

# Comparison of Preoperative Costs Between Cervical Disc Arthroplasty and Anterior Cervical Discectomy and Fusion: A Retrospective Analysis

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## INTRODUCTION:

Cervical spine procedures such as cervical disc arthroplasty (CDA) and anterior cervical discectomy and fusion (ACDF) are widely performed for cervical degenerative disc disease. While both are clinically effective, the preoperative costs associated with each procedure remain underexplored and inadequately compared in existing literature in comparison to postoperative costs. This study aims to compare preoperative healthcare utilization costs between patients undergoing ACDF and those undergoing CDA by analyzing spending patterns across major service categories using a large national claims database. We hypothesize that both ACDF and CDA are associated with substantial preoperative expenditures, largely driven by variations in nonoperative care such as physical therapy, imaging, and office visits, and that these cost patterns differ by procedure type and insurance status due to underlying disparities in healthcare utilization and reimbursements.

**METHODS:** This retrospective cohort study was conducted using a national claims database that included de-identified healthcare data from both Medicare and commercial insurance providers. The study period spanned from 2010 to 2022. Patients who underwent either single-level CDA or ACDF between 2010 and 2022 were identified using ICD-9, ICD-10, and CPT codes. Eligible patients had primary procedures and continuous insurance enrollment with complete claims data available for at least one year prior to surgery. Those with revision procedures, multilevel surgeries, or incomplete preoperative data were excluded. The primary outcome of interest was total preoperative healthcare costs incurred during the one-year period preceding surgery. These costs were further broken down into the following categories: opioid prescriptions, steroid injections, office visits, physical therapy (PT), and imaging studies, including X-ray, magnetic resonance imaging (MRI), and computed tomography (CT) scans. All cost data reflected actual reimbursements made by the insurer and were inflation-adjusted to 2022 U.S. dollars. Comparisons of preoperative costs between the CDA and ACDF cohorts were conducted using Welch's t-tests to account for unequal variances. Subgroup analyses were performed within Medicare and commercial insurance cohorts to evaluate payer-specific differences. Statistical significance was set at the  $P < 0.05$  level.

## RESULTS:

CDA was associated with significantly higher preoperative costs compared to ACDF. The mean total preoperative cost for CDA was \$10,967.98 versus \$9,463.64 for ACDF ( $P < 0.001$ ), driven by greater expenditures on physical therapy, imaging, and office visits. Among Medicare beneficiaries, CDA patients had preoperative costs of \$9,517.83 versus \$9,178.40 for ACDF ( $P < 0.001$ ), with significant differences in imaging. In the commercial insurance cohort, CDA patients incurred \$11,062.86 compared to \$9,226.20 for ACDF ( $P < 0.001$ ), with larger differences in physical therapy, imaging, and office visits.

## DISCUSSION AND CONCLUSION:

CDA is associated with higher preoperative costs than ACDF, particularly in imaging studies and physical therapy. These findings underscore the economic implications of surgical choice, suggesting that while CDA may offer clinical advantages, it imposes a greater financial burden. Policymakers and healthcare systems should consider these cost differences when evaluating surgical strategies for cervical degenerative disc disease.

Table 1. Summary Profile of Medicare Beneficiaries Who Underwent ACDF or CDA

Demographic	ACDF (N=10,549)	CDA (N=2,531)	P Value*
Age (Years)	68	67	<0.001
Male	58	56	
Female	48	50	
White	85	84	
Black	10	11	
Hispanic	3	3	
Other	2	2	
Married	55	54	
Widowed	22	23	
Divorced	15	16	
Never Married	8	8	
Medicaid	0.5	0.5	
Medicare	99.5	99.5	
Medicaid/Medicare	0.5	0.5	
Other	0.5	0.5	

Table 2. Summary Profile of Commercial Insured Patients Who Underwent ACDF or CDA

Demographic	ACDF (N=15,812)	CDA (N=3,716)	P Value*
Age (Years)	45	46	<0.001
Male	55	54	
Female	45	46	
White	75	74	
Black	15	16	
Hispanic	8	9	
Other	2	2	
Married	65	64	
Widowed	25	26	
Divorced	8	9	
Never Married	2	2	
Commercial Insurance	100	100	

Table 3. Comparison of Costs Based on Insurance Status

Variable	ACDF	CDA	P Value*
Overall	\$9,463.64	\$10,967.98	<0.001
Medicare	\$9,178.40	\$9,517.83	<0.001
Commercial	\$9,808.84	\$11,062.86	<0.001
Medicaid	\$0	\$0	<0.001
Other	\$0	\$0	<0.001
Medicare/Commercial	\$9,463.64	\$10,967.98	<0.001
Medicare/Medicaid	\$0	\$0	<0.001
Commercial/Medicaid	\$0	\$0	<0.001
Other/Other	\$0	\$0	<0.001

Table 4. Comparison of Costs Based on Insurance Status

Variable	ACDF	CDA	P Value*
Overall	\$9,463.64	\$10,967.98	<0.001
Medicare	\$9,178.40	\$9,517.83	<0.001
Commercial	\$9,808.84	\$11,062.86	<0.001
Medicaid	\$0	\$0	<0.001
Other	\$0	\$0	<0.001
Medicare/Commercial	\$9,463.64	\$10,967.98	<0.001
Medicare/Medicaid	\$0	\$0	<0.001
Commercial/Medicaid	\$0	\$0	<0.001
Other/Other	\$0	\$0	<0.001

Table 5. Comparison of Costs Based on Insurance Status

Variable	ACDF	CDA	P Value*
Overall	\$9,463.64	\$10,967.98	<0.001
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Other	\$0	\$0	<0.001
Medicare/Commercial	\$9,463.64	\$10,967.98	<0.001
Medicare/Medicaid	\$0	\$0	<0.001
Commercial/Medicaid	\$0	\$0	<0.001
Other/Other	\$0	\$0	<0.001

Table 6. Comparison of Costs Based on Insurance Status

Demographic	ACDF	CDA	P Value*
Age (Years)	68	67	<0.001
Male	58	56	
Female	48	50	
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Black	10	11	
Hispanic	3	3	
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Married	55	54	
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Divorced	15	16	
Never Married	8	8	
Medicaid	0.5	0.5	
Medicare	99.5	99.5	
Medicaid/Medicare	0.5	0.5	
Other	0.5	0.5	

Table 7. Comparison of Costs Based on Insurance Status

Demographic	ACDF	CDA	P Value*
Age (Years)	45	46	<0.001
Male	55	54	
Female	45	46	
White	75	74	
Black	15	16	
Hispanic	8	9	
Other	2	2	
Married	65	64	
Widowed	25	26	
Divorced	8	9	
Never Married	2	2	
Commercial Insurance	100	100	

ACDF = Anterior Cervical Discectomy and Fusion; CDA = Cervical Disc Arthroplasty; P Value = P-value for statistical significance.

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