Impact of Body Mass Index on Radiographic Outcomes Following Transforaminal Lumbar Interbody Fusion (TLIF)

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INTRODUCTION: Obesity is increasingly prevalent and contributes to higher rates of degenerative spinal conditions requiring surgical intervention. While several studies have examined perioperative risks associated with obesity, there is limited data assessing the impact of body mass index (BMI) on radiographic alignment following open transforaminal lumbar interbody fusion (TLIF). As sagittal balance plays a critical role in long-term spinal function, evaluating whether higher BMI hinders radiographic correction is essential for improving surgical planning and patient outcomes.

METHODS: A retrospective cohort study was conducted at two academic centers evaluating adult patients who underwent primary open TLIF between 2017 and 2021. Patients were stratified into five BMI categories: normal weight (18.5–24.9), overweight (25.0–29.9), class I obesity (30.0–34.9), class II obesity (35.0–39.9), and class III obesity (≥40). Demographic and perioperative variables were collected, including operative time, estimated blood loss, and complications. Radiographic parameters—lumbar lordosis (L1–S1), segmental lordosis (L4–S1), apex of lordosis (L1–S1), pelvic tilt (PT), sacral slope (SS), and PI–LL mismatch—were recorded preoperatively and at one-year follow-up. Statistical comparisons assessed differences across BMI groups, with significance set at $p<0.05$.

RESULTS: A total of 487 patients were included (normal weight: n=84; overweight: n=152; class I: n=139; class II: n=67; class III: n=45). Class III patients were younger (p=0.002) and had a higher prevalence of diabetes. There were no significant differences in operative time, blood loss, or complication rates between BMI cohorts. Preoperatively, radiographic alignment was largely similar, except for L4 pelvic angle, which increased with BMI (p=0.016). At one year, no significant differences were observed between groups in lumbar lordosis (p=0.462), segmental lordosis (p=0.308), apex angle (p=0.653), PI–LL mismatch (p=0.665), pelvic tilt (p=0.592), or sacral slope (p=0.611). All groups demonstrated comparable changes in alignment from baseline to follow-up (all $p>0.05$).

DISCUSSION AND CONCLUSION: Despite baseline anatomical differences, obesity does not appear to negatively affect sagittal alignment correction following open TLIF. Patients with elevated BMI achieved radiographic outcomes similar to those with normal weight, suggesting that BMI alone should not deter surgical intervention. Further studies with long-term follow-up and incorporation of functional outcomes are warranted to fully understand the influence of obesity on spine surgery success.

Table 1. Patient Demographics

Characteristic	Total (n=487)	Normal (n=84)	Overweight (n=152)	Obesity Class I (n=139)	Obesity Class II (n=67)	Obesity Class III (n=45)	*p-value
Age (mean ± SD, years)	61.9 ± 10.45	63.64 ± 10.87	63.68 ± 11.03	61.24 ± 9.96	59.72 ± 7.84	57.91 ± 11.00	**0.002**
Gender							**0.027**
Female	277 (56.88%)	51 (60.71%)	71 (46.71%)	86 (61.87%)	38 (56.72%)	31 (68.89%)	
Male	210 (43.12%)	33 (39.29%)	81 (53.29%)	53 (38.13%)	29 (43.28%)	14 (31.11%)	
BMI (mean ± SD, kg/m²)	31.05 ± 6.57	22.75 ± 1.55	27.59 ± 1.46	32.36 ± 1.46	37.26 ± 1.42	45.01 ± 4.29	**<0.001**
Comorbidities							
Current Smoker	87 (17.94%)	15 (17.86%)	26 (17.22%)	32 (23.19%)	9 (13.43%)	5 (11.11%)	0.289
Hypertension	61 (56.48%)	12 (54.55%)	17 (53.12%)	16 (59.26%)	9 (56.25%)	7 (63.64%)	0.974
Diabetes	101 (20.91%)	10 (11.90%)	27 (17.88%)	31 (22.46%)	18 (26.87%)	15 (34.88%)	**0.045**
CCI Score (Mean ± SD)	1.06 ± 1.25	0.98 ± 1.06	1.07 ± 1.17	1.04 ± 1.27	1.06 ± 1.29	1.20 ± 1.67	0.915

BMI = body mass index; SD= standard deviation; kg = kilograms; m = meters; CCI = Charlson Comorbidity Index
p-value calculated using one-way ANOVA for continuous variables and chi-square analysis for categorical variables. Post-hoc pairwise comparisons for significant ANOVAs were conducted using Bonferroni correction
Bolding denotes statistical significance ($p < 0.05$)

Table 2. Perioperative Characteristics

Characteristic	Total (n=487)	Normal (n=84)	Overweight (n=152)	Obesity Class I (n=139)	Obesity Class II (n=67)	Obesity Class III (n=45)	*p-value
Spinal Level							0.251
Single	201 (41.53%)	34 (40.48%)	67 (44.67%)	54 (39.13%)	31 (46.27%)	15 (33.33%)	
Two	141 (29.13%)	30 (35.71%)	41 (27.33%)	37 (26.81%)	14 (20.90%)	19 (42.22%)	
Three or more	142 (29.34%)	20 (23.81%)	42 (28.00%)	47 (34.06%)	22 (32.84%)	11 (24.44%)	
Operative Time (Mean ± SD; min)	250.29 ± 85.06	237.91 ± 84.80	242.03 ± 78.49	249.01 ± 84.34	272.24 ± 93.98	273.69 ± 89.24	0.072
LAT_S1_PI	57.28 ± 14.35	53.34 ± 15.92	57.80 ± 14.71	58.8 ± 14.11	56.56 ± 12.93	59.81 ± 11.73	0.094
Estimated Blood Loss (Mean ± SD; mL)	149 ± 42.41	143.10 ± 45.76	152.50 ± 40.75	147.06 ± 47.58	151.92 ± 36.03	155.56 ± 30.05	0.885
Length of Stay (Mean ± SD; hours)	3.48 ± 1.95	3.29 ± 1.80	3.32 ± 1.81	3.60 ± 2.40	3.50 ± 1.55	4.10 ± 1.62	0.291
In-Hospital Complication Rate	29 (6.65%)	4 (4.94%)	9 (6.82%)	8 (6.50%)	5 (8.20%)	3 (7.69%)	0.952

SD = standard deviation; min = minutes; mL = milliliters
p-value calculated using one-way ANOVA for continuous variables and chi-square analysis for categorical variables. Post-hoc pairwise comparisons for significant ANOVAs were conducted using Bonferroni correction
Bolding denotes statistical significance ($p < 0.05$)