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Recovery Trajectories After Lumbar Fusion Stratified by Baseline Patient-Reported Outcomes Measurement Information System Physical Function Disability Levels

JUSTIN J. TURCOTTE, PHD, MBA[1]; JANE C. BRENNAN, MS[1]; ANDREA H. JOHNSON, MSN, CRNP[1]; AND CHAD M. PATTON, MD, MS[1]

[1]*Luminis Health Anne Arundel Medical Center, Annapolis, MD, USA*

ABSTRACT

Background: Previous studies have identified patient and surgical factors associated with patient-reported outcomes measurement information system (PROMIS)-physical function (PF) minimal clinically important difference (MCID) rates after lumbar fusion, but investigation into the timing of MCID achievement remains limited. This study aimed to assess whether time to MCID achievement differed across patients presenting with mild, moderate, or severe disability as measured using the PROMIS-PF instrument.

Methods: A retrospective review of 144 patients undergoing 1- to 3-level lumbar fusion from 2020 to 2023 was performed. All patients completed PROMIS-PF surveys at baseline and 1 year postoperatively. Patients were classified as mild (PROMIS-PF > 40), moderate (30–40), or severe (<30) disability based on baseline PROMIS-PF T-scores. MCID achievement rates and time to MCID were compared across groups using univariate and multivariate analyses. Multivariate Cox proportional hazard models were used to assess the relationship between baseline disability and MCID achievement rates over time.

Results: Twenty (13.9%) patients presented with mild disability, 92 (63.9%) with moderate disability, and 32 (22.2%) with severe disability. The overall rate of 1-year postoperative MCID achievement was 59%. After adjusting for American Society of Anesthesiologists scores and Charlson Comorbidity Index, severe baseline disability was associated with increased odds of early MCID achievement (<90 days; OR = 2.95, $P = 0.015$) and shorter days to MCID achievement. In the adjusted Cox models, patients with severe baseline disability demonstrated increased MCID achievement at any time over the 1-year postoperative period when compared with the mild disability (HR = 3.52, $P = 0.005$) and moderate disability (HR = 1.85, $P = 0.020$) groups.

Conclusion: Patients presenting with severe disability were more likely to achieve clinically significant improvements in function across time points during the 1-year postoperative period. Furthermore, these patients demonstrated higher rates of early MCID achievement and less time to MCID than those with moderate or mild baseline disability. Utilization of PROMIS-PF may assist with preoperative patient selection and expectation setting.

Clinical Relevance: In the clinical setting, establishing realistic recovery expectations is a critical aspect of the surgeon-patient relationship. The data presented in the current study may be used in preoperative consultations to provide patients with a depiction of their potential improvement in physical function over time based on their baseline level of function. Postoperatively, the data may serve as a benchmark for assessing an individual's recovery trajectory compared to historically similar patients.

Level of Evidence: 4.

Lumbar Spine

Keywords: lumbar fusion, minimal clinically important difference, MCID, PROMIS, patient reported outcomes

INTRODUCTION

Approximately 266 million people have degenerative spine diseases and low back pain globally, representing 3.63% of the population.[1] For many patients whose symptoms do not improve with conservative treatment, lumbar fusion procedures provide significant symptom relief and improved quality of life.[2–5] Despite the efficacy of lumbar fusions in appropriately selected patients, the value of these procedures remains under scrutiny given their high volume and cost.[6] Therefore, continued investigation into patient and procedural factors affecting postoperative outcomes of lumbar fusion remains imperative to optimize the value of care provided.

The Patient-Reported Outcomes Measurement Information System (PROMIS) is a set of instruments developed by the National Institutes of Health in 2004, with the aim of improving the reporting of patient symptoms, function, and health-related quality of life.[7] Each PROMIS instrument generates a T-score with a population mean of 50 and an SD of 10, enhancing the

interpretability across measures.[7] The validity and reliability of various PROMIS domains, including physical function (PF), have been established in spine surgery populations, leading to their increased adoption over the past 2 decades.[8–10] In comparison to legacy outcome measures, the PROMIS instruments have multiple advantages including decreased floor and ceiling effects and the ability to decrease response burden through computer adaptive tests.[7,11–13]

To hold utility in practice, patient-reported outcome measures must reliably detect meaningful changes in health status. The minimal clinically important difference (MCID) of a measure represents the minimal amount of change that is important to the patient.[14] In prior studies of patients undergoing lumbar spine surgery, MCID values of a 3- to 8-point improvement on the PROMIS-PF instrument have been reported, depending on the calculation methodology.[10,15–19] Previous studies have identified patient and surgical factors associated with PROMIS-PF MCID rates after lumbar fusion, but investigation into the timing of MCID achievement remains sparse.[10,15,20,21] Therefore, the purpose of this study was to evaluate differences in 1-year recovery trajectories across lumbar fusion patients presenting with varying levels of preoperative PF limitations. Specifically, we aimed to assess whether time to MCID achievement differed across patients presenting with mild, moderate, or severe disability as measured using the PROMIS-PF instrument. We hypothesized that patients with severe disability at baseline would experience more rapid MCID achievement than those with mild or moderate functional limitations.

METHODS

This study was deemed exempt by the WCG Institutional Review Board, and a waiver of informed consent was granted.

Study Population

A retrospective observational study of 144 patients undergoing 1- to 3-level lumbar fusion (posterolateral fusion [PLF] or PLF + posterior/transforaminal lumbar interbody fusion) for degenerative pathologies from 1 June 2020 to 31 December 2023 was performed. All procedures were performed by 2 fellowship-trained orthopedic spine surgeons at a single institution. All patients included in the study completed the PROMIS-PF v2.0 short form 10 survey at clinic visits preoperatively and at 1 year postoperatively. The PROMIS-PF survey was provided to patients at all clinic visits over the study period.

Primary Outcome

The primary outcome of the study was the achievement of MCID on the PROMIS-PF survey at any time during the 1-year postoperative period. The MCID was defined as a 5-point improvement in PROMIS-PF T-scores from baseline. The 5-point threshold was selected because this represents a ½ SD improvement using the anchor-based method applied to the PROMIS population normative T-scores.[22] We elected to use the 5-point threshold rather than a ½ SD improvement from the baseline scores of the specific study population, which would have been a 2.9-point improvement, as a more conservative estimate of clinically significant improvement that is within the range of PROMIS-PF values previously reported for lumbar spine surgery patients.[10,15–19] Furthermore, the population rather than sample SD was selected to enhance external validity based on the relatively small sample size of 144 patients in this study. Time to MCID was defined as days from surgery to the first postoperative follow-up visit in which a PROMIS-PF T-score greater than 5 points higher than baseline was reported. The achievement of MCID within 90 days of surgery was noted as "early," and achievement of MCID between 91 and 365 days after surgery was noted as "late."

Secondary Outcomes

Additional clinical outcomes assessed included hospital length of stay (measured in hours and days), rates of discharge to skilled nursing facilities (SNFs), rates of 30-day emergency department returns and readmissions, and rates of revision fusion and other reoperations over the 1-year postoperative period.

Independent Variables

The primary independent variable of interest was baseline level of PF as measured by the PROMIS-PF instrument. In alignment with prior studies, levels were grouped into mild (PROMIS-PF T-scores > 40), moderate (30–40), and severe (<30) disability.[15,20] Patient demographics, including age, sex, body mass index, and race (classified as white vs non-white), patient-reported symptom type (axial only, radicular only, or axial and radicular), symptom frequency (intermittent or constant), change in symptoms (no change/improvement or worse), and symptom duration (≤1 year or >1 year), were extracted from the electronic medical record using

structured query language. Comorbidity burden at the time of surgery was quantified using American Society of Anesthesiologists (ASA) scores (categorized as <3 or ≥3) and Charlson Comorbidity Index (CCI) scores, measured as a continuous variable. History of prior spine surgery, procedure type, and primary diagnosis were manually reviewed and recorded from the electronic medical record by the study team.

Data Analysis

Baseline characteristics, PROMIS-PF scores, MCID achievement rates, and clinical outcomes were compared across the mild, moderate, and severe disability groups using univariate analyses including χ^2 tests for categorical variables and 1-way analysis of variance for continuous variables. The Fisher's exact test was performed when the assumptions of χ^2 were not met, and Bonferroni-adjusted post-hoc between-group comparisons were performed when statistically significant differences were observed across groups. Unadjusted Cox proportional hazard models were then created to assess the relationship between each independent variable and time to MCID achievement as hazard ratios with 95% confidence intervals. Variables reaching statistical significance in these models (ASA ≥ 3 and CCI) were included as covariates in the multivariate regression models. Linear and logistic regression models were created to assess time to MCID and achievement of early MCID, as these outcomes were significantly different across groups in the univariate analysis. Multivariate Cox proportional hazard models assessing the relationship between baseline disability classification and MCID achievement rates over time were then created. The cumulative incidence of MCID achievement over the 1-year postoperative period from the multivariate proportional hazard models was then depicted graphically for the entire population and stratified by level of baseline disability. All statistical analyses were performed in R Studio (Version 1.4.1717 2009–2021 RStudio, PBC, Boston, MA), and statistical significance was assessed at $P < 0.05$.

RESULTS

Of the 144 patients in the study, 20 (13.9%) presented with mild disability, 92 (63.9%) with moderate disability, and 32 (22.2%) with severe disability. Minimal differences in baseline characteristics were observed across groups, with the exception of significant differences in race ($P = 0.021$) and a primary diagnosis of spinal stenosis ($P = 0.035$; Table 1). Postdischarge outcomes were all similar across groups, while statistically significant differences in length of stay ($P = 0.016$ in hours; $P = 0.018$ in days) and rates of discharge to SNFs ($P = 0.013$) were observed, with the longest length of stay and the highest rate of SNF discharge occurring in the severe disability group (Table 2).

The average baseline PROMIS-PF scores ranged from 40.7 ± 7.1 in patients with mild disability to 26.2 ± 3.7 in patients with severe disability ($P < 0.001$). At 1-year follow-up, average PROMIS-PF scores increased across all groups, reaching 45.1 ± 7.3, 40.6 ± 7.9, and 38.4 ± 7.9 in the mild, moderate, and severe disability groups, respectively ($P = 0.011$). After Bonferroni adjustment, 1-year postoperative PROMIS-PF scores were significantly lower in the severe disability group when compared with the mild disability group. The overall rate of MCID achievement over the 1-year postoperative period was 59% and was statistically similar across groups. Significant differences in rates of early MCID achievement, which occurred in 25% of mild disability, 37% of moderate disability, and 59% of severe disability patients, were observed ($P = 0.027$), with the difference between mild and severe disability patients reaching pair-wise significance after Bonferroni adjustment. Days to MCID achievement were also significant across groups when evaluating MCID achievers only (mild: 142.4 ± 70.0, moderate: 112.2 ± 76.4, and severe: 72.8 ± 57.2, $P = 0.027$) and including all patients (ie, censored nonachievers; mild: 248.3 ± 116.7, moderate: 194.1 ± 126.7, and severe: 134.6 ± 119.0, $P = 0.005$). In both analyses, the difference between the severe and mild groups reached pair-wise significance after adjustment (Table 2).

In the unadjusted Cox models, ASA ≥ 3 (HR = 0.57, 95% CI: 0.37–0.88, $P = 0.011$) and higher CCI scores (HR = 0.85, 95% CI: 0.73–0.98, $P = 0.025$) were associated with lower rates of achievement at any given time point over the 1-year postoperative period. No other covariates demonstrated a statistically significant relationship with MCID achievement (Table 3).

After adjusting for ASA ≥ 3 and CCI, severe baseline disability was associated with increased odds of early MCID achievement (OR = 2.95, 95% CI: 1.23–7.04, $P = 0.015$) and shorter days to MCID when evaluating only patients achieving MCID ($\beta = -47.4$, 95% CI: −84.4 to −10.5, $P = 0.013$) and all patients ($\beta = -77.0$, 95% CI: −127.8 to −26.2, $P = 0.003$; Table 4). In the Cox proportional hazard model adjusting for ASA and CCI, patients with severe baseline disability demonstrated increased MCID achievement at any time over the 1-year postoperative period when compared with

Table 1. Baseline patient and operative characteristics by preoperative PROMIS-PF disability level.

Characteristic	Mild (n = 20)	Moderate (n = 92)	Severe (n = 32)	P
Demographics				
Age, y	66.0 ± 8.7	64.7 ± 11.2	67.2 ± 11.0	0.515
BMI	29.6 ± 6.3	31.4 ± 5.5	31.1 ± 4.9	0.423
Sex				0.329
Women	16 (80.0)	58 (63.0)	20 (62.5)	
Men	4 (20.0)	34 (37.0)	12 (37.5)	
Non-white race	7 (35.0)$_a$	10 (10.9)$_b$	7 (21.9)$_{a,b}$	**0.021**
ASA ≥3	6 (30.3)	52 (56.5)	17 (53.1)	0.098
CCI score	2.6 ± 1.8	2.5 ± 1.4	3.0 ± 1.8	0.293
Prior spine surgery				
Laminectomy	2 (10.0)	23 (25.0)	5 (15.6)	0.233
Fusion	2 (10.0)	10 (10.9)	2 (6.2)	0.749
Procedure type				
PLF	11 (55.0)	44 (47.8)	17 (53.1)	0.779
PLIF/TLIF	9 (45.0)	48 (52.2)	15 (46.9)	
Primary diagnosis				
Pseudarthrosis/hardware failure	0 (0)	4 (4.3)	0 (0)	0.766*
Degenerative disc disease	5 (25.0)	24 (26.1)	8 (25.0)	0.990
Degenerative spondylolisthesis	10 (50.0)	58 (63.0)	19 (59.4)	0.552
Spinal stenosis	5 (25.0)$_a$	6 (6.5)$_b$	5 (15.6)$_{a,b}$	**0.035***
Symptom type				
Axial only	1 (5.0)	8 (8.7)	3 (9.4)	
Radicular only	2 (10.0)	8 (8.7)	4 (12.5)	0.943
Axial and radicular	17 (85.0)	76 (82.6)	25 (78.1)	
Symptom frequency				
Intermittent	6 (30.0)	14 (15.2)	5 (15.6)	0.274
Constant	14 (70.0)	78 (84.8)	27 (84.4)	
Change in symptoms				
No change/better	13 (65.0)	46 (50.0)	11 (34.4)	0.090
Worse	7 (35.0)	46 (50.0)	21 (65.6)	
Symptom duration				
≤1 y	5 (25.0)	41 (44.6)	17 (53.1)	0.134
>1 y	15 (75.0)	51 (55.4)	15 (46.9)	

Abbreviations: ASA, American Society of Anesthesiologists; BMI, body mass index (kg/m^2); CCI, Charlson Comorbidity Index; PLF, posterolateral fusion; PLIF/TLIF, posterior lumbar interbody fusion/transforaminal lumbar interbody fusion; PROMIS-PF, patient-reported outcomes measurement information system-physical function.
Note: Data are presented as mean ± SD or n (%). Statistically significant values at $P < 0.05$ are in boldface.
Subscripts denote post-hoc Bonferroni adjusted comparisons. Different letters denote significant differences between groups.
*Denotes Fisher's Exact test

the mild disability (HR = 3.52, 95% CI: 1.48–8.42, P = 0.005) and moderate disability (HR = 1.85, 95% CI: 1.10–3.12, P = 0.020) groups. A statistically significant difference in MCID achievement over time was not observed between the moderate and mild disability groups (P = 0.113; Table 5). In the graphical depiction of the cumulative incidence of MCID, a steady increase in MCID rates was observed until approximately 200 days postoperatively, at which time a flattening of the curve appeared until 365 days (Figure 1). When stratified by baseline disability, the trend was similar overall, although patients in the severe disability group saw the most rapid rates of MCID achievement (Figure 2).

DISCUSSION

In the current study, approximately 69% of patients undergoing 1- to 3-level lumbar fusion for degenerative conditions with severe levels of physical impairment achieved clinically significant improvement in function within 1 year postoperatively, with 59% experiencing significant improvement by 3 months postoperatively. After adjusting for comorbidities, patients with severe baseline disability were more likely to achieve early MCID and had a shorter time to MCID achievement than those with mild or moderate disability. Furthermore, in the Cox models, patients with severe baseline disability were more likely to achieve MCID at any given time point over the 1-year postoperative period than those with mild or moderate disability. This occurred despite the longer hospitalizations and higher rates of discharge to SNF in the severe disability group. These findings demonstrate the utility of PROMIS-PF scores for assessing 1-year recovery trajectories after lumbar fusion and may be used to establish realistic patient expectations based on the severity of preoperative PF limitations.

Multiple prior studies have shown a relationship between greater preoperative disability and increased likelihood of experiencing clinically significant improvement in PROMIS scores after lumbar spine

Table 2. Patient-reported and clinical outcomes by preoperative PROMIS-PF disability level.

Variable	Mild (n = 20)	Moderate (n = 92)	Severe (n = 32)	P
PROMIS-PF				
Baseline PF	40.7 ± 7.1$_{a}$	34.3 ± 2.8$_{b}$	26.2 ± 3.7$_{c}$	**<0.001**
Last (1 y) postoperative PF	45.1 ± 7.3$_{a}$	40.6 ± 7.9$_{a,b}$	38.4 ± 7.9$_{b}$	**0.011**
MCID				
Early	5 (25.0)$_{a}$	34 (37.0)$_{a,b}$	19 (59.4)$_{b}$	**0.027**
Late	4 (20.0)	20 (21.7)	3 (9.4)	0.300
Never	11 (55.0)	38 (41.3)	10 (31.2)	0.237
Any MCID	9 (45.0)	54 (58.7)	22 (68.8)	0.237
Days to MCID (achievers only)	142.4 ± 70.0$_{a}$	112.2 ± 76.4$_{a,b}$	72.8 ± 57.2$_{b}$	**0.027**
Days to MCID (including censored non-achievers)	248.3 ± 116.7$_{a}$	194.1 ± 126.7$_{a,b}$	134.6 ± 119.0$_{b}$	**0.005**
Clinical outcome				
LOS hours	47.8 ± 29.8$_{a,b}$	50.8 ± 27.9$_{b}$	68.0 ± 37.7$_{a}$	**0.016**
LOS days	1.7 ± 1.2$_{a,b}$	1.8 ± 1.2$_{b}$	2.5 ± 1.6$_{a}$	**0.018**
SNF discharge	0 (0)$_{a,b}$	0 (0)$_{b}$	3 (9.4)$_{a}$	**0.013***
30-d ED return	1 (5.0)	10 (10.9)	0 (0)	0.122
30-d readmission	0 (0)	4 (4.3)	5 (15.6)	0.051
Repeat 1-y fusion	3 (15.0)	7 (7.6)	2 (6.2)	0.494
Other 1-y reoperation	1 (5.0)	5 (5.4)	3 (9.4)	0.708

Abbreviations: ED, emergency department; LOS, length of stay; MCID, minimal clinically important difference; PROMIS-PF, patient-reported outcomes measurement information system-physical function; SNF, skilled nursing facility.
Note: Data are presented as mean ± SD or n (%). Statistically significant values at $P < 0.05$ are in boldface.
Subscripts denote post-hoc Bonferroni-adjusted comparisons. Different letters denote significant differences between groups.
*Denote Fisher's Exact test

Table 3. Univariate Cox models: predictors of time to MCID achievement.

Predictor	HR	95% CI	P
Demographics			
Age	0.99	0.97–1.01	0.169
BMI	1.00	0.96–1.04	0.987
Sex	1.22	0.78–1.90	0.375
Non-white race	0.67	0.36–1.27	0.223
ASA ≥3	0.57	0.37–0.88	**0.011**
CCI score	0.85	0.73–0.98	**0.025**
Prior spine surgery			
Laminectomy	1.02	0.61–1.72	0.941
Fusion	0.80	0.37–1.73	0.566
Procedure type			
PLF	1.15	0.75–1.76	0.522
Primary diagnosis			
Pseudarthrosis/hardware failure	0.69	0.17–2.80	0.603
Degenerative disc disease	1.04	0.63–1.72	0.885
Degenerative spondylolisthesis	0.98	0.63–1.52	0.911
Spinal stenosis	1.10	0.57–2.13	0.777
Symptom type			
Axial only	1.28	0.62–2.66	0.506
Radicular only	0.86	0.40–1.87	0.706
Axial and radicular	0.95	0.54–1.66	0.862
Symptom frequency			
Constant	0.63	0.37–1.06	0.081
Change in symptoms			
Worse	1.10	0.72–1.69	0.657
Symptom duration			
>1 y	0.94	0.61–1.44	0.772
PROMIS-PF			
Baseline PF	0.95	0.92–0.98	**0.005**
Baseline disability			
Mild (40+)	0.57	0.28–1.13	0.109
Moderate (30–40)	0.88	0.56–1.36	0.557
Severe (<30)	1.81	1.11–2.95	**0.017**

Abbreviations: ASA, American Society of Anesthesiologists Score; BMI, body mass index; CCI, Charlson Comorbidity Index; MCID, minimal clinically important difference; PLF, posterolateral fusion.
Note: Statistically significant values at $P < 0.05$ are in boldface.

surgery,[10,16,23] and similar trends have been observed in other orthopedic surgery populations evaluated using both PROMIS and legacy outcome measures.[24–27] Rubery et al evaluated 78 patients undergoing lumbar discectomy with baseline and minimum 40-day postoperative PROMIS-PF scores (average follow-up of 12.6 weeks), finding that patients with preoperative PROMIS-PF scores <30 were the most likely to achieve MCID during this early postoperative period.[16] Our findings suggest that a similar relationship exists among lumbar fusion patients, as depicted by the nearly 3-times higher odds of achieving MCID within 3 months postoperatively among severe disability patients. In a sample of 138 patients undergoing lumbar decompression or

Table 4. Multivariate linear and logistic regression: time to MCID and early MCID achievement.

Predictors	β/OR	95% CI	P
Linear regression (β): days to MCID achievement (MCID achievers only)			
ASA ≥3	−13.1	−45.9 to 19.8	0.430
CCI score	9.5	−2.6 to 21.6	0.122
Severe disability	−47.4	−84.4 to −10.5	**0.013**
Linear regression (β): days to MCID achievement (all patients)			
ASA ≥3	28.0	−15.8 to 71.7	0.208
CCI score	14.8	0.56 to 29.0	**0.042**
Severe disability	−77.0	−127.8 to −26.2	**0.003**
Logistic regression (OR): early MCID achievement			
ASA ≥3	0.64	0.30–1.35	0.236
CCI score	0.76	0.59–0.98	**0.038**
Severe disability	2.95	1.23–7.04	**0.015**

Abbreviations: ASA, American Society of Anesthesiologists Score; CCI, Charlson Comorbidity Index; MCID, minimal clinically important difference.
Note: P values < 0.05 in bold.

Table 5. Multivariate Cox proportional hazard model: predictors of time to MCID.

Predictors	HR	95% CI	*P*
Demographics			
ASA ≥3	0.55	0.34–0.91	**0.018**
CCI score	0.88	0.75–1.03	0.118
PROMIS-PF baseline disability			
Moderate (30–40) vs mild	1.90	0.86–4.22	0.113
Severe (<30)			
vs mild	3.52	1.48–8.42	**0.005**
vs moderate	1.85	1.10–3.12	**0.020**

Abbreviations: ASA, American Society of Anesthesiologists Score; CCI, Charlson Comorbidity Index; MCID, minimal clinically important difference.
Note: P values < 0.05 in bold.

fusion procedures, lower levels of preoperative PF and greater pain interference were associated with higher rates of MCID achievement at 2 years postoperatively using the PROMIS instruments.[10] On multivariate analysis, a preoperative PROMIS-PF score below 31.6 resulted in a 64% probability of achieving MCID, suggesting that this may serve as a threshold for identifying patients most likely to experience clinically significant improvement.[10] Interestingly, in the current study, we did not observe differences in the absolute rates of MCID achievement over the 1-year postoperative period, which occurred in approximately 45%, 59%, and 69% of patients with mild, moderate, and severe preoperative disability, respectively. However, the significant differences observed within the Cox models highlight the important effect of time on PF improvements, particularly within the early recovery period.

Relatively fewer studies have assessed the relationship between preoperative disability and time to experience clinically significant improvement after lumbar fusion using the PROMIS-PF instrument. In a recent study of 147 patients undergoing lumbar fusion for degenerative pathology, Shaikh et al evaluated rates of early (<6 months) and late (>6 months) MCID achievement on the PROMIS-PF and pain interference measures. Patients with severe preoperative PROMIS-PF disability (defined as <30) were more likely to achieve MCID by final postoperative follow-up at 1–3 years compared with those with mild or moderate preoperative PROMIS-PF disability. However, baseline levels of disability were not associated with whether a patient was an early or late responder for achieving MCID.[15] Direct comparison of the results of the current study and those of Shaikh et al's study is limited by significant differences in patient populations, definitions of early achievement, and regression techniques employed. However, our results demonstrating higher rates of early (<3 months) MCID achievement, shorter time to MCID, and significantly higher likelihood of MCID achievement after accounting for time in the Cox models among patients with severe preoperative PROMIS-PF disability suggest that this subset of patients may experience greater early functional improvements than those with mild or moderate levels of preoperative disability.

A final important finding of the current study was the difference in actual PROMIS-PF at final follow-up

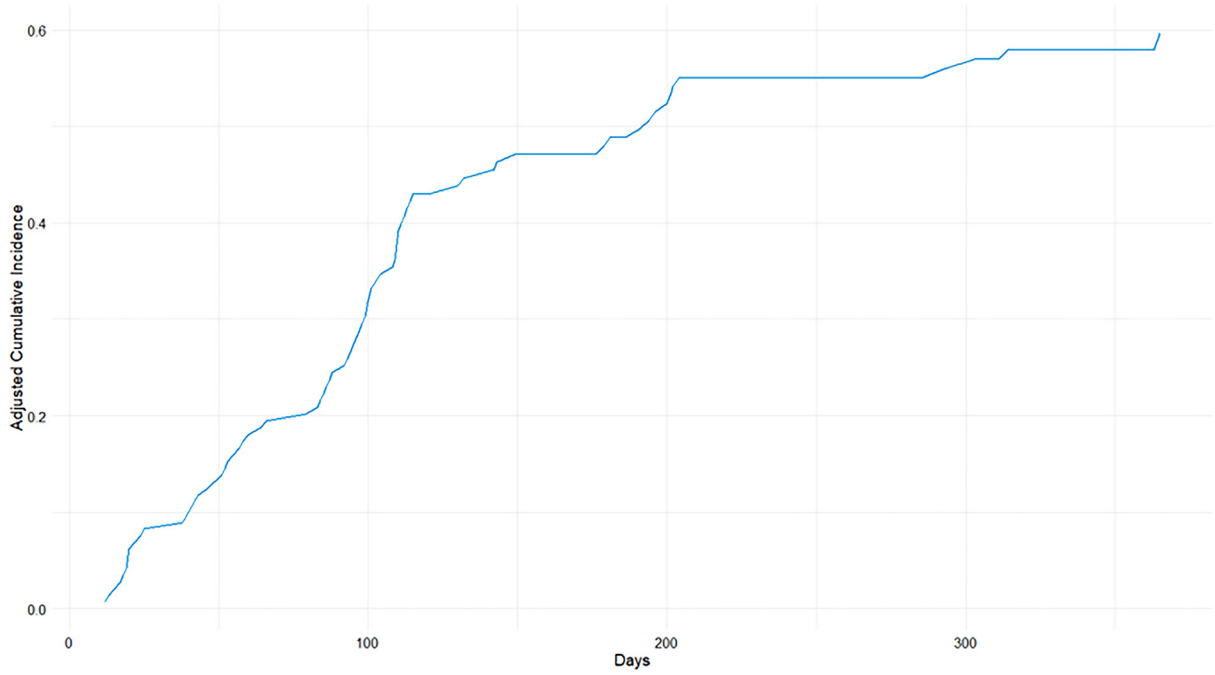

Figure 1. Adjusted cumulative incidence curve depicting time to minimal clinically important difference achievements for all patients.

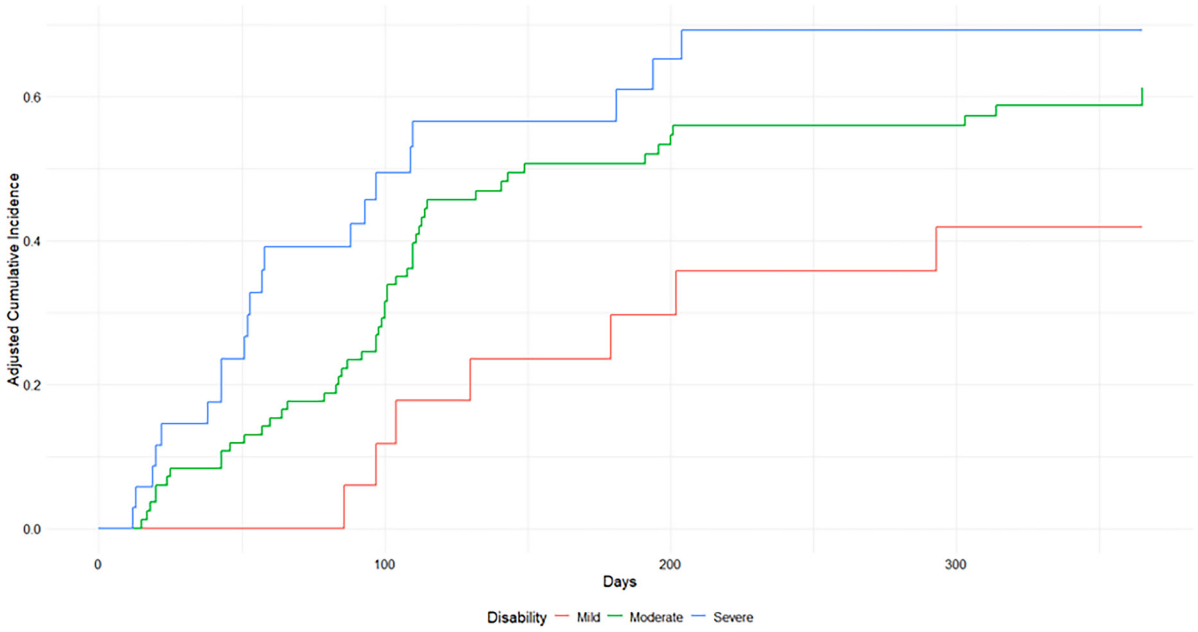

Figure 2. Adjusted cumulative incidence curve depicting time to minimal clinically important difference achievements stratified by baseline patient-reported outcomes measurement information system-physical function disability.

across the disability groups. While we observed a shorter time to clinically significant improvement among patients presenting with severe disability, these patients still achieved lower levels of postoperative function than those presenting with less severe functional impairment preoperatively. By 1 year postoperatively, this subset of patients improved to an average PROMIS-PF score of 38.4, indicating they would now be considered moderately disabled. This finding was not unexpected and is in alignment with prior studies showing lower levels of absolute postoperative function among patients presenting with more severe preoperative disability.[20,28] This information is critical when counseling patients preoperatively to set realistic expectations, as those with severe disability can reasonably expect to experience significant improvements in PF but should not anticipate a complete elimination of functional impairment.

Limitations

There are multiple limitations to the current study that warrant consideration. As a single institution retrospective study, our population may not be representative of the broader population of lumbar fusion patients, and selection bias may exist. Additionally, negative findings from the study should be interpreted with caution, as they may be a result of type II error due to the small sample size, particularly in the mild and severe disability groups. Furthermore, while we adjusted for ASA and CCI scores in our multivariate analyses due to these factors showing an association with time to MCID achievement, it is possible that other unmeasured variables confound our results. While this study focused on the relationship between baseline functional status and MCID achievement over time, further work is needed to incorporate additional clinical and radiographic findings into models to enhance the ability to predict the timing of functional improvements. In addition, this study evaluated outcomes over only the 1-year postoperative period, necessitating further investigation into whether the relationships identified remain over long-term follow-up.

Of further note, our evaluation of time to MCID is influenced by follow-up patterns. While consistent follow-up protocols were used during the study period, actual postoperative visits over the 1-year period varied. Although we attempted to mitigate the effect of loss to follow-up by ensuring all patients completed a 1-year postoperative visit, those following up more frequently within this time inherently had more opportunities to report PROMIS-PF scores meeting the MCID threshold. Finally, there are multiple limitations to the use of MCID as the primary endpoint of this study. Given the multitude of ways MCID values may be calculated and the relatively new nature of the PROMIS instruments, the threshold for MCID achievement is highly variable across studies.[10,15–19] While our MCID value of 5 points falls in the range of previously reported values and the population distribution-based method is well established, direct comparison between studies remains challenging due to the variability in definitions of clinically

significant improvement. Despite these limitations, we suggest the findings of the current study hold value as one of the more rigorous assessments of the relationship between preoperative PF and time to significant postoperative improvement measured using the PROMIS-PF instrument to date.

CONCLUSION

In our population, patients presenting with severe disability as measured by the PROMIS-PF instrument were more likely to achieve clinically significant improvements in function across time points during the 1-year postoperative period. Furthermore, these patients demonstrated higher rates of early MCID achievement and less time to MCID than those with moderate or mild baseline disability. These results highlight the differences in the early recovery trajectories among patients with varying levels of preoperative disability. While further research into the relationship between baseline disability and long-term outcomes is needed, utilization of PROMIS-PF in practice may assist with preoperative patient selection and expectation setting.

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Corresponding Author: Justin J. Turcotte, Luminis Health Anne Arundel Medical Center, 2000 Medical Parkway Suite 101, Annapolis, MD, 21401, USA; jturcotte@luminishealth.org

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