



Clinical Study

Do obese patients have worse outcomes after direct lateral interbody fusion compared to non-obese patients?



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ABSTRACT

Obese patients undergoing lumbar spinal fusion surgery are a challenge to the operating surgeon. Direct lateral interbody fusion (DLIF) has been performed for degenerative disease of the lumbar spine with good outcomes; nevertheless, how obese patients fare compared to non-obese patients after DLIF remains unknown. The primary aim of this study is to compare rates of postoperative complications and long-term outcomes between obese and non-obese patients undergoing DLIF. Sixty-three patients (obese: 29, non-obese: 34) undergoing index DLIF for degenerative disease of the spine between 2010 and 2012 at our institution were retrospectively enrolled. We analyzed data on demographics, postoperative complications, back and leg pain, and functional disability over 2 years. Patients completed the Oswestry Disability Index (ODI) and Visual Analog Scale (VAS) back and leg pain numerical rating scores before surgery, then at 12 and 24 months after surgery. Outcomes and complication rates were compared between the cohorts. The cohorts were similar at baseline. Postoperative complication rates were similar between obese and non-obese patients. There was no statistically significant difference in the incidence of durotomy ($p = 0.91$), anterior thigh numbness ($p = 0.60$), cerebrospinal fluid leak ($p = 0.91$), postoperative infection ($p = 0.37$), or bleeding requiring transfusion ($p = 0.16$). No patient experienced a nerve injury or psoas hematoma. Both cohorts had similar 2 year improvement in VAS for back pain, leg pain, and ODI. Our study demonstrates that obese and non-obese patients undergoing DLIF have similar complication profiles; hence, a patient's weight should not be a contraindication to DLIF.

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1. Introduction

The obesity epidemic continues to be a major issue in the USA, with a prevalence reaching as high as 35% in the adult population [1,2], and accounting for an estimated 150 billion dollars in medical costs [3]. Numerous studies have demonstrated that obesity is a significant risk factor for degenerative spinal disorders [4–7]. The surgical management of this subgroup of patients is technically challenging for spine surgeons as anatomical landmarks are less well defined.

A number of studies have shown that obesity is associated with worse clinical outcomes such as increased postoperative complications and poor functional status following spine surgery [8–11]. A study by Kalanithi and colleagues demonstrated that morbid

obesity was associated with higher in-hospital complication rates, and is an independent predictor of complications in patients undergoing spinal fusion surgery [8]. However, other studies have shown that obesity does not affect outcomes after lumbar spine surgery [12,13]. Peng and colleagues in a prospective longitudinal study demonstrated that perioperative outcomes were similar between obese and non-obese patients [13]. Furthermore, Djurasovic et al. presented mixed results, indicating that obese patients undergoing lumbar fusion enjoy similar clinical benefits to non-obese patients; however, complications are more likely in the obese cohort [14]. The majority of these studies have been small retrospective reviews of primarily the direct lateral interbody fusion (DLIF) approach, and the current literature remains equivocal. The primary aim of this study is to compare the rate of postoperative complications and the long-term functional outcomes between obese and non-obese patients undergoing DLIF.

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2. Methods

2.1. Study design

This study compares complication rates and outcomes following DLIF between obese and non-obese cohorts of patients. We retrospectively reviewed a total of 63 patients (29 obese and 34 non-obese) undergoing DLIF for degenerative disease of the lumbar spine. Institutional Review Board approval was obtained prior to study initiation. Obesity was defined as body mass index (BMI) >30 kg/m². All patients were over 18 years of age and presented with (1) low back pain and/or radiculopathy; (2) MRI evidence of Grade I spondylolisthesis with central or foraminal stenosis; (3) failure of at least 6 weeks of non-surgical treatment; and (4) available patient reported outcomes data at baseline and at 1 and 2 years postoperatively. Patients were excluded if they had (1) prior back surgery and (2) severe co-existent pathology that could confound the assessment of operative outcome (specifically, rheumatoid arthritis, osteoarthritis, or metabolic bone disease). All procedures in the study were performed by the senior author. Plain upright films were obtained on all patients. Fusion was determined in all cases by postoperative CT scans at 1 year following surgery. For each case, we performed a retrospective chart review of patient demographics, clinical presentation, co-morbidities, radiological studies, and complication variables.

2.2. Immediate postoperative complications

We assessed the following postoperative complications for all patients: wound infections, durotomy, cerebrospinal fluid (CSF) leak, urinary tract infections (UTI), nerve injury, deep vein thrombosis (DVT)/pulmonary embolism (PE), bleeding requiring transfusion, anterior thigh numbness and psoas hematoma.

2.3. Patient reported outcomes

We collected and analyzed data on patient reported back pain, leg pain, and functional disability over two years. Back pain was assessed using the Back Pain-Visual Analog Scale (VAS-BP), while leg pain was assessed using the Leg Pain-Visual Analog Scale (VAS-LP). Functional status was assessed using the Oswestry Disability Index (ODI) questionnaire. These questionnaires have been validated and used widely in prior spine surgery literature, with several studies showing their relevance to clinical practice [15–18]. The questionnaires were administered before surgery and then re-administered at 12 and 24 months after surgery.

2.4. Statistical analyses

We compared baseline variables (including comorbidities and operative measures), postoperative complications, and patient reported outcomes between obese and non-obese patients undergoing DLIF. Continuous data was expressed as the means ± standard deviation (SD) with assumed normal distribution and compared via Student's *t*-test. Binary data was compared with the chi-squared test. Categorical data (number of spine levels fused) was expressed as median [interquartile range] and compared via the Mann–Whitney U test. For all comparisons, statistical significance was defined as *p* value less than 0.05.

3. Results

We retrospectively enrolled a total of 69 patients undergoing DLIF for degenerative disease of the lumbar and thoracic spine between 2010 and 2012. Six patients were lost to follow up. Of the total 63 patients analyzed, 29 were obese and 34 were non-obese.

3.1. Baseline characteristics

In our study, patients with obesity were younger than the non-obese patients; the overall mean ± SD age was 65.91 ± 12.59 years (obese: 61.04 ± 11.14 years versus non-obese: 70.06 ± 12.40 years, *p* = 0.03). Approximately a third of the patients enrolled in this study were male (obese: 36.0%, non-obese: 38.0%, *p* = 0.76). The baseline comorbidities between cohorts were statistically similar. Overall, 12.70% were smokers (obese: 13.78%, non-obese: 11.76%, *p* = 0.81). Chronic obstructive pulmonary disease was present in 3.17% (obese: 0.0%, non-obese: 5.88%, *p* = 0.16). A history of coronary artery disease was seen in 22.22% of patients (obese: 24.13%, non-obese: 20.58%, *p* = 0.74). Overall 61.9% of patients had hypertension at baseline (obese: 65.51%, non-obese: 58.82%, *p* = 0.59) (Table 1). No variable overcame obesity as a potential driver of poor outcomes.

3.2. Operative variables

Operative variables between the cohorts were statistically similar. The overall ± SD duration of surgery was 291 ± 318 minutes (obese: 248 ± 305 minutes versus non-obese: 324 ± 328 minutes, *p* = 0.35). The estimated blood loss for the combined cohorts was 241 ± 185 mL (obese: 255 ± 149 mL versus non-obese: 232 ± 208 mL).

Table 1

Baseline characteristics of overall direct lateral interbody fusion study cohort and stratified by obesity status

Variable	Combined cohorts n = 63	Obese n = 29	Non-obese n = 34	p value
<i>Patient characteristics</i>				
Mean age ± SD (years)	65.91 ± 12.59	61.04 ± 11.14	70.06 ± 12.40	0.03
Male (%)	36.51	36.00	38.00	0.76
Smoker (%)	12.70	13.78	11.76	0.81
COPD (%)	3.17	0	5.88	0.16
CAD (%)	22.22	24.13	20.58	0.74
HTN (%)	61.90	65.51	58.82	0.59
BMI (kg/m ²)	28.58 ± 6.36	33.04 ± 5.64	23.95 ± 2.68	0.01
<i>Operative characteristics</i>				
Duration of surgery (minutes)	291 ± 318	248 ± 305	324 ± 328	0.35
Estimated blood loss (mL)	241 ± 185	255 ± 149	232 ± 208	0.68
Median [IQR] number of levels involved	2 [1–3]	2 [1–4]	2 [2–3]	0.82

BMI = body mass index, CAD = coronary artery disease, COPD = chronic obstructive pulmonary disease, HTN = hypertension, IQR = interquartile range, SD = standard deviation.

232 ± 208 mL, $p = 0.68$). The median number of levels fused for both cohorts was two [1–3] (obese: two [1–4] versus non-obese: two [2–3], $p = 0.82$) (Table 1).

3.3. Postoperative complications

As shown in Table 2, postoperative complication rates did not show statistically significant differences between the two cohorts. Overall, durotomies occurred in two patients (overall 3.17%; obese: 3.44% versus non-obese: 2.94%, $p = 0.91$), anterior thigh numbness occurred in eight patients (overall 12.70%; obese: 10.34% versus non-obese: 14.70%, $p = 0.60$), UTI occurred in six patients (overall 9.52%; obese: 10.34% versus non-obese: 8.82%, $p = 0.84$) and post-operative wound infection occurred in four patients (overall 6.35%; obese: 3.44% versus non-obese: 8.82%, $p = 0.37$). CSF leak occurred in two patients (overall 3.17%; obese: 3.44% versus non-obese: 2.94%, $p = 0.91$), DVT/PE occurred in one patient (overall 1.59%; obese: 3.44% versus non-obese: 0.00%, $p = 0.32$), and bleeding requiring transfusion occurred in two patients (overall 3.17%; obese: 0.0% versus non-obese: 5.88%, $p = 0.16$). No patient in either cohort experienced a nerve injury or psoas hematoma (Table 2).

3.4. Patient reported outcomes after DLIF

Both cohorts demonstrated similar improvements in VAS-BP, VAS-LP, and functional status (ODI) 2 years following surgery. Overall, the change from baseline in the VAS-BP score was 3.71 ± 2.13 (obese: 3.61 ± 0.56 versus non-obese: 4.48 ± 0.32 , $p = 0.41$). The change from baseline in the VAS-LP score for all patients was 3.68 ± 1.27 (obese: 3.00 ± 3.49 versus non-obese: 4.69 ± 3.41 , $p = 0.09$). The 2 year change in the ODI score for the combined cohorts was 26.65 ± 5.08 (obese: 21.87 ± 3.22 versus non-obese: 30.68 ± 3.02 , $p = 0.16$). The overall 30 day readmission rate was 6.35%. The 30 day mortality rate was 0% for both cohorts of patients (Table 3).

4. Discussion

This 2 year single institutional retrospective study compared the rate of postoperative complications and the long-term patient-reported functional and pain outcomes between obese and non-obese patients undergoing DLIF. The overall postoperative complication rates were not significantly different between the obese and non-obese patients. Furthermore, both cohorts showed similar 2 year improvement in the ODI and VAS scores for back and leg pain. This study demonstrates that there is no greater risk of complications associated with obesity, and that these patients may expect similar improvements in function and pain when undergoing DLIF.

The surgical management of obese patients undergoing spinal fusion represents a technical challenge for the surgeon. Studies in the current literature are split on whether or not obesity is associated with increased rates of complications. A study by Vaidya et al. reported a high incidence of postoperative complications among obese patients undergoing lumbar spinal fusion. This retrospective review of 63 patients with a BMI >30 kg/m² found that postoperative complications occurred in 45% of morbidly obese and 44% of obese patients. Major postoperative complications included myocardial infarction, cardiac arrhythmia, and PE, while surgical complications included non-union, adjacent level disease, dural leak, and wound infection, among others [11].

Conversely, other studies have found no association between increased complication rates and obesity. A prospective analysis of 74 obese (BMI >30 kg/m²) patients undergoing anterior retroperitoneal lumbar disc procedures found that there was no significant difference in the complication rates between obese and non-obese patients ($p = 0.6$). The major complication rate was 6.1% versus 7.3% and the minor complication rate was 6.1% versus 4.9% in the obese and non-obese patient cohorts, respectively. Obesity did not affect blood loss, use of analgesia, length of hospital stay, or return to ambulation. The authors concluded that obesity did not affect perioperative outcomes, and it was not related to

Table 2
Postoperative complications following direct lateral interbody fusion in obese versus non-obese patients

Variable	Combined cohorts n = 63	Obese n = 29	Non-obese n = 34	p value
Wound infection (%)	6.35	3.44	8.82	0.37
Durotomy (%)	3.17	3.44	2.94	0.91
CSF leak (%)	3.17	3.44	2.94	0.91
UTI (%)	9.52	10.34	8.82	0.84
Nerve injury	0	0	0	0
DVT/PE (%)	1.59	3.44	0	0.32
Bleeding requiring transfusion (%)	3.17	0	5.88	0.16
Anterior thigh numbness (%)	12.7	10.34	14.7	0.60
Psoas hematoma (%)	0	0	0	0

CSF = cerebrospinal fluid, DVT/PE = deep vein thrombosis/pulmonary embolism, UTI = urinary tract infection.

Table 3
Thirty day outcome and patient reported outcomes following direct lateral interbody fusion in obese versus non-obese patients

Variable	Combined cohorts n = 63	Obese n = 29	Non-obese n = 34	p value
<i>30 day outcomes</i>				
Readmission rate (%)	6.35	6.89	14.70	0.35
Mortality rate (%)	0	0	0	0
<i>Change from baseline in patient reported outcomes measures</i>				
VAS-BP (mean ± SD)	3.71 ± 2.13	3.61 ± 0.56	4.48 ± 0.32	0.41
VAS-LP (mean ± SD)	3.68 ± 1.27	3.00 ± 3.49	4.69 ± 3.41	0.09
ODI (mean ± SD)	26.65 ± 5.08	21.87 ± 3.22	30.68 ± 3.02	0.16

ODI = Oswestry Disability Index, SD = standard deviation, VAS-BP = Visual Analog Scale-Back Pain, VAS-LP = Visual Analog Scale-Leg Pain.

increased risk of morbidity in anterior lumbar surgery [13]. Another retrospective review comparing the incidence of early complications between obese and non-obese patients undergoing extreme lateral interbody fusion by Rodgers et al. found that this minimally invasive procedure had no greater risk of complications in the obese patient. This study defined early complications as all adverse events that took place within the first 3 months of the original operation. Complications were minimal and comparable in each cohort [19].

Similar to the Rodgers et al. study, we found that the rate of postoperative complications was similar between obese and non-obese patients. The rates of durotomy ($p = 0.91$), anterior thigh numbness ($p = 0.6$), UTI ($p = 0.84$), postoperative wound infection ($p = 0.37$), CSF leak ($p = 0.91$), DVT/PE ($p = 0.32$), and bleeding requiring transfusion ($p = 0.16$) were not significantly different between the two cohorts. No patient in either group experienced a nerve injury or psoas hematoma.

The impact of obesity on long-term clinical outcomes is unclear in the current literature. Rihn et al. performed an as-treated analysis on patients in the Spine Patient Outcomes Research Trial (SPORT) for treatment of lumbar disc herniation. At 4 year follow up, obese patients in the operative group experienced significantly less improvement from baseline than the non-obese patients, including scores on the Short Form-36 physical function (SF-36), 37.3 versus 47.7 points ($p < 0.001$), SF-36 bodily pain, 44.2 versus 50.0 points ($p = 0.005$), and ODI, 33.7 versus 40.1 points ($p < 0.001$). This study concluded that obese patients undergoing surgery for lumbar disc herniation achieved less clinical benefit than non-obese patients [10]. In contrast, Djurasovic et al. in a study of 270 obese and non-obese patients undergoing lumbar fusion with complete 2 year clinical outcome measures demonstrated similar improvement in patient-reported outcome measures. The authors concluded that obese patients can expect similar clinical outcomes when undergoing lumbar fusion, and that weight is not a contraindication to surgery [14]. Similarly, Singh et al. examined the relationship between obesity, clinical outcomes, and return to work in patients undergoing less invasive posterior lumbar interbody fusion. The authors observed a significant improvement at 12 months in the ODI (14.78 ± 6.0 , $p = 0.03$), and in the VAS for back pain (3.2 ± 0.76 , $p = 0.001$). Furthermore, 66.6% of patients returned to their normal preoperative employment within 1 year of the original procedure [12]. We observed no difference in the extent of functional improvement, including the VAS-BP ($p = 0.41$), VAS-LP ($p = 0.09$), and ODI ($p = 0.16$), between obese and non-obese patients following DLIF.

This study has several limitations. The follow up period for patient reported outcomes was 2 years after index DLIF surgery. Though 2 years is a relatively long time for postoperative outcomes in spine surgery, results from this study cannot necessarily be extrapolated into the longer term. It is possible that obese patients may experience a decline in outcome measures at increased intervals from surgery. We utilized standardized inclusion and exclusion criteria; however, bias may have been introduced as all clinical and surgical decision-making was done by the senior surgeon in this study. Additionally, we included only those patients with available outcomes reported at 2 years following surgery. By doing so, we may have excluded patients whose 2 year outcomes

were different from the distribution observed in our cohorts. Other aspects of the procedure that were not considered include which patients underwent decompression and what was used as the fusion substrate.

5. Conclusions

Obese patients undergoing DLIF experience similar rates of postoperative complications and long-term outcomes as non-obese patients. Obesity should not be considered a contraindication for DLIF.

Conflicts of Interest/Disclosures

The authors declare that they have no financial or other conflicts of interest in relation to this research and its publication.

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