

Redefining Clinical Success Following Adult Spine Deformity Surgery Using a Multifactorial Composite Metric

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INTRODUCTION: Adult spinal deformity (ASD) is a complex condition with diverse deformity types, varying disability levels, and multiple treatment options. Optimal surgical treatment aims to improve function, reduce radicular pain, and minimize revision surgery. Although some studies have considered combined outcomes, comprehensive evaluation using a multifactorial composite framework remains limited. The purpose of this study was to evaluate success rate following ASD surgery and evaluate rates across diverse patient subgroups.

METHODS: This study is a retrospective review of a prospective, multicenter database of ASD patients treated in North America between 2008 and 2018. Surgical success was assessed across three domains: (1) disability, (2) radicular pain, and (3) reoperation. Disability success was defined as either a 2-year ODI ≤ 20 or an improvement (Δ ODI) > 14 points. Radicular pain success was defined as either a 2-year NRS Leg Pain ≤ 3 or an improvement (Δ NRS Leg Pain) > 3 points. Reoperation success was defined as no return to surgery for mechanical or neurologic complications by 2 years. Patients were classified as having high disability (ODI > 40) and/or high radicular pain (NRS Leg Pain > 5) preoperatively. Success rates were evaluated independently for each domain and collectively (composite success). Comparisons were made across preoperative deficits and deformity types, categorized as Hyper Thoracic Kyphosis, Severe Coronal, Severe Sagittal, or Moderate deformity. Patient satisfaction and willingness to undergo the same treatment were assessed based on meeting success criteria. Multivariate analysis identified independent predictors of composite success.

RESULTS:

Of 1,504 patients, 1,084 (71.9%) completed 2-year follow-up (median age: 64 years, 75.4% female, 50.7% prior surgery). Median preoperative scores were ODI 44, NRS Back 8, and NRS Leg Pain 5. Preoperatively, 40.7% had combined high disability and pain, 21.6% had high disability only, 13.5% had high pain only, and 20.2% had neither. At 2 years, success rates were 60.9% for disability, 64.8% for radicular pain, 81.2% for reoperation, and 40.5% for all three domains (Figure 1). Composite success rates were highest in patients with no preoperative disability or pain (59.4%), followed by isolated deficits (38.0% for high disability only, 43.8% for high pain only), and lowest for combined deficits (32.2%).

Patients with Severe Coronal deformities had the highest composite success rate (51.7%), while other deformity types ranged from 32.0% to 41.3%. Independent predictors of composite success included lumbar scoliosis $>35^\circ$ (OR 2.103), baseline PCS >35 (OR 2.279), baseline leg pain <3 (OR 1.546), and fewer treated levels (<12 ; OR 1.619) (all $p < 0.05$). As illustrated Table 1, achieving composite success was strongly associated with satisfaction (87.2%) and willingness to undergo the same treatment (94.4%)

DISCUSSION AND CONCLUSION: Success following surgery should reflect both improvement and final outcomes. In this ASD cohort, success based on 3 criteria was reached in only 40.5% of patients and associated with better pre-operative physical scores, lower leg pain, and coronal deformities. While this measure of success was strongly associated with high satisfaction (87.2%) and willingness to repeat treatment (94.4%), other dimensions, such as psychosocial improvements or long-term durability, may also play a critical role.

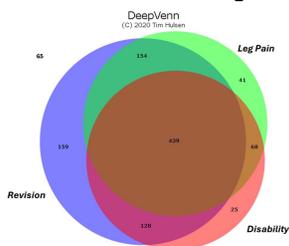


Table 1: Patient satisfaction ("Satisfied" or "Very Satisfied") and willingness to choose the same treatment again ("Probably" or "Definitely") stratified by 2-year success criteria.

	Satisfied?			Do it Again?		
	No Success	Success	p-value	No Success	Success	p-value
Disability success?	44.4%	84.4%	<0.001	64.4%	92.0%	<0.001
Radicular Pain success?	53.4%	76.0%	<0.001	67.2%	87.6%	<0.001
Revision Success?	58.8%	71.4%	<0.001	74.1%	83.1%	0.004
Total success?	54.7%	87.2%	<0.001	71.4%	94.4%	<0.001

Figure 1: Venn diagram reporting the number of patients achieving successful outcomes across three metrics (Disability, Leg Pain, and Revision), including the intersections representing simultaneous success across different combinations of these metrics.