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Clinical Study

Characteristics and outcomes of patients undergoing lumbar spine surgery for axial back pain in the Michigan Spine Surgery Improvement Collaborative

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Abstract

BACKGROUND CONTEXT: The indications for surgical intervention of axial back pain without leg pain for degenerative lumbar disorders have been limited in the literature, as most study designs allow some degree of leg symptoms in the inclusion criteria.

PURPOSE: To determine the outcome of surgery (decompression only vs. fusion) for pure axial back pain without leg pain.

STUDY DESIGN/SETTING: Prospectively collected data in the Michigan Spine Surgery Improvement Collaborative (MSSIC).

PATIENT SAMPLE: Patients with pure axial back pain without leg pain underwent lumbar spine surgery for primary diagnoses of lumbar disc herniation, lumbar stenosis, and isthmic or degenerative spondylolisthesis ≤ grade II.

OUTCOME MEASURES: Minimally clinically important difference (MCID) for back pain, Numeric Rating Scale of back pain, Patient-Reported Outcomes Measurement Information System Physical Function (PROMIS-PF), MCID of PROMIS-PF, and patient satisfaction on the North American Spine Surgery Patient Satisfaction Index were collected at 90 days, 1 year, and 2 years after surgery.

METHODS: Log-Poisson generalized estimating equation models were constructed with patient-reported outcomes as the independent variable, reporting adjusted risk ratios (RR_{adj}).

RESULTS: Of the 388 patients at 90 days, multi-level versus single level lumbar surgery decreased the likelihood of obtaining a MCID in back pain by 15% (RR_{adj}=0.85, p=.038). For every one-unit increase in preoperative back pain, the likelihood for a favorable outcome increased by 8% (RR_{adj}=1.08, p<.001). Of the 326 patients at 1 year, symptom duration > 1 year decreased the

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likelihood of a MCID in back pain by 16% (RR_{adj}=0.84, p=.041). The probability of obtaining a MCID in back pain increased by 9% (RR_{adj}=1.09, p<.001) for every 1-unit increase in baseline back pain score and by 14% for fusions versus decompression alone (RR_{adj}=1.14, p=.0362). Of the 283 patients at 2 years, the likelihood of obtaining MCID in back pain decreased by 30% for patients with depression (RR_{adj}=0.70, p<.001) and increased by 8% with every one-unit increase in baseline back pain score (RR_{adj}=1.08, p<.001).

CONCLUSIONS: Only the severity of preoperative back pain was associated with improvement in MCID in back pain at all time points, suggesting that surgery should be considered for selected patients with severe axial pain without leg pain. Fusion surgery versus decompression alone was associated with improved patient-reported outcomes at 1 year only, but not at the other time points.

Keywords: Axial; Back; Lumbar; MCID; NRS; Pain; PROMIS

Introduction

The increasing incidence and wide geographic variability of spine surgery in the United States over the past 20 years, without changes in the epidemiology of back pain, has raised serious questions about the appropriateness of such surgery, especially in the case of lumbar fusions [1,2]. Some authors have attributed this increase to aggressive marketing and financial incentives to surgeons [3]. However, most of the data on such surgeries use administrative databases with limited information on outcomes, other than opioid use [3,4]. To examine the appropriateness criteria for lumbar surgery, we elected to examine the Michigan Spine Surgery Improvement Collaborative (MSSIC) registry for surgical outcomes of patients with axial back pain but no radicular pain. Our main hypothesis was that surgery for axial back pain in patients without severe structural pathology (fracture, deformity, high grade spondylolisthesis, etc.) and without radicular pain, is ineffective. We also sought to assess the associations between preoperative characteristics and surgical outcomes.

Methods

Study design, setting, participants

Following Institutional Review Board (IRB #10582) approval, the prospectively collected data in the MSSIC − established by Blue Care Network/ Blue Cross Blue Shield of Michigan (BCBSM) as part of the Value Partnership program − registry was queried for lumbar spine surgeries from February 1, 2014 to July 31, 2019 [5]. Patients with pure axial back pain without leg pain underwent lumbar spine surgery for primary diagnoses of lumbar disc herniation, lumbar stenosis, and isthmic or degenerative spondylolisthesis ≤ grade II. Because radiographic images were not available for the entire study population, the amount of nerve compression from the primary diagnosis could not be ascertained. Other exclusion criteria include spondylolistheses > grade II and significant scoliosis, defined as a Cobb angle >25 degrees. Patients with neoplastic, infectious, traumatic and/or metabolic indications for spine surgery were also excluded. At the time of this study, 26 hospitals across the State of Michigan participated in MSSIC, which comprises the practices of over 170 orthopedic spine and neurosurgeons across a variety of practice environments: tertiary care hospitals, academic practice, community hospitals, and private practices.

Variables and data sources/ measurements

Prognostic factors collected include preoperative demographic data and comorbidity burden, baseline self-assessment metrics, intraoperative parameters, and postoperative complications up to 90 days after surgery. Zip code was used to estimate median household income from the 2010 Census. Patient-reported outcomes (PROs) were collected 90 days, 1 year, and 2 years after surgery. Follow-up techniques included routine postoperative clinic visits or distributed surveys via phone, mail, or e-mail. The primary outcome measure was the minimally clinically important difference (MCID) on back pain. Secondary outcomes include Numeric Rating Scale (NRS) on back pain, Patient-Reported Outcomes Measurement Information System Physical Function (PROMIS-PF), MCID of PROMIS-PF, and patient satisfaction.

A MCID for back pain was determined as a two-point change in the NRS pain score [6]. The percentage of patients who achieved an NRS back score of zero to two, the criterion for remission, was also examined. In an effort to improve PROs in patients with chronic disability, the PROMIS was developed by the National Institutes of Health. The PROMIS-PF, in particular, seems well-suited for patients with musculoskeletal disorders and is well correlated with other functional measures, such as the Oswestry Disability Index [7]. MSSIC utilizes a previously described difference of 4.5 points for MCID on the PROMIS-PF [8−10]; thus, MCID was treated as a binary outcome [7,11,12]. Satisfaction was measured using the North American Spine Surgery (NASS) Patient Satisfaction Index, where "satisfied patients" were defined as a score of one ("the treatment met my expectations") or two ("I did not improve as much as I had hoped, but I would undergo the same treatment for the same outcome"), and three "dissatisfied patients" ("I did not improve as much as I had hoped, and I would not undergo the same treatment for the same outcome") or four ("I am the same or worse than before treatment") [13].

Quantitative variables and statistical methods

Variables abstracted from the MSSIC database were presented with summary statistics. To evaluate the association between prognostic factors and binary PROs on MCID for back pain at 90 days, 1 year and 2 years, log-Poisson generalized estimating equation (GEE) models were constructed using an exchangeable working correlation structure. The Poisson distribution with a log-link function was used rather than a logistic model because the outcomes being modeled were not rare, meaning the odds ratio obtained from a logistic model would not approximate the risk ratio. Hospital location was used as the clustering variable in the GEE models to take into account possible correlations among patients receiving their procedures at different hospitals. GEE models were also used to compare procedures (fusion vs. decompression only) within specific cohorts of patients based on presence of scoliosis and presenting pathologies while adjusting for baseline values for the PROs.

Results

Participants

MSSIC collected clinical data on 37,407 patients who underwent lumbar spine surgery between February 2014 and July 2019. Of these cases, 14,256 patients were excluded for missing baseline back or leg pain scores, and 21,990 patients had a back pain score of 0 or leg pain score >0. Next, 439 patients with prior lumbar operations were removed (Fig. 1). The remaining 722 patients with back pain without the presence of leg pain were included in the study population listed in Table 1. For the calculation of the relative risk in the GEE model, data for all variables included in the model were available for 388 patients at 90 days, 326 patients at 1 year, and 282 patients at 2 years.

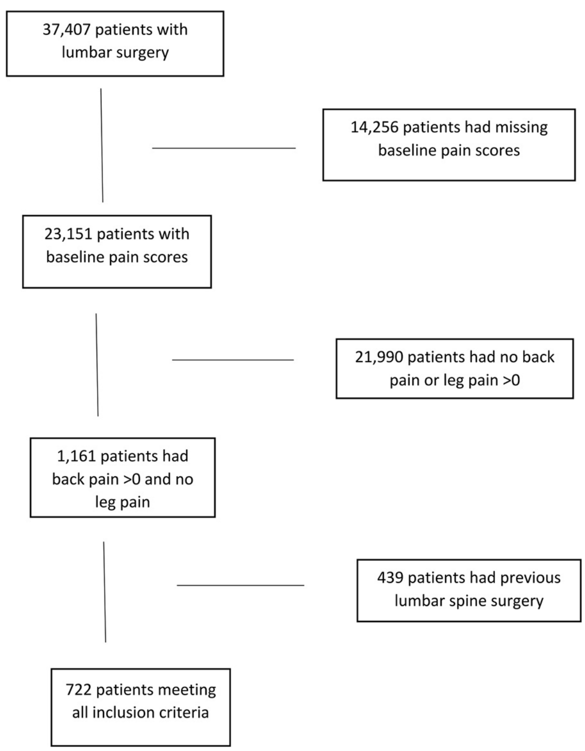


Fig. 1. Flowchart for patient selection.

Descriptive data

Table 1 summarizes the baseline characteristics of the 722 patients who underwent first-time lumbar surgery for low back pain without appendicular leg pain. The majority of patients were between 49 and 77 years of age, of white race, and independently ambulatory prior to surgery. The vast majority of patients had symptoms which lasted for greater than 1 year.

Table 1
Patient demographics and surgical characteristics

Variable	Lumbar (N = 722)
Age, Mean ± SD	62.4 ± 14.5
Male sex	396/722 (55%)
Non-White	64/692 (9%)
Zip code median household income, median (IQR)	51782 (42740, 66946)
Diabetes	155/716 (22%)
Scoliosis < 25°	132/714 (18%)
Deep venous thrombosis	42/716 (6%)
CAD	116/719 (16%)
Depression	149/714 (21%)
Baseline depression (patient health questionnaire-2)	157/689 (23%)
Anxiety	143/715 (20%)
Osteoporosis	67/714 (9%)
American Society Association (ASA) classification > 2	376/722 (52%)
Current smoker	93/706 (13%)
Workmen's comp	13/690 (2%)
Spondylolisthesis	322/722 (45%)
Stenosis	616/722 (85%)
Disc herniation	437/722 (61%)
Independently ambulatory	607/721 (84%)
Baseline PROMIS physical function, Mean ± SD	37.1 ± 5.7
Baseline back pain, Median (IQR)	7 (5, 8)
Private insurance	307/722 (43%)
Previous non-lumbar spine surgery	73/615 (12%)
Fusion	395/722 (55%)
Multiple levels	393/717 (55%)
Ambulated on Post-Operative Day (POD) zero	364/680 (54%)
Duration of surgery (h), Median (IQR)	1.9 (1.3, 3)
Symptom duration	
< 3 mo	54/688 (8%)
3 mo- 1 y	142/688 (21%)
> 1 y	492/688 (72%)

Table 2
Patient reported/surgical outcomes

Variable	Lumbar (N = 722)
Urinary retention	67/722 (9%)
Readmission	
Within 30 d	26/709 (4%)
Within 90 d	53/722 (7%)
Surgical site infection	15/722 (2%)
Non-home discharge	100/722 (14%)
Venous thromboembolic events: Pulmonary embolism/ deep vein thrombosis	13/722 (2%)
Urinary tract infection	22/722 (3%)
Ileus	9/722 (1%)
North American Spine Surgery (NASS) patient satisfaction index satisfied	
After 90 d	400/462 (87%)
After 1 y	287/386 (74%)
After 2 y	265/341 (78%)
PROMIS physical function change, Mean ± SD	
Baseline to 90 d	5.2 ± 7.0
Baseline to 1 y	5.8 ± 7.5
Baseline to 2 y	5.5 ± 8.1
Minimally Clinically Important Difference (MCID) on the PROMIS physical function	
After 90 d	246/448 (55%)
After 1 y	231/378 (61%)
After 2 y	173/314 (55%)
Numerical Rating Score (NRS) for back pain change, Mean ± SD	
Baseline to 90 d	-3.3 ± 3.2
Baseline to 1 y	-3.1 ± 3.2
Baseline to 2 y	-2.8 ± 3.3
Minimally Clinically Important Difference (MCID) in back pain	
After 90 d	335/470 (71%)
After 1 y	265/388 (68%)
After 2 y	220/334 (66%)
Numerical Rating Score (NRS) for back pain ≤ 2	
After 90 d	220/470 (47%)
After 1 y	189/388 (49%)
After 2 y	151/334 (45%)
Returned to Work, among patients planning to return to work	
After 90 d	114/162 (70%)
After 1 y	117/148 (79%)
After 2 y	94/122 (77%)

Table 3
Reason for readmission* (n = 53)

	N (%)
Surgical site infection	8 (15%)
Deep vein thrombosis/pulmonary embolism	7 (13%)
New spine-related radicular finding of numbness, pain/weakness	5 (9%)
Abdominal complications	4 (8%)
Pain	4 (8%)
Pneumonia	4 (8%)
Surgical site hematoma	4 (8%)
Other	3 (6%)
Other pulmonary	3 (6%)
Myocardial infarction	2 (4%)
Urinary tract infection	2 (4%)
Other infectious	2 (4%)
Other cardiac	2 (4%)
Unplanned spine procedure that met MSSIC inclusion criteria	1 (2%)
Congestive heart failure	1 (2%)
Debilitation	1 (2%)
Electrolyte	1 (2%)
New neuro deficit related to cervical spinal cord	1 (2%)
Other pain	1 (2%)
Pharmacological	1 (2%)
Other scheduled procedure	1 (2%)
Psych	1 (2%)
Fall/trauma	1 (2%)

* Patients may have had more than one reason listed for readmission.

Outcome data

Overall, 87% of the patients undergoing lumbar surgery reported satisfaction after 90 days from surgery (Table 2). The majority of patients remained satisfied at 1 year (74%) and 2 years (78%) after surgery. After 90 days the average back pain score fell 3.3 points, after 1 year 3.1 points, and after 2 years 2.8 points. This translates to a back pain MCID for 71% of patients 90 days after surgery, 68% after 1 year, and 66% after 2 years. Remission, defined as back pain ≤ 2 out of 10, was achieved in 47% of patients after 90 days, 49% after 1 year, and 45% after 2 years. A MCID on the PROMIS-PF reached 55% after 90 days, 61% after 1 year, and 55% after 2 years. Within 90 days, 7% of patients were readmitted with the most common reasons being surgical site infection, DVT/PE and new radicular findings (Table 3). Of those intending to return to work prior to surgery, 70% did so at 90 days, 79% at 1 year and 77% at 2 years.

Main results: factors associated with good outcome

There were 388 patients included in the multivariate GEE for associations with MCID in back pain at 90 days (Table 4). Multiple level versus single level lumbar surgery decreased the likelihood of obtaining a MCID in back pain by 15% (adjusted risk ratios, RR_{adj}=0.85 [95% confidence interval, 95% CI 0.72−0.99], p=.038). The only variable that positively affected a MCID in back pain was higher baseline back pain. For every 1-unit increase in preoperative back pain, the likelihood for a favorable outcome increased by 8% (RR_{adj}=1.08 [95% CI 1.05−1.12], p<.001). Of the 326 patients at 1 year, symptom duration > 1 year decreased the likelihood of a MCID in back pain by 16% (RR_{adj}=0.84 [95% CI 0.72−0.99], p=.041) (Table 5). The probability of obtaining a MCID in back pain increased by 9% (RR_{adj}=1.09 [95% CI 1.06−1.13], p<.001) for every 1-unit increase in baseline back pain score. The likelihood of obtaining MCID in back pain was higher in those patients who underwent fusion when compared to decompression alone (RR_{adj}=1.14 [95% CI 1.00−1.29], p=.036). Of the 282 patients for whom we had data at 2 years, the likelihood of obtaining MCID in back pain decreased by 30% for patients

Table 4
GEE results for associations with back pain MCID achievement at 90 days (N = 388)

Variable	Adjusted risk ratio (95% confidence interval)	p
Age (5-y increments)	1.02 (0.99, 1.04)	.146
Non-White Race/Ethnicity	0.93 (0.78, 1.11)	.426
Current smoker	0.91 (0.73, 1.14)	.416
American Society Association (ASA) classification > 2	0.92 (0.80, 1.05)	.204
Spondylolisthesis	0.93 (0.82, 1.05)	.228
Scoliosis	1.07 (0.95, 1.20)	.269
Preoperative ambulation	1.04 (0.89, 1.21)	.650
Symptom duration > 1 y	1.02 (0.87, 1.21)	.784
Baseline depression (patient health questionnaire-2)	0.92 (0.83, 1.02)	.112
Private insurance	1.03 (0.89, 1.18)	.711
Zip code median household income ($10k increments)	1.01 (0.99, 1.03)	.200
Back pain baseline	1.08 (1.05, 1.12)	**<.001**
Fusion	1.14 (0.98, 1.32)	.086
Multiple versus single levels	0.85 (0.72, 0.99)	**.038**

Bold indicates statistical significance (p<.05).

with depression (Patient Health Questionnaire-2) at baseline compared to patients without depression at baseline (RR_{adj}=0.70 [95% CI 0.60−0.82], p<.001) and increased by 8% with every one-unit increase in baseline back pain score (RR_{adj}=1.08 [95% CI 1.05−1.11], p<.001) (Table 6).

Other analysis

As baseline back pain proved to have the favorable relationship with MCID in back pain, a predicted probability model was developed to stratify by the level of baseline back pain (Fig. 2). The model shows a positive linear correlation, demonstrating that the likelihood of achieving a MCID in back pain at 90 days postoperatively increases as the baseline back pain increases. A baseline back pain score between five and eight showed the largest improvement of a MCID in back pain. In addition, the rate of MCID in back pain did not differ among the different hospitals at 90 days (p=.503, Fig. 3), 1 year (p=.282) or 2 years (p=.91).

Table 5
GEE results for associations with back pain MCID achievement at 1 year (N = 326)

Variable	Adjusted risk ratio (95% confidence interval)	p
Age (5-y increments)	0.99 (0.96, 1.03)	.631
Non-White Race/Ethnicity	0.78 (0.60, 1.00)	.053
Current smoker	0.86 (0.69, 1.09)	.206
American Society Association (ASA) classification > 2	0.86 (0.72, 1.02)	.087
Spondylolisthesis	1.09 (0.90, 1.33)	.387
Scoliosis	0.94 (0.80, 1.09)	.391
Preoperative ambulation	0.96 (0.77, 1.20)	.706
Symptom duration > 1 y	0.84 (0.72, 0.99)	**.041**
Baseline depression (patient health questionnaire-2)	0.92 (0.81, 1.04)	.160
Private insurance	1.00 (0.82, 1.23)	.952
Zip code median household income ($10k increments)	1.02 (1.00, 1.05)	.082
Back pain baseline	1.09 (1.06, 1.13)	**<.001**
Fusion	1.14 (1.00, 1.29)	**.036**
Multiple versus single levels	0.94 (0.81, 1.08)	.384

Bold indicates statistical significance (p<.05).

Table 6
GEE results for associations with back pain MCID achievement at 2 years (N = 282)

Variable	Adjusted risk ratio (95% confidence interval)	p
Age (5-y increments)	0.99 (0.95, 1.02)	.414
Non-White Race/Ethnicity	0.92 (0.64, 1.34)	.667
Current smoker	1.03 (0.88, 1.22)	.704
American Society Association (ASA) classification > 2	0.88 (0.71, 1.10)	.268
Spondylolisthesis	1.09 (0.94, 1.26)	.259
Scoliosis	1.11 (0.94, 1.31)	.201
Preoperative ambulation	1.17 (0.93, 1.47)	.190
Symptom duration > 1 y	0.98 (0.85, 1.14)	.824
Baseline depression (patient health questionnaire-2)	0.70 (0.60, 0.82)	**<.001**
Private insurance	0.94 (0.81, 1.08)	.373
Zip code median household income ($10k increments)	1.03 (1.00, 1.06)	.098
Back pain baseline	1.08 (1.05, 1.11)	**<.001**
Fusion	1.05 (0.88, 1.25)	.607
Multiple versus single levels	0.91 (0.79, 1.06)	.230

Bold indicates statistical significance (p < .05).

In Table 7**,** the indications for surgery that included spinal fusion were most commonly seen in spondylolisthesis (78%) followed by scoliosis (61%). Disc herniations and spinal stenosis were least likely to include fusion operations. There was an association of improved outcomes with decompression alone when compared to fusion surgeries in PROMIS − MCID at 2 years for disc herniation (Table 8). Conversely, the fusion operations were associated with better outcomes than decompression alone in back pain − MCID at 90 days for spondylolisthesis and stenosis, as well as in PROMIS − MCID at 1 year for spondylolisthesis.

Discussion

Key results

Among patients undergoing lumbar surgery for purely axial back pain without leg pain, patients reported in a variety of PROs at all time points in this study: satisfaction score, PROMIS-PF, and back pain score at 90 days, 1 year, and 2 years after surgery, as well as MCIDs for back pain and PROMIS-PF. In the multivariable regression, only the severity of preoperative back pain was associated with improvement in MCID in back pain at all three time points.

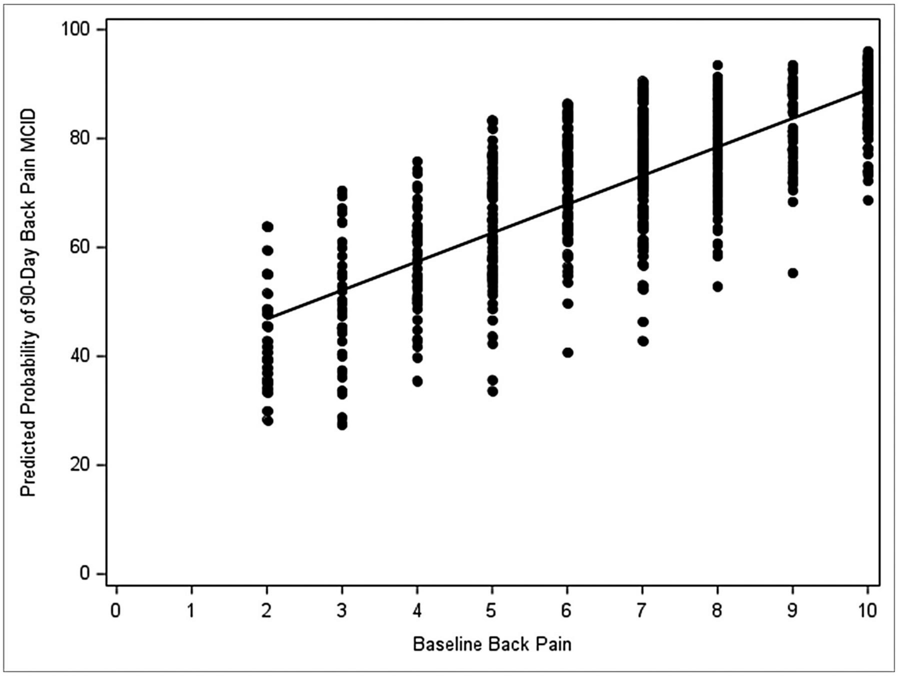
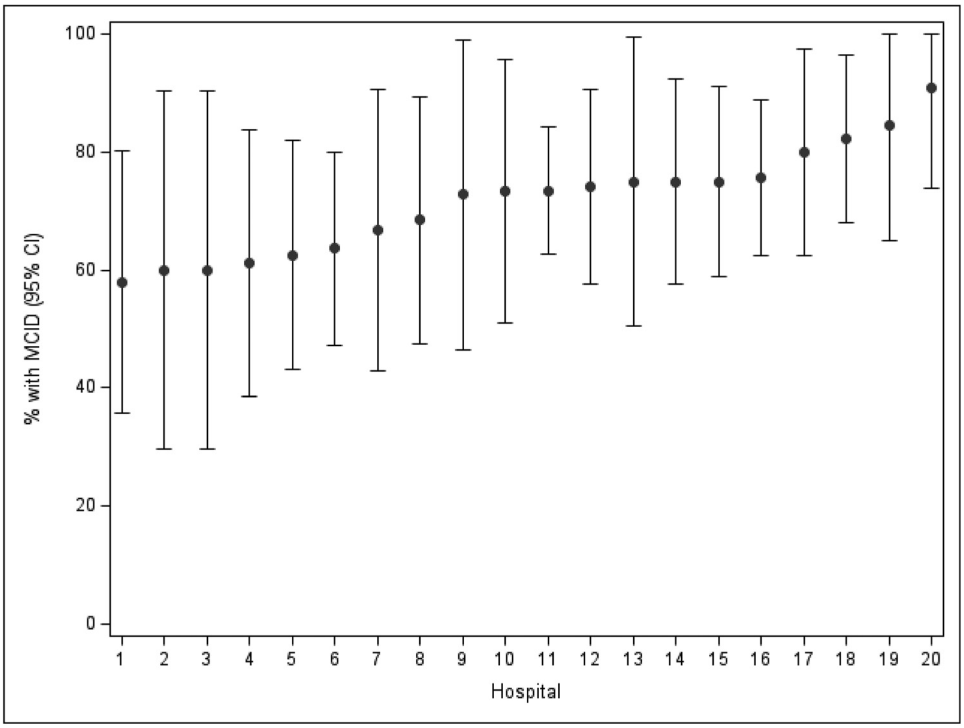


Fig. 2. Predicted probability of 90-day back pain MCID by baseline back pain.

Multi-level surgery, symptom duration greater than 1 year and baseline depression were negatively associated with MCID in back pain at 90 days, 1 year and 2 years, respectively, while fusion surgery was associated with reaching MCID in back pain at 1 year.

Interpretation

The indications for surgical intervention of axial back pain for degenerative lumbar conditions have been limited in the literature, as most study designs allow some degree



*Includes hospitals with at least 10 patients.

Fig. 3. 90-Day back pain MCID by hospital*.

Table 7
Fusion information for scoliosis and pathologies

Variable		N	# with Fusion (%)
Scoliosis		132	80 (61%)
Disc herniation		437	220 (50%)
Spondylolistheses		322	252 (78%)
Stenosis		616	329 (53%)
Pathology	Disc herniation only	49	16 (33%)
	Spondylolistheses only	34	31 (91%)
	Stenosis only	136	53 (39%)
	Disc herniation and spondylolistheses	17	14 (82%)
	Disc herniation and stenosis	209	69 (33%)
	Spondylolistheses and stenosis	109	86 (79%)
	All three	162	121 (75%)
	Other	6	5 (83%)

of leg symptoms in the inclusion criteria. Treatment algorithms for patients with lumbar disc herniation were defined by landmarks studies, such as the Spine Patient Outcomes Research Trial (SPORT) [14,15], Leiden-The Hague Spine Intervention Prognostic Study Group [16], The Maine Lumbar Spine Study [17], and, more recently, a study from the group at London Health Sciences Centre [18]. While the results of these trials demonstrate the benefits of lumbar discectomy over non-operative management, the inclusion criteria specified the presence of sciatica. Similarly, in comparing decompression versus medical management in patients with lumbar stenosis, SPORT [19] was limited to patients with neurogenic claudication or radicular leg symptoms. Lastly, surgical versus medical management in patients with spondylolisthesis in SPORT [20] again excluded patients without leg symptoms.

There have been studies comparing lumbar fusion to non-operative management for patients with predominant axial back pain outside the United States. The Swedish Lumbar Spine Study Group [21], the Stockholm collaborators [22,23], the Norway Group [24,25], and the Spine Stabilization Trial Group [26] all included patients with more pronounced back pain than signs of nerve root compression/radiculopathy. These studies demonstrated better clinical outcomes with lumbar fusion in selected subpopulations, which differed among the various publications. Thus, spine surgeons are left without a consensus on who would best benefit from lumbar surgery for axial back pain.

This study on lumbar surgery for pure axial back pain reflects a query of a statewide database. Even though patients with axial back pain only represent a small proportion of patients who undergo spine surgery in the State of Michigan (722/23,151, or 3.1%), our study is unique in that MSSIC has the data granularity and sample size to explore spinal PROs while controlling for demographic data, comorbidity burden, and operative parameters. Patients with higher preoperative back pain score have a higher probability of postoperative improvement. Therefore, severe back pain may be amenable to surgical intervention in selected circumstances. *Our hypothesis that surgery for*

Table 8
Comparing patient-reported outcomes between decompression and fusion within specific patient cohorts

Patient cohort	PRO outcome	Decompression lonly	Fusion	p-value*
Disc herniation	Back pain - MCID at 90 d	87/137 (64%)	96/136 (71%)	.337
	Back pain - MCID at 1 y	67/115 (58%)	77/113 (68%)	.145
	Back pain - MCID at 2 y	62/100 (62%)	61/96 (64%)	.887
	PROMIS - MCID at 90 d	74/130 (57%)	77/132 (58%)	.874
	PROMIS - MCID at 1 y	67/113 (59%)	65/111 (59%)	.949
	PROMIS - MCID at 2 y	52/88 (59%)	43/94 (46%)	**.037**
Spondylolisthesis	Back pain - MCID at 90 d	31/53 (58%)	133/177 (75%)	**.011**
	Back pain - MCID at 1 y	22/41 (54%)	111/142 (78%)	**<.001**
	Back pain - MCID at 2 y	22/38 (58%)	86/119 (72%)	.234
	PROMIS - MCID at 90 d	22/50 (44%)	86/168 (51%)	.460
	PROMIS - MCID at 1 y	19/43 (44%)	87/134 (65%)	**.014**
	PROMIS - MCID at 2 y	18/33 (55%)	58/116 (50%)	.746
Stenosis	Back pain - MCID at 90 d	121/181 (67%)	167/219 (76%)	.083
	Back pain - MCID at 1 y	91/157 (58%)	137/182 (75%)	**<.001**
	Back pain - MCID at 2 y	82/134 (61%)	104/144 (72%)	.141
	PROMIS - MCID at 90 d	100/173 (58%)	108/208 (52%)	.157
	PROMIS - MCID at 1 y	87/155 (56%)	106/174 (61%)	.454
	PROMIS - MCID at 2 y	71/122 (58%)	72/137 (53%)	.342
Scoliosis	Back pain - MCID at 90 d	26/37 (70%)	46/56 (82%)	.549
	Back pain - MCID at 1 y	15/28 (54%)	32/42 (76%)	.055
	Back pain - MCID at 2 y	18/22 (82%)	22/31 (71%)	.079
	PROMIS - MCID at 90 d	18/31 (58%)	25/55 (45%)	.192
	PROMIS - MCID at 1 y	15/27 (56%)	20/40 (50%)	.542
	PROMIS - MCID at 2 y	11/18 (61%)	16/33 (48%)	.249

Bold indicates statistical significance (p<.05).
* p-value from GEE model adjusting for corresponding baseline PRO.

axial back pain is largely ineffective and should be advocated against is not supported.

Of those patients with appropriate indications for operative intervention, the type of spine surgery remains a point of contention. In the multivariate regression of this study, addition of spinal arthrodesis was only associated with reaching MCID in back pain at 1 year. Only preoperative back pain score was statistically significantly associated with the primary outcome measure at all three time points: 90 days, 1 year, and 2 years after surgery. There are two explanations: (1) decompression with or without fusion results in similar outcomes or (2) surgeons are skilled at choosing the right procedure for the specific patient. Since the MSSIC registry does not include radiologic data, it is difficult to know which is the case. As a surrogate marker, indications for surgery were examined instead. Patients with spondylolisthesis were most likely to receive fusion operations in the current study (Table 7). Fusion surgery over decompression alone was associated with better PROs in patients with spondylolisthesis (Table 8). These findings corroborate the Spinal Laminectomy versus Instrumented Pedicle Screw trial [27], and contradict those of the Swedish Lumbar Spine Study Group [28], although the inclusion criteria for both trials required neurogenic claudication.

Limitations and generalizability

This study demonstrates that carefully selected patients with pure axial back pain are amenable to surgical intervention across multiple practice settings and by both orthopedic and neurological surgeons. The breadth of the MSSIC collaborative suggests that these findings are generalizable in the United States. However, in the absence of radiological and complex historical data, it is impossible to give recommendations as to how to make clinical decisions as to which patients will do well with surgical intervention and with which technique(s). While lumbar disc herniations, stenoses, and spondylolistheses that typically cause leg symptoms are available in the MSSIC dataset, the radiographic severity of these disease processes, as well as other imaging findings that may contribute to axial back pain (eg, black disc disease, facet arthropathies, cysts, loss of disk height, Modic endplate changes, isthmic vs. degenerative spondylolisthesis) cannot be extrapolated. In addition, back pain can be neuropathic or mechanical. Even mechanical back pain can be subclassified as facetogenic, discogenic and claudicant. Due to the limitations of the MSSIC dataset, we are unable to ascertain the relationship between type of axial back pain and radiographic correlates that are considered "amenable to surgery."

This study is subject to the limitations inherent in large database samples. While MSSIC abstracts a comprehensive range of clinical parameters from a variety of practice environments with representation of both orthopedic surgery and neurosurgery, PROs may be subject to a selection bias to those patients who choose to follow-up for up to 2 years. Incomplete variables were assumed to be missing at random; thus, patients with missing prognosticators in the multivariate model were dropped from the regression analysis.

Conclusion

Among patients undergoing lumbar surgery for purely axial back pain without leg pain, improvements trended in all postoperative PROs − satisfaction score, PROMIS-PF, and back pain score − measured at all time points in this study: 90 days, 1 year, and 2 years after surgery. On the regression analysis, only the severity of preoperative back pain was associated with improvement in MCID in back pain at all three time points, suggesting that surgery should be considered for selected patients with severe axial pain without leg symptoms. Fusion surgery versus decompression alone did improve PROs at 1 year only. Patients can be counseled that excellent results for both improvement and remission are feasible with spinal surgery for axial back pain.

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