. 3 vs. 10.25, $p < .001$), indicating increasingly invasive surgery requires greater postoperative recovery by patients.

DISCUSSION AND CONCLUSION:

Overtime, patients undergoing cervical deformity surgery received less high-grade osteotomies, even with high grade deformities. Despite operating on a cohort with a greater degree of comorbidity, there was no deterioration in clinical and radiographic outcomes with more complex surgeries. Compared to lower invasive techniques, high grade osteotomies maintained patient outcomes in longer term follow up. These findings reflect an improved understanding of surgical management and utility of invasive osteotomies in adult cervical deformity.