Increased Cumulative Incidence of 10-Year Reoperation and Surgical Complications Following Anterior Cervical Discectomy and Fusion Compared to Cervical Disc Arthroplasty

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INTRODUCTION:
Anterior cervical discectomy and fusion (ACDF) is considered the gold-standard care for degeneration of the cervical spine, but is known to alter segmental motion at adjacent vertebrae, which places additional stress on adjacent discs that may accelerate degeneration. Recently, however, there has been a surge in interest in cervical disc arthroplasty (CDA) as CDA may preserve spinal motion, thus reducing adjacent segment disease compared with ACDF. Although short-term and mid-term data suggest comparable outcomes between the two procedures, there are few studies examining the 10-year clinical outcomes and surgical complications between CDA and ACDF. Therefore, the purpose of this study was to (1) compare the 10-year survivorship and cumulative incidence of secondary cervical procedures of CDA and ACDF and (2) identify differences in surgical complications.
METHODS:
Patients who underwent primary single-level CDA and ACDF were identified using a national administrative claims database. CDA patients were propensity-score matched by age, sex, and Charlson Comorbidity Index (CCI) to the ACDF cohort in a 1:1 ratio. The 10-year cumulative incidence rate of secondary cervical procedures, which included ACDF, CDA, cervical decompression, and posterior cervical fusion, was determined using Kaplan-Meier survival analysis. Additionally, separate surgical complications including 10-year cumulative incidence rate of all-cause revision or hardware removal, spinal complications, nerve root compression, dural tear, dysphonia and dysphagia, drainage and evacuation, and mechanical failure were determined using Kaplan-Meier survival analysis. Hazard ratios (HR) and corresponding 95% confidence intervals (CI) were conducted using Cox Proportional Hazard modeling.
RESULTS: In total, 18,192 CDA patients were matched to 18,192 ACDF patients. The 10-year cumulative incidence of secondary cervical procedures for CDA was 8.7% and ACDF was 11.4%. ACDF patients were significantly more likely to undergo secondary cervical procedures over a 10-year period compared to CDA counterparts (HR: 1.12, P = 0.005). Additionally, ACDF patients were significantly more likely to experience complications including spinal complications (HR: 4.73), nerve root compression (HR: 2.61), drainage and evacuation (HR: 2.01), and mechanical failure (HR: 1.36) when compared patients who underwent CDA over a 10-year period (P < 0.05 for all).
DISCUSSION AND CONCLUSION: This study suggests that CDA may provide superior long-term outcomes by reducing the need for future cervical procedures and minimizing the risk of cervical complications compared to ACDF. The motion-preserving benefits of CDA translate into clinical advantages over the decade following surgery. While short and mid-term studies have demonstrated comparable outcomes between the two procedures, this study highlights the potential long-term benefits favoring CDA over the historical gold standard of ACDF for single-level cervical degeneration. Spine surgeons should consider these 10-year data when counseling patients on the most appropriate surgical option.

Table 1: Demographics and clinical characteristics of Unmatched ACDF and CDA cohorts

	ACDF		CDA		
	n	%	n	%	P-Value
Total	182,654	-	18,193	-	-
Demographic and Comorbidity Characteristics					
Age (years)	53.4 ± 11.8	-	46.2 ± 10.0	-	**<0.001**
<50	69,504	38.05%	11,817	64.95%	**<0.001**
50-59	57,414	31.43%	4,674	25.69%	**<0.001**
60-69	36,978	20.24%	1,525	8.38%	**<0.001**
70-74	11,907	6.52%	179	0.98%	**<0.001**
75+	6,945	3.80%	93	0.51%	**<0.001**
Sex	-	-	-	-	-
Male	81,129	44.42%	7,636	41.97%	**<0.001**
Female	101,525	55.58%	10,557	58.03%	**<0.001**
Charlson Comorbidity Index	1.61 ± 1.99	-	1.32 ± 1.47	-	**<0.001**
0	62,288	34.10%	5,584	32.18%	**<0.001**
1	50,258	27.52%	6,434	35.37%	**<0.001**
2	29,521	16.16%	3,203	17.61%	**<0.001**
3+	40,587	22.22%	2,702	14.85%	**<0.001**

Table 2: Demographics and clinical characteristics of Matched ACDF and CDA cohorts

	ACDF		CDA		
	n	%	n	%	P-Value
Total	18,192	-	18,192	-	-
Demographic and Comorbidity Characteristics					
Age (years)	46.3 ± 10.0	-	46.2 ± 10.0	-	0.338
<50	11,776	64.73%	11,779	64.75%	0.983
50-59	4,643	25.52%	4641	25.51%	0.990
60-69	1,510	8.30%	1,508	8.29%	0.985
70-74	177	0.97%	178	0.98%	1.00
75+	93	0.51%	93	0.51%	1.00
Sex	-	-	-	-	-
Male	7,635	41.97%	7,635	41.97%	1.00
Female	10,557	58.03%	10,557	58.03%	1.00
Charlson Comorbidity Index	1.32 ± 1.47	-	1.32 ± 1.47	-	1.00
0	5,796	35.50%	5,792	35.53%	0.973
1	6,459	22.83%	6,464	22.70%	0.965
2	3,214	17.67%	3,217	17.68%	0.978
3+	2,723	14.97%	2,719	14.95%	0.965

Table 3: Cox proportional hazards modeling of 10-year revision etiologies: ACDF versus CDA cohort

Surgical Outcome	Hazards Ratio	95% Confidence Interval	P-Value
Unmatched Analysis			
Secondary Procedure	1.45	1.34-1.56	**<0.001**
Spinal Complications	5.13	3.79-6.93	**<0.001**
Nerve Root Compression	2.19	1.03-4.67	**0.041**
Dural Tear	1.37	0.96-1.96	0.082
Dysphonia and Dysphagia	1.26	1.20-1.33	**<0.001**
Drainage and Evacuation	3.02	1.42-6.40	**0.004**
Mechanical Failure	1.77	1.50-2.10	**<0.001**
Matched Analysis			
Secondary Procedure	1.12	1.04-1.22	**0.005**
Spinal Complications	4.73	3.47-6.45	**<0.001**
Nerve Root Compression	2.61	1.10-6.17	**0.030**
Dural Tear	0.96	0.63-1.46	0.840
Dysphonia and Dysphagia	1.01	0.95-1.07	0.726
Drainage and Evacuation	2.01	1.01-3.98	**0.045**
Mechanical Failure	1.36	1.14-1.62	**<0.001**

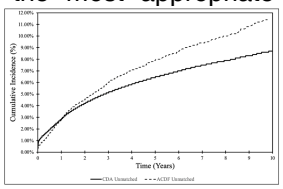

Figure 1: 10-Year cumulative incidence of secondary cervical procedure for unmatched CDA and ACDF cohorts.