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Minimally Invasive Surgery for Lumbar Decompression in Obese Patients

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Abstract

Background: Micro endoscopic decompression of stenosis and micro endoscopic discectomy has been shown to be safe and effective. Minimally invasive techniques are associated with decreased soft tissue injury, less pain, and quicker patient recovery. The obese population can pose unique peri-operative challenges. We explored the role of obesity on self-reported outcomes, blood loss, operative time, length of stay, and complications following minimally invasive lumbar decompression.

Methods: A retrospective review of outcomes on 60 obese patients (BMI ≥30 kg/m^2) who underwent minimally invasive micro endoscopic decompression of stenosis or micro endoscopic discectomy, compared to 51 normal-weight patients (BMI 18.5 kg/m^2-24.9 kg/m^2), undergoing the same procedures. Outcomes analyzed included the Visual Analog Scale (VAS) and Oswestry Disability Index (ODI).

Results: In 51 normal-weight patients, the mean age was 55.0 years and average BMI was 23.2 ± 0.4 kg/m^2. In 60 obese patients, the mean age was 58.0 years and average BMI 34.2 ± 0.6 kg/m^2. Mean operative time was 99 ± 4 minutes, and LOS was 9.8 ± 2.7 hours for the normal-weight group. For obese patients, the mean operative time was significantly longer with 117 ± 5 minutes; LOS was 16.1 ± 5.1 hours. BMI significantly correlated with operative time (p= 0.002). Obese patients had a statistically significant (p=0.04) increased estimated blood loss (26.7 cc) compared to normal-weight patients (19.5 cc). Improvements in VAS-back, VAS-leg, and ODI were seen within each cohort. There were no statistically significant differences between the obese and normal groups at the last follow-up. The obese group had more complications (8.33%) compared to normal controls (3.92%), but was not statistically significant.

Conclusion: Microendscopic decompression of stenosis and micro endoscopic discectomy are effective surgical options for the obese population. Obesity did not have an impact on self-reported outcomes or length of stay. Obesity was associated with an increase in average operative time, estimated blood loss, and subsequent return to surgery.

Keywords: Decompression; Laminectomy; Lumbar; Micro endoscopic decompression; Minimally invasive; Obesity; Spine surgery

Introduction

Obesity, or body mass index (BMI) greater than or equal to 30 kg/m^2, is an increasingly prevalent and worrisome problem in American society [1,2]. Clinically, obese patients are often affected by multiple medical co-morbidities, each of which can increase the risks of surgery and general anesthesia [3]. Traditional lumbar spine operations become uniquely challenging in obese patients. The additional subcutaneous fat deposited above the fascia often necessitates longer incisions and deeper exposures; this can create a potential soft-tissue space that is difficult to re-approximate. Minimally invasive spine surgery (MISS) techniques have the potential to minimize the soft-tissue corridor required to address patient pathology [4-11]. These techniques have been shown to improve recovery times and minimize peri-operative morbidities, while producing clinical outcomes comparable to traditional, open techniques.

Given the unique challenges of soft-tissue exposure and potential surgical morbidity in the obese patient population, the application of MISS techniques may be particularly advantageous. We have previously reported on the role of BMI on outcomes following minimally invasive lumbar fusion [12]. The goal of this report is to evaluate this relationship in patients treated with non-instrumented minimally invasive lumbar micro endoscopic decompression procedures.

The primary aims of the study are to answer the following clinical questions: 1) Does obesity have an effect on self-reported clinical outcomes following non-instrumented minimally invasive lumbar procedures? 2) Does obesity have an effect on peri-operative end-points, such as estimated blood loss (EBL), operative time, or length of stay (LOS)? 3) Does the presence of obesity modify the presence of either peri- or post-operative complications?

Patients and Methods

Study design included restrospective analysis of a prospectively collected database; the appropriate Institutional Review Board endorsed approval. Clinical data was obtained at baseline pre-operatively, as well as in multiple post-operative time periods. Outcomes were measured by three self-reported clinical end-points, including the Visual Analog Scale for both back (VAS-B) and leg (VAS-L) pain, and Oswestry Disability Index (ODI). Additionally, patient demographics including age, height, and weight were collected. Peri-operative data included estimated blood loss (EBL), operative time, complications and hospital length of stay (LOS); length of stay was defined as time from end of surgery to discharge. The side of approach and level of operation were also recorded. Individual patient BMI was calculated from a standard equation utilizing patient height and weight. Outcome measures were obtained at 6 weeks, 4.5 months, and 10.5 months, post-operatively following non-instrumented minimally invasive lumbar decompression. Clinical complications were documented in all patients during the immediate peri-operative and post-operative follow-ups; additionally, reasons for return to surgery were documented.

All patients undergoing micro endoscopic decompression of stenosis (MEDS) or micro endoscopic discectomy (MED) over a four-year period were included in this analysis. Patients undergoing this operation for lumbar radiculopathy and neurogenic claudication were included. Patients with neoplastic disease and traumatic fractures, as well as patients who were underweight (BMI \<18.5 kg/m^2) or overweight (BMI 25 kg/m^2 to 29.9 kg/m^2) were excluded from the study. All surgeries were performed under the senior author (R.G.F). BMI was used to separate patients of normal weight (BMI 18.5 kg/m2 to 24.9 kg/m^2) from clinically obese patients (BMI ≥ 30 kg/m^2). Our definition of obesity was based upon the classification guidelines proposed by the National Institutes of Health guidelines relating to BMI [13]. Using these criteria, 111 consecutive patients were included in the analysis of outcomes.

Decompression techniques used in this study were originally described in a cadaver model by Guiot et al., and later clinically evaluated by Khoo et al. [{Khoo, 2002 #10}6,10]. Patients were operated on in the prone position under general anesthesia using a radiolucent Wilson frame and Jackson table. Localization was achieved using real-time fluoroscopic images. Following infiltration of local anesthesia, a stab incision was made 1.5 cm off midline through which a K-wire was passed, docking on the appropriate facet. Serial dilators were then passed over the K-wire until an 18-mm final working channel was placed. An endoscopic camera was then inserted into the working channel. Ipsilateral decompression was achieved using standard curettes and Kerrison rongeurs. The tube was then angled to the contralateral side, and contralateral decompression was accomplished using a drill with a unilateral retractable shield. Bilateral foraminotomies and removal of ligamentum flavum were performed using Kerrison rongeurs. Hemostasis was achieved with Surgifoam (Ethicon/Johnson and Johnson; Somerville, NJ) and wound closure was completed using facial and subcuticular stitches and Dermabond (Ethicon/Johnson and Johnson; Somerville, NJ).

For patients undergoing micro endoscopic discectomy, the traversing nerve root was retracted slightly medially, the annulus incised, and the discectomy performed using standard curettes and pituitary rongeurs.

Intra-operative data used in this analysis was obtained from anesthesia flow sheets that were crosschecked against the surgeon's operative dictations. Major complications were defined as any clinical condition requiring further intervention, return to higher level of care, new neurological deficit, or return to operating room (OR). Minor complications were defined as any event requiring deviation from normal operative or post-operative treatment.

Statistical analysis

Patients were assigned to two groups, obese (BMI ≥30 kg/m^2) and control (BMI 18.5 kg/m^2-24.9 kg/m^2). Continuous variables following a non-Gaussian distribution were compared using the Wilcoxon rank-sum test (Mann Whitney U test), whereas t-test was used for normally distributed continuous variables. Categorical variables following the non-Gaussian distribution were compared using the Fisher Exact test. Primary outcome measures were analyzed using the Mann Whitney U test. Rates of intra-operative and post-operative complications, such as durotomy, infection, return to surgery for adjacent level decompression, and repeat operation were compared using the Fischer Exact test. Tests with p-value ≤ 0.05 were considered statistically significant. Microsoft Excel 2011 for OS X was used for the analysis of the data.

Results

The 111 patients that met the study inclusion criteria were divided according to BMI, 60 obese and 51 normal-weight (control) patients. The obese group consisted of 38 males and 22 females, while the control group included 29 males and 22 females. A summary of the baseline characteristics is presented in Table 1. There was no statistically significant difference in age between the two groups (p=0.22), with an average of 58 years for the obese group and 55 years for the normal-weight controls. The BMI for the obese group was 34.2 kg/m^2, while it was significantly less (p<0.01) in the control group with an average BMI of 23.2 kg/m^2. Seventy-four patients underwent MED (39 normal weight, 35 obese) and 37 patients underwent MEDS (12 normal weight, 25 obese). The distribution of operation level is presented in Figure 1. Average time from operation to most recent follow-up was 366 days for the obese group, and 363 days for the control group.

	Obese (n=60)	Normal-weight (n=51)	p-value
Age in years (SEM)	58.0 (2.1)	55.0 (2.5)	0.22
BMI in kg/m^2 (SEM)	34.2 (0.6)	23.2 (0.4)	<0.01

Estimated blood loss in cc (SEM)	26.7 (3.8)	19.5 (2.0)	0.04
Operative time in minutes (SEM)	117 (5)	99 (4)	0.002
Length of stay in hours (SEM)	16.1 (5.1)	9.8 (2.7)	0.38
Abbreviations: BMI – body Mass Index, cc – Cubic Centimeters, SEM – Standard Error of the Mean			

Table 1: Baseline characteristics, intra-operative data, and peri-operative data for obese and normal-weight cohorts

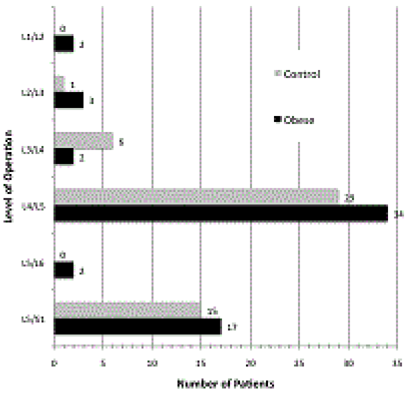

Figure 1: Distribution of level of operation for obese and normal-weight cohorts.

Effect of obesity on outcomes

There were no statistically significant differences in baseline VAS-B, VAS-L, or ODI. Both groups improved significantly following surgery, at each follow-up, and during the last visit compared to pre-operatively (Table 2 and Figures 2-4). VAS-B improved 2.49 points ($p<0.01$) for normal-weight patients and 3.38 points ($p<0.01$) for obese patients, from baseline to 10.5-month follow-up; no significant difference was seen between the two groups ($p=0.8$). VAS-L improved 3.12 points ($p<0.01$) in control subjects and 3.8 points ($p<0.01$) in the obese group, with no statistical difference in improvement between the two groups ($p=0.6$). ODI improved 14.93 points ($p=0.01$) in the control group, and 16.3 points ($p<0.01$) in the obese group from baseline to 10.5 months. ODI improvements were similar comparing obese patients to normal-weight patients ($p=0.5$).

		Baseline		6 Weeks			4.5 Months			10.5 Months		
		n	Mean ± SEM	n	Mean ± SEM	p-Value	n	Mean ± SEM	p-Value	n	Mean ± SEM	p-Value
VAS-B	Control	34	5.20 ± 0.09	24	2.67 ± 0.09	<0.01	17	2.81 ± 0.13	<0.01	15	2.71 ± 0.17	<0.01
	Obese	46	5.20 ± 0.07	34	1.82 ± 0.06	<0.01	20	2.99 ± 0.16	<0.01	19	1.82 ± 0.16	<0.01
VAS-L	Control	33	5.61 ± 0.10	24	2.90 ± 0.12	<0.01	17	2.20 ± 0.17	<0.01	15	2.49 ± 0.21	<0.01
	Obese	47	5.79 ± 0.07	34	1.87 ± 0.07	<0.01	20	2.96 ± 0.18	<0.01	19	1.99 ± 0.14	<0.01
ODI	Control	34	41.53 ± 0.54	21	30.95 ± 0.88	0.04	17	27.00 ± 1.22	0.01	15	26.60 ± 1.35	0.01
	Obese	46	37.72 ± 0.43	32	18.60 ± 0.49	<0.01	20	24.82 ± 1.07	0.02	19	21.42 ± 1.03	<0.01
Abbreviations: VAS-B – Visual Analog Scale for Back, VAS-L – Visual Analog Scale for Leg, ODI – Oswestry Disability Index, SEM – Standard Error of the Mean Mean self-reported outcomes from questionnaires at baseline, 6 weeks, 4.5 months, 10.5 months, and last follow-up. Values are presented as mean ± standard error of the mean.												

Table 2: Self-reported outcomes of obese and normal-weight (control) cohorts.

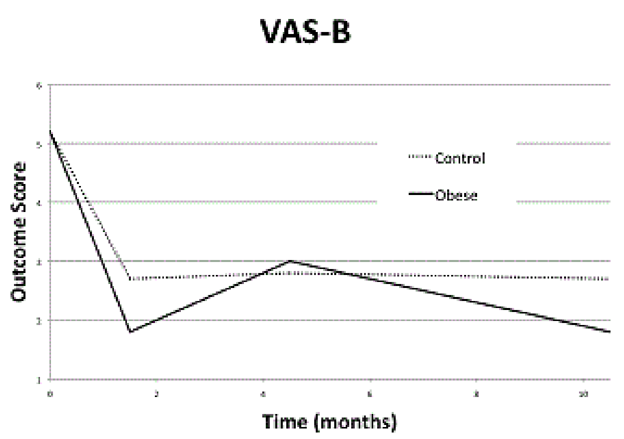

Figure 2: VAS-B self-reported outcomes for obese and control groups

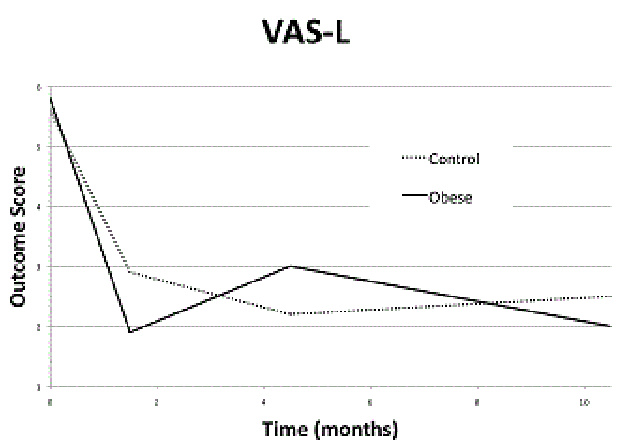

Figure 3: VAS-L self-reported outcomes for obese and control groups

Effect of obesity on blood loss, operative time, and length of stay

Average operative time was significantly longer (p=0.002) in the obese group compared to the normal-weight group, 117 minutes and 99 minutes respectively (Table 1). Estimated blood loss was significantly more (p=0.04) in the obese group (26.7 cc) compared to the normal-weight group (19.5 cc). Length of stay did not reach statistical significance (p=0.38); length of stay was 16.1 hours and 9.8 hours for the obese and normal weight groups, respectively.

Effect of obesity on complications

No major complications were observed in either group. Minor complication rates were higher in the obese group, but did not reach statistical significance (p=0.59). These included four durotomies and one superficial wound infection in the obese group, and two durotomies in the normal-weight patients (Table 3).

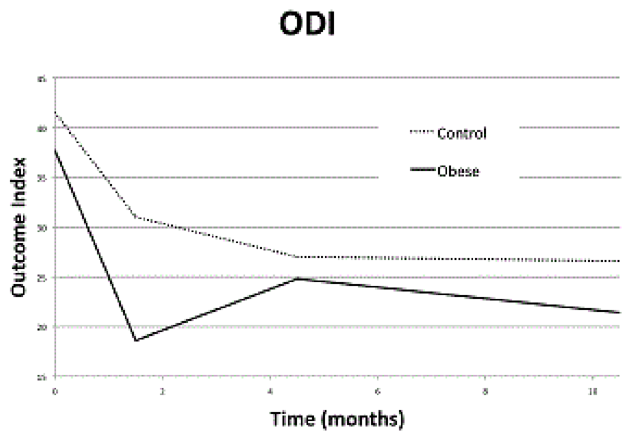

Figure 4: ODI self-reported outcomes for obese and control groups

Five obese patients had further spinal surgeries; three had adjacent level discectomy performed for virgin disc herniation, at 3, 9 and 15 months after the index case (discectomy). Two obese patients required a repeat, same-level surgery for recurrent disc herniation at 3 and 27 months after the index case. Among the control patients, there were no subsequent surgeries during the follow-up period.

	Obese (n=60)	Control (n=51)	p-Value
Peri-Operative Complications	5 (8.33%)	2 (3.92%)	0.59
Durotomy	4	2	0.35
Post-operative Infection	1 (superficial)	0	0.14
Return to Surgery	5 (8.33%)	0 (0.0%)	0.007
Adjacent Level Decompression	3 (3, 9, 15 months)	0	0.24
Repeat Operation (Same Level)	2 (3, 27 months)	0	0.49

Table 3: Complications and return to surgery for obese and normal-weight (control) cohorts. (p-values)

Discussion

Micro endoscopic decompression of stenosis and micro endoscopic discectomy procedures have been shown to be both efficacious and safe [10]. This surgical technique may produce specific benefits including less soft-tissue injury, quicker patient recovery, and less pain. As with traditional lumbar approaches, the obese patient population can pose unique intra- and post-operative surgical challenges with MISS techniques. The goal of this report was to determine the effect of obesity (BMI ≥30 kg/m^2) on self-reported outcomes and complications following minimally invasive lumbar decompression.

Limitations of this study should be noted. The current report is a retrospective evaluation of prospectively collected data. The data is that of a single surgeon, operating with both residents and fellows at an academic spine center. This setting is not representative of the majority of neurosurgical practices. Further, the reported technique has multiple commonly employed variations. While an endoscope was used in the current series, other common techniques utilize either an operating microscope or Loupe magnification. Lastly, extended clinical follow-up will be needed to assess the long-term effects of surgery at the operative level as well as those at adjacent levels.

Effect of obesity on outcomes

A principle finding of this study is that obesity does not negatively influence outcomes following minimally invasive lumbar decompression. Patient outcomes as measured by VAS-B, VAS-L, and ODI were similar regardless of the patient's body habitus. Rosen et al., in a study of 110 patients treated with minimally invasive lumbar fusion, did not find a relationship between self-reported outcomes or peri-operative measures when patients were stratified by body habitus [12]. In a single-center retrospective study of 15 patients with BMI >30 undergoing less invasive posterior lumbar interbody fusion, Singh et al. demonstrated significant improvement in ODI, VAS, and return to work outcomes [14].

The results of minimally invasive lumbar microdiscectomy in obese patients have also been encouraging. In a 2007 study of 32 obese patients undergoing a single-level minimally invasive discectomy, Cole et al. reported 60% rate of excellent leg pain relief [15]. Tomasino et al. evaluated 115 obese and non-obese patients following either tubular discectomy or laminectomy [16]. In this study, 87 of the 115 patients had a microdiscectomy procedure. Using the Macnab outcome criteria, a favorable outcome was found in 92% and 84% of obese and non-obese patients. These results bear comparison to similar findings using a more traditional open approach. As demonstrated by Andreshak et al., in 159 consecutive obese and non-obese patients treated without instrumentation in the lumbar spine, favorable functional outcome was comparable in obese (64%) and control (64%) cohorts alike [17].

Effect of obesity on blood loss, operative time, and length of stay

Estimated blood loss and operative time were slightly increased in the obese. There are unique challenges for minimally invasive surgery in the obese that may increase operative times. One factor is that the surgeon commonly must use longer instruments through the working portal. The second factor is that intra-operative localization may require extra time, given that fluoroscopic images can be attenuated in patients with increased body mass. This often increases the number of lateral fluoroscopic images needed.

Effect of obesity on complications

Complications of surgery can be divided into those directly related to the procedure, and those not directly related to the procedure. In this study, we noted any medical adverse event as a complication of the patient's care. Given that obese patients may be more prone to these medical sequelae, this is critical to evaluating the efficacy of these lumbar decompression procedures.

Post-operative infections are a significant concern in obese patients. In a review of 850 separate spinal procedures, Wimmer et al. noted obesity to be a co-morbid condition in 31% of infectious complications [18]. Similarly, in a survey of lumbar spine surgeries in obese patients, Telfeian et al. reported a similar infection rate of 33% [19]. In the current study, we had one superficial infection that occurred in the obese patient cohort. Similar findings have been reported in other studies. In 110 obese and normal-weight patients treated with MISS lumbar fusion, Rosen et al. reported a single superficial wound infection [12]. Notably, this occurred in one of 38 normal-weight patients and there were no infections in either the overweight or obese patient subsets. Cole et al. reported no infectious complications in a study of minimally invasive microdiscectomy [15]. In general, and regardless of body habitus, minimally invasive spine techniques appear to have a low rate of infectious complications. In a report that included both cervical and lumbar minimally invasive surgeries, O'Toole et al. reported only three infections in 1338 cases [20].

Durotomy is a well-known complication during lumbar spine operations. In our series, we had six (5.4%) durotomies. Four (6.7%) occurred in the obese patient group and two (3.9%) in the normal-weight patients; none of these required revision surgery. The overall rate is somewhat lower than the range reported with open lumbar operations. Desai et al. reported a 10.5% incidence of durotomy when evaluating 389 patients treated for lumbar degenerative disease in the Spine Patient Outcomes Research Trial (SPORT) [21]. The majority of dural tears occurred while using the Kerrison rongeur in the central canal or lateral recess; this mechanism of injury is a common cause of durotomy in open series, and not idiosyncratic to MISS techniques.

An important observation in our study is that obese patients were more likely to require a second spine surgery during the follow-up period. Five (8.3%) of our 60 obese patients had a subsequent lumbar spine operation for new or persistent leg symptoms. This was most common at an adjacent spinal level. These findings are consistent with the fact that single-level operations were commonly offered to obese patients when there was marginal stenosis at an adjacent level. Also, the increased body weight may predispose to more spinal instability. Given the results of this report, we have modified our practice to more commonly include an additional level in this patient population.

In general, the presence of obesity remains a significant concern for increased cost and rates of complication with spine surgery. When analyzed across all surgical techniques, a recent study of a large California inpatient database with 84,607 admissions found increased in-hospital complication rates (13.6% vs. 6.9%) as well as increased hospital costs ($108,604 vs. $84,861) and longer length of stays in obese patients [22]. Although the current literature remains quite limited in scope, the impact of obesity on post-operative complications following minimally invasive procedures may be less pronounced [23,24].

Conclusion

Micro endscopic decompression of stenosis and micro endoscopic discectomy are effective surgical options for the obese population with lumbar spine pathology requiring decompression. Clinical obesity, as measured by BMI, did not have an impact on self-reported outcomes or length of stay. Obesity was associated with an increase in average operative time and estimated blood loss. Overall complications were not statistically significant between obese and normal-weight cohorts undergoing minimally invasive spinal decompression.

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