Preoperative Back Pain Severity Influences Postoperative Clinical Outcomes and Trajectory in Patients undergoing Lateral Lumbar Interbody Fusion

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INTRODUCTION: The Visual Analog Scale (VAS) is a frequently used and validated instrument for assessing a patient's self-perceived lower back and leg pain and is often employed to assess the efficacy of lumbar surgical intervention. Our study seeks to assess how preoperative severity of presenting lumbar back pain may influence postoperative clinical trajectory and patient-reported outcome measures (PROMs) following lateral lumbar interbody fusion (LLIF).

METHODS:

A prospectively maintained surgical database was retrospectively reviewed for lumbar operations between June 2005 and December 2021. Patients with primary LLIF procedures were included while those with incomplete preoperative VAS back surveys, or had surgery indicated for infectious, malignant, or traumatic etiologies were excluded. PROMs were administered at preoperative and various postoperative time points and included physical function, pain, and disability. Postoperative complications were collected for each group as well. Patients were grouped into two cohorts, dependent on preoperative VAS back scores of <7 for mild-moderate pain or ≥7 indicative of severe back pain. Demographic and perioperative characteristics were compared among groups using chi-square and Student's t-test for categorical and continuous variables, respectively. Mean PROM scores were compared between cohorts at each time point utilizing a unpaired Student's t-test. Postoperative improvement from preoperative baseline within each cohort was assessed with paired samples t-test. Achievement of Minimum Clinical Important Difference (MCID) was determined by comparing ΔPROM scores to previously established threshold values. MCID achievement rates were compared between groups with chi-squared analysis.

RESULTS: The patient cohort consisted of 199 patients with 84 patients in VAS back Preoperative <7. The only demographic difference of note is the higher rate of hypertension ($p<0.029$) in the VAS back Preoperative <7 cohort. Majority of patients in both cohorts had presenting spinal pathology of degenerative spondylolisthesis with concomitant central stenosis. A significantly greater proportion of patients in the VAS back preoperative <7 cohort reported central and foraminal stenosis. No significant differences were noted between cohorts for operative duration, estimated blood loss, or postoperative day of discharge. Patients in the severe back pain cohort demonstrated significantly greater mean postoperative length of stay, greater postoperative VAS pain scores on POD0 and 1, and greater postoperative narcotic consumption on POD1 ($p\leq0.049$, all). Rate of postoperative complications did not differ between cohorts. Preoperative mean PROM scores were significantly different for all PROMs collected. Cohorts demonstrated significant mean postoperative differences for the following PROMs at the following postoperative time points: VAS back at 6 weeks, 12 weeks, 6 months, and 2 years, VAS leg at 6 months, ODI at 6 weeks, 12 weeks, 6 months, and 2 years, SF-12 PCS at 6 months, and PROMIS-PF at 12 weeks, 6 months, and 1 year ($p\leq0.049$, all). The Preop VAS back <7 patient cohort showed improvements from preoperative to 2 years for all PROMs collected at postoperative timepoints except for VAS leg at 1-year, ODI at 6 weeks, SF-12 PCS at 6 weeks, and PROMIS-PF at 6 weeks. Preop VAS back ≥7 patient cohort demonstrated improvement in this time period for all PROMs collected at all postoperative timepoints. Patients in the VAS back ≥7 patient cohort demonstrated greater proportion achieving MCID for VAS back at 6 weeks, 12 weeks, 1 year, and overall as well as for VAS leg at 6 weeks ($p\leq0.043$, all).

DISCUSSION AND CONCLUSION:

Patients in both preoperative back pain severity cohorts demonstrated significant long-term clinical improvement from their respective preoperative baselines at 2-years postoperatively for back pain, leg pain, physical function, and general disability. Patients with severe preoperative back pain (VAS >7), however, demonstrated significantly inferior short (6weeks-6months) and long-term (2 years) mean outcome scores for back pain and general disability. 2-year mean outcome scores for leg pain and physical function were similar between cohorts. Results from our study may be used by surgeons to understand differing postoperative trajectories of patients undergoing LLIF stratified by back pain severity.

Table 1. Patient Demographics

	Total (n=199)	**VAS- Back <7 (n=84)**	**VAS- Back≥7 (n=115)**	***p-value**
Age (mean±SD)	59.6 ± 11.6	60.5 ± 11.2	58.9 ± 11.9	0.323
Gender				
Female	48.2% (96)	42.9% (36)	52.2% (60)	0.194
Male	51.8% (103)	57.1% (48)	47.8% (55)	
Body Mass Index (Mean ± SD)				0.069
	30.3 ± 6.1	29.4 ± 5.7	30.9 ± 6.2	
Ethnicity				
Caucasian	80.8% (160)	83.1% (69)	79.1% (91)	
African American	6.6% (13)	6.0% (5)	6.9% (8)	
Hispanic	7.1% (14)	4.8% (4)	8.7% (10)	
Asian	2.0% (4)	2.4% (2)	1.7% (2)	0.862
Other	3.5% (7)	3.6% (3)	3.5% (4)	
Diabetes				
Non-Diabetic	85.9% (171)	86.9% (73)	85.2% (98)	0.735
Diabetic	14.1% (28)	13.1% (11)	14.8% (17)	
Smoking Status				
Non-Smoker	85.3% (168)	82.9% (68)	86.9% (100)	0.431
Smoker	14.7% (29)	17.1% (14)	13.0% (15)	
Hypertensive Status				
Non-Hypertensive	53.5% (106)	62.7% (52)	46.9% (54)	**0.029**
Hypertensive	46.5% (92)	37.4% (31)	53.0% (61)	
ASA Classification				
<3	70.1% (138)	68.7% (57)	71.1% (81)	0.719
≥3	29.9% (59)	31.3% (26)	28.9% (33)	
CCI Score (Mean ± SD)	3.1 ± 2.2	3.3 ± 2.4	2.9 ± 2.1	0.224
Insurance				
Medicare/Medicaid	21.1% (42)	15.5% (13)	25.2% (29)	
Workers' Compensation	16.1% (32)	11.9% (10)	19.1% (22)	0.050
Private	62.8% (125)	72.6% (61)	55.7% (64)	

ASA = American Society of Anesthesiologists
CCI = Charlson Comorbidity Index
*p-value calculated using Student's t-test for continuous variables and chi-square for categorical variables
Boldface indicates statistical significance

Table 2. Perioperative Characteristics

	Total (n=199)	**VAS- Back <7 (n=84)**	**VAS- Back ≥7 (n=115)**	***p-value**
Spinal Pathology				
Central Stenosis	86.9% (173)	92.9% (78)	82.6% (95)	**0.034**
Foraminal Stenosis	38.2% (76)	46.4% (39)	32.2% (37)	**0.041**
Herniated Nucleus				0.205
Pulposus	7.5% (15)	4.8% (4)	9.6% (11)	
Degenerative				0.450
Spondylolisthesis	50.8% (101)	47.6% (40)	53.0% (61)	
Degenerative Scoliosis	32.2% (64)	36.9% (31)	28.7% (33)	0.221
Isthmic Spondylolisthesis	10.1% (20)	15.5% (13)	6.1% (7)	0.080
Number of Operative Levels				0.242
Single Level	73.1% (144)	77.4% (65)	69.9% (79)	
Multiple Levels	26.9% (53)	22.6% (19)	30.1% (34)	
Operative Time (Mean±SD;				0.395
min)	163.3 ± 90.5	156.8 ± 87.0	167.9± 93.0	
Estimated Blood Loss				0.673
(Mean±SD; mL)	96.8 ± 176.4	103.1 ± 250.8	92.0 ± 84.8	
1-year arthrodesis	99.1% (112)	97.2% (36)	100.0% (75)	-
Length of Stay (Mean±SD;				**0.011**
hours)	48.3 ± 35.1	40.6 ± 31.8	53.9 ± 36.3	
Post-operative Day of				
Discharge (POD)				
POD0	11.3% (21)	14.1% (11)	9.3% (10)	0.129
POD1	36.6% (68)	42.3% (33)	32.4% (35)	
POD2	23.1% (43)	26.9% (21)	20.4% (22)	
POD3	14.5% (27)	7.7% (6)	19.4% (21)	
POD4	8.6% (16)	6.4% (5)	10.2% (11)	
Postoperative VAS Pain				
Score				
POD0	5.4 ± 1.9	4.8 ± 1.9	5.7 ± 1.9	**0.008**
POD1	4.8 ± 1.8	4.2 ± 1.3	5.1 ± 1.9	**0.013**
Postoperative Narcotic				
Consumption (OME)				
POD0	61.2 ± 41.1	54.5 ± 32.5	66.0 ± 45.9	0.051
POD1	47.5 ± 47.6	39.7 ± 32.2	53.2 ± 55.7	**0.049**

OME = Oral Morphine Equivalents; POD = Postoperative Day
Re-hospitalization = Defined as returning to hospital within 6-weeks of surgery with a surgical related complaint.
Boldface indicates statistical significance

Table 3. Postoperative Complications

Complication	**Total (n=199)**	**VAS- Back <7 (n=84)**	**VAS- Back ≥7 (n=115)**	***p-value**
Reintubation	0.0% (0)	0.0% (0)	0.0% (0)	-
Urinary Retention	6.0% (12)	9.5% (8)	3.5% (4)	0.077
Urinary Tract Infection	0.0% (0)	0.0% (0)	0.0% (0)	-
Acute Renal Failure	0.0% (0)	0.0% (0)	0.0% (0)	-
Altered Mental Status	2.0% (4)	0.0% (0)	3.5% (4)	0.084
VTE	0.0% (0)	0.0% (0)	0.0% (0)	-
Pulmonary Embolism	0.5% (1)	0.6% (1)	0.0% (0)	0.672
Pneumothorax	0.5% (1)	0.0% (0)	0.9% (1)	0.392
Pneumonia	0.5% (1)	0.0% (0)	0.9% (1)	0.392
Atelectasis	1.5% (3)	0.0% (0)	2.6% (3)	0.136
Pleural Effusion	0.5% (1)	0.0% (0)	0.9% (1)	0.392
Arrhythmia	0.5% (1)	1.2% (1)	0.0% (0)	0.241
Ileus	2.5% (5)	0.0% (0)	4.4% (5)	0.053
Nausea / Vomiting	7.5% (15)	4.8% (4)	9.6% (11)	0.205
Fever of Unknown				0.392
Origin	10.6% (21)	7.1% (6)	13.0% (15)	

VTE = venous thromboembolism

Table 4. Patient Reported Outcome Measures

	VAS-Back <7 Mean±SD	**VAS-Back <7** Post-operative PROM Improvement	**VAS-Back ≥7** Mean±SD	**VAS-Back ≥7** Post-operative PROM Improvement	***p-value**
VAS Back					
Preoperative	4.7 ± 1.7	-	8.3 ± 0.9	-	**<0.001**
6-weeks	3.3 ± 1.9	**<0.001**	4.2 ± 2.5	**<0.001**	**0.012**
12-weeks	2.6 ± 2.2	**<0.001**	3.6 ± 2.7	**<0.001**	**0.017**
6-months	2.0 ± 2.3	**<0.001**	3.5 ± 2.7	**<0.001**	**0.003**
1-year	3.5 ± 3.0	**0.038**	3.6 ± 2.9	**<0.001**	0.841
2-year	3.0 ± 2.6	**<0.001**	5.8 ± 3.4	**0.006**	**0.049**
VAS Leg					
Preoperative	4.8 ± 2.5	-	6.9 ± 2.2	-	**<0.001**
6-weeks	2.9 ± 2.7	**<0.001**	3.8 ± 2.5	**<0.001**	0.117
12-weeks	1.9 ± 2.2	**<0.001**	3.1 ± 2.8	**<0.001**	0.064
6-months	1.9 ± 2.6	**<0.001**	3.5 ± 2.7	**0.002**	**0.026**
1-year	3.1 ± 3.5	0.060	3.6 ± 2.9	**<0.001**	0.593
2-year	2.7 ± 2.7	**0.018**	4.9 ± 3.5	**0.002**	0.122
ODI					
Preoperative	32.9 ± 13.0	-	49.0 ± 15.0	-	**<0.001**
6-weeks	32.6 ± 16.7	0.981	39.1 ± 16.4	**<0.001**	**0.045**
12-weeks	21.1 ± 16.6	**<0.001**	35.4 ± 20.9	**<0.001**	**0.001**
6-months	19.1 ± 14.9	**<0.001**	29.6 ± 18.7	**<0.001**	**0.010**
1-year	24.8 ± 21.3	**0.019**	36.4 ± 25.6	**0.013**	0.091
2-year	19.6 ± 18.8	**0.028**	39.0 ± 22.5	**0.017**	**0.043**
SF-12 PCS					
Preoperative	31.9 ± 8.4	-	27.3 ± 6.8	-	**0.003**
6-weeks	32.6 ± 8.8	0.738	31.7 ± 9.5	**0.012**	0.651
12-weeks	37.8 ± 10.4	**0.007**	37.2 ± 11.1	**<0.001**	0.808
6-months	41.3 ± 11.4	**0.004**	35.1 ± 12.0	**<0.001**	**0.041**
1-year	41.7 ± 11.6	**0.003**	36.2 ± 13.4	**0.003**	0.122
2-year	43.6 ± 10.3	**0.026**	41.9 ± 12.4	**0.004**	0.691
PROMIS PF					
Preoperative	37.7 ± 5.5	-	31.7 ± 5.8	-	**<0.001**
6-weeks	37.9 ± 5.9	0.959	35.3 ± 6.1	**0.039**	0.075
12-weeks	42.0 ± 6.7	**0.015**	38.5 ± 6.9	**<0.001**	**0.043**
6-months	46.3 ± 8.4	**<0.001**	39.9 ± 7.2	**<0.001**	**0.005**
1-year	46.3 ± 6.9	**<0.001**	40.2 ± 9.2	**0.001**	**0.014**
2-year	44.2 ± 5.8	**0.014**	41.8 ± 7.4	**0.026**	0.414

*p-values calculated using Student's t-test to compare PROMs between groups.
Boldface indicates statistical significance

Table 5. MCID Achievement

PROM	**VAS- Back <7**	**VAS-Back≥7**	***p-value**
VAS Back			
6-weeks	34.9%	72.7%	**<0.001**
12-weeks	44.5%	72.3%	**0.002**
6-months	56.5%	72.9%	0.068
1-year	33.3%	75.0%	**0.005**
2-year	55.6%	50.0%	0.795
Overall	57.1% (44)	83.3% (90)	**<0.001**
VAS Leg			
6-weeks	40.8%	61.2%	**0.043**
12-weeks	50.0%	63.9%	0.223
6-months	56.3%	56.3%	1.000
1-year	52.4%	66.7%	0.329
2-year	44.4%	77.8%	0.147
Overall	61.0% (36)	77.2% (44)	0.060
ODI			
6-weeks	16.0%	28.6%	0.133
12-weeks	34.2%	44.7%	0.335
6-months	50.0%	52.8%	0.819
1-year	33.3%	33.3%	1.000
2-year	55.6%	55.6%	1.000
Overall	46.7% (28)	60.0% (36)	0.143
SF-12 PCS			
6-weeks	34.1%	53.6%	0.102
12-weeks	58.3%	82.6%	0.052
6-months	71.4%	77.3%	0.640
1-year	73.9%	75.0%	0.935
2-year	75.0%	81.8%	0.675
Overall	72.0% (36)	83.3% (30)	0.220
PROMIS PF			
6-weeks	23.8%	41.7%	0.135
12-weeks	46.7%	64.0%	0.199
6-months	68.0%	66.7%	0.921
1-year	76.2%	70.0%	0.655
2-year	55.6%	50.0%	0.809
Overall	67.4% (29)	74.3% (26)	0.510

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