



Original Article

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INTRODUCTION

Minimally invasive lumbar decompression (MIS LD) is an effective treatment option for individuals experiencing degenerative spinal pathologies such as lumbar stenosis. Although its minimally invasive nature and proven efficacy make it a desirable procedure for individuals that have failed conservative management,^{1,2} complications and persistent symptoms following MIS LD may require some patients to undergo a revision procedure. Significant efforts should be made to avoid repeat lumbar surgeries, as prior studies have demonstrated revision lum-

Change in Patient-Reported Outcome Measures as Predictors of Revision Lumbar Decompression Procedures

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Objective: To assess change in Patient-Reported Outcome Measures (PROM) as predictors for revision lumbar decompression (LD).

Methods: Patients who underwent primary, single or multilevel LD were retrospectively reviewed. Patients were categorized according to whether or not they underwent revision LD within 2 years of the primary procedure. Visual analogue scale (VAS), Oswestry Disability Index (ODI), 12-item Short Form Health Survey and 12-item Veterans RAND physical component score (SF-12 PCS and VR-12 PCS), and Patient-Reported Outcome Measurement Information System physical function (PROMIS-PF) were recorded. Delta PROM scores were evaluated for differences between groups and as a risk factor for a revision LD.

Results: The study included 135 patients, 91 undergoing a primary procedure only and 44 undergoing a primary and revision procedure. Matched patients did not demonstrate any significant differences in demographics or perioperative characteristics. Patients who underwent a revision had a mean time to revision of 7.4 ± 5.7 months. Primary cohort significantly improved for all PROMs (all $p < 0.05$), while the primary plus revision cohort significantly improved for VAS back, ODI, and PROMIS-PF (all $p < 0.05$). However, cohorts differed in VAS back and PROMIS-PF ($p < 0.05$). Delta PROMs were not a significant risk factor for revision except at 6 months for PROMIS-PF ($p = 0.024$).

Conclusion: LD has been associated with reliable outcomes, but early identification of patients at risk for revision is critical. This study suggests that tools such as PROMIS-PF may serve a role in predicting who is at risk and the 6-month follow-up period may be valuable for counseling patients who are not experiencing improvement.

Keywords: Lumbar vertebrae, Decompression, Patient-Reported Outcome Measures

bar procedures to be associated with higher complication rates and worse outcomes than primary surgical intervention. Proietti et al.³ demonstrated revision cases had a higher rate of infection and unintended durotomy compared to primary procedures. Additionally, Singh et al.⁴ reported revision lumbar discectomy patients had higher postoperative narcotic utilization, prolonged hospital stay, and higher postoperative pain scores at 6 weeks. Therefore, it is critical to identify possible predictors of revision procedures in an attempt to modify risk factors and counsel those at risk.

Identifying predictors can serve as an effective way to proac-

tively determine individuals likely to require revision surgery following MIS LD, thus avoiding a second surgery and the negative outcomes associated with it. Several past studies of the lumbar spine have established various predictors of revision, most of which focus on an individual's pathological diagnoses or radiographic imaging. Hwang et al.⁵ and Deyo et al.⁶ identified moderate disk degeneration in lower lumbar segments and history of a lumbar procedure prior to the index operation to be strong clinical predictors of reoperation following surgery for lumbar spinal stenosis. Additionally, Abdul Jalil et al.⁷ used preoperative magnetic resonance imaging to identify presence of retrolisthesis or foraminal disc herniation to be predictive of higher risk for revision following lumbar discectomy. While these results provide meaningful insight, it is critical to look beyond objective diagnoses and work to identify additional predictors that include a patient's own perception of their health and well-being.

Patient-Reported Outcome Measures (PROMs) are self-reported questionnaires that allow clinicians to understand a patient's perception of their own pain, disability, and physical function.⁸ PROMs have become increasingly relied on to quantify postoperative outcomes and define the success of surgery, making it important to determine whether or not they can also be used for identifying patients at risk for revision surgery. Due to the lack of literature focusing on PROMs in this context, our study aims to quantify differences in the incremental changes of PROMs following a primary MIS LD between patients who did or did not subsequently undergo revision surgery. It is critical to understand this relationship, as we would expect patients requiring a future revision to have a significantly different postoperative course regarding improvement in postoperative outcomes. Using PROMs specific for pain, disability, and physical function, we hypothesize that patients that undergo subsequent revision MIS LD procedures will experience less improvement in PROMs between postoperative timepoints than those patients that do not undergo a revision procedure.

MATERIALS AND METHODS

1. Inclusion Exclusion Criteria

Eligible study participants were identified through a retrospective review of a prospective single surgeon database for spinal procedures performed at a single academic medical institution between May 2008 and January 2020. Inclusion criteria were set as patients undergoing primary, elective, single, or multilevel MIS LD for a degenerative spinal pathology. Exclusion

criteria were set as patients undergoing surgery for trauma, infection, or malignancy, or a revision procedure greater than 2 years after their primary MIS LD procedure. All aspects of the current study were approved by the Institutional Review Board of Rush University Medical Center (ORA 14051301) and all participants provided written informed consent prior to commencement of the study.

Patients were categorized into 2 groups: those who underwent only a primary procedure and those who underwent both a primary and subsequent revision procedure within 2 years of the primary surgery. All surgeries, primary and revision, were performed using either a microscopic or microtubular approach and included laminectomy, hemilaminectomy, discectomy, foraminotomy, or facetectomy. All revision decompression surgeries involved the same level of the primary decompression.

2. Data Collection

Demographic information and perioperative characteristics were collected through a retrospective review. Demographic information included age, self-identified gender, body mass index (BMI), active smoker status, diabetic status, and insurance collected. Additionally, appropriateness for surgery and comorbidity burden were recorded and collected using the American Society of Anesthesiologists physical status classification and Charlson Comorbidity Burden, respectively. Perioperative information included associated preoperative spinal pathology, number of operative levels, operative duration, intraoperative estimated blood loss (EBL), postoperative length of stay (LOS), and time to revision procedure.

The primary outcome of interest was PROMs which were evaluated using the visual analogue scale (VAS), Oswestry Disability Index (ODI), 12-item Short Form and Veterans RAND physical composite score (SF-12 PCS and VR-12 PCS), and Patient-Reported Outcome Measurement Information System physical function (PROMIS-PF). All outcome measures were collected at a baseline preoperative timepoint and subsequently at 6 weeks, 12 weeks, 6 months, and 1 year postoperatively following the primary procedure. If a patient were to undergo revision surgery within 2 years of the primary, their subsequent PROMs following the primary procedure were not included in analysis. For example, a patient in the primary plus revision cohort who underwent the revision procedure at 9 months from the primary procedure would not have a 1-year PROM included in analysis. Change in PROMs between consecutive timepoints was calculated as follows: Delta (Δ) = [timepoint 1 value - timepoint 2 value].

3. Statistical Analysis

As previously described, patients were divided and analyzed in 2 cohorts; those who underwent only a primary procedure and patients who underwent both a primary and subsequent revision procedure. To control for significant differences in demographic variables between groups, a propensity score was calculated for all patients and a nearest neighbor match performed. Patients were matched based on age, sex, BMI, smoker, and diabetic status. Unmatched patients were excluded from analysis. Following propensity score matching, groups were evaluated for differences in demographics, perioperative characteristics using chi-square test for categorical variables and an unpaired Student t-test for continuous variables. PROM scores associated with the primary procedure that were collected after the date of revision of index-level surgery were excluded from analysis. As such, delta PROM comparisons were ensured to be between primary cohort and primary plus revision cohort for each index operation without factoring in PROM scores taking place after revision procedure. Groups were evaluated for significant differences in PROM score improvements from their respective baseline value using a paired Student t-test and any differences in PROM scores between groups were evaluated at each timepoint using an unpaired Student t-test. To evaluate delta PROM values between timepoints as a predictor of undergoing an MIS LD revision, a simple logistic regression was performed. All statistical tests and analyses were performed using StataIC 16.1 (StataCorp, College Station, TX, USA) and an alpha value was set to 0.050 to reject the null hypothesis.

RESULTS

A total of 135 propensity score matched patients were included in the final study cohort with 91 undergoing only a revision procedure and 44 having undergone a revision procedure. The cohort had a mean age of 42.7 years with majority (75.8%) being male and nonobese (BMI < 30 kg/m²). The 2 cohorts did not demonstrate any significant differences in baseline characteristics (Table 1). Majority of patients were associated with a preoperative spinal pathology of herniated nucleus pulposus (70.0%) and underwent a procedure at a single level (73.8%). Mean operative duration was 55.2 minutes with an associated EBL of 55.8 mL and LOS of 11.4 hours. Mean time to revision was 7.4 months.

Comparison of perioperative characteristics between groups did not demonstrate significant differences (Table 2).

Table 3 summarizes mean PROM scores by group. Patients

Table 1. Propensity matched demographics

Characteristic	Total (n = 135)	Primary only (n = 91)	Primary+ revision (n = 44)	P- value*
Age (yr)	42.7 ± 15.0	42.3 ± 14.7	43.6 ± 15.8	0.652
Sex				0.315
Female	32 (24.2)	19 (21.6)	13 (29.5)	
Male	100 (75.8)	69 (78.4)	31 (70.4)	
Body mass index (kg/m ²)				0.533
< 30	77 (58.3)	53 (60.2)	24 (54.5)	
≥ 30	55 (41.7)	35 (39.8)	20 (45.5)	
Smoking status				0.869
Nonsmoker	100 (83.3)	73 (82.9)	37 (84.1)	
Smoker	22 (16.7)	15 (17.1)	7 (15.9)	
Diabetic status				1.00
Nondiabetic	120 (90.9)	80 (90.9)	40 (90.9)	
Diabetic	12 (9.1)	8 (9.1)	4 (9.1)	
ASA PS classification				0.880
≤ 2	93 (89.4)	57 (89.1)	36 (90.0)	
> 2	11 (10.6)	7 (10.9)	4 (10.0)	
CCI score				0.892
< 1	58 (50.4)	39 (50)	19 (51.3)	
≥ 1	57 (49.6)	39 (50)	18 (48.7)	
Insurance				0.869
Medicare/medicaid	10 (7.6)	7 (7.9)	3 (6.8)	
Workers' compensation	47 (35.6)	30 (34.1)	17 (38.6)	
Private	75 (56.8)	51 (58)	24 (54.6)	

Values are presented as mean ± standard deviation or number (%). ASA PS, American Society of Anesthesiologists physical status; CCI, Charlson Comorbidity Index.

*p-value was calculated using chi-square or t-test.

who underwent a primary procedure demonstrated significant improvements in VAS back, ODI, and PROMIS-PF from baseline values at 6-week, 12-week, and 6-month follow-up ($p \leq 0.050$, all). Similarly, improvement from baseline values was demonstrated at the 6-week and 12-week timepoint for both VAS leg and VR-12 PCS ($p \leq 0.003$, all). Patients who underwent both a primary and revision procedure demonstrated significant improvements in VAS back (6 weeks, 12 weeks, and 1 year) ($p \leq 0.002$, all), ODI (6 weeks and 12 weeks) ($p \leq 0.035$), and PROMIS-PF (6 weeks and 12 weeks) ($p \leq 0.028$) when compared to preoperative PROM score prior to index operation. Comparison of mean PROM scores between groups demonstrated significantly worse values for VAS back and PROMIS-PF at the preoperative timepoint for patients who underwent both pri-

Table 2. Perioperative characteristics

Characteristic	Total (n = 135)	Primary only (n = 91)	Primary+revision (n = 44)	p-value*
Spinal pathology				
HNP	105 (70.0)	72 (70.6)	35 (68.7)	0.164
Central stenosis	90 (60.0)	65 (63.7)	25 (52.1)	0.175
Foraminal stenosis	41 (27.3)	29 (28.4)	12 (25.0)	0.660
Operative levels				0.528
1 Level	93 (73.8)	63 (72.4)	30 (76.9)	
2 Levels	21 (16.7)	14 (16.1)	7 (17.9)	
3 Levels	12 (9.5)	10 (11.5)	2 (5.1)	
Operative time (min)	55.2 ± 31.0	55.2 ± 31.0	57.2 ± 28.4	0.707
Estimated blood loss (mL)	55.8 ± 30.1	46.7 ± 68.6	39.5 ± 24.5	0.501
Length of stay (hr)	11.4 ± 27.7	12.1 ± 31.2	9.9 ± 19.1	0.665
Time to revision (mo)	-	-	7.4 ± 5.7	-

Values are presented as number (%) or mean ± standard deviation.

HNP, herniated nucleus pulposus.

*p-value was calculated using chi-square or t-test.

mary and revision procedures ($p \leq 0.020$, both). Additionally, these patients also demonstrated significantly worse PROMIS-PF scores at the 6-week and 6-month timepoint ($p \leq 0.032$, both).

Delta (Δ) values for VAS back, VAS leg, ODI, SF-12 PCS, and VR-12 PCS at all postoperative timepoints were not significant predictors for undergoing a revision procedure (Table 4). A similar observation was made for Δ PROMIS-PF at all timepoints except for 6 months ($p = 0.024$). Preoperative PROM scores for index operation and subsequent revision operation for patients in primary+revision cohort were not significantly different from one another (Table 5).

DISCUSSION

The timely identification of patients at risk for requiring revision LD surgery is valuable, but unfortunately has remained a challenge for care providers.⁶ Prior research has suggested that several demographic and surgical factors may be associated with a higher likelihood of revision surgery, including younger age, male sex, and positive smoking status.⁹⁻¹² Similar studies have also shown that revision surgery is frequently associated with a lesser degree of improvement in patient-reported outcomes (PROs).¹²⁻¹⁵ However, there has been a paucity of literature examining the relationship between PROs following the primary surgery, and the likelihood of subsequent revision surgery. Although PROs as a predictor of revision have been analyzed in trauma surgery and total joint arthroplasty, the potential association has yet to be explored in spine surgery.¹⁶⁻¹⁸

In the present study, we sought to analyze the relationship between both the absolute and change in PROMs for patients who underwent primary LD alone versus primary and revision LD within 2 years. Following the primary surgery, there were no significant differences between postoperative absolute and change in VAS, ODI, SF-12 PCS, or VR-12 PCS scores. The 2 cohorts did however have significant differences in absolute PROMIS physical function scores at 6 weeks, 6 months, and 1 year postoperative from the primary procedure, with the primary plus revision cohort reporting worse scores at each time point. Similarly, the degree of improvement in PROMIS-PF scores at 6-month follow-up was significantly smaller for the primary plus revision cohort.

These findings suggest that although legacy metrics such as VAS and ODI may not be as predictive as demographic and surgical factors for the likelihood of revision surgery, the PROMIS-PF assessment may play a unique and valuable role in identifying patients at risk for requiring revision surgery. The PROMIS system offers a computer-based, efficient, flexible, and precise tool that may carry distinct advantages compared to previously utilized PRO assessment tools.¹⁹ In fact, PROMIS-PF has been shown to outperform the ODI and 36-item Short Form Health Survey in the spine patient population in its ability to provide a more accurate measure of function, while taking less time to administer and fewer questions to answer.^{20,21} It is therefore feasible that PROMIS-PF may be more accurately illustrating the postoperative experience, and therefore providing a more reliable indicator of the likelihood of revision surgery.

Table 3. PROM scores for lumbar decompression patients

PROM	Primary only	p-value [‡]	Primary+revision	p-value [‡]	p-value [†]
VAS back					
Preoperative	6.8±2.3 (71)	-	5.7±2.6 (36)	-	0.020*
6 Weeks	3.2±2.8 (63)	<0.001*	3.6±2.5 (29)	<0.001*	0.523
12 Weeks	3.5±3.0 (30)	<0.001*	2.6±2.8 (17)	<0.001*	0.303
6 Months	3.7±2.4 (12)	0.004*	4.3±3.4 (20)	0.094	0.653
1 Year	3.6±3.8 (5)	0.196	3.9±3.4 (9)	0.002	0.869
VAS leg					
Preoperative	6.3±2.8 (43)	-	6.1±3.6 (22)	-	0.823
6 Weeks	2.8±3.0 (37)	<0.001*	3.3±2.9 (16)	0.079	0.573
12 Weeks	3.4±3.8 (16)	0.003*	3.1±2.4 (8)	0.069	0.828
6 Months	2.9±3.1 (7)	0.074	5.3±3.3 (14)	0.381	0.118
1 Year	3.1±2.7 (5)	0.347	3.5±2.9 (9)	0.196	0.796
ODI					
Preoperative	43.5±19.9 (44)	-	46.0±26.6 (22)	-	0.647
6 Weeks	26.3±19.6 (37)	<0.001*	29.1±15.3 (16)	0.004*	0.607
12 Weeks	28.7±22.3 (18)	<0.001*	21.1±13.4 (9)	0.035*	0.359
6 Months	28.0±21.8 (9)	0.050*	40.2±25.4 (14)	0.448	0.248
1 Year	35.7±28.3 (8)	0.199	29.0±23.0 (10)	0.065	0.584
SF-12 PCS					
Preoperative	32.5±9.1 (42)	-	32.4±7.8 (20)	-	0.964
6 Weeks	38.6±8.5 (33)	0.001*	34.7±8.4 (17)	0.429	0.127
12 Weeks	39.2±9.7 (17)	<0.001*	35.7±7.7 (12)	0.139	0.313
6 Months	37.5±9.9 (9)	0.282	33.4±6.4 (14)	0.622	0.282
1 Year	39.6±10.5 (9)	0.194	37.9±9.9 (14)	0.059	0.694
VR-12 PCS					
Preoperative	33.1±9.7 (41)	-	34.2±9.8 (20)	-	0.668
6 Weeks	42.8±8.6 (32)	<0.001*	37.7±10.7 (17)	0.155	0.083
12 Weeks	42.2±10.1 (16)	<0.001*	38.2±8.7 (11)	0.196	0.299
6 Months	40.8±11.5 (5)	0.279	35.5±8.1 (14)	0.635	0.271
1 Year	44.6±11.1 (7)	0.169	39.9±10.5 (14)	0.106	0.356
PROMIS-PF					
Preoperative	39.1±7.8 (29)	-	33.2±6.9 (19)	-	0.011*
6 Weeks	42.6±6.7 (22)	0.002*	38.1±5.2 (16)	0.009*	0.032*
12 Weeks	46.6±7.5 (12)	<0.001*	40.8±7.2 (10)	0.028*	0.078
6 Months	52.3±11.0 (7)	0.006*	37.7±6.9 (12)	0.102	0.002*
1 Year	46.8±4.7 (6)	0.060	37.9±9.6 (12)	0.242	0.052

Values are presented as mean ± standard deviation (number).

PROM, Patient-Reported Outcome Measures; VAS, visual analogue scale; ODI, Oswestry Disability Index; SF-12 PCS, 12-item Short Form Health Survey physical composite score; VR-12 PCS, 12-item Veterans RAND physical component score; PROMIS-PF, Patient-Reported Outcome Measurement Information System physical function.

*p < 0.05, statistical significance. †p-values calculated using paired t-test. ‡p-values calculated using unpaired t-test. Indicates significance for mean PROM scores at specific time point between primary cohort and primary+revision cohort.

Table 4. Delta PROM for lumbar decompression patients

PROM	Primary only	Primary+revision	p-value [†]
Δ VAS back			
6 Weeks	3.5 ± 3.3	2.6 ± 2.8	0.192
12 Weeks	0.57 ± 2.3	1.1 ± 3.3	0.535
6 Months	0.23 ± 1.6	1.3 ± 3.6	0.334
1 Year	1.5 ± 2.5	0.25 ± 3.5	0.531
Δ VAS Leg			
6 Weeks	3.6 ± 3.1	2.4 ± 5.1	0.305
12 Weeks	0.42 ± 1.8	0.36 ± 2.9	0.393
6 Months	0.07 ± 2.9	2.5 ± 3.3	0.126
1 Year	0.33 ± 4.1	1.6 ± 4.6	0.632
Δ ODI			
6 Weeks	16.8 ± 21.5	19.7 ± 23.6	0.662
12 Weeks	4.5 ± 12.6	4.9 ± 10.6	0.956
6 Months	4.2 ± 10.6	7.0 ± 14.9	0.662
1 Year	0.66 ± 11.0	10.7 ± 19.4	0.357
Δ SF-12 PCS			
6 Weeks	7.3 ± 9.8	1.9 ± 9.8	0.079
12 Weeks	1.8 ± 8.4	0.71 ± 5.1	0.712
6 Months	0.49 ± 11.9	2.7 ± 9.9	0.561
1 Year	5.6 ± 1.7	3.8 ± 10.9	0.809
Δ VR-12 PCS			
6 Weeks	9.6 ± 9.5	4.3 ± 11.6	0.108
12 Weeks	1.1 ± 7.3	0.33 ± 7.1	0.613
6 Months	0.55 ± 9.5	2.1 ± 10.8	0.775
1 Year	5.1 ± 1.4	4.3 ± 12.2	0.924
Δ PROMIS-PF			
6 Weeks	4.4 ± 5.8	5.8 ± 7.5	0.512
12 Weeks	4.6 ± 7.2	3.5 ± 4.3	0.659
6 Months	6.9 ± 8.7	3.8 ± 7.5	0.024*
1 Year	9.9 ± 12.2	0.48 ± 10.6	0.105

Values are presented as mean ± standard deviation. PROM, Patient-Reported Outcome Measures; VAS, visual analogue scale; ODI, Oswestry Disability Index; SF-12 PCS, 12-item Short Form Health Survey physical composite score; VR-12 PCS, 12-item Veterans RAND physical component score; PROMIS-PF, Patient-Reported Outcome Measurement Information System physical function. *p < 0.05, statistical significance. †p-values calculated using logistic regression.

Absolute preoperative PROMIS-PF score may also play a valuable predictive role. Despite propensity matching, our primary plus revision cohort reported worse mean preoperative PROMIS-PF scores compared to the primary alone cohort. A similar

Table 5. Preoperative PROM scores for lumbar decompression patients in primary+revision cohort

PROM	Index operation for primary+revision cohort	Revision operation for primary+revision	p-value [†]
VAS back			
Preoperative	5.7 ± 2.6 (36)	6.1 ± 2.7 (26)	0.951
VAS leg			
Preoperative	6.1 ± 3.6 (22)	6.2 ± 2.7 (32)	0.564
ODI			
Preoperative	46.0 ± 26.6 (22)	45.5 ± 20.7 (23)	0.582
SF-12 PCS			
Preoperative	32.4 ± 7.8 (20)	29.7 ± 6.6 (32)	0.187
VR-12 PCS			
Preoperative	34.2 ± 9.8 (20)	31.6 ± 8.5 (31)	0.655
PROMIS-PF			
Preoperative	33.2 ± 6.9 (19)	32.5 ± 6.8 (21)	0.537

Values are presented as mean ± standard deviation (number). PROM, Patient-Reported Outcome Measures; VAS, visual analogue scale; ODI, Oswestry Disability Index; SF-12 PCS, 12-item Short Form Health Survey physical composite score; VR-12 PCS, 12-item Veterans RAND physical component score; PROMIS-PF, Patient-Reported Outcome Measurement Information System physical function. †p-values calculated using 2-sample t-test.

finding was made by Karhade et al.,²² who reviewed 909 patients undergoing LD and found that lower preoperative PROMIS-PF score was the lone independent PRO metric to predict failure of achieving MCID in PROMIS-PF at final postoperative follow-up. One explanation for this may be that patients with a more severe baseline pathology, and therefore a worse preoperative PROMIS-PF score, may benefit from a more meticulous decompression during the primary procedure when compared to patients with higher preoperative PROMIS-PF.

It should also be noted that the degree of change in PROMIS-PF scores was statistically significant at the 6-month follow-up appointment, and patients within our study population underwent revision surgery at an average of 7.4 months. Prior to this timepoint, there were no significant differences in the degree of change. Hung et al.²³ established a repository of MCID values for patients with spinal conditions, and found the MCID for improvement in PROMIS-PF score at 6-month follow-up to range from 5.3 to 7.9 points. Given the common use of the 6-month follow-up appointment following common lumbar spine surgeries, this may be a valuable time for clinicians to carefully assess patients and consider if a revision surgery is indicated for those with a total change in PROMIS-PF score of approximate-

ly 5 points or fewer.^{23,24}

Interestingly, there was no difference in the degree of change in PROMIS-PF scores at 1-year follow-up, though it did trend towards statistical significance. This may be explained by the fact that the majority of patients that required revision surgery within 2 years had already been identified by that time, thereby decreasing statistical power. In fact, most patients who have not undergone revision surgery are likely to have experienced a plateau in their clinical status by the 1-year postoperative mark. In a large PRO analysis of 909 patients undergoing lumbar surgery, for example, Adogwa et al.²⁵ found that that outcome measures obtained at 12 months postoperatively were highly predictive of and consistent with outcomes at 24 months.

The present study has important limitations. These data are not reflective of our comprehensive patient population, but were rather presented using a propensity matched analysis in order to more fully understand associations with PROMs. Furthermore, in an effort to focus on acute and subacute revisions, data was not analyzed beyond two-years postoperative and longer term insights are therefore not available. However, outcomes at one-year postoperative are likely representative of long-term follow-up for the majority of patients undergoing LD.²⁵ In addition, despite our propensity matching strategy, there was a trend towards a difference in the prevalence of lumbar pathology (central stenosis versus herniated nucleus pulposus) between the 2 cohorts. Given an inherent difference in the natural history and likelihood of recurrence for both of these pathologies, this may have influenced the degree of patient improvement for the respective cohorts.^{9,15}

CONCLUSION

LD surgery has generally been associated with reliable outcomes, but early identification of the few patients that may be at risk for requiring a revision surgery is critical. The findings of the present study suggest that although legacy outcome metrics may not provide insights, novel tools such as PROMIS-PF may serve a valuable role in predicting who is at risk. Furthermore, the 6-month follow-up period may be particularly valuable for counseling patients who are not experiencing improvement in their symptoms relative to their peers. Clinicians may use these findings to better identify and educate patients both before and after LD surgery in order to maximize the likelihood of an optimal outcome.

CONFLICT OF INTEREST

The authors have nothing to disclose.

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