Identifying Factors Associated with Disability and Outcomes of Adult Spinal Patients with Severe Sagittal Malalignment and Insufficient Pelvic Compensation at Presentation

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INTRODUCTION: Previous studies have identified patients with high sagittal vertical axis (SVA) imbalance and low pelvic tilt (PT) as a unique subset of patients who are unable to compensate relatively severe deformity. Yet, patient factors and predictive analytics assessing trends in disability and recovery have not been assessed.

METHODS: ASD patients with minimum baseline (BL) and 2-year(2Y) data were stratified into two groups: those with severe SVA (++, >9.5 cm) and non-severe PT (0, <20°) by SRS-Schwab criteria at BL (Malcomp+), and those with Severe SVA (++) and Moderate (+) or Severe (++) PT (Malcomp-). Baseline factors were assessed via ANOVA. ANCOVA assessed peri-operative factors controlling for age, CCI, and levels fused. NRS-Back/NRS-Leg ratio was used as a surrogate to assess severity of lumbar spinal stenosis. ANCOVA assessed post-operative factors while controlling for age, CCI, and levels fused. Backstep linear modeling assessed correlation between BL and 2Y ODI and NRS-Back/Leg pain controlling for age, CCI, pelvic incidence (PI), and levels fused. Similar controls were used to assess predictive factors for achieving Smith et al. Best Clinical Outcomes (BCO) by 2Y.

RESULTS: 308 patients (59.8±15.1yrs, 77.6% F, 26.8±5.6 kg/m2) were assessed. At baseline, 26.6% of patients were considered Malcomp-, and 5.8% were considered Malcomp+. Baseline demographic analysis revealed that Malcomp+ patients were significantly more likely to present with abnormal neurological exam (p=.030), and with abnormal lower extremity motor scores (p=.025). Radiographically, Malcomp+ patients presented with lower PI-LL, C7-S1 SVA, and GAP scores and were less likely to be mismatched by Roussouly typing (all p<.001). Although NRS-Back/Leg scores were comparable at baseline (p>.05), 2Y ratio scores were significantly higher in the Malcomp+ group (p=.046). ODI improvement by 1Y and 2Y was comparable between groups (p>.05). Radiographically, Malcomp+ patients were less likely to meet age-adjusted criteria by 1Y (p=.028), and by 2Y reported lower mean improvement in PI-LL (p<.001). In Malcomp+ patients, backstep regression revealed that decreased frailty by mASD-FI and lower BL PI-LL to be significant predictor of achieving BCO by 2Y (model p<.001), and that belonging to the Malcomp- group was itself an independent predictor of achieving BCO (p<.001. In Malcomp+ patients, backstep linear regression identified decreased BL sacral slope and PI-LL as significant correlators to increasing improvement in NRS-Back/Leg pain by 2Y (all p<.033).

DISCUSSION AND CONCLUSION: The present study demonstrates that adult spinal deformity patients with severe baseline sagittal malalignment and insufficient pelvic compensation demonstrate comparable improvement in patient-reported outcomes by two-years post-operatively versus patients with moderate-robust compensatory abilities, though symptoms of stenosis persist. Predictive analysis reveals that decreased baseline frailty and PI-LL mismatch are significantly correlated to increased probability of achieving optimal clinical outcomes by two-years in this unique subsect of patients.