Case Report: Novel Technique for Minimally Invasive Spine Surgery in Obese Patients

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Abstract

Purpose: This case report describes the post-operative outcomes of obese patients (BMI ≥ 30) undergoing minimally invasive lumbar spinal fusion surgery utilizing a novel surgical technique. Rationale/Significance: Advantages to the use of minimally invasive surgical techniques for spine surgery include reduced blood loss, less soft tissue trauma, decreased length of hospital stay, less postoperative pain, less scarring, and improved cosmesis when compared to traditional open procedures. Positioning and adequate surgical exposure for an obese patient, in addition to traditional co-morbidities found in these patients, add complexity and risk for both the patient and surgeon which frequently discourages surgeons from utilizing minimally invasive techniques in this patient population. Methods: A retrospective chart review of 5 patients with a BMI ≥ 30 who underwent minimally invasive spine fusion surgery with a newly introduced surgical technique utilizing a central incision. Data collected were amount of blood loss during surgery, length of hospital stay, return to function as evidenced by use of an assistive device for ambulation, preoperative pain levels, and short term postoperative pain levels at 3 weeks and 3 months after surgery as documented by the Visual Analog Scale (VAS). Results: All patients were female with a mean age of 64.4 years and a mean BMI of 44. Statistically significant pain differences were identified between preoperative present and 3 week postoperative present (p=0.02) and between preoperative worst and 3 month postoperative worst (p=0.022) VAS score. Mean length of hospital stay was 2.5 hospital days. Mean EBL was 309 ml. No patient required a blood transfusion postoperatively. All patients were discharged directly to home. Conclusion: This case report demonstrates that use of a minimally invasive technique through a single central and two Wiltse muscle splitting incisions on obese patients can provide a safe and effective alternative to traditional open lumbar spine fusion surgeries.

INTRODUCTION AND BACKGROUND

The prevalence of obesity (20% greater than normal body weight) is increasing in the United States. The spine is designed to carry and distribute the body’s weight. An excess amount of weight puts excess strain on the structural components of the spine. Whether obese patients are more likely to develop arthritic changes in the vertebral column is an ongoing debate. Being overweight can significantly contribute to symptoms associated with osteoporosis, osteoarthritis, degenerative disc disease, and spinal stenosis.

A review of studies attempting to link obesity and lumbar spine disorders by Tomasino et al. (2009) found evidence suggesting that obesity causes additional biomechanical stress in the thoracic and lumbar spine which in turn may increase the need for surgical intervention in these patients. Lumbar fusion is one of the most common procedures performed by spine surgeons, and obesity is common among patients requiring this surgery with roughly one-third of North Americans now considered obese. The literature suggests that there are increased complication rates and poorer outcomes among this group of patients requiring any surgical intervention. Spine surgery in the obese patient can be extremely challenging. Patient positioning and adequate surgical exposure add complexity and risk for the patient and surgeon. There are difficulties with anesthesia and intravenous access as well as longer operative times in this population of patients when compared to normal weight patients.

As technology has advanced, so have the surgical techniques utilized in spine surgery. The goal of any surgical procedure is to provide maximal benefit to the patient while minimizing associated morbidity. Minimally invasive techniques in spine surgery have been introduced over the past 10 years as an alternative to traditional open approach...
procedures. The added technical challenge of working through a limited surgical corridor may discourage surgeons from utilizing these techniques in obese patients.

**LITERATURE REVIEW**

Review of recent articles reveals several advantages to the use of minimally invasive techniques that include reduced blood loss, less soft tissue trauma, decreased length of hospital stay, and less postoperative pain than traditional open procedures. Percutaneous techniques and utilization of a tubular retraction system through two vertical two inch incisions (Wiltse approach) create a working channel between the muscle fibers permitting access to the bony anatomy without the need for muscle stripping or disruption of the posture stabilizing muscles of the lumbar spine. The use of a muscle-splitting, tubular retraction system limits the injury to the ipsilateral paraspinal musculature which results in preservation of healthy muscle tissue and decreased postoperative pain. Decreased postoperative pain leads to lesser and shorter use of narcotic analgesia. Faster recovery from surgery, secondary to decreased surgical morbidities from limited muscle disruption, leads to decreased length of hospital stay thus decreasing costs. Shorter hospital stays may also reduce the risk of nosocomial infection. Smaller amounts of blood loss sustained during surgery lead to decreased number of blood transfusions required postoperatively allowing for early mobilization and decreased length of hospital stay.

Several studies have demonstrated similar benefits and outcomes in performing spine surgery using minimally invasive techniques on obese patients when compared to non-obese patients. There is speculation that there likely exists a degree of spine surgeon bias against operating on obese patients. Perceived longer operative times and technical challenge of exposure of the spine leading to inferior clinical results may contribute to this bias.

**METHODOLOGY**

For the obese patient, who may not be deemed appropriate for minimally invasive techniques secondary to increased BMI, to benefit from similar results of these techniques as the non-obese patient, a modified technique for minimally invasive lumbar fusion is being introduced. In obese patients, the difficulty with the use of tubular retractors is the depth of tissue between the skin and subcutaneous fat and the bone of the spine. Longer tube lengths and decreased working area substantially increase the difficulty of the case. If a midline incision is used followed by mobilization and lateralization of the subcutaneous fat, a shorter tube can be used to decrease the difficulty of the case. Through one central incision dissecting the subcutaneous fat to the level of the deep fascia, two smaller incisions are made through the muscle thus achieving “normal” depth for the insertion of the tubular retraction system to perform the lumbar fusion via minimally invasive techniques and avoiding the muscle stripping. Although minimally invasive spine surgery in the obese patient carries added technical challenges, other than additional superficial scarring and loss of cosmesis, these patients may be candidates to experience the benefits that come from the significant reduction in soft tissue destruction.

**SURGICAL PROCEDURE**

After appropriate preoperative evaluation and medical clearance, each patient was brought to the preoperative staging area where patient identification and procedure verification was performed prior to going into the operating room. In the operating room, the following procedure was performed on each patient. After endotracheal intubation, the patients were placed on OSI table with a Jackson frame and prepped and draped in the usual sterile fashion. A midline skin incision was then made over the area of pathology after spinal level localization. Dissection was carried through the skin and subcutaneous tissue down to the deep lumbar fascia. This layer was developed over the paraspinal musculature bilaterally approximately two finger breadths. Angled Cerebellar Retractors were then placed. A 2.5 cm incision was then made over the area of pathology at the lateral border of the pedicles and the level of pathology was confirmed by image intensification. A minimally invasive tubular retractor was then placed, after serial dilation between multifidus and longissimus muscles (muscle-splitting), on to the facet joint of interest. A partial facetectomy was then made and a high speed 3mm carbide burr was used to decorticate the facet joint. Local bone from the facetectomy was morsalized on the back table and packed into the decorticated facet joint, completing the posterolateral fusion.

Attention was then turned to the contralateral (more symptomatic) side and the minimally invasive retractor is then placed in the identical fashion as previously described on the facet joint. A hemilaminotomy with complete facetectomy and designated foraminaly was then performed. Bone from the decompression was preserved and morsalized on the back table.
The ligamentum flavum was removed and decompression completed until laterally flush with the medial wall of the inferior pedicle of the motion segment of interest. The exiting and traversing nerve roots were visualized. If clinically necessary, a contralateral decompression was performed using a laminoplasty type technique. The disc space was identified and neurologic elements were protected as an annulotomy followed by sub-total discectomy was performed in preparation for a Transforaminal Lumbar Interbody Fusion (TLIF). The anterior aspect of the annulus was packed with local bone and a PEEK biomechanical spacer was impacted into place. Its position was confirmed with fluoroscopic image intensification. Guide wires were then inserted using Jamshidi Needles and biplanar fluoroscopy. Globus Revolve (Globus Medical, Audubon, Pa) pedicle screws were then placed. Rod and set screws were added and tightened to industry specifications. AP and lateral image confirmed appropriate position of the screw/graft construct. The wound was the irrigated and subsequently closed in standard fashion.

DATA COLLECTION

This descriptive correlational study utilized a retrospective chart review by one independent nurse practitioner in one setting. All procedures were performed by a single surgeon (CFW) who has performed more than 300 minimally invasive lumbar fusions. The patients underwent a one or two level spinal fusion via minimally invasive surgical techniques for the diagnosis of degenerative spondylolisthesis and/or stenosis as described. The surgical procedure was performed at the Surgical Specialty Center at Coordinated Health in the Allentown or Bethlehem facility.

Charts of all patients undergoing this procedure between March 2009 and August 2010 were reviewed to ensure all patients that met the criteria for review were included. All patients enrolled met body mass index (BMI) requirements with a BMI of 30 or greater. Patients were aged 30 years or older. All necessary measures were taken to ensure and maintain confidentiality and privacy of individuals. A letter of support was obtained from the health system and Institutional Review Board (IRB) approval from Robert Morris University was obtained. Data was abstracted into a coded secure computerized database by the study coordinator.

Data collection included the patient’s age, gender, and BMI. The amount of estimated blood loss sustained in surgery was measured in milliliters and extracted from the operative record in the patient’s chart. Length of hospital stay was represented in days from admission starting with registration in the preoperative staging area to the time they were discharged. Any event not surgically related that caused a delay in discharge was documented. Back and leg pain levels were recorded using the visual analog scale (VAS). At their preoperative visit the patient was asked to fill out a VAS for their pain presently, at its best, and at its worst for a total of 3 separate scores. The patient was also given the VAS at their three week and three month postoperative visits and these numbers were recorded. It is protocol for all patients to be issued a walker to assist with ambulation upon discharge from the hospital. At the three week and three month postoperative visits, it was recorded if the patient still required an assistive device for ambulation such as a walker or cane.

RESULTS

The mean age of the patients (n=5) was 64 (56-82) with a mean BMI of 44 (33-53). All patients were female. VAS Scores were as follows (See Table 1).

Figure 1

Table 1

<table>
<thead>
<tr>
<th>VAS Scores</th>
<th>Mean</th>
<th>Range</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>PreOp Present</td>
<td>7.30</td>
<td>5.00</td>
<td>1.643</td>
</tr>
<tr>
<td>PreOp Best</td>
<td>4.60</td>
<td></td>
<td>2.198</td>
</tr>
<tr>
<td>PreOp Worst</td>
<td>9.60</td>
<td></td>
<td>5.483</td>
</tr>
<tr>
<td>1 Wk PostOp Present</td>
<td>3.00</td>
<td></td>
<td>2.44</td>
</tr>
<tr>
<td>1 Wk PostOp Best</td>
<td>1.40</td>
<td></td>
<td>1.99</td>
</tr>
<tr>
<td>1 Wk PostOp Worst</td>
<td>6.30</td>
<td></td>
<td>3.05</td>
</tr>
<tr>
<td>3 Mo PostOp Present</td>
<td>1.00</td>
<td></td>
<td>1.89</td>
</tr>
<tr>
<td>3 Mo PostOp Best</td>
<td>1.90</td>
<td></td>
<td>1.67</td>
</tr>
<tr>
<td>3 Mo PostOp Worst</td>
<td>3.60</td>
<td></td>
<td>3.362</td>
</tr>
</tbody>
</table>

Pearson’s correlation was used to determine any association or functional relationship between variables. Significant correlations were identified between 3 week present and worst VAS scores postoperatively (r = .907), 3 month present and best VAS scores postoperatively (r = .916), and 3 month present and worst VAS scores postoperatively (r = .965). The wide range in the 3 week postoperative and 3 month postoperative scores might reflect the use as of pain medication in the postoperative period. Lack of a significant correlation was seen between preoperative and postoperative
VAS scores, between age and BMI, and BMI and VAS scores.

Repeated Measures ANOVA was used to compare each subject’s VAS scores preoperatively, 3 weeks postoperatively, and 3 months postoperatively. No significant differences were identified between preoperative best, 3 week postoperative best, and 3 month postoperative best VAS scores. There was a statistically significant difference identified between preoperative present and 3 week postoperative present (p=.02), preoperative present and 3 month postoperative present (p=.014), and preoperative worst and 3 month postoperative worst VAS scores (p=.022).

Mean length of hospital stay was 2.5 hospital days (2.3-2.8). Mean EBL was 309 ml (210-420). No patient required a blood transfusion postoperatively. All patients were discharged directly to home. No patient required inpatient rehabilitation. Three of the five patients (60%) still required use of an assistive device at the three week postoperative visit. No patient required the use of an assistive device for ambulation at the 3 month postoperative visit.

DISCUSSION

Results of this new technique may be compared to reports of other minimally invasive technique studies or to studies of traditional techniques in obese patients. Isaacs et al described a minimally invasive technique for performing TLIF that involves the use of percutaneous instrumentation (METLIF) and compared 20 patients undergoing this surgical technique to 24 patients who underwent similar surgery but utilizing traditional open procedures. The METLIF group experienced a significantly decreased mean EBL (226ml versus 1147ml) and a shorter mean LOS (3.4 versus 5.1 days). No patient in the METLIF group required inpatient rehabilitation. Park and Ha conducted a prospective cohort study to determine any statistical difference between minimally invasive and traditional open approach for one-level instrumented posterior lumbar interbody fusion by comparing perioperative data and clinical outcomes. The minimally invasive group was found to have significantly less blood loss (432.8 ml versus 737.9 ml), decreased need for transfusion, less post-operative back pain as evidenced by significantly reduced VAS scores in minimally invasive group (p < 0.05), decreased time needed before ambulation (1.22 days versus 2.97 days) and shorter length of hospital stay (5.3 days versus 10.8 days). Neither of these studies was directed specifically at the obese patient but the results are consistent with this case report.

Rosen et al looked at 110 patients with a mean BMI of 28.7 who underwent minimally invasive lumbar spinal fusion surgery and any relationship between their body habitus and outcome after minimally invasive TLIF. BMI correlated marginally with EBL but not with operative time, LOS, or complications causing the authors to conclude that obesity should not be considered a contraindication to minimally invasive surgery. Lack of a relationship identified between BMI and complication rates in a study by Park et al on obese patients who underwent minimally invasive spine surgery when compared to non-obese patients undergoing similar procedures was thought to reflect the benefits of minimally invasive techniques including decreased surgical stress from less bleeding and the potential for early mobilization.

In a retrospective cohort analysis of 270 patients comparing back and leg pain, and health related quality of life measures in obese and non-obese patients who underwent traditional open lumbar spine fusion surgery, Djurasovic et al found postoperative complication rates of 17.4% in the non-obese group compared to 28.4% in the obese group, but found that obese patients obtained similar degrees of improvement and benefits with lumbar fusion as the non-obese patient. Vaidya et al compared surgical experience, clinical outcomes, and effect of body weight between obese patients and normal weight patients undergoing traditional open lumbar spine surgery demonstrating longer operative times and a higher incidence of postoperative complications in the obese patients. All patients had a BMI ≥ 30. Average blood loss was 987.9 ml and average LOS was 5.8 days. This case report’s average blood loss of 309 ml and average LOS 2.5 days supports the need for development of minimally invasive surgical techniques for the obese patient to undergo spine surgery safely and effectively.

This current study is limited by a small sample size and the cases of one surgeon in a specific geographic patient population. Larger randomized prospective studies over a longer term are needed to support the results of the current study. Comparison studies with this case report’s variables are suggested for further research.

Minimally invasive spine surgery may be preferred for the obese patient because it limits the amount of tissue exposure and needed access to the spine. The shortened length of hospital stay experienced by these patients may result in
decreased hospital costs and risk of nosocomial infections. The absence of needed inpatient rehabilitation after discharge from the hospital may also reduce overall cost of the procedure. This case report suggests that a new surgical technique for minimally invasive spine surgery has the potential to improve surgical outcomes for obese patients.

References

7. Park, Y & Ha, JW: Comparison of one-level posterior lumbar interbody fusion performed with a minimally invasive approach or a traditional open approach. Spine; 2007; 32, 537-543.
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