CLINICAL AND RADIOLOGICAL OUTCOMES OF MINIMALLY INVASIVE VS CONVENTIONAL SURGERY FOR LUMBAR SPINAL STENOSIS: A PROSPECTIVE COHORT STUDY

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ABSTRACT

OBJECTIVES

The objective of this study is to compare the clinical and radiological outcomes of minimally invasive surgery (MIS) versus conventional surgery for patients with lumbar spinal stenosis (LSS).

METHODOLOGY

This prospective cohort study was conducted at a tertiary care hospital in Peshawar, Pakistan, the study enrolled 200 patients diagnosed with symptomatic LSS, confirmed by MRI. Patients were assigned to MIS (n=100) or conventional surgery (n=100) groups based on surgeon discretion and patient preference. Preoperative and postoperative evaluations included clinical assessments using the Visual Analog Scale (VAS) for pain, Oswestry Disability Index (ODI), and patient satisfaction scores, alongside radiological assessments of spinal canal diameter and residual stenosis. Data analysis was performed using SPSS version 25.0, with a significance level set at $p<0.05$.

RESULTS

The MIS group exhibited significantly lower VAS scores (6 months: 2.8±1.2 vs. 4.5±1.5, $p<0.01$; 12 months: 2.5±1.1 vs. 4.2±1.3, $p<0.01$) and ODI scores (6 months: 18.4±5.2 vs. 25.6±6.3, $p<0.01$; 12 months: 17.8±4.9 vs. 24.8±6.0, $p<0.01$) compared to the conventional surgery group. Patient satisfaction was higher in the MIS group (85% vs. 70%, $p<0.05$). Radiological outcomes showed a greater increase in spinal canal diameter in the MIS group at 6 months (13.5±1.4 mm vs. 12.1±1.5 mm, $p<0.01$) and 12 months (13.2±1.3 mm vs. 11.8±1.4 mm, $p<0.01$) postoperatively. The incidence of residual stenosis was lower in the MIS group at both follow-ups (6 months: 10% vs. 25%, $p<0.05$; 12 months: 12% vs. 28%, $p<0.05$).

CONCLUSION

MIS offers superior clinical and radiological outcomes compared to conventional surgery for LSS, with better pain relief, functional improvement, and patient satisfaction. The study supports MIS as a viable alternative to conventional surgery, though further research is needed to explore its long-term efficacy and safety.

KEYWORDS: *Lumbar Spinal Stenosis, Minimally Invasive Surgery, Conventional Surgery, Clinical Outcomes, Radiological Outcomes, Prospective Cohort Study*

INTRODUCTION

Obesity is a global public health challenge impacting Lumbar spinal stenosis (LSS) is a common condition, especially in the elderly population, characterized by the narrowing of the spinal canal, leading to compression of the neural elements. This can result in symptoms such as lower back pain, leg pain, and neurogenic claudication. The prevalence of LSS increases with age, and it significantly affects the quality of life of the affected individuals.[1] Traditional open surgery has been the standard treatment for severe cases of LSS. It involves decompression of the spinal canal by removing parts of the vertebrae, ligaments, or intervertebral discs. However, this approach is associated with significant muscle and tissue damage, longer hospital stays, and prolonged recovery periods.[2] Minimally invasive surgery (MIS) for LSS has emerged as an alternative to conventional open surgery. MIS techniques aim to reduce the extent of muscle and tissue disruption, thereby potentially decreasing postoperative pain, reducing hospital stays, and accelerating recovery. Various MIS techniques, such as endoscopic decompression, microdiscectomy, and percutaneous interlaminar decompression, have been developed and are being increasingly adopted.[3] Several

studies have compared the outcomes of MIS and conventional surgery for LSS. A systematic review by Phan et al. indicated that MIS could offer similar clinical outcomes to open surgery with the added benefits of less blood loss and shorter hospital stays.[4] Similarly, a meta-analysis by Tuchman et al. reported that patients undergoing MIS had lower rates of perioperative complications compared to those undergoing conventional surgery.[5,6] Despite these promising findings, there remains some controversy regarding the long-term efficacy and safety of MIS compared to conventional surgery. Some studies have reported similar reoperation rates between the two approaches, while others have suggested a higher incidence of complications such as dural tears and nerve root injuries in MIS.[7,8] Given the increasing adoption of MIS and the ongoing debate regarding its benefits and risks, it is crucial to conduct comprehensive studies that compare the clinical and radiological outcomes of MIS and conventional surgery for LSS. This prospective cohort study aims to fill this gap by evaluating these outcomes in a cohort of patients treated at a tertiary care hospital in Peshawar, Pakistan.

METHODOLOGY

This prospective cohort study was designed to compare the clinical and radiological outcomes of MIS versus conventional surgery in patients with LSS. The study was conducted at a tertiary care hospital in Peshawar, Pakistan. The study duration was two years, from January 2022 to December 2023. A total of 200 patients were included in the study, with 100 patients undergoing MIS and 100 patients undergoing conventional surgery. The sample size was calculated using power analysis, assuming a 5% significance level (alpha), 80% power (beta = 0.20), and an effect size based on previous studies comparing MIS and conventional surgery for LSS.(9) A consecutive sampling technique was used to recruit eligible patients presenting to the hospital with symptomatic LSS. Patients were assessed preoperatively through a comprehensive clinical evaluation and radiological imaging, including MRI and X-rays. They were then assigned to either MIS or conventional surgery based on the surgeon's discretion and patient preference. The Patients were aged 18-80 years, diagnosed with symptomatic LSS confirmed by MRI and Failed conservative management for at least 6 months. The patients had previous lumbar spine surgery, severe comorbidities contraindicating surgery and incomplete clinical or radiological data were excluded. Data were analyzed using SPSS version 25.0. A p-value of <0.05 was considered statistically significant.

RESULTS

Table 1: Demographic and Baseline Characteristics

Variable	MIS Group (n=100)	Conventional Surgery Group (n=100)	P-Value
Age (years)	62.4 ± 8.5	63.1 ± 9.2	0.45
Gender (Male/Female)	56/44	58/42	0.75
BMI (kg/m²)	27.3 ± 3.5	27.8 ± 3.6	0.34
Hypertension (%)	45	48	0.65
Diabetes Mellitus (%)	38	40	0.76
Smoking (%)	30	33	0.68

Semaglutide was superior to Liraglutide in controlling sugars (HbA1c% reduction 1.13 vs 0.94) as well as in weight control (10.6 vs 6.2kg weight loss) respectively.

Table 2: Clinical Outcomes

Radiological Measure	MIS Group (n=100)	Conventional Surgery Group (n=100)	P-value
Spinal Canal Diameter (mm)			
Preoperative	7.2 ± 1.1	7.3 ± 1.2	0.62
6 Months Postoperative	13.5 ± 1.4	12.1 ± 1.5	<0.01
12 Months Postoperative	13.2 ± 1.3	11.8 ± 1.4	<0.01
Residual Stenosis (%)			
6 Months Postoperative	10	25	<0.05
12 Months Postoperative	12	28	<0.05

Table 3 presents the radiological outcomes for the MIS and conventional surgery groups. The spinal canal diameter was measured preoperatively, and at 6 and 12 months postoperatively. The MIS group demonstrated a significantly greater increase in spinal canal diameter at both follow-up points compared to the conventional surgery group. Additionally, the percentage of patients with residual stenosis was significantly lower in the MIS group at both 6 and 12 months postoperatively. This indicates that MIS may be more effective in relieving spinal canal narrowing and reducing residual stenosis compared to conventional surgery.

DISCUSSION

The findings of this prospective cohort study indicate that minimally invasive surgery (MIS) for lumbar spinal stenosis (LSS) results in superior clinical and radiological outcomes compared to conventional surgery. Patients who underwent MIS reported significantly lower pain levels and better functional outcomes at both 6 and 12 months postoperatively. Additionally, MIS was associated with greater

improvements in spinal canal diameter and lower rates of residual stenosis. These results align with recent research highlighting the benefits of MIS in treating LSS.[10,11] Several studies have demonstrated the advantages of MIS over conventional surgery for LSS. A systematic review and meta-analysis by Phan et al. (2017) found that MIS techniques were associated with reduced intraoperative blood loss, shorter hospital stays, and comparable clinical outcomes to conventional surgery.[4] Our study corroborates these findings, showing that MIS not only provides effective symptom relief but also enhances recovery and patient satisfaction. Further supporting our results, a study reported that MIS resulted in lower perioperative complication rates and similar or better clinical outcomes compared to open surgery.[12] This aligns with our observation of higher patient satisfaction and improved functional outcomes in the MIS group. Radiologically, our study found significant improvements in spinal canal diameter and reduced residual stenosis in the MIS group. A study confirmed that MIS techniques, such as endoscopic decompression, effectively increase spinal canal diameter while minimizing tissue disruption.[13] These radiological benefits translate into better clinical outcomes, as seen in our study. However, some concerns remain regarding the potential complications associated with MIS. A study highlighted an increased risk of dural tears and nerve root injuries with MIS compared to conventional surgery.[14] While our study did not specifically assess complication rates, the overall clinical and radiological outcomes suggest that the benefits of MIS outweigh these risks. Long-term outcomes are also a critical consideration. A recent study evaluated long-term results of MIS for LSS and found sustained improvements in pain and functional outcomes up to five years postoperatively.[15] This underscores the potential for durable benefits with MIS, which is consistent with the positive outcomes observed in our study at one year follow-up. Another important aspect is the patient selection and surgical expertise required for MIS. A study emphasized the importance of proper patient selection and surgeon experience in achieving optimal outcomes with MIS.[16,17] This is particularly relevant in our study setting, where the surgeons had substantial experience with MIS techniques. Economic considerations also favor MIS. According to a cost-effectiveness analysis MIS for LSS was associated with lower overall healthcare costs compared to conventional surgery due to shorter hospital stays and quicker return to work.[7,18] This economic advantage is crucial for healthcare systems in developing countries like Pakistan.

LIMITATIONS

The relatively small sample size and the potential for selection bias given the non-randomized design. Future randomized controlled trials with larger sample sizes are needed to validate our findings and provide more definitive conclusions.

CONCLUSIONS

In conclusion, this prospective cohort study demonstrates that minimally invasive surgery offers superior clinical and radiological outcomes compared to conventional surgery for patients with lumbar spinal stenosis. MIS is associated with better pain relief, improved functional outcomes, and greater patient satisfaction, making it a viable alternative to conventional surgery. Further research is warranted to explore the long-term efficacy and safety of MIS for LSS.

CONFLICT OF INTEREST: None

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