Physical Function at Presentation May Influence Postoperative Clinical Outcome Trajectory and Long Term Patient Satisfaction following Single-Level Lumbar Fusion

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INTRODUCTION: This study aims to compare patient-reported outcome measures (PROMS), postoperative patient reported satisfaction, and minimum clinically important difference (MCID) achievement following lumbar fusion in patients stratified by their preoperative Patient-Reported Outcomes Measurement Information System-Physical Function (PROMIS-PF) score.

METHODS: Patients who underwent a primary, single-level anterior, lateral, or transforaminal lumbar fusion procedure with posterior instrumentation were retrospectively included in this study. The two propensity score matched cohorts were stratified by a preoperative PROMIS-PF score of ≥35. Exclusion criteria was set as revision procedures or those indicated for infection, trauma, or malignancy, or if patients failed to complete a preoperative PROMIS-PF survey. Patient demographics, perioperative characteristics, postoperative patient reported satisfaction scores and complications, and PROMs were collected. PROMs were administered preoperatively and 6 weeks, 12 weeks, 6 months, and 1 year postoperatively and included Visual Analogue Scale (VAS) for back and leg pain, Oswestry Disability Index (ODI), 12-Item Short Form Physical and Mental Composite Score (SF-12 PCS/MCS), and PROMIS-PF. Postoperative patient satisfaction surveys consisted of the ODI for sleep, lift, walk, stand, sex, and travel, and utilized the VAS scoring system for back pain, leg pain, and disability.

RESULTS:

113 patients were included with 65 in the preoperative PROMIS-PF ≥35 cohort. The PROMIS-PF <35 cohort demonstrated increased VAS pain scores and narcotic consumption on postoperative day (POD) 0 and 1, improvement from preoperative baseline to the 1 year time point for all PROMs collected at all postoperative time points except for SF-12 MCS at 6 weeks, 12 weeks, and 1 year, and a greater proportion achieving MCID at 6 weeks for VAS back, VAS leg, ODI, and SF-12 MCS, with the addition of VAS leg at 12 weeks and overall (p ≤0.044, all). Cohorts demonstrated differences between all preoperative PROM scores except for SF-12 MCS, and postoperative differences for the following PROMs: VAS back at 12 weeks and 6 months, VAS leg at 6 weeks and 6 months, PROMIS-PF and ODI at all postoperative time points, SF-12 MCS at 6 weeks and 12 weeks, SF-12 PCS at 6 weeks, 12 weeks, and 6 months (p ≤0.045, all), which all favored the PROMIS-PF ≥35 cohort. The PROMIS-PF ≥35 cohort demonstrated improvement from preoperative baseline to the 1-year time point for all PROMs collected at all postoperative time points except for SF-12 MCS at 1 year, SF-12 PCS and PROMIS-PF at 6 weeks, greater postoperative satisfaction for VAS back at 12 weeks, ODI at 6 weeks, 12 weeks, and 1 year, and ODI for the following categories: lifting and walking at 12 weeks, standing and sexual at 6 and 12 weeks, and travel at 6 weeks, 12 weeks, and 1 year (p ≤0.049, all).

DISCUSSION AND CONCLUSION:

Patients with poor preoperative physical function demonstrated significantly inferior back and leg pain up-to 6 months, and significantly inferior disability and physical function up-to 1 year. However, patients with both “poor” and “fair” physical function preoperatively demonstrated significant long term clinical improvement from their respective preoperative baselines at 1-year postoperatively for back pain, leg pain, physical function, and general disability. Additionally, patients with poorer preoperative physical function consumed larger quantities of narcotics on POD 0 and 1 and reported greater postoperative VAS pain scores on POD 0 and 1. Finally, patients with inferior preoperative physical function reported inferior long term postoperative satisfaction with their disability levels. By stratifying patients by their PROMIS-PF scores in the preoperative period, surgeons may be able to better predict expected postoperative clinical improvement which may aid them in preoperative patient counseling as well as promoting realistic patient expectations for patients undergoing single level lumbar fusion.

Table 1. Patient Demographics

	Total (n=113)	PROMIS-PF<35 (n=48)	PROMIS-PF >=35 (n=65)	*p-value
Age (mean ±SD)	54.6 ± 9.2	54.4 ± 8.8	54.7 ± 9.5	0.850
Gender				
Female	50.4% (57)	54.2% (26)	47.7% (31)	0.496
Male	49.6% (56)	45.8% (22)	52.3% (34)	
Body Mass Index Category (BMI)				0.061
<30 kg/m²	54.0% (61)	43.8% (21)	61.5% (40)	
≥30 kg/m²	46.0% (52)	56.2% (27)	38.5% (25)	
Body Mass Index (Mean ± SD)	30.8 ± 5.9	31.8 ± 6.7	30.1 ± 5.1	0.115
Ethnicity				
Caucasian	78.7% (89)	83.3% (40)	75.4% (49)	
African-American	5.3% (6)	6.3% (3)	4.6% (3)	
Hispanic	9.7% (11)	8.3% (4)	10.8% (7)	
Asian	4.4% (5)	2.1% (1)	6.2% (4)	0.551
Other	1.8% (2)	0.0% (0)	3.1% (2)	
Smoking Status				
Non-Smoker	87.6% (99)	87.5% (42)	87.7% (57)	0.976
Smoker	12.4% (14)	12.5% (6)	12.3% (8)	
Diabetes				
Non-Diabetic	91.2% (103)	93.4% (45)	89.2% (58)	0.403
Diabetic	8.8% (10)	6.4% (3)	10.8% (7)	
Hypertensive Status				
Non-Hypertensive	62.8% (71)	68.8% (33)	58.5% (38)	0.263
Hypertensive	37.2% (42)	31.2% (15)	41.5% (27)	
ASA Classification				
<3	85.6% (95)	87.5% (42)	84.1% (53)	0.616
>= 3	14.4% (16)	12.5% (6)	15.9% (10)	
Insurance				
Medicare/Medicaid	0.9% (1)	2.1% (1)	-	
Workers' Compensation	20.4% (23)	27.1% (13)	15.4% (10)	0.144
Private	78.8% (89)	70.8% (34)	84.6% (55)	

ASA = American Society of Anesthesiologists
Boldface indicates statistical significance

Table 2. Perioperative Characteristics

	Total (n=113)	PROMIS-PF<35 (n=48)	PROMIS-PF >=35 (n=65)	*p-value
Spinal Pathology				
Central Stenosis	94.7% (107)	93.8% (45)	95.4% (62)	0.702
Foraminal Stenosis	82.3% (93)	79.2% (38)	84.6% (55)	0..453
Degenerative Spondylolisthesis	54.0% (61)	50.0% (24)	57.0% (37)	0.465
Isthmic Spondylolisthesis	29.2% (33)	25.0% (12)	32.3% (21)	0.398
Degenerative Scoliosis	14.2% (16)	18.8% (9)	10.8% (7)	0.229
Recurrent Herniated nucleus Pulposus	9.7% (11)	8.3% (4)	10.8% (7)	0.666
Fusion Procedure				
MIS-TLIF	56.6% (64)	62.5% (30)	52.3% (34)	0.187
ALIF	23.0% (26)	14.6% (7)	29.2% (19)	
LLIF	20.4% (23)	22.9% (11)	18.5% (12)	
Fusion Level				**0.025**
L3-L4	7.0% (8)	14.6% (7)	1.5% (1)	
L4-L5	49.6% (56)	47.9% (23)	50.8% (33)	
L5-S1	43.4% (49)	37.5% (18)	47.7% (31)	
Operative Time (mean ±SD; min)	128.2 ±33.8	126.6 ± 35.8	129.5 ± 32.5	0.659
Estimated Blood Loss (mean ±SD; mL)	47.7 ± 28.5	50.0 ± 32.8	46.0 ± 25.0	0.490
Length of Stay (mean ±SD; hours)	25.6 ± 17.2	29.0 ± 19.5	23.1 ± 14.8	0.072
1-year Arthrodesis	91.4%	88.8%	94.1%	0.801
Post-operative Day of Discharge (POD)				
POD0	27.9% (31)	22.9% (11)	31.8% (20)	0.224
POD1	55.9% (62)	52.1% (25)	58.7% (37)	
POD2	13.5% (15)	20.8% (10)	7.9% (5)	
POD3	1.8% (2)	2.1% (1)	1.6% (1)	
POD4	0.9% (1)	2.08% (1)	0.0% (0)	
Postoperative VAS Pain Score				
POD0	5.1 ± 1.8	5.7 ± 1.4	4.4 ± 2.0	**0.004**
POD1	4.8 ± 1.6	5.3 ± 1.4	4.0 ± 1.6	**0.004**
Postoperative Narcotic Consumption (OME)				
POD0	55.0 ± 27.7	62.7 ± 26.1	49.0 ± 27.9	**0.009**
POD1	31.3 ± 28.9	40.9 ± 31.8	24.3 ± 24.0	**0.002**

OME = Oral Morphine Equivalents; POD = Postoperative Day
Re-hospitalization = Defined as returning to hospital within 6-weeks of surgery with a surgical related complaint.
*p-value calculated using Student's t-test for continuous variables and chi-square for categorical variables
Boldface indicates statistical significance

Table 3. Patient Reported Outcome Measures

	PROMIS-PF<35 Mean ±SD	PROMIS-PF<35 Post-operative PROM Improvement	PROMIS-PF >=35 Mean ±SD	PROMIS-PF >=35 Post-operative PROM Improvement	*p-value
VAS Back					
Preoperative	7.1 ± 2.2	-	5.0 ± 2.4	-	**<0.001**
6-weeks	4.2 ± 2.0	**<0.001**	3.4 ± 2.4	**<0.001**	0.101
12-weeks	4.0 ± 2.4	**<0.001**	3.0 ± 2.3	**<0.001**	**0.031**
6-months	4.6 ± 2.9	**<0.001**	2.4 ± 2.4	**<0.001**	**<0.001**
1-year	3.6 ± 3.0	**<0.001**	2.1 ± 2.1	**0.014**	0.091
VAS Leg					
Preoperative	6.7 ± 2.6	-	4.1 ± 3.1	-	**<0.001**
6-weeks	3.4 ± 2.6	**<0.001**	2.2 ± 2.7	**0.001**	**0.033**
12-weeks	2.8 ± 3.2	**<0.001**	2.1 ± 2.5	**<0.001**	0.243
6-months	3.9 ± 3.4	**<0.001**	1.8 ± 2.4	**<0.001**	**0.002**
1-year	3.3 ± 3.5	**<0.001**	2.1 ± 2.4	**0.029**	0.204
ODI					
Preoperative	51.2 ± 13.3	-	30.7 ± 12.2	-	**<0.001**
6-weeks	38.1 ± 13.9	**<0.001**	25.7 ± 19.1	**0.021**	**<0.001**
12-weeks	32.6 ± 17.6	**<0.001**	19.3 ± 13.0	**<0.001**	**<0.001**
6-months	32.5 ± 19.3	**<0.001**	17.4 ± 14.5	**<0.001**	**<0.001**
1-year	28.3 ± 24.7	**0.003**	14.8 ± 11.9	**<0.001**	**0.041**
SF-12 MCS					
Preoperative	48.0 ± 12.1	-	51.2 ± 11.0	-	0.139
6-weeks	50.3 ± 11.2	0.254	55.1 ± 10.9	**0.008**	**0.045**
12-weeks	52.7 ± 10.9	0.070	57.7 ± 8.8	**<0.001**	**0.022**
6-months	54.3 ± 11.5	**0.003**	53.9 ± 10.7	**0.023**	0.891
1-year	53.8 ± 9.0	0.113	54.9 ± 11.8	0.078	0.707
SF-12 PCS					
Preoperative	25.1 ± 5.9	-	34.0 ± 7.2	-	**<0.001**
6-weeks	28.7 ± 7.3	**0.004**	34.8 ± 9.3	0.966	**0.001**
12-weeks	32.4 ± 10.1	**<0.001**	39.1 ± 8.8	**0.007**	**0.002**
6-months	34.2 ± 10.2	**<0.001**	41.2 ± 10.7	**<0.001**	**0.008**
1-year	37.7 ± 11.5	**<0.001**	42.7 ± 10.6	**<0.001**	0.125
PROMIS-PF					
Preoperative	30.3 ± 3.4	-	39.6± 3.4	-	**<0.001**
6-weeks	34.7 ± 6.1	**<0.001**	40.2 ± 6.8	0.932	**<0.001**
12-weeks	39.1 ± 9.2	**<0.001**	43.6 ± 5.1	**<0.001**	**0.012**
6-months	40.3 ± 6.6	**<0.001**	46.4 ± 5.9	**<0.001**	**0.001**
1-year	39.0 ± 7.6	**<0.001**	50.0 ± 10.3	**0.002**	**0.003**

*p-values calculated using paired samples t-test to determine postoperative improvement
Boldface indicates statistical significance

Table 4. MCID Achievement

PROM	PROMIS-PF<35	PROMIS-PF >=35	*p-value
VAS Back			
6-weeks	60.0%	38.0%	**0.032**
12-weeks	54.1%	46.9%	0.514
6-months	44.1%	58.1%	0.221
1-year	61.9%	44.4%	0.276
Overall	72.9% (35)	62.9% (39)	0.267
VAS Leg			
6-weeks	57.8%	34.0%	**0.020**
12-weeks	64.9%	40.0%	**0.022**
6-months	47.1%	38.6%	0.455
1-year	57.1%	33.3%	0.137
Overall	70.8% (34)	46.0% (29)	**0.009**
ODI			
6-weeks	44.4%	25.0%	**0.044**
12-weeks	46.0%	38.0%	0.457
6-months	51.4%	50.0%	0.900
1-year	47.6%	55.6%	0.621
Overall	70.8% (34)	54.0% (34)	0.071
SF-12 MCS			
6-weeks	14.0%	32.6%	**0.041**
12-weeks	18.9%	28.3%	0.323
6-months	46.4%	25.6%	0.070
1-year	32.0%	21.7%	0.424
Overall	45.8% (22)	40.3% (25)	0.562
SF-12 PCS (2.5)			
6-weeks	46.5%	34.1%	0.238
12-weeks	67.6%	58.7%	0.406
6-months	78.6%	67.4%	0.308
1-year	72.0%	65.2%	0.613
Overall	83.3% (40)	74.2% (46)	0.250
PROMIS-PF			
6-weeks	36.6%	33.3%	0.748
12-weeks	58.1%	50.0%	0.504
6-months	77.3%	63.3%	0.282
1-year	73.9%	62.5%	0.401
Overall	74.5% (35)	68.4% (39)	0.498

*p-value calculated with chi-squared analysis
Boldface indicates statistical significance

Table 5. Satisfaction Score By PROMIS-PF Preoperative Cutoff

PROM	PROMIS-PF<35 (Mean ± SD)	PROMIS-PF >=35 (Mean ± SD)	*p-value
VAS leg			
6-weeks	6.2 ± 3.3	7.4 ± 3.2	0.087
12-weeks	7.2 ± 3.6	7.4 ± 3.0	0.729
6-months	7.5 ± 3.3	6.8 ±3.6	0.368
1-year	6.4 ± 4.2	7.4 ± 3.2	0.260
VAS back			
6-weeks	6.1 ± 2.8	7.1 ± 3.2	0.117
12-weeks	6.3 ± 3.1	7.6 ± 2.3	**0.034**
6-months	6.6 ± 3.1	5.9 ± 3.7	0.358
1-year	6.0 ± 3.5	7.2 ± 3.7	0.172
ODI			
6-weeks	5.7 ± 2.1	7.1 ± 2.1	**0.002**
12-weeks	6.3 ±2.7	7.6 ± 1.7	**0.007**
6-months	6.6 ± 2.7	6.6 ± 3.0	0.900
1-year	6.7 ± 2.7	7.9 ± 2.2	**0.041**

*p-values calculated using Student's t-test
Boldface indicates statistical significance

Table 6. Individual Item Satisfaction Score By Preoperative PROMIS-PF Cutoff

ODI satisfaction Individual categories	PROMIS-PF<35	PROMIS-PF >=35	*p-value
Sleep Satisfaction			
6-weeks	6.1 ± 2.5	7.1 ± 2.6	0.063
12-weeks	6.3 ± 3.2	7.4 ± 2.4	0.071
6-months	6.8 ± 3.1	6.8 ± 3.4	0.947
1-year	6.8 ± 3.3	8.0 ± 2.3	0.081
Lift Satisfaction			
6-weeks	4.6 ± 2.1	5.6 ± 3.0	0.076
12-weeks	5.6 ± 2.8	6.7 ± 2.3	**0.049**
6-months	6.2 ± 2.6	6.3 ± 3.4	0.984
1-year	6.5 ± 3.0	7.7 ± 3.0	0.101
Walk Satisfaction			
6-weeks	5.8 ± 2.8	6.9 ± 3.0	0.062
12-weeks	6.4 ± 3.1	7.8 ± 2.1	**0.014**
6-months	6.7 ± 3.1	6.8 ± 3.4	0.819
1-year	6.9 ± 3.3	8.0 ± 2.7	0.119
Stand Satisfaction			
6-weeks	5.3 ± 2.6	7.5 ± 2.5	**<0.001**
12-weeks	6.1 ± 3.1	7.5 ± 2.3	**0.011**
6-months	6.2 ± 3.2	6.7 ± 3.3	0.503
1-year	6.3 ± 3.1	7.3 ±3.2	0.169
Sex Satisfaction			
6-weeks	4.9 ± 3.1	7.0 ± 2.9	**0.001**
12-weeks	6.0 ± 3.6	7.4 ± 3.0	**0.047**
6-months	6.1 ± 3.5	6.6 ± 3.6	0.528
1-year	6.3 ± 3.4	8.2 ± 2.9	0.010
Travel Satisfaction			
6-weeks	5.7 ± 2.5	7.4 ± 2.5	**0.002**
12-weeks	6.2 ± 3.1	7.8 ± 2.5	**0.011**
6-months	6.8 ± 2.9	6.7 ± 3.4	0.926
1-year	6.7 ± 3.4	8.2 ± 2.1	**0.025**

Boldface indicates statistical significance
*p-values calculated using Student's t-test