Early Complications of Extreme Lateral Interbody Fusion in the Obese

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Study Design: A retrospective review of prospective data of all patients undergoing extreme lateral interbody fusion (XLIF) for degenerative disease of the lumbar and thoracic spine.

Objectives: To compare between obese and nonobese patients, the incidence of early complications and predictive factors affecting complication rate.

Summary of Background Data: XLIF is a 90-degree off midline approach that allows for large graft placement, excellent disk height restoration, and indirect decompression at the stenotic motion segment. As the psoas muscle is traversed, the lumbosacral plexus is protected by the use of automated electrophysiology through dynamic discrete evoked electromyogram thresholding. Exposure is achieved with an expandable split-blade retractor, which allows for direct illuminated visualization facilitating discectomy and complete anterior column stabilization by using a large load-bearing implant that rests on the dense ring apophysis bilaterally.

Methods: A retrospective chart review of a prospectively compiled database of all patients treated with the XLIF procedure between October 2006 and July 2008 was completed. Early complications were defined as any adverse events occurring within the first 3 months of the index procedure. The National Institute of Health Guidelines for defining obesity relating to body mass index were used.

Results: Out of 432 patients, 313 have complete data: 156 obese, 157 nonobese. The ages, comorbidities, earlier surgeries, and diagnoses were equivalent. There were no transfusions and no infections. Complications were minimal and about the same in each group.

Conclusions: Unlike traditional open lumbar fusion procedures, minimally invasive surgery (XLIF) has no greater risk of complication in the obese patient.

Key Words: obesity, spinal fusion, minimally invasive, XLIF, complications

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Fusion of the thoracolumbar spine has become a more commonly used technique in the treatment of spinal conditions in the last several decades. Concomitantly, the lifestyle of the industrialized nations has become more sedentary and a greater percentage of the population has become obese. In parts of the United States, fully 66.3% of the adults are overweight by body mass index (BMI).[1–4] Traditionally, surgeons have avoided (when possible) operative intervention in the obese patient because of the higher risk of complications.[5–15] Despite this predilection away from operative care for the obese patient with spinal pathology, very little literature exists to describe the outcomes in these patients. Even less has been written to assist the surgeons who choose to care for the obese patients with spinal maladies.[14,16–20]

The literature on fusion surgery in the obese patient is limited and discouraging. In 1 study,[6] 13% of obese patients (defined as >20% over ideal body weight) treated with posterior lumbar fusions developed wound infections. In our own series of 144 obese patients undergoing instrumented posterior lumbar fusions, we noted a 4.2% infection rate and a panoply of positioning-related complications, most commonly facial abrasions (20.9%) and transient ulnar neuropathies (4.6%).[19] Despite these issues, we found that obese patients tended to have outcomes similar to the nonobese and thus it has been our practice to offer surgical therapy to those patients in need of such treatment.[16–20]

Although, in several recent studies, obesity was shown to be a contributing factor for the development of complications in lumbar surgery,[13,15,18] 2 recent studies of minimally invasive surgery spinal procedures showed no difference in complications between the obese and nonobese.[16,18] Minimally invasive approaches may obviate some of the risks of traditional open procedures by minimizing collateral damage to surrounding structures created by the surgical approach, reducing blood loss and postoperative hematoma collection, and, in our experience, shortening the surgical time. The techniques for such minimally invasive procedures in the obese patient have been reported earlier (unpublished data, 2008). In this report, we compare our early complications in extreme lateral interbody fusion (XLIF; NuVasive, Inc., San Diego, CA) in obese and nonobese patients.

METHODS

A retrospective review of a prospectively compiled database maintained by the senior author (W.B.R.) was

completed. Patients were assessed postoperatively by the operative surgeon (senior author). Patient data were entered into the database as were all complications and adverse events. We reviewed all patients treated with the XLIF procedure since its introduction at our institution in 2006. Patients were candidates for surgery if fusion was indicated due to degenerative disease and if a full course of conservative care had been exhausted. For study purposes, we excluded any nonelective or nondegenerative fusion procedure; thus all neoplastic, traumatic, and infectious cases were excluded. Of 432 XLIF procedures performed between October 2006 and July 2008, 313 met the inclusion criteria and form the study group. All procedures were performed by the senior author (W.B.R.) at St. Mary's Health Center. Appropriate Health Insurance Portability and Accountability Act guidelines were followed. The St. Mary's Health Center Institutional Review Board gave approval to the study and this report.

Early complications were defined as any adverse event occurring within the first 3 months of the index procedures. These were divided into categories: Wound complications, nerve injuries, cardiac or renal or gastrointestinal or respiratory complications, vertebral body-related complications, and hardware-related complications. Complications that required readmission to the hospital or reoperation were specifically noted.

The National Institutes of Health guidelines for defining obesity relating to BMI were used. BMI is calculated as body weight in kilograms divided by height in meters squared. BMI of 30 kg/m^2 is defined as obese; between 25 and 29.9 kg/m^2 is overweight. Morbid obesity is defined as BMI greater than 40 kg/m^2.[22]

XLIF Surgical Technique

Extreme lateral interbody fusion or XLIF[19,23,24] is a 90-degree off midline or true lateral approach that allows for large graft placement, excellent disk height restoration, and indirect decompression at the stenotic motion segment. This approach can be performed using two 3 to 4-cm incisions. Safe passage to the retroperitoneal space is assured by gentle blunt dissection. As the psoas muscle is traversed, the lumbosacral plexus is protected by the use of automated electrophysiology via dynamic discrete evoked electromyogram thresholding (NeuroVision, NuVasive, Inc.).[24–27] Exposure is achieved with an expandable split-blade retractor (MaXcess, NuVasive, Inc.), which allows for direct illuminated visualization facilitating diskectomy and complete anterior column stabilization using a large load-bearing implant (CoRoent XL, NuVasive, Inc.) that rests on the dense ring apophysis bilaterally (Fig. 1).

Statistical Analysis

Multivariate logistic regression analysis was performed using BMI, age, sex, raw measures of height and weight, comorbidities (including diabetes mellitus, coronary artery disease, chronic obstructive pulmonary disease, chronic steroid use, and smoking, and number of levels treated to test whether each parameter was independently associated with complications. T tests and χ^2 tests were used where appropriate to assess differences between study groups (obese and nonobese) and between those with complications and those without. All analyses were performed using Analyse-It software (Analyse-It Software, Ltd., Leeds, England) with significance defined as P value of less than 0.05.

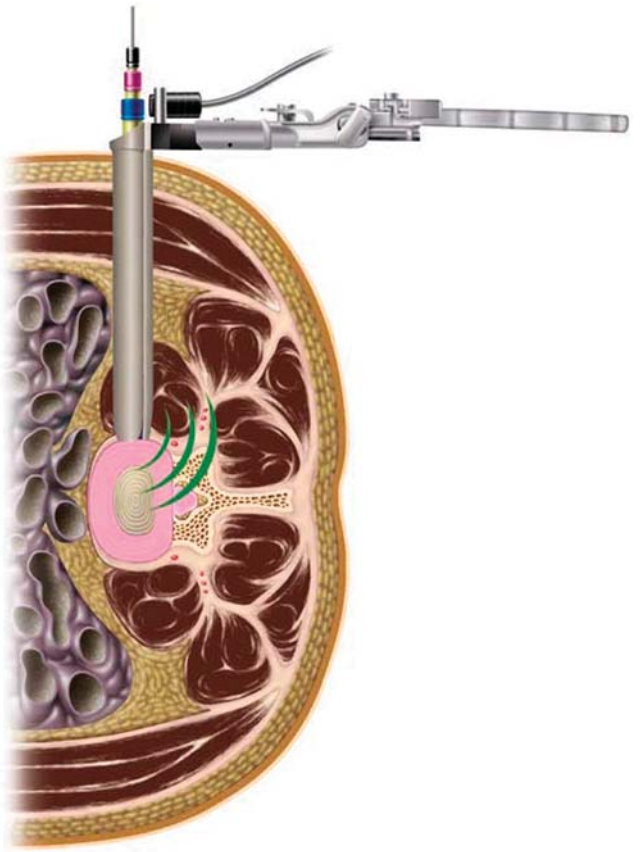

FIGURE 1. XLIF Technique.

RESULTS

Data were complete to 3 months after the index procedure (XLIF) in 313 patients: 156 were obese and 157 were not obese. Demographic and surgical data for the 2 groups is shown in Table 1. There were few statistically significant differences between the obese and nonobese groups with respect to demographics, comorbidities, or levels treated, except that average age was slightly lower in the obese group (58.9 y) than in the nonobese group (62.9 y) ($P = 0.0066$), and the incidence of diabetes mellitus was not surprisingly higher in the obese group than in the nonobese group ($P < 0.0001$).

There were 27 complications in these patients (8.6%). The complications between the 2 groups are shown in Table 2. There were 10 early complications in the obese group and 17 in the nonobese group. There were no infections in either group. The incidence of

TABLE 1. Patients Demographic Data

Factor	Obese	Nonobese
Demographics		
Patients (no.)	156	157
Age (y), mean (range)	58.9 (30-87)	62.9 (24-88)
Sex (M/F)	64/92	71/86
BMI	36.0	25.7
< 25.0		53
25.0-29.9		104
30.0-39.9	121	
> 40	35	
Comorbidities		
DM	48	17
CAD	82	83
COPD	9	9
Steriod use	22	16
Smoking	49	55
Prior surgery	58	56
Discectomy	21	15
Laminectomy	4	11
Fusion	33	30
Diagnoses		
DDD	18	18
HNP	16	26
Postlaminectomy instability	17	11
Scoliosis	15	5
Spondylolisthesis	25	28
Stenosis	66	68
Average LOS (d)	1.33	1.27
Hgb change (g)	1.39	1.53

CAD indicates coronary artery disease; COPD, chronic obstructive pulmonary disease; DDD, degenerative disk disease; DM, diabetes mellitus; HNP, hermiated nucleus pulposus; LOS, length of stay.

complication was not statistically different between the obese and nonobese groups ($P = 0.1639$).

Four patients required an additional operation for treatment of one of the early complications: 1 patient required posterior stabilization for a vertebral body fracture with subsidence of the interbody graft (Fig. 2A,B); 1 patient's gastric volvulus was repaired (necessitating a 16-day hospitalization); the third patient developed a hernia of the lateral abdominal wall, which was repaired 6 weeks after XLIF; and the fourth developed recurrent stenosis after cage subsidence, which was treated with posterior decompression. One nonobese patient required readmission to the hospital for anticoagulation after she developed a pulmonary embolus; 2 patients, 1 obese and 1 nonobese, were readmitted with an ileus. The reoperation rate was not statistically different between the obese and nonobese groups ($P = 0.9949$).

TABLE 2. Complication Data

Complication	Obese	Nonobese
Vertebral body	2	1
Fracture—reoperation	1	
Fracture—healed	1	1
Nerve injury	1	3
Gastrointestinal	1	6
Ileus	1	5
Gastric volvulus		1
Renal		2
Respiratory	2	2
Pneumonia	2	1
Pulmonary embolism		1
Wound		1
Incisional hernia		1
Hardware failure	2	1
Cardiac	2	1
Atrial fibrillation	1	1
Myocardial infarction	1	
Infection	0	0
Transfusion	0	0
Total	10	17

On the whole, the number of complications across the entire group was quite low—evidence, we believe, of the promise of minimally invasive spinal fusion. Specifically, in the entire 432 patients treated, there were no cerebrospinal fluid leaks, no infections, and no patient required transfusion. Blood loss was equally low in the 2 groups, with no statistically significantly different change in hemoglobin from preop to postop (average of all patients was 1.45) between the obese and nonobese ($P = 0.1629$). The average length of stay was 1.24 days across the entire group, with no differences between obese and nonobese ($P = 0.9034$), but with a significant difference between those with and those without complications ($P < 0.0001$). Short-term clinical outcomes were equivalent as well, with no differences found between the obese and nonobese in visual analog scale (VAS) pain score improvement at 3 months ($P = 0.1996$); nor was VAS improvement different between those with and those without complications ($P = 0.1017$).

Diagnosis was the only variable found to significantly affect whether or not complications occurred ($P = 0.0075$). A higher complication rate was noted in patients with primary diagnosis of degenerative disk disease (DDD) and recurrent disk herniation. Patients with diagnoses of stenosis and spondylolisthesis, which were by volume the largest groups, had the lowest rates of complications.

DISCUSSION

Traditional spinal surgical procedures have been shown to have a higher incidence of complications in the obese.[6] When fusion is necessary, traditional approaches involve either anterior or posterior exposure of the spine. However, both of these approaches carry concomitant risks with them. Anterior approaches to lumbar spine are associated with risks of injury to the abdominal contents, iliac vasculature, and sympathetic plexus including the risk of sexual dysfunction,[23] not to mention the technical difficulty of accessing the spine in a patient with a large pannus. Traditional open posterior interbody fusion approaches avoid many of those risks but carry their own set of concerns: devitalization of paraspinous musculature, inadvertent durotomy, and traction neurapraxia.[13,15,19]

The incidence of complications in lumbar fusion surgery varies widely across the literature because of differences in definition and specificity. For the purposes

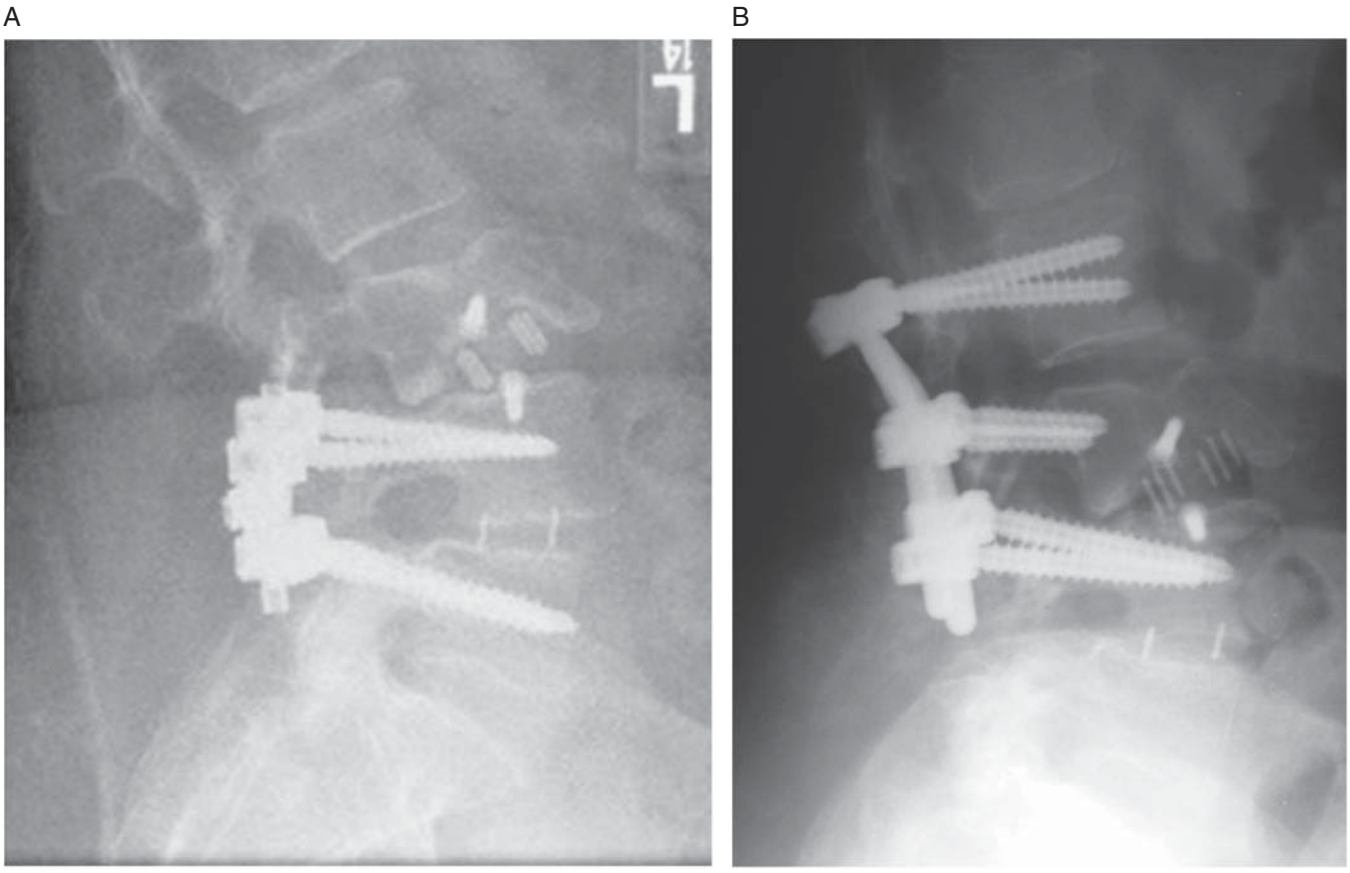

FIGURE 2. A, Lateral radiograph showing vertebral fracture and graft subsidence. B. Lateral radiograph after posterior revision surgery.

of this study, we used a broad definition of complications and attempted to capture the incidence in an MIS fusion cohort. To our knowledge, no one has reported this type of information before. It is our belief that the relatively low incidence of complications across the entire group is derivative of the diminished trauma caused by minimally invasive approaches.

FIGURE 3. Patient positioned for XLIF with pannus falling ventrally.

In a previous publication, we outlined the fundamental tenets of XLIF surgery.[25] The surgical technique has been described in detail,[24] including specifically in the obese patient. As we have stated previously, experience has taught us that there are 5 key steps for making XLIF a safe, simple, and efficacious procedure:

1. Careful patient positioning
2. Gentle retroperitoneal dissection
3. Meticulous psoas traverse using neurological monitoring
4. Discectomy and fusion site preparation
5. Interbody implant placement.

These steps are all the more critical in the obese patient in which external landmarks may be hidden by overlying adipose tissue.

It is impossible to overemphasize the importance of reliable, timely monitoring of the neural elements as the surgeon traverses the psoas. Visual identification of the lumbar plexus is not possible but the plexus can be protected by using an automated electrophysiology technology. Lateral approaches have been used in the past and without the use of real-time electrophysiology have resulted in relatively high complication rates.[28]

Despite the obese patients' large size, access can be obtained through 2 small incisions without difficulty. The lateral position causes the pannus to fall out of the operative track (Fig. 3). If desired, unilateral pedicle screws can also be placed without having to reposition the patient on the operating table.

Although we believe that the lateral position decreases the risk of ocular injury, we have found that hypotensive anesthesia has not been necessary. We believe this to be related to the decreased exposure and muscle damage that the XLIF approach allows. In addition, we have had no instances of facial abrasions, doubtless because of avoiding the facedown position.

Minimally invasive interbody fusion has been shown to be safe and effective in the treatment of a wide variety of degenerative conditions, including spondylolisthesis, degenerative disk disease, spinal stenosis, scoliosis, and failed disk arthroplasty.[17,18–24,29–31]

Traditional teachings about spinal fusion in the obese is, in our opinion, derivative of the limitations of traditional techniques as much as the technical limitations imposed by the patients' constitutional habitus. Recent publications have begun to discuss acceptable levels of complications in the obese patient population.[16,18] Our experience demonstrates the safety of this MIS technique—XLIF—in treating obese patients. Proper positioning, reliable automated neurological monitoring and fluoroscopic guidance, and meticulous attention to operative technique are required, but, when these caveats are acknowledged, the early outcomes compare well with traditional interventions.

In our entire experience, we have had no patient that we could not successfully complete the surgery due to obesity or body habitus. Longer-term follow-up is needed to determine final outcomes of these promising procedures.

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