

Comparison of Outcomes Following Anterior vs Posterior Fusion Surgery for Patients With Degenerative Cervical Myelopathy: An Analysis From Quality Outcomes Database

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BACKGROUND: The choice of anterior vs posterior approach for degenerative cervical myelopathy that spans multiple segments remains controversial.

OBJECTIVE: To compare the outcomes following the 2 approaches using multicenter prospectively collected data.

METHODS: Quality Outcomes Database (QOD) for patients undergoing surgery for 3 to 5 level degenerative cervical myelopathy was analyzed. The anterior group (anterior cervical discectomy [ACDF] or corpectomy [ACCF] with fusion) was compared with posterior cervical fusion. Outcomes included: patient reported outcomes (PROs): neck disability index (NDI), numeric rating scale (NRS) of neck pain and arm pain, EQ-5D, modified Japanese Orthopedic Association score for myelopathy (mJOA), and NASS satisfaction questionnaire; hospital length of stay (LOS), 90-d readmission, and return to work (RTW). Multivariable regression models were fitted for outcomes.

RESULTS: Of total 245 patients analyzed, 163 patients underwent anterior surgery (ACDF-116, ACCF-47) and 82 underwent posterior surgery. Patients undergoing an anterior approach had lower odds of having higher LOS ($P < .001$, odds ratio 0.16, 95% confidence interval 0.08-0.30). The 12-mo NDI, EQ-5D, NRS, mJOA, and satisfaction scores as well as 90-d readmission and RTW did not differ significantly between anterior and posterior groups.

CONCLUSION: Patients undergoing anterior approaches for 3 to 5 level degenerative cervical myelopathy had shorter hospital LOS compared to those undergoing posterior decompression and fusion. Also, patients in both groups exhibited similar long-term PROs, readmission, and RTW rates. Further investigations are needed to compare the differences in longer term reoperation rates and functional outcomes before the clinical superiority of one approach over the other can be established.

KEY WORDS: Cervical myelopathy, Anterior discectomy and fusion, Posterior cervical fusion, Quality outcomes database, Neurosurgical registry

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Degenerative cervical myelopathy is the most common cause of acquired neurological disability in people older than 50 yr of age.¹ It may be attributed to an array of degenerative changes occurring in the aging spine, including degenerative disc disease, facet joint arthritis, ligamentum flavum hypertrophy, and ossification of the posterior longitudinal

ABBREVIATIONS: ACCF, anterior cervical corpectomy and fusion; ACDF, anterior cervical discectomy and fusion; ASA, American Society of Anesthesiologists; BMI, body mass index; CAD, coronary artery disease; CI, confidence interval; CSM, cervical spondylotic myelopathy; EQ-5D, EuroQol-5D; HR, hazard ratio; LOS, length of stay; mJOA, modified Japanese Orthopedic Association; NDI, Neck Disability Index; NRS, numeric rating scale; OR, odds ratio; PROs, patient-reported outcomes; QOD, Quality Outcomes Database; RTW, return to work; US, United States

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ligament.² According to a report published in 2009, degenerative cervical myelopathy is the most common primary diagnosis (36%) among elderly patients admitted to a hospital between 1992 and 2005 in the United States (US) to undergo surgical treatment for degenerative cervical spine disease.³

Surgical management is the treatment of choice in cases of progressive or severe neurological deficits. However, the optimal approach, ie anterior vs posterior, still remains an area of contention among surgeons.⁴⁻⁷ Anterior decompressive approaches typically involve anterior cervical discectomy and fusion (ACDF) or anterior cervical corpectomy and fusion (ACCF), whereas posterior approaches comprise laminoplasty or laminectomy with or without arthrodesis. In general, an anterior approach is preferred in cases of ventral compression occupying few levels while attempting to restore cervical lordosis.⁴

Previous studies have reported up to 90% fusion rates and significant clinical improvement following ACDF for single-level cervical myelopathy,^{8,9} however, for the multisegments (≥ 3) cervical myelopathy the evidence on the relative efficacy of different treatment modalities is still unclear.¹⁰⁻¹² To address this gap in current knowledge, we conducted an analysis of prospectively collected data from a multicenter spine registry to determine the outcomes following anterior and posterior approach for patients undergoing multilevel fusion for degenerative cervical myelopathy.

METHODS

We queried the Quality Outcomes Database (QOD) registry for patients undergoing 3 to 5 level cervical spine surgery for primary indication of degenerative cervical myelopathy. An approval for the study and waiver of informed consent was obtained from the institutional review board. The QOD is a prospective registry, enrolling patients since 2012, and is designed to evaluate risk-adjusted expected morbidity and 12-mo outcomes with the aim of improving efficiency and quality of care for the most commonly performed spinal surgical procedures.^{13,14} The cervical spine module was developed in 2013, enrolling patients undergoing surgery for degenerative cervical spine disease.

Inclusion and Exclusion Criteria

The general inclusion and exclusion criteria for the QOD spine modules are described previously.¹³⁻¹⁵ For this analysis, patients presenting with myelopathy and undergoing equal to or more than 3-levels surgery with at least 12 mo of follow-up were eligible for inclusion in the study. The clinical variables and outcomes were compared between those undergoing anterior or posterior approach. Anterior approaches consisted of ACDF with and without corpectomy, whereas posterior approaches consisted of posterior cervical decompression with instrumented fusion.

Outcomes of Interest

Baseline and postoperative patient-reported outcomes (PROs) including disability, pain, and quality of life are captured at baseline, 3-mo and 12-mo after surgery via self-administration or phone interview. For this study, the outcomes of interest were 12 mo

Neck Disability Index (NDI),¹⁶ numeric rating scale (NRS) for neck and arm pain,¹⁷ EuroQol-5D (EQ-5D),¹⁸ modified Japanese Orthopedic Association scale (mJOA),¹⁰ and NASS satisfaction questionnaire.¹⁹ Other outcomes of interest included hospital length of stay (LOS), 90-d readmission, and return to work (RTW). The occurrence of postoperative complications, including deep venous thrombosis, pulmonary embolism, myocardial infarction, urinary tract infection, surgical site infection, hematoma, dysphagia, vocal cord paralysis, CSF leak, wound dehiscence, cerebrovascular accident within 30 d, and new motor deficit were also compared between the anterior and posterior approach.

Statistical Analysis

Descriptive statistics (mean, standard deviation, median, and interquartile range for continuous variables; frequency and proportion for categorical variables) were used for patient demographic and comorbidity information as well as baseline symptoms, diagnosis, PRO scores, LOS, readmission, RTW, and complications. Between the 2 surgical approach groups, continuous variables were compared using Wilcoxon Rank Sum test, whereas categorical variables were compared using Pearson's Chi-square. Responder/nonresponder analysis was also performed in order to investigate to compare the baseline profile of patients who completed the 12-mo follow-up evaluation vs those who did not. Multivariable proportional odds ordinal logistic regression models were fitted for NDI, NRS-neck pain, NRS-arm pain, EQ5D, mJOA satisfaction, and LOS; logistic regression model was fitted for readmission, and Cox proportional hazards model was fitted for RTW. The variables included in the models were age, gender, race, body mass index (BMI), American Society of Anesthesiologists (ASA) grades, insurance status, smoking, diabetes, coronary artery disease (CAD), depression, principal diagnosis, presence of motor deficit or numbness, ambulation, duration of symptoms, education level, worker's compensation, employment liability claim, principal symptom, and baseline functional outcome score. The confidence intervals (CI) for the adjusted odds ratio (OR) or hazard ratio (HR) of surgical procedure were computed using profile likelihood method. The analysis was performed using R 3.1.2 and rms package.^{20,21}

RESULTS

A total of 363 patients met the inclusion criteria for the study. Of those, 245 patients (anterior-163, posterior-82) had 12-mo follow-up (70.8% follow-up rate) and were further analyzed. In the anterior approach group, 116 patients underwent ACDF and 47 patients underwent corpectomy. On responder analysis, no significant differences were found between patients with and without complete 12-mo follow-up data, except for diabetes (17% vs 29%, $P = .012$) and number of surgical levels (overall $P = .008$; **Table, Supplemental Digital Content**).

Patients undergoing anterior surgery were slightly younger (median age 61 vs 66 yr, $P < .001$); no differences were observed with regards to gender (male: 47% vs 52%, $P = .62$), BMI distribution (median: 31 vs 30, $P = .43$), smoking status (22% vs 21%, $P = .81$), CAD (11% vs 10%, $P = .76$), diabetes (17% vs 17%, $P = .92$), and ASA classification (overall $P = .68$; **Table 1**).

TABLE 1. Patient Demographics and Comorbidities by Approach

Variable	Available data	Anterior (n = 163)	Posterior (n = 82)	P-value
Age, median (IQR)	245	61 (54-69)	66 (57-72)	<.001
Male gender, n (%)	245	76 (47)	41 (52)	.62
BMI, median (IQR)	245	31 (26-34)	30 (26-33)	.43
Race, n (%)	245			.32
White		138 (85)	63 (77)	
Other		25 (15)	19 (20)	
Education, n (%)	241			<.001
Less than high school		6 (4)	13 (16)	
High school diploma		78 (49)	31 (38)	
Two-year college degree		42 (26)	10 (12)	
Four-year college degree		21 (13)	10 (12)	
Postcollege		13 (8)	17 (21)	
Smoking, n (%)	242	36 (22)	17 (21)	.81
CAD, n (%)	245	18 (11)	8 (10)	.76
Diabetes, n (%)	245	27 (17)	14 (17)	.92
Depression, n (%)	245			.031
Moderate		58 (36)	41 (50)	
Extreme		25 (15)	5 (6)	
ASA, n (%)	245			.68
1/2		75 (46)	40 (49)	
3/4		88 (54)	42 (51)	
Employment, n (%)	245			.12
Sedentary		12 (7)	11 (13)	
Light		24 (15)	8 (10)	
Medium		21 (13)	5 (6)	
Heavy		14 (9)	4 (5)	
Unemployed/attending school		92 (56)	54 (66)	
Worker's Compensation, n (%)	242	3 (2)	1 (1)	.72
Liability, n (%)	242	9 (6)	2 (2)	.26
Insurance, n (%)	245			.045
Uninsured		2 (1)	1 (1)	
Medicare		64 (40)	40 (49)	
Medicaid		3 (2)	3 (4)	
VA/Government		4 (2)	7 (9)	
Private		90 (55)	31 (38)	

ASA, American Society of Anesthesiologists; BMI, body mass index; CAD, coronary artery disease; VA, Veteran's Affairs. Bold denotes statistical significance.

Baseline symptoms, diagnoses, and PROs are presented in Table 2. Patients undergoing anterior surgery were more often diagnosed with intervertebral disc herniation (15% vs 4%) whereas those undergoing posterior surgery had more often central canal stenosis (77% vs 62%; overall $P = .014$). There was no significant difference in the baseline PROs between the anterior approach and posterior approach group, (median NDI [38 vs 37, $P = .19$], EQ-5D [0.69 vs 0.6, $P = .77$], median NRS-neck pain [6 vs 5, $P = .16$], median NRS-arm pain [5 vs 5, $P = .24$]), except for mJOA (13 vs 12, $P = .02$). In terms of number of level fused, patients undergoing anterior surgery were more likely to receive 3-level surgery (74% vs 35%), whereas patients undergoing posterior surgery were more likely to receive 4-level (49% vs 25%) or 5-level fusion (16% vs 2%; overall $P < .001$). Finally, an anterior approach was associated with relatively lower intra-

operative blood loss (100 vs 200 ml, $P < .001$); operative time was not different between the 2 groups though (166 vs 146 min, $P = .06$).

Table 3 summarizes comparison of hospital LOS, complications, 90-d readmission, and 12-mo reoperation rates for anterior and posterior approach for degenerative cervical myelopathy. Patients undergoing posterior surgery had a longer median LOS by 2 d compared to those undergoing anterior surgery (3 vs 1, $P < .001$). Although not significant, overall complication risk was slightly higher in the anterior group (10% vs 7%, $P = .52$). There were no statistically significant differences in 90-d readmission (anterior-9% vs posterior-7%, $P = .62$) and RTW (anterior-66% vs posterior-76%, $P = .34$) as well as 12-mo reoperation (anterior-1% vs posterior-1%, $P > .99$). Patients in the posterior cohort were more likely to report worse 12-mo mJOA scores (median:

TABLE 2. Baseline Symptoms, Diagnoses, and PRO Scores by Approach

Variable	Available data	Anterior (n = 163)	Posterior (n = 82)	P-value
Symptom duration, n (%)	237			.63
Less than 3 mo		15 (9)	10 (13)	
3-12 mo		67 (42)	32 (42)	
More than 12 mo		79 (49)	34 (45)	
Motor deficit present, n (%)	245	86 (53)	49 (60)	.30
Numbness present, n (%)	245	87 (53)	4 (51)	.75
Independent ambulation, n (%)	245	143 (88)	65 (79)	.08
Diagnosis, n (%)	245			.014
Disc herniation		25 (15)	3 (4)	
Foraminal stenosis		37 (23)	16 (20)	
Central stenosis		101 (62)	63 (77)	
Baseline PROs, median (IQR)				
NDI	245	38 (28-52)	37 (20-50)	.19
EQ5D	245	0.69 (0.44-0.78)	0.6 (0.47-0.78)	.77
NRS-neck pain	245	6 (3-8)	5 (2-7)	.16
NRS-arm pain	245	5 (2-8)	5 (2-7)	.24
mJOA	241	13 (11-14)	12 (10-14)	.02

IQR, interquartile range; NDI, neck disability index; NRS, numeric rating scale; mJOA, modified Japanese Orthopedic Association. Bold denotes statistical significance.

TABLE 3. Summary of Operative Variables and Postoperative Outcomes

Variable	Available data	Anterior (n = 163)	Posterior (n = 82)	P-value
Operative variables				
Estimated blood loss in ml, median (IQR)	221	100 (50-150)	200 (100-300)	<.001
Operative time in min, median (IQR)	245	166 (125-216)	143 (112-178)	.009
Number of levels, n (%)	245			
3		120 (74)	29 (35)	<.001
4		40 (25)	40 (49)	
5		3 (2)	13 (16)	
Postoperative variables				
LOS, days, median (IQR)	245	1 (1-3)	3 (2-4)	<.001
Any adverse event ^a , n (%)	245	25 (15)	10 (12)	.51
Any complication, n (%)	245	16 (10)	6 (7)	.52
Deep venous thrombosis, n (%)	245	0 (0)	1 (1)	.16
Pulmonary embolism, n (%)	245	0 (0)	1 (1)	.16
Myocardial infarction, n (%)	245	0 (0)	0 (0)	NA
Urinary tract infection, n (%)	245	1 (1)	1 (1)	.62
Surgical site infection, n (%)	245	1 (1)	1 (1)	.62
Hematoma, n (%)	245	0 (0)	2 (1)	.31
Dysphagia requiring nasogastric tube, n (%)	245	2 (1)	0 (0)	.31
Dysphagia not requiring nasogastric tube, n (%)	245	8 (5)	1 (1)	.15
Vocal cord paralysis, n (%)	245	0 (0)	0 (0)	NA
CSF leak, n (%)	245	0 (0)	1 (1)	.16
Wound dehiscence, n (%)	245	1 (1)	1 (1)	.62
CVA within 30 d, n (%)	245	0 (0)	0 (0)	NA
New motor deficit, n (%)	245	2 (4)	0 (0)	.33
Readmission within 90 d, n (%)	245	15 (9)	6 (7)	.62
RTW within 90 d, n (%)	103	49 (69)	22 (76)	.34
Reoperation within 12 mo, n (%)	245	2 (1)	1 (1)	>.99

CSF, cerebrospinal fluid leak; CVA, cerebrovascular accident; NDI, neck disability index; NRS, numeric rating scale; mJOA, modified Japanese Orthopedic Association.

^aAdverse event is defined as the occurrence of any complication, readmission, or reoperation.

Bold denotes statistical significance.

TABLE 4. Summary of 12-mo Patient-Reported Outcomes by Approach

Variable	Available data	Anterior (n = 163)	Posterior (n = 82)	P-value
NASS satisfaction	245			.70
1		98 (60)	50 (62)	
2		39 (24)	15 (19)	
3		15 (9)	9 (11)	
4		10 (6)	7 (9)	
NDI, median (IQR)	245	16 (6-29)	17 (8-28)	.41
EQ-5D, median (IQR)	245	0.82 (0.69-0.86)	0.78 (0.69-0.83)	.25
NRS-neck pain, median (IQR)	245	2 (0-4)	2 (1-4)	.31
NRS-arm pain, median (IQR)	245	1 (0-4)	0.5 (0-5)	.87
mJOA, median (IQR)	253	15 (13-17)	14 (12-16)	.002

mJOA, modified Japanese Orthopedic Association; NASS, North American Spine Society; NDI, Neck Disability Index; NRS, Numeric rating scale. Bold denotes statistical significance.

14 vs 15, $P = .002$). There were no significant differences in the PROs between the 2 groups (Table 4).

In risk-adjusted multivariable analysis, within the limits of baseline variables included in the model, the patients undergoing anterior approach had lower odds of having higher LOS ($P < .001$, OR 0.16, 95% CI 0.08-0.30; Table 5). The effect of anterior vs posterior approach was not found to be significant for 90-d readmission ($P = .17$, OR 0.32, 95% CI 0.06-1.66), 90-d RTW ($P = .07$, HR 0.40, 95% CI 0.1-1.08) or 12-mo NDI ($P = .36$, OR 0.76, 95% CI 0.42-1.37), EQ-5D ($P = .30$, OR 1.36, 95% CI 0.76-2.44), NRS-neck ($P = .19$, OR 0.67, 95% CI 0.37-1.21) and -arm pain scores ($P = .96$, OR 0.99, 95% CI 0.51-1.93), mJOA scores ($P = .08$, OR 1.74, 95% CI 0.94-3.24), and satisfaction ($P = .43$, OR 1.34, 95% CI 0.64-2.85).

DISCUSSION

Decision making for the treatment of degenerative cervical myelopathy can be challenging for treating spinal surgeons, as surgical complexity, blood loss, operative time, and the incidence of complications increase significantly with the number of involved surgical segments.^{22,23} In this study, we performed a retrospective analysis of prospectively collected data from multiple surgical practices across the US. With over 250 patients undergoing 3 to 5 level fusion surgery for degenerative cervical myelopathy and employing robust statistical methodology, our study is the largest to report postoperative and functional outcomes in this group of patients. After adjusting for a number of preoperative and operative variables, the patients undergoing ACDF with or without corpectomy had lower odds of having longer LOS compared to those undergoing posterior fusion. The 12-mo PROs, 90-d readmission and RTW were statistically similar between the groups.

The literature on PROs following multilevel fusion surgery for degenerative cervical myelopathy is sparse. Similar to our analysis, the AOSpine North America cervical myelopathy study

(nonrandomized, prospective study involving 278 patients from 12 US sites) demonstrated that patients with degenerative cervical myelopathy failed to detect any difference with regards to PRO scores at 12 mo between the 2 approaches.⁴ The authors included patients undergoing single-level as well as multilevel anterior and posterior fusion. Our analysis was focused on patients undergoing fusion at 3 to 5 levels; therefore, allowing to compare the approach in more homogenous population. Kristof and colleagues,²² in a large, single-institutional study of 103 patients, found that patients with multilevel disease treated with laminectomy and fusion compared favorably with patients treated with an anterior approach. Postoperative outcomes, including change in Nurick myelopathy scores, change in Visual Analog neck pain Scale, and satisfaction with treatment did not differ between the 2 groups at last follow-up (at least 1 yr). Finally, a recently published study by Kato and colleagues²⁵ analyzed 435 patients enrolled in 2 international AOSpine cervical spondylotic myelopathy (CSM) studies. Following magnetic resonance imaging-based 1-to-1 propensity score matching analysis, the authors found that anterior and posterior groups did not differ significantly in terms of the postoperative mJOA score, NDI disability Index, and Short Form-36 Physical Component Summary score.

In our analysis, patients undergoing a posterior approach spent on average 2 more days in the hospital, an observation that has been reported by previous prospective studies as well.^{5,26} This is an expected finding given the older age of the patients and the more extensive nature of the procedure, as levels of surgery and intraoperative blood loss were higher in posterior cervical fusion group. Both the anterior and posterior cervical fusions are associated with complications.²⁷⁻³¹ A recent systematic review and meta-analysis found the complication and reoperation rates to be significantly higher in the anterior group, with the most common causes being graft nonunion and adjacent segment disease.³² In our cohort, we found that the complications including dysphagia, surgical site hematoma, and new neurological deficit were higher in anterior group, whereas pulmonary

TABLE 5. Adjusted OR (Hazard Ratio) of Approach on Outcomes

Outcome	OR/Hazards ratio	95% CI	P-value
12m NDI	0.76	0.42 - 1.37	.36
12m EQ5D	1.36	0.76 - 2.44	.30
12m NRS-neck pain	0.67	0.37 - 1.21	.19
12m NRS-arm pain	0.99	0.51 - 1.93	.96
12m mJOA	1.74	0.94 - 3.24	.08
12m patient satisfaction	1.34	0.64 - 2.85	.43
LOS	0.16	0.08 - 0.30	<.001
90-d readmission	0.32	0.06 - 1.66	.17
RTW within 3 mo	0.40	0.16 - 1.08	.07

NRS: numeric rating scale; NDI: neck disability index; mJOA: modified Japanese Orthopedic Association.

Bold denotes statistical significance.

embolism, deep venous thrombosis, and cerebrospinal fluid leak were higher in the posterior group. However, there was no significant difference in overall complications, readmission, or 12-mo reoperation rate between the groups. In the study by Kato et al,²⁵ the overall rates of perioperative complications were similar between the 2 groups (16% vs 11%); interestingly, dysphagia, and dysphonia were reported only in the anterior group, whereas surgical site infection and C5 radiculopathy were reported only in the posterior group.²⁵

Although relatively rare, previous studies have found the anterior approaches to be relatively cost-effective compared to the posterior approaches.^{33,34} Specifically, Whitmore and colleagues³³ analyzed 85 patients with CSM, aged 40 to 85 yr, across 7 sites. The authors investigated multiple different carotid endarterectomy methods, including Medicare cost-to-charge ratios and Medicare coding reimbursement, and consistently found ventral approaches to be more cost-effective compared to dorsal approaches (approximately \$34 533).³³ Similarly, Fehlings and colleagues³⁴ analyzed 70 patients undergoing surgery for CSM at a single institution in Canada and found that the cost-utility ratio for CSM surgeries to be \$32 916/ quality-adjusted life years, which is below the national benchmark to be considered highly cost-effective.

Ultimately, the surgeon's familiarity and comfort with the surgical technique is a key element to be considered in decision-making. Surgeons generally prefer to treat patients with focal pathology, eg intervertebral disc herniation, using an anterior approach. Similarly, our data revealed that patients in the anterior group had a higher percentage of herniated disc than patients in the posterior group. In such cases, anterior surgery allows for better decompression of the spinal cord and improvement in myelopathy symptoms.

It is important to note that arthrodesis-related variables, such as the inclusion of C7 vertebra in the multilevel constructs or development of pseudarthrosis, are not included in QOD, therefore their impact on 12-mo PROs could not be determined.

Nevertheless, only 4 patients (2 in the anterior group and 2 in the posterior group) underwent revision surgery within the first 12 mo. Similarly, radiographic parameters, including T1 slope or C2-C7 lordosis, are not being captured in the spine module of QOD. These variables were included in the first version of the module; however, they were subsequently removed and are being redesigned for future versions of the spine module. Finally, given the national attention on opioid utilization and addiction, future prospective cohort studies and RCTs should incorporate postoperative opioid prescription rate as an outcome when evaluating the comparative effectiveness of different surgical approaches. Relevant variables, including opioid type, length of prescription, and dose in oral morphine milligram equivalents are currently being designed and scheduled to be released in a new, pilot version. Overall, as our knowledge on the registry's capabilities and challenges grows, there is increasing recognition of the importance of capturing a broader disease portrait with these additional data elements that can further enhance inference using real-world, observational data.

Limitations

This study has some limitations. First, it is a nonrandomized study and the type of surgical procedure to be performed is surgeon dependent. Given the risk for selection bias for performing one procedure over the other, future research should also focus on the factors that lead surgeons to perform anterior vs posterior surgery. A previous survey study of 91 spinal surgeons across the US showed that there is a remarkable equipoise in selection of surgical approach in patients with CSM, with the exception of C2-C7 kyphosis $>5^\circ$, segmental kyphotic deformity, age over 85 yr, ossification of the posterior longitudinal ligament, and congenital canal stenosis.³⁵ Furthermore, the results of this study should be viewed within the context of limitations of adjusting for possible confounding by indication using the baseline variables, ie there could be alternative explanations for the observed differences due to variables not included in the analysis, such as socioeconomic variables, and associated imaging findings, which may be useful in assessing patient disease severity. Second, radiographic parameters, as aforementioned, are not available in the QOD registry. As such, we could not incorporate these variables in the analysis. Nevertheless, the impact of these parameters on postoperative patient-reported outcomes has not yet been fully elucidated. According to previous work, cervical sagittal balance seems to influence only the presentation of pain and the severity of myelopathy.³⁶ In addition, surgical treatment improved pain and mJOA scores regardless of radiographic parameters and baseline sagittal balance. Therefore, the effect of radiographic parameters on the surgical outcomes of interest remains to be determined. Third, we are limited by the 12-mo follow-up duration and the follow-up rate (71%), which is lower than the threshold of 80% that is typically set in prospective studies to ensure that the validity of findings is not threatened. However, this is not an uncommon finding in

real-world registries. To address this concern, when we conducted responder/nonresponder analysis, similar patient profiles were found between the 2 groups. More importantly, this is the largest study analyzing the outcomes for patients undergoing 3 to 5 level fusion for degenerative cervical myelopathy. Fourth, given the real-world nature of our registry, standardization of the radiographic evaluations is not feasible.

CONCLUSION

Patients undergoing anterior approaches for 3 to 5 level degenerative cervical myelopathy had shorter hospital LOS compared to those undergoing posterior decompression and fusion. Also, patients in both groups exhibited similar long term PROs, readmission, and RTW rates. Further investigations are needed to compare the differences in longer term reoperation rates and functional outcomes before the clinical superiority of one approach over the other can be established.

Disclosures

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Supplemental Digital Content. Table. Comparison of demographics and clinical characteristics between responders and non-responders

COMMENT

Degenerative cervical myelopathy (DCM) is a common condition in the elderly. In today's society, with demographic data reflecting the growing senior population, prompt diagnosis and treatment is crucial for this condition. Current operative treatment for DCM includes mainly anterior cervical discectomy or corpectomy and fusion (ACDF or ACCF) and posterior spinal decompression and fusion (PSF). The authors of this article aimed to compare anterior versus posterior surgery in terms of outcome for 3–5 level DCM. The authors conduct a well-organized analysis of a multicenter, prospectively collected dataset examining a very relevant topic that remains controversial in the field of spine surgery today.

While controversial, it is generally accepted that ACDF is preferable for focal disease while PSF is used when multilevel long fusion construct is required. The intermediate levels are where controversies exist. Using the Quality Outcomes Database (QOD), the authors of this article reported their assessment of postoperative functional outcome related to surgical approach for DCM. They demonstrated an advantage of reduced length of stay (LOS) with the anterior procedure for 3 to 5 levels fusion. However, 90-day readmission, 12-month NDI, EQ-5D, NRS-neck, arm

pain, mJOA, overall complications, return to work, and patient satisfaction were not significantly different between groups. Furthermore, the authors showed that although overall complication rate between the 2 groups were similar, the types of complications were specific to either the anterior or posterior approach.

Finally, we applaud the authors on their contribution to our understanding of DCM. Currently there are some generally accepted indications for anterior surgery including ventral pathology, focal disease, and presence of kyphotic deformity. Conversely, the presence of posterior pathology, ossification of the posterior longitudinal ligament, and multi-level stenosis usually favors a decompression and fusion through a posterior approach.¹ Previously, the outcome of anterior versus posterior surgery had been shown to be equivalent in a multicenter, prospective observational study by Fehlings et al 2013.² Hence, there is still no definitive answer as to the best surgical approach for DCM. Surgical decision making is still largely based on surgeon preference, individual experience, and technical comfort. Thus, we believe with ongoing research in this field, we will continue to resolve the controversies and improve our knowledge in the area of DCM.

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¹Wilson JR, Tetreault LA, Kim J, et al. State of the Art in Degenerative Cervical Myelopathy: An Update on Current Clinical Evidence. *Neurosurgery* 2017;80:S33-S45.

²Fehlings MG, Barry S, Kopjar B, et al. Anterior versus posterior surgical approaches to treat cervical spondylotic myelopathy: outcomes of the prospective multicenter AOSpine North America CSM study in 264 patients. *Spine (Phila Pa 1976)* 2013;38:2247-52.