

Case Report

Clinical outcomes of three Level Interlaminar Endoscopic Decompression Surgery in the Treatment of Multilevel lumbar Spinal Stenosis

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ABSTRACT

This is the first case report to test the efficacy of three-level endoscopic spine surgery for the treatment of lumbar spinal stenosis. The patient was a 50-year-old entrepreneur with pain on standing and walking and all activities that compress the canal such as lumbar extension. Three-level endoscopic surgery was performed at L3-L4, L4-L5, and L5-S1. Certain clinical and surgical outcomes were selected such as the Visual Analogue Scale for pain, Oswestry Disability Index score for level of disability and functional limitation, pain on certain aggravating activities involving extension like walking and moving downstairs, spinal and core stability using prone segmental instability test and patient satisfaction values taken at baseline and after the endoscopic surgery at two levels i.e. immediately after surgery and after one month follow up. Multiple-level interlaminar endoscopic surgery was successful in terms of reducing pain, improving score on the Oswestry disability index, improving daily life activities, increasing spinal and core stability, and increasing patient satisfaction.

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INTRODUCTION

Lumbar spinal stenosis is characterized by the narrowing of the spinal canal as a result of different etiologies including thickening of ligamentum flavum, disc bulge, and degenerative changes in bone, capsule, and disc.¹ It is a prevalent and disabling cause of back and leg pain in older adults and affects an estimated 103 million individuals worldwide. The majority of cases are treated conservatively through lifestyle modifications, medications, and physical therapy. Approximately 0.6 million surgical procedures are performed each year in the United States.²

Literature suggests that in patients over age 65, the most common indication of spinal surgery is spinal stenosis. Patients suffering from chronic pain along with progressive neurological impairments need decompression surgeries³. The main aim of surgery is to relieve pressure and decompress nerve roots. The selection of surgical techniques depends on several factors. With the advancement in medical sciences, surgical procedures are becoming less invasive and more effective. Decompression approaches for spinal stenosis include bilateral laminotomy, unilateral laminotomy with contralateral recess decompressed by the transmedia way, partial facetectomy, and endoscopic surgery⁴. Traditionally performed open spine surgeries including pure decompression or decompression along with fusion are categorized as effective for lumbar spine stenosis however long-term clinical outcomes of open surgery are still unclear. Open spine surgeries are extensive and have a greater risk of tissue injury, secondary instability, and increased reoperation rates. With the advancement in surgical tools minimally invasive spine surgery (MISS) methods such as endoscopic spine surgery are utilized with fewer post-op complications and improved patient outcomes⁵. Minimal-invasive surgery is becoming increasingly popular due to the reason that it preserves the muscular and surrounding structures. Endoscopic techniques have different procedures depending on the level of nerve root entrapment and endoscopes. The most commonly used approaches for decompression are transforaminal (TF) and interlaminar (IL). In lateral recess stenosis due to hypertrophy of the superior articular pillar (SAP), the procedure most commonly incorporated is a trans-femoral approach.⁶

This case report represents the first known data-based case of three-level interlaminar endoscopic spine surgery in the treatment of lumbar spine stenosis. The purpose of this study was to examine the efficacy of a surgical procedure for lumbar spine stenosis using

multiple-level endoscopic surgery. Multiple-level endoscopic surgery has the advantages of less tissue damage and preserved muscular and supporting structures making it effective in terms of patient's clinical outcomes. Thus, it may offer an effective and time-saving surgical technique for spinal compressions.

CASE DESCRIPTION

Patient Demographics

A 50-year-old male entrepreneur came to our clinic with a complaint of back and leg pain for 2 years.

History of Presenting Condition

The patient reported that he is suffering from back pain which radiates to both legs. The pain was described as vague, aching, cramping, deep in the back while sharp and shooting in the legs. The pain was intermittent and aggravated with standing and walking and all activities requiring spinal extension. Pain is relieved with stooped postures, sitting, or bending forward. The patient reported increasing pain and numbness in their legs after 3 minutes of walking which made him sit at certain intervals to reach a specific destination. The patient reported that pain is increased while going downstairs as compared to ascending stairs. According to the patient, for the past few weeks, he was unable to hold urine and was unable to reach the bathroom.

Physical Examination

On postural examination, it was observed that the patient had a decreased lumbar curve while the anterior superior iliac spine was at level with the posterior superior iliac spine on both sides suggesting posterior pelvic tilt of the pelvis and nutation of the sacrum. Paraspinals and erector spinae were found to be overactive and tender on palpation. There was visible wasting in the left

side calf muscles. On assessment of ranges, it was observed that flexion was 2/3 and pain-free while extension was limited by 1/3 and was painful. On repeated extension pain was peripheralized into legs. Side bendings were also limited with left side bending limited more than right. Combined movements provoked the patient's symptoms on the same side. The patient demonstrated significant weakness in toe and heel walking. Straight leg raise was 50 and painful on the left side. The knee to the chest was pain-free and was a movement of comfort. The patient demonstrated delayed activation of transversus abdominis and multifidus resulting in weak core stability. On dermatomal assessment, there was mild sensory loss at the inner thigh and perineal area. Resisted knee extension (L3), big toe extension (L5) and plantar flexion, eversion (S1) showed weakness. On reflex testing, there was diminished knee jerk and achilles reflex. The hamstring also demonstrated tightness with the right hamstring more shorter than the left.

MRI Findings

The patient was referred to the Radiology Department for an MRI lumbar spine. T2 weighted sagittal and axial views were obtained. The sagittal view showed a significantly decreased space in the spinal canal. On axial view, there were hypertrophied ligamentum flavum and superior articular processes at three different levels i.e., L2-L3, L3-L4, L4-L5 compressing the nerves.

Diagnosis and Treatment

As the MRI findings correlated with the subjective and objective examination, the diagnosis of lateral recess spinal stenosis at multiple levels was made. The patient was counseled about the condition and treatment options. By looking at the extent and chronicity of the condition, it was decided to perform endoscopic surgical decompression. As the patient was obese,

sedentary, and had weak spine stabilizers it was decided to perform a three-level endoscopic spine surgery to preserve muscle and related tissues and to prevent post-surgical instability secondary to muscle and tissue damage.



Figure 1: Preoperative MRI axial view (Image attached with patient consent).

Screening and Pre-operative Data of Outcome Measures

Oswestry low back disability questionnaire was filled by the patient the results of which showed that the patient had a severe disability (score 26) while pain on the Visual analog scale was reported to be 8 out of 10. Pre-operative SLR was 60 degrees on the left side.

Procedure for Three-Level Interlaminar Endoscopic Spine Surgery

The patient was positioned in a prone and pillows were placed under the chest and pelvis with the abdomen lying freely and the bed was tilted slightly downward to increase the interlaminar spaces. After that x-ray guided mark was placed followed by a 7mm incision at the entry point just medial to the spinous process and then the dilator was passed. A working cannula was inserted to find out the bony landmarks. Three

levels were marked for the incision. After that endoscope was inserted at the first incision point, irrigation channel was opened. Initially, RF (radiofrequency) was used to stop bleeding and cauterize the muscle. After that muscles were cleared to reach deeper and have a clear visualization of landmarks especially the inferior articular process and ligamentum flavum. The inferior articular process is then incised followed by the superior articular process. After that unilateral ligamentum flavum was excised from a medial to lateral direction layer by layer. Then a nerve root retractor was inserted to retract the nerve root medially following which contralateral ligamentum flavum was also excised and the nerve root was decompressed. In the final stage of the procedure unilateral disc fragments were also removed. The endoscope was then removed and the patient was reassessed after the surgery. The same procedure was incorporated for the other two levels. Post-surgical early mobilization was initiated and the patient was guided with a home-based exercise plan along with medications.

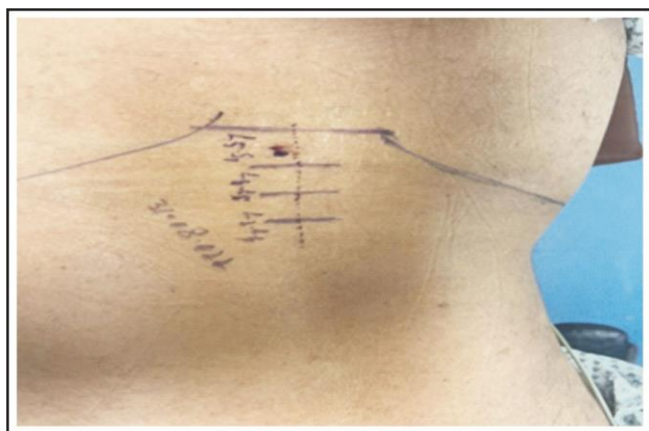


Figure 2: Incision levels for the surgical procedure (Image included with patient consent).

Post-treatment Analysis of Outcome Measures

The same outcome measures (VAS, Oswestry low back disability questionnaire, and SLR) were

assessed after the surgery at 2 intervals i.e., initially after surgery and after one-month follow-up.

RESULTS

After undergoing three-level interlaminar surgery, the patient demonstrated significant improvements in all outcome measures as the pain score on the visual analog scale reduced to 5 after being assessed immediately post-surgery while it further reduced to 2 after 1 month, Oswestry's low back disability score was reported to be 4 while the range of Straight leg raise was increased up to 90 degrees without pain at a one-month follow-up (Table 1).

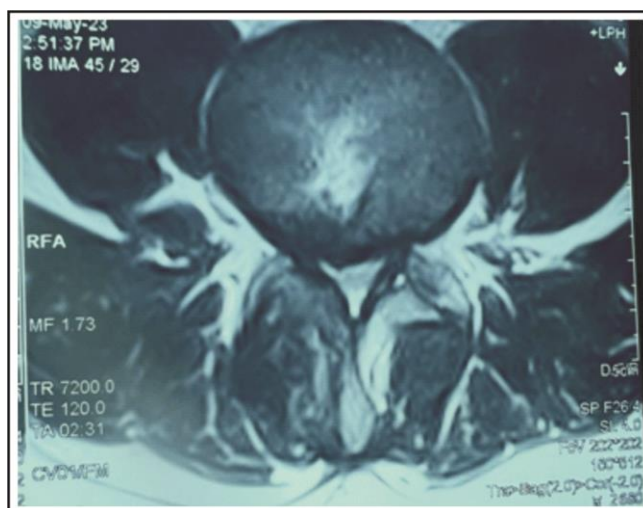


Figure 3: Post-operative MRI (Image included with patient consent).



Figure 4: Post-operative stitches status (Image included with patient consent).

Table 1: Pre and post-operative outcome measures.

Outcome Measures	Pre-surgery Values	Post-surgery Values Initially after Post-op	Post-surgery Values after 1-Month Follow-up
Visual analog scale	8	5	2
Oswestry low back disability questionnaire	26	7	4
Straight leg raise test	50	70	90
Pain on walking and moving downstairs	Positive	Negative	Negative

DISCUSSION

Minimal invasive endoscopic techniques are becoming increasingly popular in the management of lumbar spinal stenosis as compared to open spine surgeries with merits such as decreased blood loss, fewer chances of secondary instability, less trauma to the tissues, decreased incision area, and improved patient outcomes.⁷ A comparative study carried out in Korea, analyzed three different techniques for lumbar canal and lateral recess stenosis including microscopic, tubular, and endoscopic decompression. The results of the study showed that the minimally invasive spinal decompression technique was safe and effective in decompressing the neural structures with decreased complication rates, less muscle damage, and improved patient outcomes.⁸ Despite the advantages and increased effectiveness of endoscopic spine surgeries, there are also some challenges in performing the procedure such as appropriate patient selection, economic and regional differences, the learning curve to effectively differentiate and dissociate the neural structures from the instrument, and the expertise and skill to safely and effectively perform the procedure.⁹

In Pakistan, no such study has been carried out to find the clinical and surgical outcomes of endoscopic surgery at three levels of spinal stenosis. Our case report is the first of its kind to evaluate the surgical and clinical outcomes by performing three levels of nerve root decompression (L3-L4, L4-L5, L5-S1) in spinal stenosis by three-level incisions. Multi-level decompression is not investigated or performed

according to our literature search in the country. This case report study may serve as a pioneer in introducing the technique which would further decrease the complications and costs associated with single-level decompressions repeated at certain times for multi-nerve root compressions. It also decreases the damage to surrounding structures including muscles and fascia and reduces the secondary instability most commonly associated with open or multiple endoscopic surgeries.

An experimental study carried out in China compared conventional and percutaneous transformational endoforaminal discectomy in patients with senile lumbar stenosis. The surgical procedure mentioned in the study illustrated that two incisions were made to decompress the nerve. The results were consistent with our study and patients receiving endoforaminal surgery showed improved outcomes and lumbar function.¹⁰

The results of our case report demonstrated improved patient outcomes after endoscopic surgery for nerve root decompression. A systematic review and meta-analysis conducted to find out the effectiveness of different treatment options used in spinal stenosis also illustrated that endoscopic decompression is a new and less invasive surgical procedure and is a safe and effective option for lumbar spinal stenosis patients.¹¹ The reason for improved patient outcomes may be attributed to less incision area, minimal damage to the surrounding muscles, tissues, and fascia, and early mobilization of the patient.

Randomized controlled trials need to be

carried out to illustrate its effects while the sample is being randomized into experimental and control groups to further enhance our learning of the subject. This case report adds value to the existing literature as no such endoscopic technique at three levels has been incorporated before in the country. The outcomes associated with the technique in terms of pain reduction, improving quality of life and early mobilization are satisfactory.

CONCLUSION

The results of our case report concluded that multilevel minimal invasive endoscopic surgery is an effective and efficient decompression technique used in multilevel spinal nerve entrapment due to spinal stenosis. Multiple-level minimal invasive spinal endoscopic surgery results in better clinical outcomes in terms of pain relief, improved score on Oswestry disability score, improved ranges, and stability.

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Additional Information

Disclosures: Authors report no conflict of interest.

Ethical Review Board Approval: The research was a retrospective study.

Human Subjects: Consent was obtained by all patients/participants in this study.

Conflicts of Interest:

In compliance with the ICMJE uniform disclosure form, all authors declare the following:

Financial Relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work.

Other Relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

AUTHOR CONTRIBUTIONS

Sr. No.	Author's Full Name	Intellectual Contribution to Paper in Terms of
1	Muhammad Farooq & Abdul Haseeb Sahibzada	Study Design, Methodology, and Paper Writing
2	Mahboob khan,	Data Calculation and Data Analysis
3	Muhammad Zubair & Ikram Alam	Interpretation of Results
4	Muhammad Farooq & Abdul Haseeb Sahibzada	Statistical Analysis
5	Haider Ali	Literature Review
6	Muhammad Idrees	Literature Review and Quality Insurer