Influence of Obesity on Perioperative Outcomes, Patient-Reported Outcome Measures, and Minimal Clinically Important Difference Achievement among Isthmic Spondylolisthesis Patients Receiving Minimally Invasive Transforaminal Lumbar Interbody Fusion

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INTRODUCTION:
Patients with persistent, severe symptoms stemming from isthmic spondylolisthesis may require minimally invasive transforaminal lumbar interbody fusion (MIS TLIF); however, the influence of obesity on postsurgical outcomes within this population has hardly been explored. We aim to determine whether obesity holds a significant influence on patient-reported outcome measures (PROM) or minimal clinically important difference (MCID) results within a population of patients with isthmic spondylolisthesis receiving MIS TLIF.
METHODS: The review of a single-surgeon retrospective database was conducted to identify patients diagnosed with isthmic spondylolisthesis who underwent single-level MIS TLIF. Exclusion criteria were those missing body mass index (BMI) data, individuals with comorbid degenerative spondylolisthesis, recurrent herniated nucleus pulposus, or degenerative scoliosis, and subjects receiving surgery for infection, trauma, or tumor management. Patients were grouped by obesity status: Non-Obese = BMI <30 kg/m2; Obese = BMI ≥30 kg/m2. Patient demographic characteristics and perioperative variables were collected, with descriptive analysis subsequently performed for these variables. PROMs included were Visual Analog Scale (VAS) back and leg, Oswestry Disability Index (ODI), 12-Item Short Form (SF-12) Physical Composite Score (PCS), and Patient-Reported Outcome Measurement Information System physical function (PROMIS-PF), which were collected preoperatively and at 6-weeks, 12-weeks, 6-months, 1-year, and 2-years after MIS TLIF. Significance in PROM score improvements from preoperative to postoperative timepoints was determined with paired samples t-test. Differences in mean PROMs between non-obese and obese cohorts was determined with Student's t-test for independent samples. ΔPROMs were compared to established threshold values in literature to determine MCID achievement across PROMs. Rates of MCID achievement were compared between non-obese and obese cohorts with chi-square analysis.
RESULTS:
A total of 134 patients were included, 72 were non-obese and 62 were obese. The obese group had greater proportion of patients with hypertension, more patients with American Society of Anesthesiologists (ASA) classification ≥2, and a higher mean Charlson Comorbidity Index (CCI) score ($p \leq 0.032$, all). No significant differences were noted in perioperative characteristics. Non-obese patients significantly improved for all PROMs at all timepoints, with the exception of PROMIS-PF, SF-12 PCS, and ODI at 6-weeks ($p \leq 0.019$, all). Obese patients significantly improved for all PROMs at all timepoints, with the exception of PROMIS-PF at 6-weeks, SF-12 PCS at 2-years, and ODI at 2-years ($p \leq 0.024$, all). Non-obese patients had significantly greater PROMIS-PF at 1-year/2-years and SF-12 PCS at 1-year ($p \leq 0.027$, all). Non-obese patients reported less VAS back at 1-year, VAS leg at 1-year/2-years, and less ODI preoperatively and from 6-months through 2-years ($p \leq 0.036$, all). MCID achievement was significantly higher in the non-obese cohort for PROMIS-PF at 2-years ($p=0.035$), and VAS leg at 1-year ($p=0.017$).
DISCUSSION AND CONCLUSION: Patients with isthmic spondylolisthesis and obesity receiving MIS TLIF demonstrated similar perioperative characteristics compared to non-obese counterparts. However, postoperative physical function, back pain, leg pain, and disability scores were generally lower at the 1-year and/or 2-year final follow-up point among obese patients. While MCID achievement rates tended to be lower for physical function for patients with obesity, MCID achievement for disability and pain PROMs were largely similar during the postoperative period.

Table 1. Patient Demographics

Characteristic	Total (n=134)	Non-Obese (n=72)	Obese (n=62)	*p-value
Age (mean ± SD, years)	49.9±13.6	49.7±14.6	50.0±12.5	0.890
Gender				0.630
Female	42.5% (57)	44.4% (32)	40.3% (25)	
Male	57.5% (77)	55.6% (40)	59.7% (37)	
Ethnicity				0.086
Caucasian	63.9% (85)	67.6% (48)	59.7% (37)	
African-American	14.3% (19)	8.5% (6)	21.0% (13)	
Hispanic	14.3% (19)	12.7% (9)	16.1% (10)	
Asian	3.0% (4)	5.6% (4)	0.0% (0)	
Other	4.5% (6)	5.6% (4)	3.2% (2)	
Diabetic Status				0.062
Non-Diabetic	95.5% (128)	98.6% (71)	91.9% (57)	
Diabetic	4.5% (6)	1.4% (1)	8.1% (5)	
Smoking Status				0.555
Non-Smoker	87.3% (117)	88.9% (64)	85.5% (53)	
Smoker	12.7% (17)	11.1% (8)	14.5% (9)	
Hypertension Status				**0.001**
Non-hypertensive	68.7% (92)	80.6% (58)	54.8% (34)	
Hypertensive	31.3% (42)	19.4% (14)	45.2% (28)	
ASA Classification				**0.002**
<2	82.1% (110)	91.7% (66)	71.0% (44)	
≥2	17.9% (24)	8.3% (6)	29.0% (18)	
CCI Score (Mean ± SD)	1.8±1.8	1.5±1.6	2.2±2.0	**0.032**
Insurance				0.543
Medicare/Medicaid	8.2% (11)	6.9% (5)	9.7% (6)	
Workers' Compensation	33.6% (45)	30.6% (22)	37.1% (23)	
Private	58.2% (78)	62.5% (45)	53.2% (33)	

ASA = American Society of Anesthesiologists; CCI = Charlson Comorbidity Index; SD= standard deviation

*p-values calculated using Student's t-test for continuous variables and chi-square analysis for categorical variables

Boldface indicates significance

Table 2. Perioperative Characteristics

Characteristic	Total (n=134)	Non-Obese (n=72)	Obese (n=62)	*p-value
Spinal Pathology				
Central Stenosis	88.1% (118)	90.3% (65)	85.5% (53)	0.393
Foraminal Stenosis	38.1% (51)	38.9% (28)	37.1% (23)	0.831
Operative Time (Mean ± SD; min)	144.1±36.7	139.4±35.6	149.5±37.4	0.112
Estimated Blood Loss (Mean ± SD; mL)	69.2±44.9	70.7±52.0	67.5±35.4	0.684
Length of Stay (Mean ± SD; hours)	45.8±27.3	44.5±27.3	47.3±27.4	0.577
Postoperative Vas pain				
POD 0	5.4±1.8	5.2±1.6	5.7±2.0	0.115
POD 1	5.0±1.9	4.6±1.9	5.3±1.7	0.055
Postoperative Narcotic Consumption				
POD 0	78.6±63.7	75.4±59.2	82.3±68.9	0.534
POD 1	61.9±63.2	58.1±68.1	66.2±57.2	0.462
1-year Arthrodesis	90.5% (95)	87.0% (47)	94.1% (48)	0.217

POD = postoperative day; mL = milliliters; SD= standard deviation

*p-values calculated using Student's t-test for continuous variables and chi-square analysis for categorical variables

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Table 3. Mean Patient Reported Outcomes

PROM	Non-Obese Mean ± SD	*p-value	Obese Mean ± SD	†p-value	*†p-value
PROMIS PF					
Preoperative	37.7±5.1	-	34.6±6.7	-	0.091
6-weeks	38.3±8.1	0.609	36.3±8.2	0.528	0.434
12-weeks	42.5±9.4	**0.005**	39.2±7.7	**0.027**	0.337
6-months	46.6±7.3	**0.001**	43.2±7.6	**0.001**	0.184
1-year	53.3±9.6	**<0.001**	39.2±8.7	**0.001**	**<0.001**
2-year	49.5±6.3	**<0.001**	41.3±9.7	**0.017**	**0.027**
SF-12 PCS					
Preoperative	33.3±8.2	-	30.9±11.0	-	0.266
6-weeks	33.±9.8	0.711	30.2±7.3	0.434	0.217
12-weeks	38.2±10.9	**0.019**	36.1±8.3	**0.005**	0.455
6-months	41.9±12.3	**<0.001**	37.4±10.2	**0.001**	0.162
1-year	46.0±11.9	**<0.001**	35.8±12.7	**0.001**	**0.013**
2-year	42.9±12.4	**0.017**	35.6±13.7	0.118	0.127
VAS back					
Preoperative	6.5±2.4	-	7.0±2.2	-	0.185
6-weeks	4.1±2.7	**<0.001**	4.6±2.6	**<0.001**	0.307
12-weeks	3.6±2.6	**<0.001**	3.9±2.7	**<0.001**	0.506
6-months	3.6±2.9	**<0.001**	4.2±2.7	**<0.001**	0.300
1-year	2.0±2.1	**<0.001**	4.1±2.8	**0.004**	**0.006**
2-year	3.0±2.9	**0.002**	5.2±3.3	**0.015**	0.050
VAS leg					
Preoperative	5.3±2.8	-	5.2±2.9	-	0.783
6-weeks	3.1±3.4	**0.001**	3.4±2.9	**<0.001**	0.768
12-weeks	2.3±2.6	**<0.001**	2.9±3.2	**<0.001**	0.401
6-months	2.2±2.6	**<0.001**	3.2±3.4	**<0.001**	0.166
1-year	1.0±1.5	**<0.001**	3.7±3.3	**0.003**	**0.001**
2-year	2.1±2.5	**<0.001**	4.7±3.6	**0.024**	**0.026**
ODI					
Preoperative	37.1±14.7	-	46.3±17.4	-	**0.008**
6-weeks	36.0±20.6	0.847	37.9±19.1	**0.002**	0.668
12-weeks	23.8±17.3	**<0.001**	30.9±20.4	**<0.001**	0.116
6-months	19.8±21.7	**<0.001**	30.7±22.7	**<0.001**	**0.036**
1-year	14.8±16.5	**<0.001**	31.9±23.5	**0.007**	**0.005**
2-year	17.6±16.8	**0.002**	37.1±27.4	0.216	**0.021**

*p-values calculated using paired sample t-test to determine preoperative to postoperative improvement in Non-Obese cohort

†p-values calculated using Student's t-test to determine preoperative to postoperative improvement in Obese cohort

*†p-values calculated using Student's t-test to compare mean PROMs between both cohorts

Boldface indicates significance

Table 4. Minimum Clinically Important Difference

PROM	Non-Obese %, (n)	Obese %, (n)	*p-value
ODI			
6-weeks	27.0% (10)	32.4% (12)	0.611
12-weeks	43.8% (14)	54.6% (18)	0.384
6-months	57.1% (20)	60.6% (20)	0.772
1-year	69.6% (16)	61.1% (11)	0.571
2-year	62.5% (10)	54.6% (6)	0.679
Overall	58.7% (27)	65.9% (27)	0.492
PROMIS-PF			
6-weeks	33.3% (6)	29.4% (5)	0.803
12-weeks	64.3% (9)	54.6% (6)	0.622
6-months	76.9% (10)	66.7% (10)	0.549
1-year	86.7% (13)	80.0% (8)	0.656
2-year	83.3% (10)	37.5% (3)	**0.035**
Overall	95.5% (21)	76.2% (16)	0.068
SF-12 PCS			
6-weeks	32.0% (8)	8.3% (14)	0.225
12-weeks	56.5% (13)	63.6% (14)	0.626
6-months	84.2% (16)	63.6% (14)	0.138
1-year	88.9% (16)	70.6% (12)	0.176
2-year	66.7% (10)	46.7% (7)	0.269
Overall	87.9% (29)	68.6% (24)	0.055
VAS back			
6-weeks	49.0% (25)	47.9% (23)	0.913
12-weeks	51.1% (23)	55.3% (21)	0.706
6-months	53.3% (24)	55.6% (20)	0.842
1-year	65.2% (15)	56.3% (9)	0.571
2-year	60.0% (9)	41.7% (5)	0.343
Overall	71.2% (42)	68.6% (35)	0.770
VAS leg			
6-weeks	48.5% (16)	51.5% (17)	0.806
12-weeks	50.0% (16)	41.9% (13)	0.521
6-months	62.5% (20)	44.8% (13)	0.167
1-year	78.3% (18)	41.2% (7)	**0.017**
2-year	68.8% (11)	66.7% (6)	0.915
Overall	72.1% (31)	63.9% (23)	0.435

*p-values calculated using chi-square analysis

Boldface indicates significance