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CLINICAL ARTICLE

Does smoking status affect baseline symptom severity and patient-reported outcomes and satisfaction in patients with cervical myelopathy at 24 months? A Quality Outcomes Database study

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OBJECTIVE It is not clear whether smoking impacts patient-reported outcomes (PROs) in patients with cervical spondylotic myelopathy (CSM). The aim of this study was to explore the impact of smoking status on baseline symptom severity and the rate of achieving satisfaction and the minimal clinically important differences (MCIDs) for PROs in patients with CSM.

METHODS This study was an analysis of the prospective Quality Outcomes Database CSM module. Patients aged ≥ 18 years diagnosed with primary CSM who underwent elective surgery were included. PROs (visual analog scale [VAS] neck and arm pain, Neck Disability Index [NDI], modified Japanese Orthopaedic Association [mJOA], and EQ-5D scores and North American Spine Society [NASS] patient satisfaction) were collected at baseline and 24 months of follow-up.

RESULTS Of the 1141 patients with CSM, 202 (17.7%) were smokers and 939 (82.3%) were nonsmokers. Compared with the nonsmokers, smokers were younger (56.3 ± 11.3 years vs 61.5 ± 11.7 years, $p < 0.01$) and had a lower BMI (29.3 ± 6.8 vs 30.3 ± 6.3, $p = 0.04$). A higher proportion of smokers had depression, anxiety, and chronic obstructive pulmonary disease (all $p < 0.01$). At baseline, smokers had worse pain (VAS neck pain score: 6.0 ± 3.2 vs 5.1 ± 3.3; VAS arm pain score: 5.7 ± 3.2 vs 4.7 ± 3.5), disability (NDI score: 45.2 ± 20.0 vs 37.1 ± 20.6), myelopathy (mJOA score: 11.5 ± 2.9 vs 12.2 ± 2.8), and quality of life (EQ-5D score: 0.51 ± 0.23 vs 0.57 ± 0.22) (all $p < 0.01$). At the 24-month follow-up, a higher proportion of smokers achieved the MCID in mJOA (69.4% vs 56.6%, $p < 0.01$) compared with nonsmokers. However, after accounting for significant covariates, there was no significant difference in the baseline disease severity.

ABBREVIATIONS CSM = cervical spondylotic myelopathy; MCID = minimal clinically important difference; mJOA = modified Japanese Orthopaedic Association; NASS = North American Spine Society; NDI = Neck Disability Index; PRO = patient-reported outcome; QOD = Quality Outcomes Database; SES = socioeconomic status; VAS = visual analog scale.

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There was also no difference between the PROs at the 24-month follow-up. The two groups also achieved similar MCIDs for most PROs and were similarly satisfied (NASS score of 1 or 2: smoker 81.2% vs nonsmoker 84.6%, p = 0.29) 24 months after surgery.

CONCLUSIONS Smokers and nonsmokers with CSM had similar baseline disease severity and 24-month PROs. They also achieved similar rates of MCIDs for PROs and satisfaction after surgery. Numerous previous studies have documented the association between tobacco usage and inferior clinical outcomes after spine surgery. However, in the context of severe and debilitating spinal disorders such as cervical myelopathy, meaningful and impactful improvements are still seen in properly selected patients.

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KEYWORDS cervical spondylotic myelopathy; patient-reported outcomes; satisfaction; smoking; Quality Outcomes Database

A majority of human diseases are either caused or aggravated by smoking. The public health burden of smoking is escalating annually, such that in 2030, nearly 10 million lives will be lost as a result.[1] Productivity losses of beyond $180 billion have been reported due to smoking-inflicted morbidity.[2] The trends of smoking have declined, likely as a result of antismoking campaigns, but nevertheless, smoking still remains a prevalent public health concern.[3] Smoking, a modifiable risk factor, has been associated with the development of a number of age-associated diseases.[4] Nearly a decade of life can be restored with smoking cessation.[5] Multidisciplinary healthcare practitioners must be aware of the multisystemic effects of smoking. Although the general public acknowledges the negative consequences of smoking, their awareness of the impact of smoking on spine disease is limited.[6,7]

Smoking has numerous implications for spine disease and postoperative outcomes. Broadly, smoking has been associated with worse baseline disease severity, poorer perception of treatment-related benefit, delayed recovery course, wound-related complications, reoperations, and a predisposition to complications such as pseudarthrosis.[8–11] A period of smoking cessation prior to spine surgery is often recommended to adequately prehabilitate patients. Despite the harms of smoking, the literature among patients with cervical spondylotic myelopathy (CSM) reports conflicting results with regard to its influence on symptom severity and postoperative outcomes.[12–16] This study was undertaken to determine how smoking affects the preoperative and long-term postoperative outcomes of patients with CSM by leveraging the Quality Outcomes Database (QOD).

Methods

Patient Selection

This was a retrospective study using the prospective QOD CSM subset. Participating sites obtained institutional review board approval. This registry consists of adult patients diagnosed with primary CSM at 14 hospital sites who met the following inclusion criteria: 1) underwent elective cervical spine surgery between January 2016 and December 2018 and 2) had a modified Japanese Orthopaedic Association (mJOA) score < 17.[17–33] Patients were excluded if they had a spinal infection, tumor, fracture, traumatic dislocation, deformity, or neurological paralysis due to preexisting spine disease or injury.

Study Variables

The cohort was divided into two groups based on smoking status. Baseline variables included age, sex, insurance status, education level, race, socioeconomic status (SES) index, employment status, smoking status, medical comorbidities, American Society of Anesthesiologists grade, baseline symptoms and symptom duration, underlying pathology, and patient-reported outcomes (PROs) such as mJOA, visual analog scale (VAS) neck and arm pain, Neck Disability Index (NDI), and EQ-5D (measured in quality-adjusted life-years) scores.

Study Outcomes

PROs of interest were patient satisfaction and achievement of the minimal clinically important differences (MCIDs) in VAS neck and arm pain, NDI, EQ-5D, and mJOA scores. Satisfaction was measured based on the 4-point North American Spine Society (NASS) scale; patients were considered satisfied if they had an NASS score of 1 or 2. NDI percentage scores (ranging from 0 to 100) were captured, with higher scores indicating greater disability. VAS pain scales ranged from 0 to 10, with higher scores signifying more intense pain. The EQ-5D is a tool to assess the health-related quality of life of patients and is graded on a scale from −0.11 (state equivalent to being dead) to 1 (full health). The MCID for the mJOA score was calculated based on the CSM severity at baseline, as previously described;[16] the MCIDs for the VAS neck and arm pain and NDI scores were defined as a reduction of 30% from baseline;[34] and the MCID for the EQ-5D score was defined as an increase of 0.240 points.[35] Surgical outcomes included length of stay, nonroutine discharge rates, and readmission and reoperation rates at various time points.

Statistical Analysis

Continuous variables were presented as means with standard deviations, and categorical variables were presented as frequencies with percentages. Univariate analyses of continuous outcomes were performed using the Student t-test, while chi-square tests were performed for binary outcomes. To adjust for differences in baseline characteristics between the two groups that could influence clinical outcomes, we performed multivariable logistic regressions for all binary outcomes. Multivariable linear regression was performed for continuous variables. All clinically relevant baseline variables ($p < 0.2$) were adjusted in all multivariable models. Patients with non-available data were excluded from all analyses. Multiple imputation was performed using the MissForest imputation algorithm to generate replacement values for missing baseline data, and the final imputed data were used for our analysis.[36] The R software (version 4.1.1, R Foundation for Statistical Computing) was used for all statistical analyses. A p value < 0.05 was considered statistically significant.

Results

Demographics and Baseline Characteristics

Of the 1141 patients with CSM, 202 (17.7%) were smokers and 939 (82.3%) were nonsmokers. Compared with the nonsmokers, smokers were younger (56.3 ± 11.3 years vs 61.5 ± 11.7 years, p < 0.01) and had a lower BMI (29.3 ± 6.8 vs 30.3 ± 6.3, p = 0.04) (Table 1). A higher proportion of smokers had a high school education or lower (58.9% vs 41.0%, p < 0.01), and smokers had a lower SES index than nonsmokers (52.0 ± 4.3 vs 53.2 ± 5.1, p < 0.01). Symptom duration before surgery was similar between the two cohorts as well (smokers vs nonsmokers: < 3 months 12.4% vs 14.4%, 3–12 months 35.6% vs 35.8%, > 12 months 52.0% vs 49.8%, p = 0.73). A higher proportion of smokers had depression, anxiety, and chronic obstructive pulmonary disease (all p < 0.01). At baseline, smokers had worse pain (VAS neck pain score: 6.0 ± 3.2 vs 5.1 ± 3.3; VAS arm pain score: 5.7 ± 3.2 vs 4.7 ± 3.5), disability (NDI score: 45.2 ± 20.0 vs 37.1 ± 20.6), myelopathy (mJOA score: 11.5 ± 2.9 vs 12.2 ± 2.8), and quality of life (EQ-5D score: 0.51 ± 0.23 vs 0.57 ± 0.22) (all p < 0.01).

Univariate Analysis Comparing Surgical Outcomes and PROs in Smoking Versus Nonsmoking Patients

Table 2 summarizes the surgical outcomes between the two cohorts. Nonsmokers had a higher nonroutine discharge rate (12.6% vs 8.0%, p = 0.07) than smokers, but the difference was not statistically significant. Otherwise, the two groups had similar lengths of stay (nonsmokers vs smokers: 2.1 ± 2.4 days vs 1.9 ± 2.1 days, p = 0.20), readmission rates within 30 days (2.3% vs 2.5%, p = 0.86) and 3 months (5.4% vs 3.5%, p = 0.25), and reoperation rates within 30 days (1.7% vs 1.5%, p = 0.83), 3 months (2.3% vs 2.0%, p = 0.76), 12 months (3.7% vs 3.6%, p = 0.94), and 24 months (14.6% vs 15.2%, p = 0.85).

Overall, in univariate analysis at 24 months of follow-up, a higher proportion of smokers achieved the MCID in mJOA (69.4% vs 56.6%, p < 0.01) compared with nonsmokers (Table 3). Otherwise, there was no significant difference in the PROs at the 24-month follow-up between the two groups (all p > 0.05). The two groups were also similarly satisfied (NASS score of 1 or 2: smoker 81.2% vs nonsmoker 84.6%, p = 0.29) 24 months after surgery.

Multivariable Analysis of 24-Month PROs in Achievement of MCIDs

The results of the multivariable analysis on the impact of smoking status on disease characteristics are summarized in Table 4. After adjusting for all relevant covariates, there was no difference in the baseline (VAS neck pain score: β-coefficient 0.20, 95% CI −0.28 to 0.68 [p = 0.43];

TABLE 1. Baseline patient characteristics, demographics, and operative details of the included cohort by smoking status

	Nonsmoker (n = 939)	Smoker (n = 202)	p Value
Age, yrs	61.5 ± 11.7	56.3 ± 11.3	**<0.01**
Sex			0.29
Female	452 (48.1)	89 (44.1)	
Male	487 (51.9)	113 (55.9)	
BMI	30.3 ± 6.3	29.3 ± 6.8	**0.04**
Insurance payor			**<0.01**
Medicaid	42 (4.5)	37 (18.3)	
Medicare	378 (40.3)	62 (30.7)	
Private	487 (51.9)	92 (45.5)	
Uninsured	9 (1.0)	6 (3.0)	
VA/government	23 (2.4)	5 (2.5)	
Educational level			**<0.01**
Graduate degree	403 (42.9)	72 (35.6)	
High school or lower	385 (41.0)	119 (58.9)	
Postgraduate degree	151 (16.1)	11 (5.4)	
Race			0.51
White	752 (80.1)	155 (76.7)	
Black	146 (15.5)	38 (18.8)	
Other	41 (4.4)	9 (4.5)	
SES index	53.2 ± 5.1	52.0 ± 4.3	**<0.01**
Preop employment status			**0.02**
Employed	366 (39.0)	72 (35.6)	
Employed on short-term leave	63 (6.7)	23 (11.4)	
Unemployed	510 (54.3)	106 (52.5)	
Diabetes mellitus	216 (23.0)	29 (14.4)	**<0.01**
Depression	190 (20.2)	61 (30.2)	**<0.01**
Anxiety	164 (17.5)	48 (23.8)	**0.04**
CAD	100 (10.6)	8 (4.0)	**<0.01**
Osteoarthritis	272 (29.0)	54 (26.7)	0.52
COPD	51 (5.4)	30 (14.9)	**<0.01**
ASA grade			0.54
I	21 (2.2)	3 (1.5)	
II	446 (47.5)	87 (43.1)	
III	456 (48.6)	109 (54.0)	
IV	16 (1.7)	3 (1.5)	
Dependent ambulation	167 (17.8)	42 (20.8)	0.32
Radicular motor deficit	273 (29.1)	82 (40.6)	**<0.01**
Radicular numbness	553 (58.9)	123 (60.9)	0.60
Motor deficit	558 (59.4)	137 (67.8)	**0.03**
Symptom duration			0.73
<3 mos	135 (14.4)	25 (12.4)	
3–12 mos	336 (35.8)	72 (35.6)	
>12 mos	468 (49.8)	105 (52.0)	
Disc herniation	255 (27.2)	60 (29.7)	0.46
Foraminal stenosis	392 (41.7)	96 (47.5)	0.13

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TABLE 1. Baseline patient characteristics, demographics, and operative details of the included cohort by smoking status

	Nonsmoker (n = 939)	Smoker (n = 202)	p Value
Surgical approach			0.87
Anterior	650 (69.2)	141 (69.8)	
Posterior	289 (30.8)	61 (30.2)	
No. of levels treated	3.4 ± 1.3	3.4 ± 1.3	0.85
mJOA score at baseline	12.2 ± 2.8	11.5 ± 2.9	**<0.01**
Myelopathy severity			**0.02**
Mild	219 (23.3)	32 (15.8)	
Moderate	374 (39.8)	77 (38.1)	
Severe	346 (36.8)	93 (46.0)	
VAS arm pain score at baseline	4.7 ± 3.5	5.7 ± 3.2	**<0.01**
VAS neck pain score at baseline	5.1 ± 3.3	6.0 ± 3.2	**<0.01**
NDI score at baseline	37.1 ± 20.6	45.2 ± 20.0	**<0.01**
EQ-5D score at baseline	0.574 ± 0.219	0.506 ± 0.232	**<0.01**

ASA = American Society of Anesthesiologists; CAD = coronary artery disease; COPD = chronic obstructive pulmonary disease; VA = Veterans Affairs.
Values are given as number of patients (%) or mean ± SD unless otherwise indicated. Boldface type indicates statistical significance.

VAS arm pain score: β-coefficient 0.36, 95% CI −0.17 to 0.88 [p = 0.19]; NDI score: β-coefficient 2.60, 95% CI 0.31 to 5.51 [p = 0.08]; mJOA score: β-coefficient −0.38, 95% CI −0.79 to 0.03 [p = 0.07]; EQ-5D score: β-coefficient −0.02, 95% CI −0.05 to 0.01 [p = 0.22]) and 24-month (VAS neck pain score: β-coefficient 0.14, 95% CI −0.38 to 0.67 [p = 0.60]; VAS arm pain score: β-coefficient 0.52, 95% CI −0.02 to 1.06 [p = 0.06]; NDI score: β-coefficient 1.38, 95% CI −1.98 to 4.74 [p = 0.42]; mJOA score: β-coefficient 0.26, 95% CI −0.29 to 0.80 [p = 0.36]; EQ-5D score: β-coefficient −0.03, 95% CI −0.07 to 0.01 [p = 0.15]) PROs between the two groups. Further analysis was done assessing the impact of smoking status on

TABLE 2. Comparison of surgical outcomes in the two cohorts based on smoking status

	Nonsmoker (n = 939)	Smoker (n = 202)	p Value
Length of stay, days	2.1 ± 2.4	1.9 ± 2.1	0.20
Nonroutine discharge	118 (12.6)	16 (8.0)	0.07
Readmission w/in 30 days	17 (2.3)	4 (2.5)	0.86
Readmission w/in 3 mos	51 (5.4)	7 (3.5)	0.25
Reop w/in 30 days	16 (1.7)	3 (1.5)	0.83
Reop w/in 3 mos	22 (2.3)	4 (2.0)	0.76
Reop w/in 12 mos	29 (3.7)	6 (3.6)	0.94
Reop w/in 24 mos	120 (14.6)	25 (15.2)	0.85

Values are given as number of patients (%) or mean ± SD unless otherwise indicated.

TABLE 3. Postoperative patient-reported satisfaction from surgery and rates of achieving MCIDs in NDI, mJOA, and VAS arm and neck pain scores at 3, 12, and 24 months

	Nonsmoker (n = 939)	Smoker (n = 202)	p Value
Satisfaction (NASS score of 1 or 2)			
3 mos	681 (87.0)	141 (83.9)	0.30
12 mos	574 (84.9)	108 (77.7)	**0.04**
24 mos	668 (84.6)	125 (81.2)	0.29
MCID in NDI score			
3 mos	466 (58.6)	93 (55.0)	0.39
12 mos	437 (63.5)	84 (60.0)	0.43
24 mos	502 (63.2)	97 (63.4)	0.97
MCID in mJOA score			
3 mos	441 (57.1)	88 (53.7)	0.43
12 mos	374 (54.5)	73 (52.5)	0.67
24 mos	372 (56.6)	86 (69.4)	**<0.01**
MCID in EQ-5D score			
3 mos	268 (35.2)	58 (36.5)	0.75
12 mos	217 (33.3)	47 (36.2)	0.53
24 mos	259 (34.2)	56 (38.6)	0.31
MCID in VAS neck pain score			
3 mos	449 (57.0)	93 (55.7)	0.76
12 mos	399 (58.2)	78 (56.1)	0.64
24 mos	453 (59.0)	88 (59.1)	0.99
MCID in VAS arm pain score			
3 mos	445 (56.7)	96 (57.5)	0.85
12 mos	375 (54.8)	74 (53.2)	0.73
24 mos	433 (56.7)	80 (54.4)	0.60

Values are given as number of patients (%) unless otherwise indicated. Boldface type indicates statistical significance.

satisfaction and achievement of MCIDs at the 24-month follow-up (Table 5). Smokers were more likely to achieve the MCID for mJOA at 24 months (OR 1.12, 95% CI 1.02–1.24 [p = 0.02]) compared with nonsmokers. Otherwise, there was no difference in achievement of MCIDs and satisfaction between the two groups at 24 months (VAS neck pain score: OR 1.00, 95% CI 0.92–0.09 [p = 0.98]; VAS arm pain score: OR 0.97, 95% CI 0.88–1.06 [p = 0.44]; NDI score: OR 1.00, 95% CI 0.92–1.09 [p = 0.95]; EQ-5D score: OR 1.03, 95% CI 0.94–1.12 [p = 0.52]; satisfaction: OR 0.99, 95% CI 0.92–1.05 [p = 0.65]).

Discussion

At baseline, smokers tended to be younger and have a lower BMI, less educational attainment, a lower SES index, a greater psychiatric and respiratory burden, and greater symptom severity. However, both cohorts had similar symptom durations and, when adjusted for relevant covariates, no difference was observed in the baseline symptom severity for all PROs. The influence of smoking on patients with cervical spine disease has been studied before. A recent study identified that cervical spine surgery

TABLE 4. Multivariable regression analyses assessing the impact of the patients' smoking status on symptom severity before surgery and at 24-month follow-up

	Smoker			Nonsmoker
	β-Coefficient	95% CI	p Value	
Baseline PROs (before surgery)*				
NDI score	2.60	0.31 to 5.51	0.08	Reference
VAS neck pain score	0.20	−0.28 to 0.68	0.43	Reference
VAS arm pain score	0.36	−0.17 to 0.88	0.19	Reference
mJOA score	−0.38	−0.79 to 0.03	0.07	Reference
EQ-5D score	−0.02	−0.05 to 0.01	0.22	Reference
PROs at 24-mo follow-up†				
NDI score	1.38	−1.98 to 4.74	0.42	Reference
VAS neck pain score	0.14	−0.38 to 0.67	0.60	Reference
VAS arm pain score	0.52	−0.02 to 1.06	0.06	Reference
mJOA score	0.26	−0.29 to 0.80	0.36	Reference
EQ-5D score	−0.03	−0.07 to 0.01	0.15	Reference

β-coefficients for PRO measures are reported such that a negative value for NDI and VAS arm and neck pain scores and a positive value for EQ-5D and mJOA scores represent superior outcomes compared with the reference.
* Adjusted for age, sex, BMI, race, insurance payor, education level, employment status, SES index, ambulation status, comorbidities (diabetes, osteoarthritis, anxiety, depression, coronary artery disease, and chronic obstructive pulmonary disease), motor radiculopathy, and presence of foraminal stenosis.
† Adjusted for age, sex, BMI, race, insurance payor, education level, employment status, SES index, ambulation status, comorbidities (diabetes, osteoarthritis, anxiety, depression, coronary artery disease, and chronic obstructive pulmonary disease), motor radiculopathy, presence of foraminal stenosis, surgical approach, and number of operated levels.

was more often performed on smokers.[37] Alternatively, it may be surmised that nonsmokers are candidates for an initial conservative management approach; they become surgical candidates after they fail the former therapy,[37] extending their overall symptom duration.

Some patients with CSM may have a prolonged, stagnant disease state, whereas others may have a rapidly progressive phenotype, not associated with trauma. The rapid variant state has been associated with a worse prognosis. Abudouaini et al. identified that patients with rapid progression are more likely to be smokers.[38] Smoking also acts as a contributor to disability, further impairing the performance of activities of daily living in patients with CSM. Bisson et al. identified that smoking not only contributes to baseline sleep impairment but also leads to failure to improve postoperative sleep dysfunction, as evaluated by the NDI.[26] Agarwal et al. utilized a subcomponent of the NDI and identified that patients with CSM who had a limited ability to drive were more likely to be smokers.[39]

Some literature has reported a similar effect to the one reported in the current study. Nagoshi et al. performed a multicenter retrospective study to determine the effects of smoking on patients with CSM who were offered a laminectomy only or laminoplasty.[12] Apart from a greater risk of postoperative delirium, major complications were equivalent between smokers and nonsmokers. Functional recovery and pain improvement were similar between smokers and nonsmokers. The authors hypothesized that

TABLE 5. Multivariable regression analyses assessing the impact of the patients' smoking status on satisfaction and achievement of MCIDs at the 24-month follow-up

	Smoker			Nonsmoker
	OR	95% CI	p Value	
24-mo satisfaction (NASS score of 1 or 2)	0.99	0.92–1.05	0.65	Reference
24-mo MCID for NDI score	1.00	0.92–1.09	0.95	Reference
24-mo MCID for VAS neck pain score	1.00	0.92–0.09	0.98	Reference
24-mo MCID for VAS arm pain score	0.97	0.88–1.06	0.44	Reference
24-mo MCID for mJOA score	1.12	1.02–1.24	**0.02**	Reference
24-mo MCID for EQ-5D score	1.03	0.94–1.12	0.52	Reference

Boldface type indicates statistical significance. Odds ratios for satisfaction and achievement of MCIDs are reported such that a value > 1 represents superior outcomes and a value < 1 represents inferior outcomes compared with the reference. Adjusted for age, sex, ambulation status, surgical approach, number of operated levels, and discharge disposition.

delirium may be attributed to an improper cessation practice preoperatively. Akin to the present study, smokers were younger; however, the matched analysis performed by Nagoshi et al. removed confounders, demonstrating that the results are only due to smoking.[12]

Limitations

Because of the large sample size, statistically significant differences in variables between the two cohorts may not correlate directly to a clinically significant difference (e.g., BMI in this study). Although clinical improvements may be indifferent between the two groups, evaluation of radiographs may offer greater information between smokers and nonsmokers. Pseudarthrosis is a multifactorial, radiographic finding that may be attributed to smoking.[8] It may be symptomatic or asymptomatic. Tobacco smoking also leads to hormonal variations and osteogenic dysregulation, which may lead to poor bone mass and density, as detected by dual-energy x-ray absorptiometry scans.[40] Simultaneously, pseudarthrosis may be due to poor bone density as well. However, a recent meta-analysis determined that smoking may not contribute to proximal junctional kyphosis and failure.[41] To best reconcile these differences, radiographs need to be assessed to determine the rate of "silent" complications. These data are not available and are currently being accrued to serve as a lead point for future studies. The results from this study can only be interpreted under the context of the trends observed in PROs. Given the data available, the occurrence of postoperative surgical and medical outcomes/complications (i.e., revision surgery, infections, and hospital stay) and cost differences in management are unknown and represent a point of future exploration.

In this study, patients were grouped into a binary classification of smoker versus nonsmoker; smokers were not further examined according to their chronicity of smoking (i.e., pack-years), and this should be studied in the future. Despite the limitations, this study is one of the few in the literature to present long-term follow-up. Although the results from this study are supportive of a patient's choice and may potentially increase surgeon confidence to operate on poorly prehabilitated patients, there still must be a push to encourage smoking cessation to best optimize the patient's health and ensure positive, holistic postoperative outcomes.

Conclusions

This study was able to compare the attributes of smoking and nonsmoking patients with CSM using a large multicenter database. On comparison of symptom severity and long-term postoperative PROs between smokers and nonsmokers, smokers have greater comorbidities but similar disease severity at baseline and similar satisfactory long-term outcomes in terms of achievement of MCIDs and postoperative satisfaction. Numerous previous studies have documented the association between tobacco usage and inferior clinical outcomes after spine surgery. However, in the context of severe and debilitating spinal disorders such as cervical myelopathy, meaningful and impactful improvements are still seen in properly selected patients.

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Dr. Bhowmick reported personal fees from Bioventus and Medtronic outside the submitted work. Dr. C. Shaffrey reported personal fees from Medtronic, NuVasive/Globus, SI-Bone, and Proprio outside the submitted work. Dr. Bisson reported personal fees from Stryker, Medtronic, and MiRus; and stock in nView, Proprio, and See All outside the submitted work. Dr. Asher reported personal fees from Globus outside the submitted work. Dr. Coric reported personal fees from Spine Wave, Medtronic, Globus Medical, Stryker, Acellus, and Premia Spine outside the submitted work. Dr. Potts reported royalties and consulting fees from Medtronic and ownership in See All AI outside the submitted work. Dr. Foley reported royalties and consulting fees from Medtronic; and stock ownership in Medtronic, Discgenics, DuraStat, NuVasive, RevBio, Spine Wave, Vori Health, and Curiteva outside the submitted work; in addition, Dr. Foley had multiple patents for Medtronic with royalties paid. Dr. P. Park reported royalties from Globus; personal fees from Globus, Medtronic, NuVasive, DePuy, Accelus, and ATEC; and grants from DePuy, SI-Bone, ISSG, Cerapedics, and SMISS outside the submitted work. Dr. Wang reported personal fees from DePuy Synthes, Stryker, Spineology, Pacira, Globus, and Medtronic; and stock in Kinesiometrics, Medical Device Partners, and ISD outside the submitted work; in addition, Dr. Wang had a patent for DePuy Synthes with royalties paid. Dr. Fu reported personal fees from Bioventus, DePuy, and Stryker outside the submitted work. Dr. Virk reported honoraria from DePuy Synthes, stock in OnPoint Surgical, and grants from NIH outside the submitted work. Dr. Uribe reported personal fees from ATEC and SI-Bone outside the submitted work. Dr. Turner reported grants from ATEC and SI-Bone and personal fees from ATEC, SeaSpine, and SI-Bone outside the submitted work. Dr. Chou reported personal fees from Orthofix, Globus, and Medtronic outside the submitted work. Dr. Mummaneni reported personal fees from DePuy

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Conception and design: C Park, Bhowmick, CI Shaffrey, Lavadi, Johnson, Potts, Virk, Knightly, Meyer, Chan, Haid. Acquisition of data: CI Shaffrey, Johnson, Bisson, Asher, Coric, Potts, Foley, P Park, Wang, Fu, Virk, Knightly, Upadhyaya, ME Shaffrey, Chan, Mummaneni. Analysis and interpretation of data: C Park, Bhowmick, Lavadi, Johnson, Virk, Schupper, Haid. Drafting the article: C Park, Lavadi, Johnson, Schupper, Uribe, Chan. Critically revising the article: C Park, Bhowmick, CI Shaffrey, Lavadi, Foley, Wang, Meyer, ME Shaffrey, Schupper, Tumialán, Turner, Chan, Haid, Mummaneni, Bydon. Reviewed submitted version of manuscript: C Park, CI Shaffrey, Lavadi, Johnson, Bisson, Asher, Coric, Potts, Foley, P Park, Wang, Fu, Virk, Knightly, Meyer, Upadhyaya, ME Shaffrey, Schupper, Uribe, Tumialán, Turner, Chan, Chou, Haid, Mummaneni, Bydon. Approved the final version of the manuscript on behalf of all authors: Gottfried. Statistical analysis: C Park, Johnson, Schupper. Administrative/technical/material support: Bisson, Bydon. Study supervision: CI Shaffrey, Bisson, Potts, Bydon.

Supplemental Information

Previous Presentations

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