Original Article

Full Endoscopic Decompression for Single Level Lumbar Stenosis: A Clinical Evaluation

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ABSTRACT:

Objective: *This study aimed to evaluate the outcomes of full endoscopic decompression for single level lumbar spinal canal stenosis.*

Methods: *This observational study was conducted on a total of 370 patients selected by purposive sampling from January 2022 and December 2023, presenting with symptoms more than 3 months and non-responding to conservative treatment. The procedure was performed by placing the patient on a radiolucent Wilson frame with single-shot epidural analgesia. Outcome was measured in terms of pain reduction using Visual analog scale (VAS) before and after surgery, at 3rd, 6th month, and functional outcome was assessed using the Modified MacNab criteria at 6th month,*

Results: *The mean age of the patients was 56.1 years, with 63% male. The most common stenosis level was L4-L5 (36.5%). The mean operation duration was 53 minutes, and the postoperative complications were minimal. Significant improvement in pain levels was observed, with back pain reduced from a preoperative mean of 3.2 to 1.1 at six months, and leg pain from 7.2 to 1.0 ($p < 0.001$). According to the Modified MacNab criteria, 91.1% of patients reported excellent outcomes at six months, and 8.4% reported good outcomes.*

Conclusion: *Full endoscopic decompression is a highly effective and safe method for treating lumbar spinal stenosis, providing substantial pain relief and excellent functional outcomes with minimal complications.*

Key Words:
Full Endoscopic Spine Surgery, Spinal Canal Stenosis, VAS, MacNab

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Introduction

Spinal canal stenosis is when the space within the spinal canal narrows and eventually compresses the spinal cord [1]. Degenerative lumbar spinal stenosis (LSS), a common pathology especially in the elderly over 60 years old, is usually caused by changes in spine structures, including discs, ligamentum flavum, and facet, which can anatomically affect the central canal, lateral recess, foramina, or a combination of the above. The prevailing symptom associated with lumbar canal stenosis is neurogenic claudication, which describes leg symptoms involving the buttock, groin, and anterior thigh, and radiates down usually from the back of the leg to the feet [2,6]. Both radicular symptoms and neurogenic claudication are best treated conservatively in the early stages, provided there is no neurological impairment with motor loss and

progressive deterioration for the early symptoms. In such circumstances, surgical intervention is advised. The conventional surgical approach for managing LSS has a potential unintended consequence of further spinal instability, which may necessitate surgical intervention to achieve stabilization. Since several studies have demonstrated comparable outcomes to open procedures, minimally invasive spine surgery (MISS) has grown in favor among spine surgeons in recent years [3, 4, 5]. Even though there are many advantages of MISS over open surgery, it also has possible drawbacks, including a constrained field of vision and workspace, a challenging learning curve, exposure to radiation, and high cost [2, 7].

Full endoscopic lumbar decompression is a MISS that is regarded as an essential alternative for a surgical approach, also popularly known as Percutaneous Stenoscopic Lumbar Decompression (PSLD). This uniportal unilateral approach allows bilateral decompression of lumbar canal stenosis, with smaller skin incisions, less muscle injury, less bleeding, less possibility of infection, shorter stay in the hospital, and early return to daily activities [8, 9].

This study was conducted to observe the surgical outcome of full endoscopic decompression for single-level lumbar canal stenosis through a large-bore stenoscope in terms of the reduction of pain assed by Visual analog scale (VAS) and functional outcome by Modified MacNab criteria.

Material and methods

Patient population

IRB (Institutional Review Board) of Anwer Khan Modern Medical College Hospital, Dhaka, has approved this study. A total number of 370 patients were selected by purposive sampling who underwent full-endoscopic decompression surgery for single-level lumbar spinal canal stenosis between January 2022 and December 2023. Patients having symptoms of less than three months, not responsive with conservative management and was image proved single level spinal canal stenosis were included in this study. Patients with the history of same level surgery, infections, spinal instability, multiple-level stenosis, cauda equina syndrome, traumatic or osteoporotic fracture, and cancer were excluded from this study.

Operative technique

The procedures were performed under single-shot epidural anesthesia without sedation on the radiolucent Wilson frame in a flexed prone position. A stab wound was made at the cutaneous entry point just beside the spinous process. The dilator was inserted down to the upper laminar surface of the pathological level via lateral fluoroscopic view. A working sleeve was inserted through this dilator, and then an endoscope was placed on the surface of the lamina through the working sleeve. A large-diameter endoscope (often termed as Stenoscope) with an integrated working channel having an outer diameter of 10 mm and a working channel of 7.1 mm was used. A radiofrequency probe was used for tissue ablation and bleeding control. An irrigation pump was used to maintain continuous water irrigation. Using a diamond burr, the lower part of the cranial lamina and the upper part of the caudal lamina were drilled until the edges of the ligamentum flavum were exposed. The medial part of the facet joint was drilled carefully to decompress the lateral recess. After the ipsilateral laminotomy, the base of the spinous process was drilled. The contralateral lamina was drilled similarly using the "over the top" technique. The ligamentum flavum was preserved till the bony drilling on both sides was completed. Then the attachment of the ligamentum flavum was detached all around and removed en-bloc. Adequate hemostasis was ensured with a radiofrequency probe. Few sheets of absorbable gelatin sponge were placed in the epidural space routinely and the tiny wound was closed without drain.

Demographic, clinical, and radiological data

A structured questionnaire was used to collect data on patients' demographic profile, the duration of their symptoms, the level of pathology, the amount of blood lost during surgery, and the length of the surgery. The outcome was measured in terms of their pain levels using a visual analog scale (VAS) for both back pain and leg pain before and on 0, 3, 6 months after surgery. After six months of surgery, we also assessed the functional outcome using the MacNab criteria. Moreover, X-ray of Lumbo-sacral spine including Dynamic X-rays, were used to exclude segmental instability and other pathologies.

Statistical analysis

Statistical analysis was analysed using the SPSS software

package (version 22). We used a t-test for quantitative variables and a chi-square test for qualitative variables to compare the data. If the p-value was <0.05, we considered the difference significant.

Result

Table 1: Distribution of cases based on demographic features and symptom duration

Variables		N (%)	Mean ± SD
Age group (years)	40-50	76 (20.6%)	56.1±12.2
	50-60	171 (46.2%)	
	>60	123 (33.2%)	
Gender	Male	231 (63%)	
	Female	139 (37%)	
Duration of symptoms (months)	3-6	181 (48.9%)	5.6±1.2
	6-12	113 (30.5%)	
	>12	76 (20.6%)	

370 patients were included in this study, with the majority falling within the age group of 50 to 60 years (46.2%). The second most common age group was over 60 (33.2%), followed by those between 40 and 50 (20.6%). The mean age of the participants was 56.1 years, with a standard deviation of 12.2. Gender distribution revealed a male predominance, with 231 male patients (63%) and 139 female patients (37%). Regarding symptom duration, nearly half of the patients (48.9%) experienced symptoms for 3 to 6 months before seeking medical intervention. A smaller percentage (30.5%) had symptoms lasting between 6 and 12 months, while 20.6% of the patients had symptoms persisting for more than 12 months. The mean symptom duration was recorded as 5.6 months.

Table 2: Distribution of Cases Based on Stenosis Level

Stenosis Level	Frequency
L1-L2	26 (7.0%)
L2-L3	37 (10%)
L3-L4	92 (24.9%)
L4-L5	135 (36.5%)
L5-S1	80 (21.6%)

The stenosis levels varied among patients, with the most common site of lumbar canal stenosis being at the L4-L5 level, affecting 135 patients (36.5%). This was followed by stenosis at the L3-L4 level in 92 patients (24.9%) and the L5-S1 level in 80 patients (21.6%). The L2-L3 and L1-L2 levels were less commonly involved, with 37 and 26 cases, respectively.

Table 3: Distribution of Cases Based on Perioperative VAS

VAS				
			Mean ±SD	P value
Back pain	Preoperative		3.2±1.9	< 0.001
	Postoperative	0 month	1.6±0.4	
		3 months	1.3±0.3	
		6 months	1.1±0.2	
Leg Pain	Preoperative		7.2±0.9	
	Postoperative	0 month	1.5±0.5	
		3 months	1.1±0.2	
		6 months	1.0±0.2	

The effectiveness of full endoscopic decompression was evaluated through changes in pain levels using the Visual Analog Scale (VAS) for both back pain and leg pain. The mean preoperative VAS score for back pain was 3.2 ± 1.9, which significantly reduced postoperatively to 1.6 ± 0.4 at 0 months, 1.3 ± 0.3 at 3 months, and 1.1 ± 0.2 at 6 months. Similarly, leg pain showed a dramatic decrease, with a preoperative VAS score of 7.2 ± 0.9, which dropped to 1.5 ± 0.5 immediately after surgery and further to 1.1 ± 0.2 and 1.0 ± 0.2 at 3 and 6 months, respectively. All these improvements were statistically significant, with P-values of less than 0.001.

Table 4: Distribution of Cases Based on Operation Duration and Complications

Duration of Surgery (Mean ± SD) In minutes		53±2.3
Complications (n)	Transient Dysesthesia	17
	Facet injury	6
	Minor dural tear	4
	Postoperative segmental instability	2
	Infection	0

The average duration of surgery was relatively short, with a mean time of 53 ± 2.3 minutes. Postoperative complications revealed 17 cases of transient dysesthesia, 6 cases of facet injury, 4 cases of dural tears, 2 cases of postoperative segmental instability, and no cases of infections.

Table 5: Distribution of Cases Based on Modified MacNab Criteria

Modified MacNab Grade	Number of Cases
Excellent	337 (91.1%)
Good	31 (8.4%)
Fair	2 (0.5%)
Poor	0 (0%)

Postoperative functional outcomes were assessed at 6 months using the Modified MacNab Criteria, which showed excellent outcomes in 337 cases (91.1%), while 31 patients (8.4%) reported good outcomes. Only 2 patients (0.5%) were classified as having a fair outcome, and none experienced a poor outcome.

Discussion

This study examined the demographic features, symptom duration, and clinical outcomes of patients undergoing full endoscopic decompression (FED) for lumbar canal stenosis (LCS). The results highlight significant patterns in age distribution, symptom duration, stenosis levels, and postoperative outcomes, contributing to our understanding of full endoscopic decompression for LCS in clinical practice.

Our findings reveal that most cases were observed in the 50-60 age group, accounting for 46.2% of participants, followed by those over 60 years (33.2%). This aligns with existing literature indicating that LCS predominantly affects older populations, likely due to age-related degenerative changes in the spine. The mean age of 56.1 years further underscores the prevalence of this condition in middle-aged to older adults. The findings were consistent with those of Barakat et al. [3], where 60.9% of the patients were over 50 years of age.

Additionally, the duration of symptoms varied among patients, with nearly half (48.9%) presenting with symptoms lasting between 3-6 months. This suggests that many individuals seek treatment relatively early in the disease progression, possibly due to the impact of neurogenic claudication on their quality of life. Early intervention may lead to better outcomes, as indicated by improved pain scores following surgery. The findings aligned with those of Shen et al. [4], where most patients (36.14%) experienced symptoms for less than 12 months.

Analysis of stenosis levels revealed that the L4-L5 segment was most commonly affected (135 cases), followed by L3-L4 (92 cases). The findings were consistent with those of Barakat et al. [3], where 73.9% of the patients had stenosis at the L4-L5 segment. These levels are frequently subject to degenerative changes due to mechanical stress and anatomical considerations [6, 10]. Understanding the specific levels of stenosis is crucial for tailoring surgical approaches and anticipating potential complications.

The perioperative Visual Analog Scale (VAS) scores demonstrated significant improvement post-surgery. Preoperative back pain averaged 3.2, decreasing to 1.6 at the 0-month mark and improving to 1.1 by 6 months. Similarly, leg pain, which presented a higher preoperative score of 7.2, dropped to 1.0 after 6 months. These results suggest that full endoscopic decompression for LCS alleviates pain and significantly enhances overall patient satisfaction and quality of life [11]. All the p-values of <0.001 indicate statistically significant differences between preoperative and postoperative VAS scores. The findings were consistent with those of Barakat et al. [3] and Shen et al. [4], showing a significant difference between preoperative and postoperative VAS scores ($P < 0.001$).

The mean duration of surgery was 53 (±2.3) minutes which indicates an efficient surgical process, essential for minimizing patient exposure to anesthesia and reducing hospital stay. Notably, complications were minimal, with only 17 cases of transient dysesthesia, 6 cases of facet injury, 4 cases of minior dural tears, 2 cases of postoperative segmental instability, and no cases of infections. This low complication rate emphasizes the safety of the surgical techniques and reinforces the importance of meticulous surgical practice [12]. Transient dysesthesia was self-limiting and was managed with oral pregabalin. Intraoperative minor dural tears were managed with the routine use of gelatin sponge (Gelfoam) pack. There were no cases of postoperative CSF leak. Two cases of segmental instability occurred which were assessed on 6 months after surgery as poor outcome, required spinal stabilization procedures at a later date. Barakat et al. [3] reported a 13% incidence of minor dural tears, while Shen et al. [4] documented 2.48%. Additionally, transient dysesthesia occurred in less than 1% of cases in Shen et al.'s study [4, 13].

The outcomes of this study were evaluated using the modified MacNab criteria at 6 months postoperatively, which provides a clear framework for assessing patient recovery following treatment for lumbar spinal stenosis. The results indicate a predominantly positive response to the interven-

tion. A striking 337 patients achieved an "Excellent" outcome: no pain, unrestricted mobility, and the ability to return to normal activities and work. This underscores the effectiveness of the surgical approach in alleviating symptoms and significantly enhancing the quality of life for most participants [14]. In addition to those with excellent outcomes, 31 patients (a noteworthy proportion) reported a "Good" outcome. This indicates that while they experience occasional non-radicular pain, they have experienced relief from their presenting symptoms and can return to modified work. This suggests that even in cases with residual discomfort, the overall improvement allows for greater functionality and participation in daily life [15]. The study documented only 2 cases classified as "Fair," indicating limited improvement in functional capacity. Their postoperative imaging revealed segmental instability requiring spinal stabilization procedures at a later date. Notably, the absence of cases rated as "Poor" reflects a low incidence of ongoing symptoms indicative of root involvement. These finding suggest that the full endoscopic decompression effectively address the primary issues associated with lumber canal stenosis (LCS) and highlighted the efficacy of this surgical approach in achieving favorable outcomes where a substantial majority of patients experiencing significant improvements in their conditions. The findings were similar to those of Dowling et al. [5], where 71.5% of patients had a good outcome based on the modified MacNab criteria.

Conclusion

This study shows that full endoscopic decompression is a highly successful treatment modalities of surgical treatment for lumbar spinal canal stenosis. This minimally invasive procedure is safe and effective, causing minimal tissue damage and allowing for a rapid recovery. It's a promising alternative to traditional surgical methods and could become the preferred choice for this condition. However, it requires specialized surgical skills and advanced medical equipments.

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