

# A Decade-Long Analysis of a Large, Urban Academic Hospital on the Comparative Clinical Outcomes Following 1-2 Level and 3-4 Level Anterior Cervical Discectomy and Fusion

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**INTRODUCTION:** Currently, there is a robust body of clinical evidence regarding risks and outcomes of 1- and 2-level anterior cervical discectomy and fusion (ACDF). However, the risk profile of 3+ multilevel ACDF, a less common and more complex procedure, is not well understood. Greater understanding of the safety and outcomes of multilevel ACDF may help improve perioperative management, risk stratification and clinical decision making. As such, the study aims to compare clinical outcomes and resource utilization in patients undergoing 1-2-level versus 3-4-level elective ACDF.

## METHODS:

2,227 elective ACDF cases performed between 2008-2019 were retrospectively identified using ICD-10 CPT codes from our institutional database. Patients were then divided into either 1-2 levels or 3-4 levels fused. Baseline characteristics, perioperative variables, and clinical outcomes data were compared between cohorts using chi-square analysis and multivariate logistic regression.

**RESULTS:** The 1-2 level (n=1871) and 3-4 level (n=356) ACDF groups differed in age (p<0.001), ASA status (p<0.001), ethnicity (p=0.001), and payer status (p<0.001). Patients undergoing 3-4 level ACDF were older, held more Medicare/Medicaid insurance, and were more likely to have back pain, spondylolisthesis, spondylosis, and stenosis as the preoperative diagnosis (table 1). Compared to 1-2 level patients, 3-4 level patients had higher rates of all-cause complications (p<0.001), particularly neurological complications (p=0.02) and dysphagia (p=0.01). The 3-4 level cohort also had longer length of stay (LOS) (p<0.001), more required ICU stay (p<0.001), higher rates of 30-day readmission (p=0.03), and accumulated higher costs (p<0.001), although non-home discharge and 90-day readmission rates did not differ between 1-2 and 3-4 level cohorts (table 2). After controlling for demographic variables, 3-4 level ACDF patients are twice as likely as 1-2 level ACDF patients to require ICU stay and experience complications, including both dysphagia and neurological complications (table 3).

## DISCUSSION AND CONCLUSION:

Patients undergoing 3-4 level ACDF may benefit from measures such as closer neurophysiological monitoring and more prompt postoperative speech and swallow evaluation, in order to minimize risks of developing dysphagia and neurological complications. Efforts to identify patients at risk may help decrease resource utilization, notably ICU stay, prolonged hospital LOS, and hospital costs, especially in 3-4 level ACDF patients. Findings from our institutional database provides a contemporary comparison in outcomes after 1-2 versus 3-4 level ACDF, thereby enriching current literature that report national findings.

Table 1. General Characteristics of Sample by Cohort

	1-2 Level (n = 1871)	3-4 Level (n = 356)	P-value
Sex, female (%)	945 (50.5%)	188 (52.8%)	0.94
Age, years (SD)	51.56 (0.27)	56.46 (0.57)	<0.001
BMI (SD)	28.08 (0.13)	28.1 (0.33)	0.94
Payer Status (%)			<0.001
Medicaid	202 (10.8%)	44 (12.4%)	
Medicare	316 (16.9%)	96 (27.0%)	
Private insurance	1058 (56.5%)	186 (52.5%)	
Other/Unknown	295 (15.8%)	30 (8.4%)	
Ethnicity (%)			0.001
White	1045 (55.9%)	181 (50.8%)	
Black	191 (10.2%)	39 (11.0%)	
Asian	147 (7.9%)	51 (14.3%)	
Other	488 (26.1%)	85 (23.9%)	
ASA Status (%)			<0.001
1	204 (10.9%)	16 (4.5%)	
2	1229 (65.7%)	219 (61.5%)	
3	424 (22.7%)	118 (33.1%)	
4	14 (0.7%)	3 (0.8%)	
Preoperative Diagnosis (%)			<0.001
Back Pain	67 (3.6%)	18 (5.1%)	
Herniation	524 (28.0%)	48 (13.5%)	
Myelopathy	174 (9.3%)	27 (7.6%)	
Radiculopathy	166 (8.9%)	30 (8.4%)	
Spondylolisthesis	7 (0.4%)	4 (1.1%)	
Spondylosis	288 (15.4%)	98 (27.5%)	
Stenosis	488 (26.1%)	107 (30.1%)	
Other	157 (8.4%)	24 (6.7%)	

Table 2. Perioperative and Postoperative Outcomes in 1-2 vs 3-4 Level ACDF Cohorts

	1-2 Level (n = 1871)	3-4 Level (n = 356)	p-value
Length of Surgery, minutes (SD)	141.49 (1.2)	213.04 (3.6)	<0.001
Estimated Blood Loss, mL (SD)	48.6 (1.58)	94.18 (7.1)	<0.001
All-Cause Complications (%)	76 (4.0%)	32 (8.6%)	<0.001
Pneumonia	10 (0.5%)	5 (1.4%)	0.15
Dysphagia	32 (1.7%)	15 (4.1%)	0.01
Pulmonary Edema	4 (0.2%)	0 (0.0%)	0.83
Bleeding	18 (1.0%)	7 (1.9%)	0.19
Dural Tear	5 (0.3%)	2 (0.5%)	0.72
Renal Failure	3 (0.2%)	1 (0.3%)	0.83
Cardiac Complications	5 (0.3%)	2 (0.5%)	0.72
Neurologic Complications	3 (0.2%)	4 (1.1%)	0.02
Prolonged Intubation (%)	21 (1.1%)	0 (0.0%)	0.08
Length of Stay, days (SD)	1.42 (0.02)	2.02 (0.25)	<0.001
Non-home Discharge (%)	50 (2.6%)	13 (3.5%)	0.45
Required ICU Stay (%)	35 (1.8%)	19 (5.1%)	<0.001
Days in ICU (SD)	0.03 (0.01)	0.14 (0.08)	0.01
30-Day Readmission (%)	27 (1.4%)	12 (3.2%)	0.03
90-Day Readmission (%)	73 (3.9%)	22 (5.9%)	0.09
Total Cost (SD)	\$20,158.93 (\$152.42)	\$31,287.03 (\$902.95)	<0.001

Table 3. Odds Ratios of Outcomes and Complications in 1-2 vs 3-4 Level ACDF

Outcomes	Odds ratio (95% CI)	P-value
30 Day Readmission	1.93 (0.95-3.90)	0.069
90 Day Readmission	1.25 (0.75-2.08)	0.392
ICU Stay	2.37 (1.29-4.36)	0.006
All-Cause Complications	1.96 (1.25-3.07)	0.003
Acute respiratory failure	1.38 (0.14-13.59)	0.785
Dysphagia	2.21 (1.17-4.17)	0.014
Neurologic Complications	7.13 (1.53-33.33)	0.013