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Original Article

Comparison of 30-day outcome following anterior cervical discectomy and fusion with or without instrumentation for cervical spondylosis: A review of 2352 elective cases

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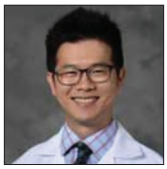

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ABSTRACT

Background: Anterior cervical discectomy and fusion (ACDF) is a commonly performed procedure to address cervical myeloradiculopathy. However, 30-day outcomes after additional plating/instrumentation are not very clear.

Methods: The authors reviewed The National Surgical Quality Improvement Program database to identify all elective ACDF cases with or without instrumentation for patients having cervical spondylosis with or without myelopathy from 2011 to 2013 using current procedural terminology and International Classification of Disease-9 codes. We identified 2352 cases and subdivided these into two cohorts based on instrumentation procedures (588 cases without instrumentation and 1764 cases with instrumentation). Baseline differences in two cohorts were adjusted by propensity score matching analysis, yielding well-matched 583 pairs.

Results: Following propensity matching, the authors observed no significant difference in 30-day complication rates (prematch, 2.4% vs. 2.4%; and postmatch, 2.4% vs. 1.7%), readmission (prematch, 4.1% vs. 3.2%; and postmatch, 3.9% vs. 3.3%), and reoperation (prematch 0.9% vs. 1.8%; and postmatch 0.9% vs. 1.5%).

Conclusion: Our results demonstrate similar 30-day outcomes in both cohorts and suggest that instrumentation can be safely implemented in the setting of ACDF.

Keywords: Anterior cervical discectomy and fusion, Cervical spondylosis, Complication, Instrumentation, National Surgical Quality Improvement Program

INTRODUCTION

Cervical spondylosis is a common degenerative condition of the spine. It often correlates clinically with radiculopathy and less commonly, myelopathy. Anterior cervical discectomy and fusion (ACDF) is commonly utilized to address cervical myeloradiculopathy, although the role of additional plating/instrumentation is less clear.[2] For single-level procedures, several studies demonstrated similar clinical outcomes and fusion rates, but better sagittal alignment with instrumentation.[6,9,17] However, there is limited evidence regarding short-term outcomes following instrumented versus noninstrumented ACDF procedures. Therefore, this study was designed to assess short-term outcomes following instrumented versus noninstrumented ACDF utilizing The American College of Surgeons National Surgical Quality Improvement

Program (NSQIP) database and to investigate whether instrumentation affects short-term postoperative outcomes.

Table 1: CPT codes used for case selection/exclusion.

Selected procedures	i. Single level: 22551 or 63075 and 22554; ii. Multi level: 22552 or 63076 and 22585
Excluded procedures*	22600, 22614, 63001, 63015, 63020, 63035, 63040, 63045, 63048, 63250, 63265, 63270, 63275, 63280, 63285, 63050, 22326, 22328, 22210, 22216, 22220, 22226, 22548, 22590, 22595, 22556, 22558, 22586, 22830, 22850, 22852, 22855, 22861, 22864

CPT: Current procedural terminology; *Excluded all cases with secondary CPT codes for trans-oral approach to C1-C2, posterior approach, noncervical vertebrae, revision, deformity procedures, and emergency

MATERIALS AND METHODS

Data acquisition

The authors reviewed the NSQIP database to identify all elective ACDF cases with or without instrumentation for patients with cervical spondylosis with or without myelopathy from 2011 to 2013. We utilized Current Procedural Terminology (CPT) and International Classification of Disease (ICD-9) codes to capture 2352 elective ACDF procedures [Table 1]. These cases were divided into two cohorts based on instrumentation (588 cases without instrumentation and 1764 cases with instrumentation).

We tracked multiple demographic and operative variables for adequate propensity score matching analysis to compare

Table 2: Unmatched patient demographics, comorbidities, and operative characteristics.

	No instrumentation		Instrumentation		*P*-value
	n=588	Percentage	*n*=1764	Percentage	
Age (years, mean±SD)	56.3±10.8		56.5±11.1		0.822
*Obese	280	47.60	755	42.80	0.041
Gender					
Female	309	52.60	905	51.30	0.6
Male	279	47.40	859	48.70	
*Race					
White	465	79.10	1466	83.10	0.028
Black	59	10.00	166	9.40	
Others	64	10.90	132	7.50	
Diabetes	93	15.80	245	13.90	0.249
Current smoker	162	27.60	513	29.10	0.477
Dyspnea	44	7.50	117	6.60	0.479
Dependent functional status prior to surgery	11	1.90	42	2.40	0.47
Chronic obstructive pulmonary disease	35	6.00	79	4.50	0.15
Chronic heart failure <30 days	0	0.00	6	0.30	0.347
Hypertension	282	48.00	875	49.60	0.49
Acute renal failure	0	0.00	1	0.10	>0.999
On dialysis	1	0.20	7	0.40	0.688
Open wound/wound infection	3	0.50	9	0.50	>0.999
Steroid use	24	4.10	71	4.00	0.952
>10% weight loss in <6 months	0	0.00	4	0.20	0.578
Bleeding disorders	4	0.70	23	1.30	0.219
Systemic sepsis	3	0.50	4	0.20	0.376
Anemia	149	25.30	454	25.70	0.849
Myelopathy	317	53.90	891	50.50	0.153
Inpatient	474	80.60	1384	78.50	0.293
*Specialty: Neurosurgery	461	78.40	1477	83.70	0.003
Orthopedics	127	21.60	287	16.30	
*ASA >2	283	48.10	758	43.00	0.029
Wound class >2	1	0.20	5	0.30	>0.999
*>2 Level	219	37.20	1069	60.60	<0.001
Corpectomy	15	2.60	46	2.60	0.94
*Total operative time (min, mean±SD)	131.9±69.8		131.1±69.8		0.637
*Total RVU (mean±SD)	35.3±12.7		49.6±11.6		<0.001
*Propensity score	0.71±0.10		0.76±0.10		<0.001

*Denotes statistical significant; *P*<0.05. SD: Standard deviation

30-day postoperative outcomes following instrumented versus noninstrumented ACDF procedures [Tables 2-3].

Statistical analysis

Continuous variables were compared using student *t*-test or Manny–Whitney U-test based on normality test. For categorical variables, we used Pearson's Chi-square test or Fischer's exact test. We also utilized propensity score matching analysis to adjust for baseline difference between two cohorts. This process yielded well-matched 583 pairs and they were analyzed using the McNemar exact test for categorical variables, and Wilcoxon Signed-rank test or paired *t*-test for continuous variables [Table 4].

For all analyses performed in this study, we used IBM SPSS Statistics version 22.0 (IBM Corp., Armonk, NY).

Table 3: Propensity-matched patient demographics, comorbidities, and operative characteristics.

	No instrumentation		Instrumentation		*P*-value
	n=583	Percentage	*n*=583	Percentage	
Age (years, mean±SD)	56.3±10.8		56.0±10.6		0.671
*Obese	276	47.30	284	48.70	0.639
Gender					
Female	305	52.30	325	55.70	0.24
Male	278	47.70	258	44.30	
*Race					
White	461	79.10	473	81.10	0.442
Black	58	9.90	59	10.10	
Others	64	11.00	51	8.70	
Diabetes	91	15.60	88	15.10	0.807
Current smoker	162	27.80	151	25.90	0.467
Dyspnea	43	7.40	47	8.10	0.661
Dependent functional status prior to surgery	11	1.90	9	1.50	0.652
Chronic obstructive pulmonary disease	34	5.80	36	6.20	0.805
Chronic heart failure <30 days	0	0.00	0	0.00	N/A
Hypertension	278	47.70	269	46.10	0.597
Acute renal failure	0	0.00	0	0.00	N/A
On dialysis	1	0.20	0	0.00	>0.999
Open wound/wound infection	3	0.50	4	0.70	>0.999
Steroid use	24	4.10	32	5.50	0.273
>10% weight loss	0	0.00	0	0.00	N/A
Bleeding disorders	4	0.70	6	1.00	0.525
Systemic sepsis	2	0.30	3	0.50	>0.999
Anemia	146	25.00	133	22.80	0.372
Myelopathy	312	53.50	314	53.90	0.906
Inpatient	469	80.40	467	80.10	0.883
*Specialty: Neurosurgery	460	78.90	458	78.60	0.886
Orthopedics	123	21.10	125	21.40	
*ASA >2	278	47.70	283	48.50	0.769
Wound class >2	1	0.20	0	0.00	>0.999
*>2 Level	219	37.60	239	41.00	0.28
Corpectomy	15	2.60	15	2.60	>0.999
*Total operative time (min, mean±SD)	131.6±69.6		122.1±61.4		0.014
*Total RVU (mean±SD)	35.4±12.7		47.5±10.5		<0.001
*Propensity score	0.71±0.10		0.71±0.10		0.657

*Denotes statistical significant; *P*<0.05. SD: Standard deviation

Propensity score was derived using logistic regression model. 1:1 nearest neighbor and without-replacement model were used, and each matched set was within the designated limit (caliper width). This process yielded well-matched 583 pairs and they were analyzed using the McNemar exact test for categorical variables and Wilcoxon Signed-rank test or paired *t*-test for continuous variables.

RESULTS

Unadjusted dataset

Of the 2352 patients included in this study, 588 were in the noninstrumentation cohort and 1764 in the instrumentation cohort. Patients who had instrumentation were more likely to be obese, Caucasian, were neurosurgical cases, had lower ASA classifications, involved two or more levels, and had a higher total RVU value [Table 2]. No significant differences were appreciated between the two cohorts in postoperative outcome including 30-day complication rates, unplanned reoperation, and readmission [Table 3].

Propensity score-matched dataset

Propensity score matching yielded 583 well-matched cases. After matching, there was no significant baseline difference

Table 4: Thirty-day outcomes following anterior cervical discectomy and fusion.

	Unmatched				*P*-value	Propensity score-matched				*P*-value
	No Instrumentation		Instrumentation			No instrumentation		Instrumentation		
	n=588	Percentage	*n*=1764	Percentage		*n*=583	Percentage	*n*=583	Percentage	
Any ≥1	14	2.4	43	2.4	0.938	14	2.4	10	1.7	0.409
Surgical complication	6	1.0	6	0.3	0.085	6	1.0	2	0.3	0.156
Superficial SSI	2	0.3	3	0.2	0.604	2	0.3	1	0.2	>0.999
Deep SSI	2	0.3	0	0.0	0.062	2	0.3	0	0.0	0.500
Organ/space SSI	2	0.3	2	0.1	0.262	2	0.3	0	0.0	0.500
Wound dehiscence	0	0.0	1	0.1	>0.999	0	0.0	1	0.2	>0.999
Graft/prosthesis failure	0	0.0	0	0.0	N/A	0	0.0	0	0.0	N/A
Medical complication	8	1.4	38	2.2	0.229	8	1.4	8	1.4	>0.999
Pneumonia	2	0.3	9	0.5	0.741	2	0.3	2	0.3	>0.999
Unplanned Intubation	1	0.2	6	0.3	0.688	1	0.2	0	0.0	>0.999
PE	1	0.2	5	0.3	>0.999	1	0.2	0	0.0	>0.999
Ventilator >48 h	1	0.2	3	0.2	>0.999	1	0.2	0	0.0	>0.999
Renal insufficiency	0	0.0	0	0.0	N/A	0	0.0	0	0.0	N/A
Acute renal failure	0	0.0	0	0.0	N/A	0	0.0	0	0.0	N/A
UTI	2	0.3	7	0.4	>0.999	2	0.3	0	0.0	0.500
CVA/Stroke	0	0.0	6	0.3	0.347	0	0.0	3	0.5	0.249
Coma >24 h	0	0.0	0	0.0	N/A	0	0.0	0	0.0	N/A
Peripheral nerve injury	0	0.0	0	0.0	N/A	0	0.0	0	0.0	N/A
Cardiac arrest	0	0.0	2	0.1	>0.999	0	0.0	0	0.0	N/A
Myocardial infarction	1	0.2	4	0.2	>0.999	1	0.2	0	0.0	N/A
DVT	1	0.2	6	0.3	0.688	1	0.2	2	0.3	>0.999
Sepsis/septic shock	1	0.2	9	0.5	0.467	1	0.2	1	0.2	>0.999
Any readmission	24	4.1	56	3.2	0.293	23	3.9	19	3.3	0.638
Unplanned reoperation	5	0.9	32	1.8	0.104	5	0.9	9	1.5	0.282

*Denotes statistical significance, $P<0.05$. SSI: Surgical site infection, PE: Pulmonary embolism, UTI: Urinary tract infection, CVA: Cerebrovascular accident, DVT: Deep venous thrombosis, N/A: Not available

other than total operative duration and total RVU. The mean difference propensity scores between the two cohorts before and after matching were 0.05 and <0.001, respectively [Table 4]. There was also no significant difference in 30-day complication rates, unplanned reoperation, and readmission rate [Table 4].

DISCUSSION

The authors relied on a prospectively maintained, national surgical database to assess how instrumentation may influence short-term postoperative outcome following single- and multi-level, elective ACDF for cervical spondylosis. This study sought to eliminate the baseline differences by utilizing a propensity score matching algorithm, which adjusted patient demographic profile, comorbidities, and major operative variables such as corpectomy or multi-level procedures. We further minimized procedural bias by selecting elective cases and tracking both individual CPT and ICD-9 codes.

Here, we demonstrated that patients in both noninstrumentation and instrumentation cohorts had comparable adverse outcome rates 30-day complication rates (prematch, 2.4% vs. 2.4%; and postmatch, 2.4% vs. 1.7%), readmission (prematch, 4.1% vs. 3.2%; and postmatch, 3.9% vs. 3.3%), and reoperation (prematch 0.9% vs. 1.8%; and postmatch 0.9% vs. 1.5%).

Complication and reoperation rates in this study were lower than previously reported rates, which were as high as 10%–13%.[1,3,4,8,10] The discrepancy is most likely attributed to a shorter follow-up period. Notably, our results showed that additional instrumentation is not significantly associated with adverse events including infection, soft tissue injury, or neurological deficit.[7,9,14,16,17] Previous studies demonstrated similar outcomes that instrumentation-related complication rates were well below 5% including unsecure screws, plate bending, and dysphagia.[5,7,11-15]

Our matched analysis also demonstrated that average operative duration was significantly longer than the noninstrumentation cohort (131.6 ± 69.6 vs. 122.1 ± 61.4; $P = 0.014$). However, 9-min difference in operative duration likely does not have any meaningful clinical influence despite the statistical difference arising from narrow standard deviation. This difference likely occurred during the matching process where operative duration was purposely not accounted for.

Here, we present a short-term multicenter analysis of outcomes following elective instrumented versus noninstrumented ACDF. We found similar 30-day outcomes in both cohorts which suggest that instrumentation can be safely implemented for ACDF resulting in comparable outcomes without incurring significant morbidity or adverse events.

CONCLUSION

Our analyses demonstrate similar 30-day outcomes in both cohorts, and suggest an additional instrumentation step can be safely implemented in the setting of cervical spondylosis with little concern for postoperative complication.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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