Rethinking Spinal Reconstruction: The Impact of Patient-Specific Implants on Thoracolumbar Deformity Surgery

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INTRODUCTION: While the use of individualized, custom rods in thoracolumbar fusion for ASD has increased in popularity, the differences in complication profiles and alignment remain to be investigated.

METHODS: Operative ASD patients aged ≥18Y with a UIV≥T1, a LIV≥S1, ≥5 levels fused, and complete BL and 2Y data included. Cohorts stratified based on use of patient-specific (PS+) rods or standard rods (PS-). Additionally, patients were stratified into thoracolumbar (TL) fusions (UIV≥T9) and upper thoracic (UT) fusions (UIV≤T8). Thoracic Decompensation: T1PA>20º, TK>60º, and SVA>5cm. Cervical Decompensation: cSVA>4cm and TSCL>20º.

RESULTS:

Of the 425 included (64.2±11.0Y, 71%F, 27.5±5.4kg/m2, CCI 1.1±1.7): 30.6% (130) PS+, 69.4% (295) PS-. Additionally, 50.6% (215) TL fusions and 49.4% (210) UT fusions. Surgical details: OR Time 409±139mins, EBL 1426±1173mL, 13.0±3.8 levels fused, LOS 7.7±4.2d. At BL, there were no differences in age, gender, BMI, CCI, radiographics, or SAAS categories.

Surgically, PS+ had shorter OR times (383 v 421mins, p=.019) and lower EBL (1146 v 1549mL, p<.001), but longer LOS (8.6 v 7.4d, p=.014) and more levels fused (13.9 v 12.6, p=.001). PS+ also had more UT cases (62.3 v 43.7%, p<.001).

Radiographically, PS+ had less thoracic decompensation at 1Y (5.4 v 14.2%, p=.008) and at 2Y (0.8 v 6.4%, p=.011). PS+ also had less cervical decompensation at 2Y (0.8 v 6.8%, p=.008). PS+ had fewer new cases of PJK at 2Y (3.8 v 14.6%, p=.001) and fewer revisions for implant failure (0.0 v 3.1%, p=.044). PS+ had fewer symptomatic radiographic complications (3.1 v 9.2%, p=.026) and fewer radiographic complications (3.8 v 10.5%, p=.023).

Additionally, PS+ had fewer postoperative sensory deficits/neuropathies (1.5 v 7.1%, p=.019). In MVA controlling for OR Time, LOS, EBL, and levels fused, PS+ was less likely to have an AE related to spine intervention (0.36, [0.16, 0.81], p=.014). In a subanalysis of UT fusions, PS+ had fewer neurologic deficits in a lower extremity (8.6 v 21.7%, p=.013).

DISCUSSION AND CONCLUSION:

Patient-specific implants demonstrate meaningful advantages in surgical efficiency, maintenance of alignment, and complication reduction, highlighting their potential to enhance outcomes in ASD corrective surgery.