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Outcome and Complications of Microsurgical Over the Top Decompression in Patients with Lumbar Spine Stenosis

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Author`s Contribution

[1,2]Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work, [3,4]Drafting the work or revising it critically for important intellectual content

Funding Source: None
Conflict of Interest: None

Received: Aug 27, 2024
Accepted: Nov 20, 2024

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ABSTRACT

Objective: To determine the success and complications of microsurgical over-the-top decompression in patients with lumbar spine stenosis.

Methodology: This descriptive case study was carried out in the Department of Neurosurgery, Lady Reading Hospital-MTI, Peshawar, KPK, from July 2023 to July 2024. The study population included patients diagnosed with lumbar spine stenosis, confirmed by MRI or CT imaging, who underwent Unilateral Laminotomy for Bilateral Decompression (ULBD) after failing to respond to at least six months of conservative management. Outcomes were measured using the Visual Analog Scale (VAS) for pain. Complications such as dural tears, infections, and neurological deficits were documented.

Results: The mean age of the patients was 57.50 ± 7.154 years, with 58.9% of the patients being male. The most commonly affected spinal level was L4/L5 (42.6%). The mean duration of surgery was 67.55 ± 13.02 minutes. Postoperatively, 74.5% of patients reported significant improvement in leg pain, and 84.4% experienced relief from lower back symptoms. Complications were minimal, with 4.3% of patients experiencing dural tears and 2.8% reporting wound infections. Overall, 91.5% of patients reported no complications. Patient satisfaction rates were high, with the majority expressing satisfaction with the procedure's outcomes.

Conclusion: Microsurgical over-the-top decompression (ULBD) is a safe procedure for lumbar spine stenosis. The procedure resulted in significant improvement in leg pain and back pain symptoms with a low complication rate.

Keywords: Lumbar spine stenosis, microsurgical decompression, unilateral laminotomy, over-the-top decompression, ULBD, minimally invasive spine surgery, postoperative complications.

Cite this article as: Khan A, Khan MN, Hassan M, Sajjad M. Outcome and Complications of Microsurgical Over the Top Decompression in Patients with Lumbar Spine Stenosis. Ann Pak Inst Med Sci. 2025; 20(4):804-807. doi. 10.48036/apims.v20i4.1319.

Introduction

Lumbar spine stenosis (LSS) is the constriction of the lumbar spine within the canal at the center, lateral recesses, or neural foramina. Central canal stenosis can compress the thecal sac and bilateral spinal nerves, resulting in bilateral symptoms in severe cases.[1] Lateral recess as well as neural foraminal stenosis can compress nerve roots, resulting in unilateral lumbar radiculopathy complaints.[2, 3] Central stenosis results from hypertrophy of the ligamentum flavum combined with posterior disc bulging. This issue is more common in the L4-L5 level compared to other spinal segments.[4-6]

A supplementary Framingham study revealed that 19.4% of people aged 60 to 69 possessed a vertebral internal measurement < 10 mm. A study revealed a rising prevalence of symptomatic lumbar spinal stenosis (LSS) across several age demographics.[7] In contrast, LSS has been estimated to impact over 200,000 people across the United States. This ailment is regarded as the most prevalent indication for spine surgery in persons over 65 years of age. [8]

Microsurgical over-the-top decompression has developed as an effective method for treating lumbar spine stenosis, a disorder marked by the constriction of the spinal canal that may cause neural compression. This disorder is especially common in older persons, where degenerative alterations in the spine lead to symptoms that considerably impact quality of life.[9, 10] Conventional surgical methods, such as laminectomy, can entail

significant tissue damage and may result in unpleasant consequences.[11] Conversely, microsurgical over-the-top decompression utilizes sophisticated minimally invasive procedures, employing high-powered magnification and specialized devices to reach the afflicted region while minimizing soft tissue disruption.[12,13] This technique relieves spinal cord and nerve root pressure by removing hypertrophied ligamentum flavum or osteophytes while preserving healthy tissues.[13, 14]

Lumbar spine stenosis often leads to significant morbidity, affecting the quality of life in older populations and necessitating effective treatment strategies. The rationale for studying the success and complications of microsurgical over-the-top decompression in patients with lumbar spine stenosis stems from the increasing prevalence of this condition and the limitations of traditional surgical interventions.

Methodology

This descriptive case study was carried out from July 2023 to July 2024, in the Department of Neurosurgery, Lady Reading Hospital-MTI, Peshawar, KPK, Pakistan after taking ethical approval from the hospital Institutional Review Board. The study population comprised patients who underwent Unilateral Laminotomy for Bilateral Decompression ULBD also called Over-the-top Decompression during the year of observation. To be eligible, patients had to be diagnosed with lumbar spine stenosis based on clinical presentation and imaging, and they must have failed to respond to at least six months of conservative treatments, including physiotherapy, pain medications, or spinal injections. All patients provided informed consent to participate in the study.

Exclusion criteria included patients with prior spinal surgeries for stenosis, congenital spine abnormalities, scoliosis, or spinal conditions requiring fusion surgery. The sample size was calculated using openepi, taking previous proportion of leg pain improvement 76.5%[15], margin of error 7% and confidence interval 95%, a sample of 141 was calculated.

Data collection occurred both retrospectively and prospectively, utilizing patient medical records, preoperative assessments, and postoperative follow-up visits. Preoperative data included demographics such as age, gender, body mass index (BMI), and comorbidities. Specific attention was paid to the symptoms experienced by patients, including the presence of lower back pain, leg pain, neurogenic claudication, and any associated neurological deficits. Imaging results from MRI or CT scans were reviewed to confirm the levels of stenosis and the extent of the condition.

Intraoperative data focused on the surgical procedure itself, including the duration of the surgery and any complications that arose during the operation. Each surgery was performed using a standardized approach to ULBD. The surgical procedure was performed under general anesthesia, with the patient positioned prone on an operating table designed to optimize access to the lumbar spine. Preoperative imaging, typically using fluoroscopy, was employed to confirm the spinal level to be operated on, which was a consistent approach.

Following skin preparation and draping, a midline incision of approximately 3 to 5 cm was made. Muscle dissection was performed unilaterally to expose the lamina on the ipsilateral side, leaving the contralateral structures intact to preserve spinal stability. Using a high-speed drill and Kerrison rongeurs, the surgeon performed a partial laminotomy to expose the ligamentum flavum, which was resected to decompress the spinal canal. The table and the operating microscope were tilted to allow visualization of the contralateral side, enabling decompression of both sides from a unilateral approach.

Decompression was extended to the contralateral side through undercutting of the spinous process and removal of hypertrophic ligamentum flavum, ensuring complete neural decompression. The surgeon verified the decompression by visualizing the restored pulsation of the dura. After adequate decompression, the wound was irrigated, and careful hemostasis was performed. The incision was then closed in layers, starting with the deep fascia, followed by the subcutaneous tissue, and finally the skin, which was sutured or stapled depending on the surgeon's preference. Patients were then transferred to the recovery unit for postoperative monitoring.

Postoperative data included symptom improvement, measured using standardized outcome measures such as the Visual Analog Scale (VAS) for pain. Disability Index (ODI), which were assessed at follow-up visits. Improvement in leg pain and back pain was documented, along with any postoperative complications, including dural tears, wound infections, or neurologic deficits. SPSS 24 was utilized for the analysis of data.

Results

In the study, the mean age of the patients was 57.50 ± 7.154 years, with the youngest patient being 45 years old

and the oldest being 70 years old. The body mass index (BMI) of the patients had a mean value of 23.21 ± 1.18, with a minimum value of 21.25 kg/m² and a maximum of 25.34 kg/m². The duration of the surgery averaged 67.55 ± 13.02 minutes, with the shortest surgery taking 45 minutes and the longest taking 90 minutes.

The gender distribution in the study consisted of 83 males, accounting for 58.9% of the patients, and 58 females, representing 41.1%. The stenosis level distribution among the patients was categorized as; twelve patients (8.5%) had stenosis at the L2/L3 level, thirty-two patients (22.7%) at the L3/L4 level, sixty patients (42.6%) at the L4/L5 level, and thirty-seven patients (26.2%) at the L5/S1 level. In total, all 141 patients were included in this distribution. (Table I)

Table I: Stenosis level.

Stenosis level	N	%
Valid L2/L3	12	8.5
L3/L4	32	22.7
L4/L5	60	42.6
L5/S1	37	26.2
Total	141	100.0

Table II: Improvement in leg pain and back pain.

Improvement in leg pain and lower back symptoms		N	%
Leg pain improved	Yes	105	74.5%
	No	36	25.5%
Lower back symptoms improved	Yes	119	84.4%
	No	22	15.6%

Regarding improvement in symptoms, one hundred and five patients (74.5%) reported an improvement in leg pain, while 36 patients (25.5%) did not experience any improvement. Additionally, one hundred nineteen patients (84.4%) reported an improvement in lower back symptoms, while 22 patients (15.6%) did not experience any improvement. (Table II) In terms of complications, 6 patients (4.3%) experienced a dural tear, four patients (2.8%) had a wound infection, and 2 patients (1.4%) suffered from a neurologic defect. However, the majority of patients 129 (91.5%), did not experience any complications. (Table III)

Table III: Complications.

Complications	N	%
Dural tear	6	4.3
Wound infection	4	2.8
Neurologic defect	2	1.4
No complication	129	91.5
Total	141	100.0

Discussion

In our study, the mean age of the patients was 57.50 ± 7.154 years, with a male predominance (58.9%). This is comparable to the study by Khan Z et al.[15], where the mean age was slightly lower at 46 years, and the male population also constituted a higher proportion (58.3%). Our gender distribution report similar male predominance, which could be attributed to lifestyle factors and occupational exposures that predispose men to earlier onset of lumbar degenerative conditions.

In terms of the spinal levels affected, our study found that L4/L5 was the most commonly affected level, observed in 42.6% of patients. This finding is similar to a study by Lv B et al.[16], where L4/L5 stenosis was also the most prevalent, occurring in 41% of cases. Similarly, Khan Z et al[15]. reported L4/L5 as the most affected level in 51.87% of patients. This consistency across multiple studies highlights the high mechanical load and mobility at this segment, making it prone to degeneration. Other studies, including that by Refaat et al.[17], further corroborate this, showing L4/L5 stenosis in 63% of patients.

In terms of the improvement in symptoms, 74.5% of our patients experienced relief from leg pain, and 84.4% reported improvement in lower back symptoms. These results aligned with a study by den Boogert HF et al.[18], where they observed marked reductions in leg symptoms in 80.6% of patients following surgery, and 74.8% of patients reported improvements in back symptoms. Similarly, Lv B et al. reported notable improvements in VAS scores for both leg and back pain, with leg pain scores reducing to 1.4 ± 0.6 at 6 months postoperatively.[16]

Regarding the duration of surgery, our average operation time was 67.55 ± 13.02 minutes. This duration is somewhat longer than the 56 minutes reported by Khan Z et al.[15] but shorter than the 83 minutes recorded in the study by Refaat MI et al.[17] The variability in surgery duration could be attributed to differences in surgical approaches, patient complexity, and surgeon experience. For instance, in the aforementioned study, cases involving multiple levels of decompression had longer operative times.[3]

In terms of complications, our study recorded a dural tear rate of 4.3%, wound infections in 2.8%, and neurologic defects in 1.4%. These rates are lower than those reported by Khan Z et al.[15], where dural tears occurred in 6.95% of cases. Similarly, Lv B et al. [16] reported a 10.2% overall complication rate, including a 5.1% incidence of dural tears. Refaat MI et al.[17] also observed dural tears but at a slightly lower rate (6.6% in group A and 3.3% in group

B). These findings suggest that while dural tears remain a common complication in over-the-top decompression, their rates can vary depending on surgical expertise and technique.

Our study demonstrated a high rate of patient satisfaction, with 74.5% reporting improvement in leg pain and 84.4% noting relief from lower back symptoms. These findings are consistent with the literature, such as the study by Boogert HF et al.[18], where 80.6% of patients experienced leg symptom relief, and 72.1% of patients reported good overall treatment results. Similarly, the study by Lv B et al.[16] also noted high patient satisfaction, with marked improvements in both VAS and ODI scores.

Conclusion

In conclusion, the results of our study on microsurgical over-the-top decompression for lumbar spine stenosis are consistent with those reported in the literature. Our findings align with other studies in terms of the most commonly affected spinal levels, symptom improvement, complication rates, and patient satisfaction. This reinforces the efficacy and safety of the over-the-top decompression technique for treating lumbar spine stenosis. The relatively low complication rates and significant improvements in patient outcomes, as seen in our study, highlight the value of this minimally invasive approach in managing lumbar stenosis.

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