

Title: Wrong Metrics: When the Benefit of Optimal Long-Term Realignment in Adult Spinal Deformity Corrective Surgery Outweighs the Risk of Transient Perioperative Complications

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Conflict(s) of Interest:

The authors declare there is no conflict of interest.

Introduction:Advancements allow surgeons to take on challenging, complex patients during corrective spine surgery. An increased risk of perioperative complications comes with increasing complexity. However, some patients persevere through short-term complications and manage to still achieve optimal, long-term outcomes. There remains a paucity exploring their characteristics and aspects of their care contributing to their success. We sought to demonstrate the superiority in long-term outcomes of achieving optimal realignment despite the increased risk of transient perioperative complications.

Methods:Operative ASD patients(scoliosis>20,SVA>5cm,PT>25, or TK>60) with baseline(BL)&2-year(2Y) HRQL data were included. Patients were stratified based on meeting 2Y optimal outcome. Optimal outcome: improvement in all three age-aligned SRS-Schwab modifiers,proportioned(P) in GAP, and a 2Y-ODI score of less than 25. Multivariate analysis was used to determine significance for complications. Published methods converted ODI to SF-6D. Cost was calculated using the PearlDiver database and CMS.gov definitions.

Results:469 ASD patients(59.9±14.7yrs,27.3±5.3kg/m²,CCI: 1.63±1.6,FI: 3.12±1.65)included and underwent surgery(11.5±4 levels fused,EBL:1565±1406 mL,OpTime:371±136 min,LOS:8.5±4.6 days). 63% of patients underwent a posterior approach, 37% combined. 52% underwent decompression, 66% underwent an osteotomy. BL radiographics: SVA:63.3±70.7 mm,PI-LL:14.4±21.2,PT:23.49±11.1. Patients grouped as follows: 105 “optimal”(O),364 “not optimal”(NO). Comparison revealed differences in age,BMI,and FI. NO group had less levels fused and osteotomies, but significantly higher EBL and decompressions. Controlling for age and frailty, the O group had more perioperative complications(58.1%vsNO:52.8%), significantly more GI complications(p=.027) and overall medical complications(10.5%vsNO:8.5%). NO group had more reoperations(p=.004),major complications(p=.024), instrumentation failures(p=.079), and higher rate of PJK/PJF. Groups were significantly different in utility gained, LEQALYs, 2-year QALYs, and overall cost(O:\$74,371.08 vs.NO:\$87,945.87,p=.008).

Discussion:Despite undergoing more invasive procedures and sustaining more perioperative complications, patients meeting optimal outcome experienced less major/mechanical complications, fewer reoperations, and lower rates of PJK/PJF. Accordingly, a higher, transient perioperative complication profile should not preclude surgical correction in ASD patients who demonstrate baseline characteristics suggestive of successful long-term outcomes.

Table 1. Baseline Cohort Demographics, Surgery Characteristics, and Radiographic Parameters

Baseline Characteristic	Mean Value±SD
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Age	59.9±14.7 years
Body Mass Index	27.3±5.3 kg/m ²
Charlson Comorbidity Index	1.63±1.6
ASD Frailty Index	3.12±1.65
Surgical/Admission Characteristic	Mean Value±SD
Length of Stay	8.5±4.6 days
Number of Levels Fused	11.5±4.0 levels
Estimated Blood Loss	1565±1406 mL
Operative Time	371±136 min
Baseline Radiographic Modifier	Mean Value±SD
Pelvic Tilt	23.49±11.1
PI-LL	14.4±21.2
SVA	63.3±70.7 mm

Osteotomy 66%, Decompression 52%, Posterior 63%, Combined 36%

Table 2. Group Demographics and Surgery Characteristics

Baseline Characteristic	Improved	Did Not Improve	P-value
Age	57.3±16.3 years	62.5±12.4 years	.005
Body Mass Index	26.4±4.9 kg/m ²	28.2±5.6 kg/m ²	.007

Charlson Comorbidity Index	1.54±1.67	1.73±1.59	.373
ASD Frailty Index	2.90±1.67	3.35±1.59	.031
Surgical/Admission Characteristic	Mean Value±SD	Mean Value±SD	
Length of Stay	8.6±5.0 days	8.3±4.2 days	.570
Number of Levels Fused	12.0±3.9 levels	11.0±4.1 levels	.043
Estimated Blood Loss	1385±1283 mL	1755±1508 mL	.038
Operative Time	362±141 min	382±131 min	.236
Osteotomy	81%	66%	.005
Decompression	43%	62%	.002

Table 3. Group Differences in Perioperative and Long-Term Complications

Complication within 90 days	Did Not Improve	Improved	p-value
Adverse Event	0.146	.114	.414
Reoperation	0.256	0.124	.004
Minor Complication	0.357	0.362	.929
Major Complication	0.302	0.191	.024
Any Perioperative Complication	0.528	0.581	.334
Medical Complication	0.085	0.105	.537
MSK Complication	0.033	0.000	.060

Cardiac	0.022	0.010	.228
GI	0.047	0.105	.027
Infection	0.036	0.010	.165
Neuro	0.066	0.019	.065
Pulmonary	0.055	0.048	.769
Renal	0.003	0.000	.592
Implant Failure	0.214	0.143	.087
Instrumentation Failure	0.159	0.076	.031
X-ray Imbalance	0.044	0.029	.106
PJK at 6W	0.536	0.514	.699
PJK at 2Y	0.566	0.476	.104
PJF by 2Y	0.220	0.152	.132

Table 4. Cost-Effectiveness Based on Meeting Optimal Outcome

	Did Not Meet Optimal Outcome	Met Optimal Outcome	p-value
Utility Gained	.0774	.1272	<.001
LEQALYs (QALYs gained based on Life Expectancy)	.981	2.31	<.001
Y2QALYs (QALYs gained based on 2 years)	.1502	.2469	<.001
Overall Cost 2Y	\$87,945.87	\$74,371.08	.008