Should Pelvic Incidence Influence Realignment Strategy? A Detailed Analysis in Adult Spinal Deformity

Tyler Kade Williamson, Tobi Onafowokan, Jordan Lebovic¹, Stephane Owusu-Sarpong², Ethan Cottrill³, Ahmed Makhani⁴, Matthew Galetta, Max Ray Fisher³, Anthony Yung³, Nathan August Lorentz, Renaud Lafage⁵, Virginie Lafage⁵, Andrew J Schoenfeld, Peter Gust Passias³

¹NYU Orthopedics, ²NYU Langone Orthopedic Hospital, ³Duke University, ⁴UT Health San Antonio, ⁵Lenox Hill Hospital INTRODUCTION: Mismatch between pelvic incidence (PI) and lumbar lordosis is one of the most commonly noted malalignment parameters in ASD patients. Classification systems including the Roussouly classification, the Global Alignment and Proportion (GAP) score, and the Sagittal Age-Adjusted Score (SAAS), have all incorporated PI into their assessment of alignment to either characterize the spine or inform surgical correction. Yet, adult spinal deformity (ASD) populations are often heterogeneous, with a variety of different characteristics that are classified as 'deformity' and, therefore, should warrant their own approach to realignment. The purpose of this study is to assess how varying realignment strategies affect mechanical failure and clinical outcomes in PI-stratified cohorts following ASD surgery.

METHODS: Median statistics were calculated for demographics and surgical details. Further statistical analysis was utilized to define subsets within pelvic incidence generating significantly different rates of mechanical failure. These subsets of pelvic incidence were further analyzed as sub-cohorts for the outcomes and effects of realignment within each. Multivariate logistic regression analysis controlling for baseline frailty and lumbar lordosis (L1-S1) analyzed the association of age-adjusted realignment (Lafage et al) and Global Alignment and Proportion (GAP; Yilgor et al) strategies with incidence of mechanical failure and clinical improvement within PI-stratified groups.

RESULTS: A total of 584 ASD patients with at least two-year data were included. A parabolic relationship between PI and mechanical failure was seen, whereas patients with either less than 51° (n=174; 39.1% of cohort) or greater than 63° (n=114; 25.2% of cohort) of PI generated higher rates of mechanical failure (18.0% and 20.0%, respectively) and lower rates of Good Outcome (80.3% and 77.6%, respectively) than those with moderate PI (51-63°). Patients with Lower PI more often met Good Outcome when undercorrected in age-adjusted PI-LL and SAAS, and those not meeting were more likely to deteriorate in GAP Relative Lordosis from first to final follow-up (OR: 13.4, 1.3-39.2]). In those with Moderate PI, patients were more likely to meet Good Outcome when aligned in GAP Lumbar Distribution Index (OR: 1.7, [1.1-3.3]). Patients with Higher PI meeting Good Outcome were more likely to be overcorrected in SVA (OR: 2.4, [1.1-5.2]) at first follow-up and less likely to be undercorrected in T1PA (OR: 0.4, [0.17-0.86]) by final follow-up. When assessing GAP alignment, patients were more likely to meet Good Outcome when aligned in GAP Lumbar Distribution Index (OR: 3.5, [1.4-8.9]).

DISCUSSION AND CONCLUSION: There is a parabolic relationship between pelvic incidence and both mechanical failure and clinical improvement following deformity correction. Understanding of the associations this fixed parameter has with poor outcomes can aid the surgeon in strategical planning when seeking to realign adult spinal deformity. Table 4. Incidence of Mechanical Complications and Clinical Improvement in PI-Stratified

Cohorts				
	Lower PI	Moderate PI	Higher PI	p-value
Major Hardware Failure	10.7%	2.6%	13.0%	.004
Proximal Junctional Failure	8.4%	7.2%	7.8%	.772
Mechanical Failure	18.0%	8.9%	20.0%	.045
Clinical Improvement	46.6%	54.1%	49.6%	.404
Good Outcome	80.3%	92.2%	77.6%	.040