Single Level Minimally Invasive Transforaminal Lumbar Interbody Fusion vs Lateral Lumbar Interbody Fusion for Degenerative Spinal Pathology: Clinical Outcome Comparison in the Elderly

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INTRODUCTION:

Two popular techniques utilized for lumbar arthrodesis are minimally invasive transforaminal lumbar interbody fusion (MIS-TLIF) and lateral lumbar interbody fusion (LLIF). Despite their high fusion rates and suitable postoperative clinical outcomes in elderly populations (age>65), literature comparing the two techniques for this target group is scarce. We aim to assess patient-reported outcome measures (PROMs) in patients age >65 undergoing single-level MIS-TLIF and LLIF for degenerative spinal pathology.

METHODS:

A retrospective review of lumbar procedures performed between November 2005 and December 2021 was conducted using a prospectively maintained single-surgeon database. Inclusion criteria were set as primary, elective, single, MIS-TLIF, or LLIF procedures for degenerative spinal pathology in patients aged 65 years or older. Patients undergoing a revision or multi-level procedure, or surgery indicated for infectious, malignant, or traumatic etiologies were excluded. Additionally, patients < 65 years old were excluded. Patient demographics, perioperative characteristics, and patient-reported outcome measures (PROM) were collected. PROMs included Patient-reported Outcome Measurement Information System-Physical Function (PROMIS-PF), Visual Analogue Scale (VAS) for back and leg pain, Oswestry Disability Index (ODI), Short Form-12 Item Survey Mental and Physical Composite Scores (SF-12 MCS/PCS) with all values collected at the preoperative, 6-week, 12-week, 6-month, 1-year follow up time points. Postoperative complications were collected. Patients were grouped into two cohorts, depending on whether a patient underwent an MIS-TLIF or LLIF. Demographic and perioperative characteristics were compared between groups using chi-square and Student's t-test for categorical and continuous variables, respectively. Groups were evaluated for significant differences in PROM score improvements from their respective baseline value using a paired samples t-test and any differences in PROM scores between groups were evaluated at each time point using an unpaired Student's t-test.

107 patients were eligible for the study, with 74 patients in the MIS-TLIF cohort. Significant differences between the cohorts were noted for smoking status (p =0.003). Degenerative spondylolisthesis predominated in the MIS-TLIF cohort while a greater proportion of the LLIF cohort demonstrated foraminal stenosis (p \leq 0.004, all). Postoperative narcotic consumption on day 0 was significantly greater for patients in the LLIF cohort (p =0.048). Patients in the MIS-TLIF cohort demonstrated greater rates of postoperative nausea and vomiting (18.9% vs 3.0%). No other significant differences in postoperative complications were noted between cohorts. Preoperative PROM scores did not significantly differ between cohorts. Postoperative mean PROMs scores did not differ for all PROMs collected at all postoperative time points. MIS-TLIF cohort reported significant improvement from preoperative baseline to the 1-year time point for all PROMs collected at all individual postoperative time points with the exception of SF-12 MCS at all timepoints, SF-12 PCS at 6-weeks, and PROMIS-PF at 6-weeks and 1-year (p \leq 0.018, all). The LLIF cohort reported significant improvement from preoperative baseline to the 1-year time point for all PROMs collected at all individual postoperative time points with the exception of VAS leg at 6-weeks, SF-12 MCS at 6-weeks, 12-weeks, and 1-year (p \leq 0.049, all).

DISCUSSION AND CONCLUSION: Elderly patients undergoing either single-level MIS-TLIF or LLIF for degenerative spinal pathology demonstrated similar long-term clinical outcomes for physical function, disability, leg pain, and back pain. Interestingly, 6-week improvement for leg pain was significantly improved for the MIS-TLIF cohort compared to the LLIF cohort. The results of our study may guide surgeons when setting expectations for elderly patients undergoing either LLIF.

			LLIF (>65	
	Total (n=107)	MIS-TLIF (>65 yrs.) (n=74)	yrs.) (n=33)	*p-valu
Age (mean ±SD)	71.2 ± 5.3	70.5 ± 4.7	72.7 ± 6.4	0.054
Gender				
Female	49.5% (53)	47,3% (35)	54,6% (18)	0.489
Male	50.5% (54)	52.7% (39)	45.5% (15)	
Body Mass Index Category				
(BMI)				0.504
<30 kg/m²	58.9% (63)	56.8% (42)	63.6% (21)	
≥30 kg/m²	41.1% (44)	43.2% (32)	36.4% (12)	
Body Mass Index (Mean ±				
SD)				0.113
	29.5 ± 5.7	30.1 ± 6.0	28.2 ± 4.6	
Ethnicity				
Caucasian	81.1% (86)	78.4% (58)	87.5% (28)	
African-American	9.4% (10)	9.5% (7)	9.4% (3)	
Hispanic	1.9% (2)	2.7% (2)	0.0% (0)	
Asian	2.8%(3)	4.1% (3)	0.0% (0)	0.620
Other	4.7% (5)	5.4% (4)	3.1%(1)	
Smoking Status				
Non-Smoker	81.6% (111)	79.1% (34)	82.8% (77)	0.602
Smoker	18.4% (25)	20.9% (9)	18.2% (16)	
Diabetes				
Non-Diabetic	85.1% (91)	85.1% (63)	84.9% (28)	0.969
Diabetic	14.9% (16)	14.9% (11)	15.2% (5)	
Smoking Status				
Non-Smoker	86.7% (91)	93.2% (68)	71.9% (23)	0.003
Smoker	13.3% (14)	6.9% (5)	28.1% (9)	
Hypertensive Status				
Non-Hypertensive	35.9% (38)	36.9% (27)	33.3% (11)	0.717
Hypertensive	64.2% (68)	63.0% (46)	66.7% (22)	
ASA Classification				
<3	64.5% (69)	67.6% (50)	57.6% (19)	0.319
>= 3	35.5% (38)	32.4% (24)	42.4% (14)	
CCI score (Mean ± SD)	4.7 ± 2.0	4.7 ± 2.0	4.9 ± 2.0	0.564
Insurance				
Medicare/Medicaid	55.1% (59)	56.8% (42)	51.5% (17)	
Workers' Compensation	7.5% (8)	6.8% (5)	9.1% (3)	0.847
Private	37.4% (40)	36.5% (27)	39.4% (13)	

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 significance

	MIS-TLIF (>65				
	Total	yrs.)	LLIF (>65 yrs.)	*p-value	
	(n=107)	(n=74)	(n=33)		
Spinal Pathology					
Central Stenosis	98.1% (105)	98.7% (73)	96.9% (32)	0.554	
Foraminal Stenosis	27.1% (29)	18.9% (14)	45.5% (15)	0.004	
Herniated Nucleus				0.591	
Pulposus	4.7% (5)	5.4% (4)	3.0% (1)		
Degenerative				0.002	
Spondylolisthesis	81.3% (87)	89.2% (66)	63.6% (21)		
Isthmic				0.337	
Spondylolisthesis	10.3% (11)	12.2% (9)	6.1% (2)	0.660	
Neuropathy				0.660	
None	6.0% (11)	5.8% (8)	6.7% (3)		
Radiculopathy	19.1% (35)	17.4% (24)	24.4% (11)		
Myelopathy	3.3% (6)	2.9% (4)	4.4% (2)		
Myeloradiculopathy	71.6% (131)	73.9% (102)	64.4% (29)		
Operative Level					
L1-L2	0.9% (1)	0.0% (0)	3.0% (1)	<0.001	
L2-L3 13-14	7.5% (8)	1.4% (1)	21.2% (7)		
	21.5% (23)	8.1% (6)	51.5% (17)		
L4-L5	70.1% (75)	90.5% (67)	24.2% (8)		
Operative Time (mean				0.695	
±SD; min)	127.0 ± 45.6	128.2 ± 40.4	124.4 ± 56.3		
Estimated Blood Loss				0.817	
(mean ±SD; mL)	56.3 ± 35.2	56.7 ± 39.2	55.0 ± 23.2		
1-year arthrodesis	92.6%	92.4%	93.3%	0.753	
Pseudoarthrosis at 6m	1.8% (2)	2.7% (2)	0.0% (0)	0.754	
Length of Stay (mean				0.101	
±SD; hours)	65.3 ± 52.2	70.7 ± 59.1	51.6 ± 24.7		
Post-operative Day of					
Discharge (POD)					
POD0	3.1% (3)	1.4% (1)	7.1% (2)	0.187	
POD1	30.6% (30)	34.3% (24)	21.4% (6)		
POD2	28.6% (28)	24.2% (17)	39.3% (11)		
POD3	19.4% (19)	18.6% (13)	21.4% (6)		
POD4	5.1% (5)	2.9% (2)	10,7% (3)		
Postoperative VAS Pain					
Score					
POD0	4.0 ± 1.6	3.8 ± 1.6	4.7 ± 1.6	0.048	
PODI	3.8 ± 1.5	3.7 ± 1.3	4.2 ± 1.9	0.258	
Postoperative Narcotic					
Consumption (OME)					
POD0	65.8 ± 56.0	68.3 ± 56.3	60.3 ± 56.0	0.500	
POD1	46.3 ± 43.9	49.0 ± 43.9	40.2 ± 43.9	0.342	

		MIS-TLIF	LLIF (>65	
	Total	(>65 yrs.)	yrs.)	*p-value
Complication	(n=107)	(n=74)	(n=33)	
Reintubation	0.0% (0)	0.0% (0)	0.0% (0)	
Urinary Retention	9.4% (10)	9.5% (7)	9.1% (3)	0.412
Urinary Tract Infection	0.0% (0)	0.0% (0)	0.0% (0)	-
Acute Renal Failure	0.9%(1)	1.4% (1)	0.0% (0)	0.502
Altered Mental Status	0.0% (0)	0.0% (0)	0.0% (0)	-
VTE	0.0% (0)	0.0% (0)	0.0% (0)	-
Pulmonary Embolism	0.0% (0)	0.0% (0)	0.0% (0)	-
Pneumothorax	0.0% (0)	0.0% (0)	0.0% (0)	-
Atelectasis	0.9%(1)	1.4% (1)	0.0% (0)	0.502
Pleural Effusion	0.0% (0)	0.0% (0)	0.0% (0)	-
Arrhythmia	0.9%(1)	0.0% (0)	3.0% (1)	0.260
Ileus	0.9%(1)	1.4% (1)	0.0% (0)	0.635
Nausea / Vomiting	14.0% (15)	18.9% (14)	3.0% (1)	0.029
Hematoma	0.0% (0)	0.0% (0)	0.0% (0)	-
Dysphagia	1.9% (2)	0.0% (0)	6.1% (2)	0.083
Fever of Unknown				0.058
Origin	8.4% (9)	5.4% (4)	15.2% (5)	

VTE = venous thromboembolism
*p-value calculated using chi-square for
categorical variables
Boldface indicates significance

		MIS-TLIF (>65			*p-value
		yrs.)		LLIF (>65 yrs.)	
	MIS-TLIF (>65	Post-operative	LLIF (>65	Post-operative	
	yrs.)	PROM	yrs.) Mean	PROM	
	Mean ±SD	Improvement	±SD	Improvement	
VAS Back					
Preoperative	6.1 ± 2.5		6.7 ± 2.3		0.350
6-weeks	2.6 ± 2.0	<0.001	2.7 ± 2.4	<0.001	0.889
12-weeks	2.8 ± 2.4	<0.001	2.0 ± 2.1	< 0.001	0.225
6-months	2.8 ± 2.4	<0.001	2.1 ± 2.4	<0.001	0.319
1-year	2.4 ± 2.8	<0.001	2.2 ± 2.9	<0.001	0.923
/AS Leg					
Preoperative	6.0 ± 2.5		5.0 ± 3.1		0.275
6-weeks	1.9 ± 2.4	< 0.001	2.6 ± 2.5	0.055	0.441
12-weeks	1.6 ± 1.9	<0.001	1.4 ± 2.3	0.035	0.777
6-months	2.1 ± 2.3	<0.001	1.2 ± 2.2	0.025	0.398
1-year	1.8 ± 2.7	<0.001	1.7 ± 3.0	<0.001	0.995
ODI					
Preoperative	35.7 ± 14.5		41.5 ± 16.6		0.254
6-weeks	26.1 ± 16.0	0.003	29.0 ± 15.0	0.029	0.596
12-weeks	24.8 ± 14.1	< 0.001	23.3 ± 11.5	0.013	0.797
6-months	20.7 ± 14.8	<0.001	17.7 ± 8.3	0.007	0.610
1-year	13.1 ± 13.2	0.002	29.6 ± 32.6	0.035	0.116
F-12 MCS					
Preoperative	52.6 ± 11.6		53.0 ± 10.9		0.916
6-weeks	57.1 ± 8.2	0.060	50.8 ± 11.3	0.890	0.146
12-weeks	53.8 ± 9.8	0.261	53.4 ± 11.0	0.547	0.932
6-months	57.8 ± 4.4	0.075	58.5 ± 3.0	0.046	0.718
1-year	52.5 ± 10.5	0.534	54.2 ± 15.9	0.091	0.801
F-12 PCS					
Preoperative	34.5 ± 7.6		29.6 ± 7.7		0.074
6-weeks	32.4 ± 8.4	0.061	33.3 ± 12.5	0.012	0.848
12-weeks	38.3 ± 9.7	0.018	38.3 ± 10.1	0.002	0.988
6-months	40.3 ± 10.7	0.003	41.9 ± 12.2	0.018	0.773
1-year	43.4 ± 10.2	0.002	43.2 ± 4.5	<0.001	0.999
ROMIS-PF					
Preoperative	37.3 ± 5.1		32.4 ± 9.4		0.164
6-weeks	40.0 ± 5.2	0.491	41.8 ± 15.0	0.036	0.758
12-weeks	44.9 ± 5.9	0.010	40.6 ± 9.4	<0.001	0.346
6-months	42.6 ± 8.3	0.002	43.0 ± 6.2	< 0.001	0.925
1-year	38 3 + 12 6	0.421	41.3 ± 7.2	0.049	0.691