Influence of Obesity on Achievement of Minimum Clinically Important Difference After Transforaminal Lumbar Interbody Fusion

Kevin C. Jacob, BS[1]; Madhav R. Patel, BS[1]; Elliot D.K. Cha, MS[1]; Conor P. Lynch, MS[1]; Michael C. Prabhu, BS[1]; Hanna Pawlowski, BS[1]; Nisheka N. Vanjani, BS[1]; Kern Singh, MD[1,2]

[1]Department of Orthopaedic Surgery, Rush University Medical Center

[2]Professor, Co-Director of the Minimally Invasive Spine Institute at Rush University Medical Center; Founder and President, Minimally Invasive Spine Study Group

Background

Obesity is a proven risk factor for poorer outcomes for minimally invasive transforaminal lumbar interbody fusion (MIS TLIF). Few studies have investigated the impact body mass index (BMI) has on minimum clinically important difference (MCID) achievement for Patient-Reported Outcome Measurement Information System Physical Function (PROMIS-PF).

Aims and Objectives

To determine the impact of obesity on postoperative outcomes and MCID achievement following MIS TLIF.

Methodology: Data Collection

Inclusion Criteria	Exclusion Criteria
• Primary, elective single level MIS TLIF procedures	• Surgeries indicated for trauma, infection, or malignancy

Demographics	Preoperative	Intraoperative	Postoperative
• Age • Gender • Ethnicity • BMI • Blood pressure • Smoking status • Diabetic status • Insurance coverage	• Charlson Comorbidity Index (CCI) • American Society of Anesthesiologists (ASA) classification • Spinal diagnosis	• Operative duration • Estimated blood loss	• Postoperative Length of stay • Postoperative day of discharge

- PROMs collected at preop and 6-weeks, 12-weeks, 6-months, 1-year, and 2-years postop
  - Visual Analog Scale (VAS) back and leg
  - Oswestry Disability Index (ODI)
  - 12-Item Short Form Physical Composite Score (SF-12 PCS)
  - PROM Information System physical function (PROMIS PF)

Methodology: Statistical Analysis

- Patients were categorized into four groups based on BMI: Non-Obese (<30 kg/m2); Obese I (≥30 and <35 kg/m2); Severe (≥35 and <40 kg/m2); Morbid (≥40 kg/m2)
- The impact of BMI on outcome measures were determined using linear regression analysis
- Pre-established MCID values were used to calculate achievement rates for all outcome measures
- Significant differences in achievement rates by BMI group were determined using Chi-square analysis

Results: Baseline Characteristics

162 patients included, mean age of each cohort was near 50 years old

Cohorts differed in diabetic status, blood pressure, and ASA score

Table 1. Patient Demographics

	Non-Obese (n=88)	Obese I (n=37)	Severe (n=25)	Morbid (n=12)	*p-value
Age (mean±SD)	50.9 ± 11.0	49.8 ± 11.8	53.2 ± 9.8	48.6 ± 10.0	0.574
Gender					0.137
Female	40.9% (36)	27.0% (10)	56.0% (14)	33.3% (4)	
Male	59.1% (52)	73.0% (27)	44.0% (11)	66.7% (8)	
Ethnicity					0.260
African-American	7.9% (7)	21.6% (8)	4.0% (1)	16.7% (2)	
Asian	5.7% (5)	0.0% (0)	0.0% (0)	0.0% (0)	
Hispanic	6.8% (6)	2.7% (1)	8.0% (2)	8.3% (1)	
White	76.2% (67)	75.7% (28)	80.0% (20)	66.7% (8)	
Other	3.4% (3)	0.0% (0)	8.0% (2)	8.3% (1)	
Diabetic Status					**0.015**
Non-Diabetic	97.7% (86)	89.2% (33)	80.0% (20)	83.3% (10)	
Diabetic	2.3% (2)	10.8% (4)	20.0% (5)	16.7% (2)	
Smoking Status					0.688
Non-Smoker	89.8% (79)	89.2% (33)	92.0% (23)	100.0% (12)	
Smoker	10.2% (9)	10.8% (4)	8.0% (2)	0.0% (0)	
Blood Pressure					**0.002**
Normotensive	80.7% (71)	78.4% (29)	52.0% (13)	41.7% (5)	
Hypertensive	19.3% (17)	21.6% (8)	48.0% (12)	58.3% (7)	
ASA score					**0.006**
≤2	91.9% (79)	80.6% (29)	72.0% (18)	58.3% (7)	
>2	8.1% (7)	19.4% (7)	28.0% (7)	41.7% (5)	
CCI Score					0.052
<1	62.7% (52)	60.0% (21)	33.3% (8)	41.7% (5)	
≥1	37.3% (31)	40.0% (14)	66.7% (16)	58.3% (7)	
Insurance Type					0.099
Medicare/Medicaid	2.3% (2)	0.0% (0)	4.0% (1)	8.3% (1)	
Workers' Comp	18.2% (16)	32.4% (12)	28.0% (7)	50.0% (6)	
Private	79.5% (70)	67.6% (25)	68.0% (17)	41.7% (5)	

ASA = American Society of Anesthesiologists; CCI = Charlson Comorbidity Index; SD = Standard Deviations; Workers' Comp = workers' compensation
*p-value calculated using Chi-square analysis
Boldface indicates significance

Results: Perioperative Characteristics

Cohorts significantly differed in day of discharge, though majority of patients were discharged by Day 1

Table 2. Perioperative Characteristics

	Non-Obese (n=88)	Obese I (n=37)	Severe (n=25)	Morbid (n=12)	*p-value
Spinal Pathology					
Degenerative Spondylolithesis	62.0% (49)	60.6% (20)	66.9% (14)	66.7% (8)	0.985
Isthmic Spondylolithesis	26.6% (21)	29.0% (9)	30.4% (7)	8.3% (1)	0.507
Recurrent HNP	9.1% (8)	10.8% (4)	12.0% (3)	25.0% (3)	0.141
Scoliosis	3.4% (3)	10.8% (4)	0.0% (0)	0.0% (0)	0.132
Operative Time (min)					
Mean±SD	122.3 ± 23.6	125.2 ± 25.4	12.7 ± 13.7	130.0 ± 28.8	0.720
Estimated Blood Loss (mL)					
Mean±SD	57.8 ± 69.0	50.0 ± 23.9	47.8 ± 24.5	48.3 ± 35.8	0.778
Length of Stay (hours)					
Mean±SD	28.2 ± 17.9	30.1 ± 14.6	35.2 ± 27.9	33.9 ± 23.0	0.401
Day of Discharge					**0.034**
POD 0	22.7% (20)	10.8% (4)	32.0% (8)	0.0% (0)	
POD 1	56.8% (50)	67.6% (25)	32.0% (8)	83.3% (10)	
POD 2	17.1% (15)	18.9% (7)	20.0% (5)	8.3% (1)	
POD 3+	3.4% (3)	2.7% (1)	16.0% (4)	8.3% (1)	

POD = postoperative day of discharge; SD = standard deviation; HNP = Herniated Nucleus Pulposus

Results: Postoperative Improvement

Cohorts demonstrated many significant differences in PROM scores for pain, disability, and physical function

Table 3. Impact of BMI on Patient Reported Outcome Measures

	Non-Obese (mean±SD)	Obese I (mean±SD)	Severe (mean±SD)	Morbid (mean±SD)	*p-value
VAS Back					
Preoperative	6.0 ± 2.5	6.6 ± 2.6	6.3 ± 2.3	7.5 ± 1.7	0.232
6-weeks	3.2 ± 2.4	3.8 ± 2.6	5.3 ± 2.6	5.1 ± 2.5	**0.002**
12-weeks	2.6 ± 2.2	4.2 ± 2.9	4.1 ± 2.5	5.4 ± 3.1	**0.001**
6-months	2.9 ± 2.8	3.6 ± 2.5	4.3 ± 3.1	4.3 ± 2.4	0.126
1-year	2.5 ± 2.8	3.7 ± 2.8	3.3 ± 1.6	2.9 ± 2.9	0.434
VAS Leg					
Preoperative	4.8 ± 3.0	5.7 ± 3.1	6.6 ± 2.4	6.9 ± 1.9	**0.012**
6-weeks	1.9 ± 2.3	3.3 ± 2.9	4.6 ± 3.0	4.4 ± 2.3	**<0.001**
12-weeks	1.4 ± 2.0	3.4 ± 2.9	4.0 ± 2.0	3.4 ± 2.4	**<0.001**
6-months	1.8 ± 2.5	3.0 ± 3.0	2.7 ± 3.2	3.0 ± 2.5	0.129
1-year	1.9 ± 2.6	3.1 ± 3.4	3.6 ± 3.0	2.7 ± 2.6	0.252
ODI					
Preoperative	36.1 ± 15.6	44.3 ± 17.0	45.1 ± 15.1	57.3 ± 10.1	**<0.001**
6-weeks	28.7 ± 17.5	33.5 ± 20.9	44.3 ± 21.5	49.0 ± 13.9	**0.002**
12-weeks	21.6 ± 14.7	35.4 ± 20.0	32.2 ± 20.2	47.0 ± 9.8	**<0.001**
6-months	17.1 ± 16.6	26.8 ± 17.9	29.2 ± 21.5	35.8 ± 17.7	**0.001**
1-year	14.6 ± 17.9	26.5 ± 19.3	30.6 ± 23.7	23.5 ± 23.6	**0.035**
SF-12					
Preoperative	33.5 ± 8.7	28.4 ± 7.0	27.7 ± 7.5	25.0 ± 5.1	**<0.001**
6-weeks	35.9 ± 7.5	30.3 ± 7.8	27.7 ± 6.8	25.1 ± 6.0	**0.001**
12-weeks	38.5 ± 9.0	32.9 ± 9.9	31.6 ± 11.1	23.7 ± 6.3	**<0.001**
6-months	42.6 ± 11.4	36.6 ± 11.3	34.6 ± 11.3	33.3 ± 8.9	**0.012**
1-year	43.7 ± 11.7	37.1 ± 11.3	36.5 ± 9.4	34.3 ± 10.8	**0.031**
PROMIS-PF					
Preoperative	37.0 ± 6.5	34.5 ± 5.4	33.4 ± 4.0	30.6 ± 5.7	**0.001**
6-weeks	38.8 ± 6.7	36.2 ± 6.6	34.0 ± 6.9	31.3 ± 3.9	**0.002**
12-weeks	43.8 ± 6.1	38.0 ± 7.6	38.4 ± 7.5	33.6 ± 4.9	**<0.001**
6-months	46.3 ± 6.1	42.0 ± 7.6	40.7 ± 6.8	38.3 ± 6.7	**0.001**
1-year	49.0 ± 9.5	41.5 ± 7.9	41.1 ± 6.4	40.9 ± 7.0	**0.001**

VAS = Visual Analog Scale; ODI = Oswestry disability index; SF-12 = Short Form-12; PROMIS PF = Patient-Reported Outcomes Measurement Information System physical function
*p-values calculated using linear regression
Boldface indicates significance

Results: MCID Achievement

Significant differences between cohorts noted only for PROMIS-PF at 12-weeks

Table 4. Impact of BMI on Patient Reported Outcome Measures

	Preop - 6wks	Preop - 12wks	Preop - 6mo	Preop - 1yr	Overall
VAS Back	n=48	n=56	n=86	n=56	n=125
Non-Obese	55.1% (25)	62.9% (56)	54.6% (47)	58.9% (33)	54.4% (68)
Obese I	25.2% (11)	18.0% (16)	24.4% (21)	19.6% (11)	23.2% (29)
Severe	9.2% (14)	12.4% (11)	10.4% (9)	14.3% (8)	13.6% (17)
Morbid	10.3% (9)	6.7% (6)	10.4% (9)	7.1% (4)	8.8% (11)
†p-value	0.051	0.124	0.232	0.697	0.691
VAS Leg	n=85	n=87	n=77	n=50	n=118
Non-Obese	52.9% (45)	56.3% (49)	49.3% (38)	60.0% (30)	51.6% (61)
Obese I	23.5% (20)	18.3% (16)	23.3% (18)	20.0% (10)	22.0% (26)
Severe	15.2% (13)	16.0% (14)	16.8% (13)	14.0% (7)	16.9% (20)
Morbid	8.24% (7)	9.2% (8)	10.3% (8)	6.0% (3)	9.3% (11)
†p-value	0.975	0.765	0.320	0.926	0.324
ODI	n=54	n=58	n=77	n=52	n=109
Non-Obese	55.5% (30)	62.0% (36)	55.8% (43)	59.6% (31)	55.9% (61)
Obese I	27.7% (15)	15.5% (9)	20.7% (16)	19.2% (10)	21.1% (23)
Severe	7.4% (4)	17.2% (10)	14.2% (11)	15.3% (8)	15.6% (17)
Morbid	9.2% (5)	5.1% (3)	9.0% (7)	5.7% (3)	7.3% (8)
†p-value	0.163	0.124	0.861	0.989	0.893
SF-12	n=40	n=56	n=60	n=59	n=104
Non-Obese	50.0% (20)	60.7% (34)	58.3% (35)	55.9% (33)	56.7% (59)
Obese I	27.5% (11)	19.6% (11)	26.6% (16)	23.7% (14)	25.9% (27)
Severe	15.0% (6)	14.2% (8)	11.6% (7)	15.2% (9)	12.5% (13)
Morbid	7.5% (3)	5.3% (3)	3.3% (2)	5.0% (3)	4.8% (5)
†p-value	0.885	0.426	0.372	0.374	0.481
PROMIS-PF	n=19	**n=35**	n=48	n=46	n=85
Non-Obese	78.9% (15)	**77.1% (27)**	60.4% (29)	60.8% (28)	62.3% (53)
Obese I	15.7% (3)	**14.2% (5)**	20.8% (10)	17.3% (8)	18.8% (16)
Severe	5.2% (1)	8.5% (3)	12.5% (6)	10.8% (5)	11.7% (10)
Morbid	0.0% (0)	**0.0% (0)**	6.2% (3)	10.8% (5)	7.0% (6)
†p-value	0.071	**0.011**	0.338	0.103	0.174

Discussion / Conclusion

- BMI is a significant predictor of ODI, SF-12, and PROMIS-PF at the preoperative to 1-year postoperative timepoint, but only up to the 12-week timepoint for VAS scores

- MCID achievement varied by weight category for PROMIS-PF only

- Our results suggest that while BMI may be a significant risk factor for statistical improvement of outcome measures, obesity may only impact a patient's perception of a meaningful improvement in physical function