



Clinical and functional outcomes of open versus minimally invasive surgeries in single-level prolapsed intervertebral disc in lumbar region at tertiary care center: A prospective study

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ABSTRACT

Background: Spine surgery has been transformed significantly by the growth of minimally invasive surgery (MIS) procedures. Modern MIS techniques allow spine surgeons to achieve the same goals of open surgery while minimizing the collateral damage associated with the open approaches. **Aims and Objectives:** The aim of MIS is to do an efficient “Target Surgery” with a minimum of iatrogenic trauma. **Materials and Methods:** This is a prospective study done in the Department of Neurosurgery, JA group of hospitals, Gajra Raja Medical College, Gwalior, from July 2021 to July 2022. Study was conducted on 30 randomly selected patients whose presentation and imaging showed indication for surgery. **Results:** Better symptomatic relief was seen in patients with MIS at 7 days with about 80% of them having a visual analog scale score between 0 and 2; however, not much difference was noted at 1 month. Not much difference was noted for wound status, neurological improvement, and Oswestry Disability Index at 1 month. However, gross difference was noted at the rate of return to work by the patients with approximately 93.3% of patients undergoing MIS returning to work within 1 month in comparison to only 20% in case of open surgery. **Conclusion:** Minimally invasive techniques are remarkably better option to traditional open surgeries, as these procedures showed a significant reduction in immediate post-operative pain, duration of hospital stay, and return to work by the patient. However, not much difference was noted in status of pain at 1 month, rehospitalization, degree of disability at 1 month, wound status, and neurological improvement of the patient.

Key words: Lumbar; Minimal invasive surgery; Prolapsed; Intervertebral disc

INTRODUCTION

Spine surgery has been transformed significantly by the growth of minimally invasive surgery (MIS) procedures.¹ Modern MIS techniques allow spine surgeons to achieve the same goals of open surgery while minimizing the collateral damage associated with the open approaches.² Main goal of MIS is to do an efficient “Target Surgery” with a minimum of iatrogenic trauma.³

MIS includes microscope-assisted/endoscopic-assisted surgeries through interlaminar or transforaminal approach. In endoscopic approach, we can use Easy Go or Destandau’s technique.

During standard open spine surgery, the surgeon creates a large incision (usually about six inches long) in the back and dissects the spinal muscles to pull them away from the bone in a process called retraction. Once they visualize the bones of the spine, they will begin the necessary spinal procedure.⁴

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Table 1: Comparison of VAS score (pain) in pre-operative, 2nd post-operative, and at 1-month follow-up in open and MIS groups

Time	At admission		On 2 nd post-operative day		At 1-month follow-up	
	MIS (%)	Open (%)	MIS (%)	Open (%)	MIS (%)	Open (%)
0–2	0 (0)	0 (0)	6 (40)	12 (80)	15 (100)	15 (100)
3–5	0 (0)	1 (6.7)	9 (60)	3 (20)	0 (0)	0 (0)
>5	15 (100)	14 (93.3)	0 (0)	0 (0)	0 (0)	0 (0)

MIS: Minimally invasive surgery, VAS: Visual analog scale

In minimally invasive spine surgery (MISS), surgeons use specialized instruments to perform spinal procedures through small incisions. Because the incisions made during MIS are much smaller than in open procedures, there is less chance of muscle and soft tissue injury.

The benefits of MISS are smaller incision, little, or no muscle cutting; less bleeding during surgery; shorter hospital stay; smaller risk of infection; less pain after surgery; decreased reliance on pain medication; faster recovery; less rehabilitation is needed; patients return to work and activities more quickly; and less scarring.

First introduced in 1997 by Foley and Smith for the microscopic decompression of spinal stenosis,⁵⁻⁷ MISS is now being applied to a broad spectrum of pathologies, including but not limited to, adult spinal deformities, trauma, and malignancies. In the surgical treatment of lumbar stenosis and degenerative lumbar spondylolisthesis, MISS procedures including unilateral laminotomy, bilateral laminectomy for bilateral decompression, and transforaminal lumbar interbody fusion have become popular procedures. Posterior lumbar interbody fusion (PLIF) is another procedure that can be performed using minimally invasive techniques. However, here in this study, we will limit our discussion to the outcomes in single level lumbar disc disease through open and MIS procedures.

Aims and objectives

- To compare the clinical outcomes between open versus MIS in lumbar spine on the basis of:
 - Pain scales
 - Wound status
 - Improvement in neurological status of the patient.
- To compare the functional outcomes between open versus MIS in lumbar spine on the basis of:
 - Disability index
 - Resuming daily activities.

MATERIALS AND METHODS

This is a prospective study done in the Department of Neurosurgery, JA group of hospitals, Gajra Raja Medical College, Gwalior, from July 2021 to July 2022.

Table 2: Comparison of wound status in open surgery and MIS groups

Wound status	Open (%)	MIS (%)
Healthy	13 (86.7)	15 (100)
SSI	2 (13.3)	0 (0)

SSI: Surgical site infection

Table 3: Pre-operative neurological status in open and MIS groups

Deficit	Motor deficit		Sensory deficit	
	Open	MIS	MIS	Open
Yes	12	12	10	10
No	3	3	5	5

Study design

Prospective study.

Sample size

30 (15 for open surgery and 15 for MIS).

Inclusion criteria

- All patients from 15 to 80 years of age whose imaging shows single-level prolapsed intervertebral disc in lumbar region necessitating surgery.

Exclusion criteria

- Patients managed conservatively
- Multilevel disc and lumbar canal stenosis
- Patients not giving consent to be included in study
- Patients with severe comorbidities
- Patients are randomly selected for open or MIS intervention.

OBSERVATIONS

Observations are based on the following parameters:

- Pain relief
 - At admission/pre-operative period.
 - On 2nd post-operative day.
 - At 1-month follow-up.
- Wound status/surgical site infection (SSI)
- Neurological outcome (motor and sensory) (at admission/pre-operative period, 2nd post-operative day and at 1-month follow-up)

Table 4: Comparison of post-operative improvement in the neurological deficits in open surgery and MIS groups

Duration/Neurological parameter	2 nd post-operative day				At 1-month follow-up			
	Motor (%)		Sensory (%)		Motor (%)		Sensory (%)	
	Open	MIS	Open	MIS	Open	MIS	MIS	Open
Improved	10 (83.3)	12 (100)	6 (60)	8 (80)	12 (100)	12 (100)	10 (100)	10 (100)
No change	2 (16.7)	0 (0)	4 (40)	2 (20)	0 (0)	0 (0)	0 (0)	0 (0)
Deteriorated	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

- Duration of hospital stay
- Rehospitalization
- Degree of disability (Oswestry Disability Index (ODI) at admission/pre-operative period, 2nd post-operative day, and 1 month).

These data are summed up in the following tables from Tables 1-8.

DISCUSSION

Twelve studies of Class I evidence were found examining MIS versus conventional open surgery in treating lumbar disc herniation. These comprised of 10 RCTs and 2 systematic reviews. The ten RCTs comprised a total of 586 MIS patients and 573 conventional open patients. No patients in either group received fusion. All 573 open patients received discectomy, whereas 564 of the 586 MIS patients received discectomy; the remaining 22 MIS patients (4%) received percutaneous nucleotomy. Eight of the ten RCTs had follow-up longer than 1 week; in these studies, follow-up ranged from 52 to 104 weeks.^{1,8-10}

The collective results of these studies indicated that MIS was inferior to conventional open surgery for lumbar disc herniation with regard to leg pain relief, low back pain relief, quality-of-life, and rehospitalization rate (due to increased disc reherniation). However, MIS was associated with lower risk of infection and shorter hospital stay. There was no difference in short-term function, long-term function, or 6-month post-operative ODI scores.

In another study (minimally invasive vs. open laminectomy/discectomy, transforaminal lumbar, and PLIF: A systematic review) published in July, 2017,⁵ a total of 18 studies were identified involving open and MISS laminectomy/discectomy: 12 analyzed MISS laminectomy/discectomy, 1 analyzed open laminectomy/discectomy, and 5 compared open versus MISS laminectomy/discectomy. The mean follow-up time was 20.47; range: 12–40 and 2 months with an average of 119.44; and range: 8–721 patients. There were no significant differences in terms of visual analog scale (VAS) for leg pain (mean=4.56±1.04 vs.

Table 5: Comparison of duration of hospital stay in open and MIS groups

Number of days	Open (%)	MIS (%)
≤5	0 (0)	14 (93.3)
6-8	7 (46.6)	1 (6.7)
>8	8 (53.3)	0 (0)

Table 6: Comparison of rehospitalization rates in open and MIS groups

Rehospitalization	Open surgery (%)	MIS (%)
Yes	3 (20.0)	1 (6.6)
No	12 (80.0)	14 (93.3)

4.58±0.96, P=0.98); no significant difference in ODI (mean=31.84±11.30 vs. 17.40±0.57, P=0.10); and no significant difference in intraoperative blood loss (mean=70±51 vs. 139±71, P=0.10).

In our study, assessment of pain was based on VAS. On 2nd post-operative day, patients who underwent open surgery showed better pain relief than those with MIS. About 80% of patients who underwent open surgery showed a VAS score between 0 and 2 while only 40% of patients who underwent MIS showed the same as summarized in Table 1.

However, at 1-month follow-up, there was no difference in the score in either of the group.

Wound status of patients undergoing MIS showed better wound recovery in comparison to the patients undergoing open surgery. About 13.3% of patients who underwent open surgery showed SSI while none in the group of MIS as shown in Table 2.

Pre-operatively, 12 out of 15 patients showed motor deficits in both the open surgery and MIS groups while 10 out of 15 patients in either of the two groups showed sensory deficit as shown in Table 3. On 2nd post-operative day, about 83.3% of the patients who underwent open surgery showed motor improvement while almost all the patients who underwent MIS showed improvement. Sensory improvement was shown by 60% of the patients who

Table 7: Comparison of disability on the basis of ODI in pre-operative and post-operative period in open and MIS groups

Duration/ODI	Pre-operative		2 nd post-operative day (%)		At 1-month follow-up (%)	
	Open	MIS	Open	MIS	Open	MIS
0–20	0	0	13 (86.7)	15 (100)	15 (100)	15 (100)
21–40	2	2	2 (13.3)	0 (0)	0 (0)	0 (0)
>40	13	13	0 (0)	0 (0)	0 (0)	0 (0)

ODI: Oswestry disability index

Table 8: Comparison of resumption of daily activities in post-operative period in open and MIS groups

Duration	Open (%)	MIS (%)
≤1 month	3 (20.0)	14 (93.3)
1–3 months	10 (66.6)	1 (6.6)
>3 months	2 (13.3)	0 (0)

underwent open surgery while 80% of the patients who underwent MIS showed improvement in sensory outcome as shown in Table 4. Deterioration was not shown in any of the groups.

However, at 1-month follow-up neither of the two groups showed any difference in the motor and sensory outcome as shown in Table 4.

Duration of hospital stay was comparatively less in patients who underwent MIS with about 93.3% of the patients being discharged within 5 days of surgery. Among those who underwent open surgery, about 46.6% of the patients were discharged within 6–8 days while about 53.3% of the patients were discharged after 8 days as shown in Table 5.

Patients who underwent open surgery had greater rehospitalization rate with about 20% of them getting readmitted while only 6.6% of the patients got readmitted in the MIS group as shown in Table 6.

Degree of disability was assessed on the basis of ODI. On 2nd post-operative day, about 86.7% of the patients showed an ODI between 0 and 20 while 13.3% patients had VAS score between 21 and 40. However, at 1-month follow-up, there was no difference in the ODI with almost 100% patients in either of the two categories with an ODI between 0 and 20 as shown in Table 7.

About 93.3% of the patients who underwent MIS resumed daily activities within a month while only 20% patients in the open surgery group resumed daily activities within a month. About 66.6% of the patients in the open surgery group resumed activities between 1 and 3 months as summarized in Table 8.

Limitations of the study

None.

CONCLUSION

Better symptomatic relief was seen in patients with MIS on 2nd day with about 80% of them having a VAS score between 0 and 2, however, not much difference was noted at 1 month. Not much difference was noted for wound status, neurological improvement, and ODI at 1 month.

However, gross difference was noted in the rate of patients resuming daily activities with approximately 93.3% of patients undergoing MIS resuming daily activities within 1 month in comparison to only 20% in case of open surgery.

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ETHICAL COMMITTEE APPROVAL

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SJ- Definition of intellectual content, Literature survey, Prepared first draft of manuscript, Implementation of study protocol, data collection, data analysis, manuscript preparation, and submission of article; **VKK**- Concept, design, clinical protocol, manuscript preparation, editing and revision, statistical analysis; **AS**- Review manuscript, preparation of tables; **AIS**- Coordination and manuscript revision.

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