Influence of Preoperative Symptom Duration on Postoperative Clinical Outcomes and Trajectory in Patients Undergoing Lateral Lumbar Interbody Fusion

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INTRODUCTION: Prior studies that have assessed how duration of symptoms preoperatively affects patient postoperative clinical outcomes postoperatively following Minimally Invasive Transforaminal Lumbar Interbody Fusion (MIS-TLIF) and Anterior Lumbar Interbody Fusion (ALIF). No such study has been conducted for Lateral Lumbar Interbody Fusion (LLIF). This study aims to compare perioperative and postoperative mean patient-reported outcome measures (PROMs) and minimum clinically important difference (MCID) achievement following LLIF in patients stratified by preoperative symptom duration.

METHODS: A retrospective review of a prospectively maintained attending academic single-surgeon database was conducted for lumbar procedures between June 2005 and December 2021. Inclusion criteria was set as primary, elective, single-level LLIF procedures. Patients undergoing a revision procedure, or surgery indicated for infectious, malignant, or traumatic etiologies were excluded. Additionally, patients without preoperative duration of symptom data were excluded as well. Duration of symptoms was defined as the time span from patient-reported onset of symptoms to the date of surgery. Patient demographics, perioperative characteristics, and PROMs were collected. PROMs were administered at preoperative and 6-week, 12-week, 6-month, and 1-year postoperative time-points and included Patient-Reported Outcomes Measurement Information System- Physical Function (PROMIS-PF), Visual Analogue Scale (VAS) for back and leg pain, Oswestry Disability Index (ODI), and 12-Item Short Form Physical and Mental Composite Score (SF-12 PCS/MCS). Postoperative complications were collected for each group as well. Patients were grouped into two cohorts, utilizing 365 days a duration of symptom cutoff – symptoms duration <365 days or symptom duration ≥365 days. 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 MCID was determined by comparing ΔPROM scores to previously established threshold values. MCID achievement rates were compared between groups with chi-squared analysis.

RESULTS:

148 patients met inclusion criteria with 49 patients in the symptom duration <365 patient cohort and 99 patients in the symptom duration ≥365 patient cohort. Significantly greater proportion of patients in the symptom duration <365 day cohort had presenting diagnosis of degenerative scoliosis (28.6% vs 14.1%, p =0.035). Preoperative mean PROM scores were similar for all PROMs collected with the exception of preoperative VAS back noted to be higher in symptom duration ≥365 day cohort (p =0.010). Cohorts demonstrated no significant mean postoperative differences for all PROMs collected at all postoperative follow-up time-points. Symptom duration <365 days patient cohort demonstrated significant improvement from preoperative baseline to the 1-year time point for all PROMs collected at all individual postoperative timepoints with the exception of SF-12 MCS at all follow-up time-points, SF-12 PCS at 6-weeks, and PROMIS-PF at 6-weeks (p ≤0.046, all). Symptom Duration ≥365 patient cohort demonstrated significant improvement from preoperative baseline to 1-year time point for all PROMs collected at all individual postoperative timepoints with the exception of ODI at 1-year, SF-12 MCS at all follow-up time-points, and SF-12 PCS and PROMIS-PF at 6-weeks (p ≤0.027, all). Both cohorts achieved overall MCID greater than 50% for the following HRQOL measures: VAS back, VAS leg, ODI, SF-12 PCS, and PROMIS-PF. No significant differences were noted between cohorts for rates of MCID achievement.

DISCUSSION AND CONCLUSION: Patients in both symptom duration cohorts demonstrated significant improvement from preoperative baseline up-to 1-years for back pain, leg pain, and physical function. Additionally, mean outcome scores for all quality of life domains did not differ postoperatively at both the short term (6-week) and long-term (1-year) time-points. However, only patients in symptom duration <365 day cohort were observed to maintain postoperative improvement from their respective preoperative baseline at the 1-year time-point. Results from our study may suggest improved ability to maintain postoperative progress in disability in patients with shorter symptom duration preoperatively who undergo lateral fusion.

Table 1. Patient Demographics -

	Total (n=148)	Symptom Duration <365 (n=49)	Symptom Duration >=365 (n=99)	*p-value
Age (mean +SD)	59.2 ± 10.1	58.8 ± 10.7	59.4 ± 9.8	0.743
Gender				
Female	48.0% (71)	46.9% (23)	48.5% (48)	0.859
Male	52.0% (77)	53.1% (26)	51.5% (51)	
Body Mass Index Category (BMI)				0.866
<30 kg/m^2	56.1% (83)	55.1% (27)	56.6% (56)	
≥30 kg/m^2	43.9% (65)	44.9% (22)	43.4% (43)	
Body Mass Index (mean + SD)	29.8 ± 6.1	30.6 ± 5.8	29.4 ± 6.3	0.274
Ethnicity				
Caucasian	74.0% (108)	70.8% (34)	75.5% (74)	
African-American	9.6% (14)	10.4% (5)	9.2% (9)	
Hispanic	8.2% (12)	12.5% (6)	6.1% (6)	
Asian	2.1% (3)	0.00% (0)	3.1% (3)	0.523
Other	6.2% (9)	6.3% (3)	6.1% (6)	
Smoking Status				
Non-Smoker	83.7% (123)	83.7% (41)	83.7% (82)	1.000
Smoker	16.3% (24)	16.3% (8)	16.3% (16)	
Diabetes				
Non-Diabetic	85.8% (127)	87.8% (43)	84.9% (84)	0.633
Diabetic	14.2% (21)	12.2% (6)	15.1% (15)	
Hypertensive Status				
Non-Hypertensive	57.4% (85)	67.4% (33)	52.5% (52)	0.086
Hypertensive	42.6% (63)	32.6% (16)	47.5% (47)	
ASA Classification <3	74.8% (110)	75.0% (36)	74.7% (74)	0.974
>= 3	25.2% (37)	25.0% (12)	25.3% (25)	
Insurance				
Medicare/Medicaid	15.5% (23)	14.3% (7)	16.2% (16)	
Workers' Compensation	18.9% (28)	24.5% (12)	16.2% (16)	0.476
Private	65.5% (97)	61.2% (30)	67.7% (67)	

ASA = American Society of Anesthesiologists

* 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.

Table 2. Perioperative Characteristics

	Total (n=148)	Symptom Duration <365 (n=49)	Symptom Duration >=365 (n=99)	*p-value
Spinal Pathology				
Central Stenosis	90.5% (134)	93.9% (46)	88.9% (88)	0.329
Foraminal Stenosis	48.0% (71)	57.1% (28)	43.4% (43)	0.116
Degenerative Spondylolisthesis	59.5% (88)	59.2% (29)	59.6% (59)	0.962
Isthmic Spondylolisthesis	9.5% (14)	6.1% (3)	11.1% (11)	0.329
Recurrent herniated nucleus pulposus	10.8% (16)	12.2% (6)	10.1% (10)	0.693
Degenerative Scoliosis	18.9% (28)	28.6% (14)	14.1% (14)	**0.035**
Fusion Procedure				
LLIF (4)	100.0% (148)	100.0% (49)	100.0% (99)	
Fusion Level				0.116
L1-L2	2.0% (3)	0.00% (0)	3.0% (3)	
L2-L3	19.6% (29)	14.3% (7)	22.2% (22)	
L3-L4	35.8% (53)	30.6% (15)	38.4% (38)	
L4-L5	41.2% (61)	51.0% (25)	36.4% (36)	
Operative Time (mean +SD; min)	138.4 ± 73.7	131.6 ± 60.3	141.8 ± 79.6	0.435
Estimated Blood Loss (mean +SD; mL)	73.5 ± 106.4	54.5 ± 52.3	81.1 ± 123.6	0.174
Length of Stay (mean +SD; hours)	42.8 ± 31.7	37.3 ± 31.9	45.3 ± 31.4	0.183
Post-operative Day of Discharge (POD)				
POD0	13.9% (18)	19.5% (8)	11.2% (10)	0.102
POD1	40.0% (52)	41.5% (17)	39.3% (35)	
POD2	24.6% (32)	29.3% (12)	22.5% (20)	
POD3	12.3% (16)	2.4% (1)	16.9% (15)	
POD4	6.2% (8)	2.4% (1)	7.9% (7)	
Postoperative VAS Pain Score				
POD0	5.4 ± 1.9	5.7 ± 2.1	5.3 ± 1.8	0.468
POD1	4.8 ± 1.8	5.0 ± 1.7	4.7 ± 1.8	0.560
Postoperative Narcotic Consumption (OME)				
POD0	57.3 ± 41.7	53.7 ± 33.4	59.1 ± 45.4	0.462
POD1	40.4 ± 40.3	32.7 ± 33.9	44.3 ± 42.8	0.101

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

Table 3. Patient Reported Outcome Measures

	Symptom Duration <365 Mean ±SD	Symptom Duration <365 Post-operative PROM Improvement	Symptom Duration >=365 Mean ±SD	Symptom Duration >=365 Post-operative PROM Improvement	*p-value
VAS Back					
Preoperative	5.9 ± 2.7	-	7.0 ± 2.0	-	**0.010**
6-weeks	3.7 ± 2.6	**0.004**	3.8 ± 2.2	**<0.001**	0.698
12-weeks	3.5 ± 3.0	**0.003**	3.0 ± 2.5	**<0.001**	0.213
6-months	2.7 ± 2.9	**0.003**	2.8 ± 2.6	**<0.001**	0.686
1-year	2.7 ± 2.7	**0.031**	3.8 ± 3.3	**<0.001**	0.496
VAS Leg					
Preoperative	5.7 ± 3.0	-	6.2 ± 2.2	-	0.321
6-weeks	3.1 ± 2.4	**<0.001**	3.0 ± 2.7	**<0.001**	0.801
12-weeks	3.0 ± 2.9	**<0.001**	1.6 ± 2.4	**<0.001**	0.060
6-months	2.1 ± 2.7	**0.001**	2.3 ± 2.4	**<0.001**	0.681
1-year	1.8 ± 1.9	**<0.001**	2.9 ± 3.2	**<0.001**	0.394
ODI					
Preoperative	43.3 ± 18.5	-	40.7 ± 14.7	-	0.438
6-weeks	34.7 ± 15.8	**0.014**	34.5 ± 16.1	**0.027**	0.491
12-weeks	32.5 ± 21.3	**0.003**	24.9 ± 18.9	**<0.001**	0.064
6-months	21.7 ± 16.8	**<0.001**	23.5 ± 17.4	**<0.001**	0.598
1-year	25.7 ± 17.5	**0.003**	32.7 ± 27.2	0.069	0.438
SF-12 MCS					
Preoperative	51.9 ± 11.4	-	47.6 ± 11.7	-	0.113
6-weeks	53.6 ± 10.6	0.710	47.4 ± 12.3	0.938	0.124
12-weeks	53.8 ± 10.3	0.079	50.5 ± 12.8	0.446	0.782
6-months	52.4 ± 10.8	0.136	52.3 ± 11.3	0.277	0.887
1-year	52.4 ± 11.1	0.159	52.6 ± 13.9	0.614	0.943
SF-12 PCS					
Preoperative	29.4 ± 8.5	-	30.2 ± 8.1	-	0.679
6-weeks	29.4 ± 7.6	0.241	30.9 ± 9.3	0.652	0.345
12-weeks	34.1 ± 11.1	**0.046**	38.5 ± 10.1	**<0.001**	0.081
6-months	37.4 ± 11.8	**0.001**	37.7 ± 11.2	**<0.001**	0.672
1-year	39.3 ± 12.5	**0.001**	37.4 ± 14.0	**0.005**	0.576
PROMIS-PF					
Preoperative	33.8 ± 7.3	-	35.9 ± 6.3	-	0.215
6-weeks	35.8 ± 5.3	0.161	36.3 ± 6.4	0.918	0.438
12-weeks	39.6 ± 7.4	**0.004**	40.2 ± 6.9	**0.022**	0.647
6-months	42.5 ± 8.1	**<0.001**	41.7 ± 7.4	**0.001**	0.756
1-year	42.8 ± 8.7	**0.001**	41.9 ± 9.3	**<0.001**	0.878

*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.

Table 4. MCID Achievement

	Symptom Duration <365	Symptom Duration >=365	*p-value
VAS Back			
6-weeks	50.0%	61.1%	0.312
12-weeks	45.8%	66.7%	0.080
6-months	42.9%	66.7%	0.102
1-year	63.6%	60.0%	0.842
Overall	65.7% (23)	76.0% (60)	0.257
VAS Leg			
6-weeks	51.9%	57.1%	0.666
12-weeks	43.5%	69.0%	0.065
6-months	71.4%	62.1%	0.546
1-year	72.7%	70.0%	0.873
Overall	67.7% (23)	75.0% (36)	0.465
ODI			
6-weeks	30.8%	19.1%	0.268
12-weeks	36.0%	44.8%	0.510
6-months	68.8%	51.7%	0.268
1-year	45.5%	30.0%	0.390
Overall	65.7% (23)	52.1% (25)	0.214
SF-12 MCS			
6-weeks	22.7%	17.9%	0.669
12-weeks	13.6%	25.0%	0.349
6-months	28.6%	33.3%	0.766
1-year	15.4%	41.2%	0.127
Overall	33.3% (9)	35.3% (12)	0.873
SF-12 PCS			
6-weeks	45.5%	37.9%	0.589
12-weeks	68.2%	70.0%	0.899
6-months	85.7%	76.2%	0.490
1-year	69.2%	76.5%	0.657
Overall	77.8% (21)	76.5% (26)	0.904
PROMIS-PF			
6-weeks	35.0%	23.1%	0.373
12-weeks	61.9%	58.8%	0.847
6-months	87.5%	61.1%	0.082
1-year	76.9%	66.7%	0.549
Overall	76.9% (20)	62.5% (20)	0.238

*p-value calculated with chi-squared analysis