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Effectiveness and outcome of spinal decompression surgery in overweight and obese patients

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ABSTRACT

Objectives: Minimal invasive spinal surgery (MISS) is a relatively new surgical approach that minimizes tissue damage, reduces blood loss, and promises faster post-operative recovery compared to the traditional open approach. The current retrospective study aimed to assess and compare the surgical time, blood loss during the procedures, post-operative mobility, hospital stay, post-operative pain, and post-surgery patient satisfaction between the two groups.

Methods: Forty patients who underwent decompression procedures at our institute were included in this retrospective study. The patients were interviewed by a phone call by a single coinvestigator 1 year after surgery to survey their satisfaction.

Results: Thirteen patients (32.5%) underwent MISS and 27 (67.5%) underwent traditional surgery. The mean operative time and blood loss volume for MISS and traditional surgery were found to be 166.08 ± 44.75 min and 193.14 ± 58.67 min, and 69.23 ± 25.31 mL and 367 ± 451.5, respectively. The hospital stay was 3.62 ± 1.38 days for the MISS and 6.48 ± 4.57 days for the traditional surgery. Post-operative mobilization was found to be the 1st day for MISS and the 1.78th day for the traditional surgery group. Statistical significance difference ($P < 0.05$) was observed in blood loss volume, hospitalization time, post-operative mobilization, and pain level after surgery in favor of MISS.

Conclusion: MISS in obese patients was found superior to traditional (open) surgery in blood loss, operative time, post-operative mobilization, and post-operative pain.

Keywords: Decompression, Minimal invasive spinal surgery, Obesity, Spinal stenosis, Spine

INTRODUCTION

Spinal decompression is a loose term used to describe various procedures aimed at giving more space to the neural elements in the vertebral column. It is indicated in several conditions when there is a compression on the neural elements due to pathology in their surroundings. This pathology could be acute or chronic, acquired or congenital, degenerative, or non-degenerative.[1]

The initial intervention for treating these conditions is conservative management through physiotherapy, medications, weight reduction, and lifestyle modifications. When conservative management does not work, that is, pain is not controlled through all measures, and neurological symptoms are uncontrolled and progressive, surgery is indicated.[2]

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There are several approaches to reach the decompression needed. It all depends on the causative-specific pathology in the first place. Procedures such as laminoplasty and laminectomy, facetectomy, discectomy, foraminotomy, osteophyte removal, and corpectomy are well known and widely practiced. Nowadays, the trend is to do most of these procedures to reach the decompression intended using minimally invasive techniques. These techniques were developed to shorten hospital stay time, reduce complications, and speed up the recovery process and patients return to normal function, while reaching the same results compared to the traditional surgical techniques.[3] On the other hand, these techniques necessitate more operative time, radiation exposure, and more surgical experience than conventional approaches.[4]

Minimal invasive spinal surgery (MISS) techniques were adopted from other general surgical methods that were developed late in the last century. Microscopy, laser technology, endoscopy and video, and image guidance systems all contributed to the MISS.

The relationship between disk herniation and sciatica was established in the 1930s. Since then, all surgical techniques in treating radicular pain aimed at alleviating the pressure of the compressed nerve root(s). In 1955, Malis used the operating microscope and bipolar coagulation to facilitate his surgical approach.[5] In 1964, Smith used a percutaneous enzymatic application to dissolve the nucleus pulposus in a rabbit model.[6] In 1975, Hijikata described the first percutaneous discectomy.[7] In 1977, Iwa and Caspar described the minimally invasive concept of microdiscectomy.[8] In addition to automated techniques, adjuvant treatments of discogenic disruption have included the use of lasers and thermal heating probes.[9,10] In 1984, Ascher and Heppner used an Nd-YAG laser to heat the nucleus pulposus in an attempt to shrink the disk and relieve radicular symptoms. Since the 1990s, with video imaging application to standard endoscopy, minimally invasive endoscopic and thoracoscopic procedures have gained rapid use and diversified in their clinical applications.[11]

Overweight is defined by a body mass index (BMI) of 25–30 kg/m^2. Obesity, on the other hand, is characterized by a BMI of more than 30 kg/m^2. It has been associated with a greater prevalence of musculoskeletal disorders, chronic low back pain, and intervertebral disk degeneration. The association between obesity and the outcome of spinal surgery is controversial. Numerous studies suggest the complications and unfavorable outcomes associated with obesity.[12]

Thus, the current retrospective study aimed to detect the surgical time, blood loss during the procedures, hospital stay, post-operative pain using visual analog scale (VAS), and procedure-related readmissions of obese patients undergoing spinal decompression. In addition, patients' satisfaction associated with minimally invasive surgical techniques and traditional open was also compared. The primary objective of this study was to compare the efficacy of minimal invasive and open traditional spinal decompression surgical techniques in overweight and obese patients. The secondary objectives were to compare patient-related characteristics (age, gender, and BMI) and surgical technique-related characteristics (duration of surgery, blood loss, post-operative mobility, and pain).

MATERIALS AND METHODS

Data for this study were obtained from the data collected for a study done by the same research group with the IRB reference RJ13/022/J, which is not published yet. Only the data of the overweight and obese patients were included and analyzed.

A retrospective review of medical records of patients who underwent spinal decompression was performed. Forty patients were identified and their data were retrospectively investigated through a specially designed sheet. The medical records of these patients were obtained and patients were further interviewed. The patients were categorized into two groups based on the operative procedure: MISS and traditional (open) surgery (TOS).

The patient went through decompression surgeries without fixation or fusion, as there were no signs of instability in their dynamic or standing radiographic images. The type of surgery was decided by the joint decision of both the patients and their respective surgeons. All surgeons who performed both MISS and TOS were trained in both areas. TOS surgeries were carried out utilizing a midline incision followed by dissection of the soft tissue to reach the posterior spine elements with a longer incision and the use of a standard soft-tissue retractor and instrument for decompression.

Minimal invasive techniques were used in the MISS, identification of the operative level for the insertion of a percutaneous access tube, and direct visualization with the use of loupes and microscopes, as well as a special long microscopic instrument were utilized in MISS. The highest level of confidentiality was observed; the patients' records were handled in the medical records department by two assigned research assistants under the principal investigator's direct supervision. All data were collected, coded, and kept with the principal investigator. No copies were made.

Data collection

According to the procedure, the data were then divided into two groups, either MISS or TOS. Twelve months post-surgery, the two groups were interviewed by a single coinvestigator, and the degree of satisfaction was determined. It was

classified into not satisfied = 0, somewhat not satisfied = 1, somewhat satisfied = 2, and satisfied = 3. Other details such as operative time, blood loss, hospital stay, post-operative pain, and surgery-related readmission were also determined from the hospital records.

Inclusion criteria

Patients who had a BMI higher than 25 kg/m^2, who had a clear area of degenerative compression in their lumbosacral spines in magnetic resonance imaging images, suffered from the lower limb neurological symptoms limiting their daily activities, showed no signs of instability in dynamic or standing radiographs, and who underwent decompression surgeries without fixation or fusion after at least 6 weeks of a failed trial of conservative management were included in this study.

Statistical analysis

Statistical evaluation was performed through SPSS (IBM Corp. IBM SPSS Statistics for Windows, Version 19.0, NY: IBM Corp). The values were presented as mean ± SD. The statistical significance was determined between the type of surgery and operative parameters by a two-sided *t*-test at $P < 0.05$. The level of satisfaction was compared through the Kruskal–Wallis test and the likelihood ratio was also determined.

RESULTS

The demographic details of patients' characteristics are presented in [Table 1]. Forty patients fulfilled the inclusion criteria. Twenty-one (52.5%) males and 19 (47.5%) females were included having a mean age of 58 ± 14.70 years. The median age, height, weight, and BMI were 60 years, 160 cm, 86 kg, and 32 kg/m^2, respectively. The patients who underwent MISS were 13 patients (32.5%) versus 27 patients (67.5%) who underwent TOS.

The post-operative patients' experiences of MISS and TOS were compared and shown in [Table 2]. Ten (77%) patients who had MISS underwent one-level surgery, while 3 (23%) underwent two-level surgery. Nineteen (70%) patients in the TOS group underwent one-level surgery, while 8 (30%) underwent two-level surgery. The mean operative time and blood loss volume for MISS and TOS were found to be 166.08 ± 44.75 min and 193.14 ± 58.67 min and 69.23 ± 25.31 mL and 367 ± 451.5 mL, respectively. The minimum blood loss volume was 50 mL for both types of surgeries, while the maximum blood loss was 100 mL and 2200 mL for MISS and TOS, respectively. Hospitalization for 2 days minimum and 7 days maximum was seen in MISS, whereas in TOS, patients stayed in the hospital for 2–22 days. Post-operative mobilization of 1 day was observed in MISS and 1–4 days in TOS groups. The post-operative pain level (VAS) of 2.08 ± 1.8 and 4.37 ± 2.28 was found in MISS and TOS, respectively. There was a statistically significant difference in favor of MISS in terms of blood loss volume, hospitalization time, post-operative mobilization, and pain level after the surgery.

Eleven (84.6%) of the patients were satisfied with MISS (patients who responded with satisfied and somewhat satisfied), and 2 (15.4%) were not satisfied (patients who responded with not satisfied and somewhat not satisfied). Twenty (74.07%) underwent TOS were satisfied (patients who responded with satisfied and somewhat satisfied), while 7 patients (25.93%) were not satisfied (patients who responded with not satisfied and somewhat not satisfied). Statistically significant difference was not observed in the level of satisfaction and type of surgery [Table 3]. The likelihood ratio was found to be 0.048.

Table 1: Demographic details of patients included in the study.

Age (years)	57.91±14.70
Gender (%)	
Male	21 (52.5)
Female	19 (47.5)
Height (centimeters)	161.59±10.98
Weight (kg)	84.16±13.87
BMI (kg/m^2)	32.39±5.76
Type of procedure (%)	
MISS	13 (32.5)
TOS	27 (67.5)

BMI: Body mass index, MISS: Minimum invasive spine surgery, TOS: Traditional open surgery

Table 2: Post-operative comparison between the MISS and traditional (open) groups.

Post-operative data	MISS	TOS (open)	*P*-value
Age	57±16.16	59.33±14	0.641
BMI	31.61±5.62	32.86±5.61	0.511
Level of procedure (%)			
Level 1	10 (77)	19 (70)	0.673
Level 2	3 (23)	8 (30)	
Surgical size (number of levels) (%)			0.673
1	10 (77)	19 (70)	
2	3 (23)	8 (30)	
Operation time (min)	166.08±44.75	193.14±58.67	0.150
Blood loss volume (mL)	69.23±25.31	367±451.5	0.023*
Hospital stay (days)	3.62±1.38	6.48±4.57	0.030*
Post-operative mobilization (days)	1.15±0.37	2.29±0.66	0.006*
Level of post-operative pain	2.08±1.8	4.37±2.28	0.003*

*Indicates statistical significance. BMI: Body mass index, MISS: Minimum invasive spine surgery, TOS: Traditional open surgery

Table 3: Level of satisfaction compared to the type of surgical procedure.

Type of surgery	Degree of satisfaction (%)				*P*-value	Likelihood ratio
	Not satisfied	Somewhat not satisfied	Somewhat satisfied	Satisfied		
MISS	0 (0)	2 (15.38)	4 (30.76)	7 (53.84)	0.088	0.048
TOS (open)	5 (18.51)	2 (7.4)	14 (51.85)	6 (22.22)		

MISS: Minimum invasive spine surgery, TOS: Traditional open surgery

The previous records showed three patients who underwent decompression surgeries and had surgery-related readmissions during the study period. These three patients were excluded as their BMI was <25 kg/m^2. Two of them were after TOS. One of them was admitted with a CSF leak and the other one was with severe unbearable pain. The third readmitted patient underwent MISS and was readmitted due to wound dehiscence that was closed with secondary intention in the operative room. No complications were detected in the present study groups.

DISCUSSION

There are numerous complications associated with spinal surgeries. Procedures causing higher blood loss and extended hospitalization lead to an increased risk associated with post-operative complications. These risks not only increase costs but can also cause morbidity and mortality. In addition, the condition of patients, including advanced age and the presence of comorbidities, increases these complications.[13] Spinal surgery has evolved in the past decades and improved post-treatment recovery. MISS is recently gaining popularity. Significant improvement in patients undergoing MISS is observed with reduced post-operative infection.[14] MISS techniques have improved recovery time and procedural morbidities compared to open approaches with similar outcomes. However, these techniques have increased costs compared to traditional techniques.[13]

Overweight and obese patients having a median BMI of 32 kg/m^2 (25–42 kg/m^2) were included in the present study. Surgeons have difficulty with surgical access in obese patients, and the operative complications associated with overweight and obesity are well reported. These unfavorable outcomes include more significant blood loss, longer operative time, and higher revision rates of spinal surgery patients.[15] The complications associated with obesity pose several challenges, including poor imaging studies attributed to size constraints and adiposity.[16] However, the correlation between lesser post-operative complications and MISS was not observed. In a study conducted by Rosen *et al.*,[17] similar operative times, hospitalization length, and complication rates were observed between obese and non-obese patients. However, estimated blood loss was higher in obese patients. In another study, there was no relationship between higher BMI and complications in patients undergoing lumbar MISS, reflecting the MISS approach's potential benefits.[18]

In our study, higher operative time and post-operative blood loss were observed in open surgery when compared to MISS in overweight and obese patients. Post-operative mobilization time and length of hospital stay were also higher in open surgery than in MISS. Statistically significant differences were found in blood loss volume, hospital stay, post-operative pain, and mobilization. Ntoukas and Müller[19] also observed MISS's superiority in terms of blood loss and post-surgery recovery. A study conducted by Wang *et al.*[20] who found a significant difference in hospital stay duration and blood loss between the two groups. Both studies did not consider BMI as selection criteria.

This study suggests that patients were more satisfied with MISS than TOS. However, a statistically significant difference was not observed. A similar outcome was observed by Mobbs *et al.*,[21] where the MISS approach provided higher patient satisfaction than the conventional TOS approach. Mummaneni *et al.* compared minimum invasive versus traditional approaches for Grade 1 spondylolisthesis fixation. They found no difference between the two techniques when the surgery was for a single level. When two levels were treated, minimum invasive technique showed superiority in terms of numeric rating scale-leg pain at 12 months.[22]

In the present study, MISS was found advantageous over TOS in terms of blood loss, operative time, post-operative mobilization, and pain level. The minimally invasive procedure significantly depends on the surgeon's skills and knowledge in contrast to the open approach, where the anatomy can be visualized well.[23] Substantial development has been noted in spinal surgery, characterized by the implementation of novel technologies in treating different spinal conditions. MISS is an independent area of modern vertebrology. Practical recommendations for reducing rehabilitation and improvement costs in the long-term post-surgery period are required for its development.[24]

A significant limitation in accepting MISS techniques is the lack of knowledge of spine surgeons who have been comfortable performing traditional open procedures.

It introduces various challenges to surgeons in terms of limited visualization of the surgical field, a narrow opening for operation, and a requirement for a high level of skills. Furthermore, unfamiliarity with the technology involved in the procedure.[25] However, increased attention is given to adopting MISS approaches. It is anticipated that continued development of new technologies, refinement of surgical techniques based on patient outcomes, increased indications of MISS, and improved accessibility of such procedures to a larger patient population will lead to improved patient condition and satisfaction.[26] This study was limited by the small number of patients included and the retrospective design.

CONCLUSION

MISS was found to have the same efficacy as TOS in achieving satisfactory and favorable outcomes in overweight and obese patients. MISS in overweight and obese patients was found to be superior to TOS in blood loss, operative time, post-operative mobilization, and post-operative pain.

RECOMMENDATIONS

Further prospective studies/RCTs with recruitment of bigger number of patients tackling this subject are recommended.

AUTHORS' CONTRIBUTIONS

MK conceived and designed the study, and provided research materials. ME conducted research, provided research materials, and collected, organized, analyzed, and interpreted the data. He also wrote the initial and final drafts of the article. All reviewers reviewed the final version and approved, and all are responsible for the similarity index.

ETHICAL APPROVAL

Ethical approval was obtained for this study from the Institutional Review Board of King Abdullah International Medical Research Center (KAIMRC). IRB approval number IRB/0350/22 approved on February 23, 2022.

DECLARATION OF PATIENT CONSENT

The authors certify that they have obtained all appropriate patients consent forms. In the form, the patients have given their consent for their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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CONFLICTS OF INTEREST

There are no conflicting relationships or activities.

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