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Functional Outcome after Posterior Decompression and Instrumented Fusion in Lumbar Spinal Stenosis

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ABSTRACT

Background*: Lumbar spinal stenosis (LSS) is a common degenerative disorder characterized by narrowing of the lumbar spinal canal and neural foramina, leading to neurogenic claudication, radiculopathy, and functional disability. Surgical intervention is indicated when conservative management fails or neurological deficits progress. Aim of the study: This study aimed to evaluate the functional outcomes, patient satisfaction, and complication profile following posterior decompression with instrumented fusion in patients with symptomatic LSS.* ***Methods & Materials****: A prospective observational study was conducted at the Department of Orthopedic Surgery, Bangladesh Medical University, Dhaka, Bangladesh from January 2024 to December 2024, enrolling 38 adult patients with MRI-confirmed LSS. All participants underwent posterior decompression and pedicle screw–based instrumented fusion. Baseline demographic and clinical data were recorded. Functional outcomes were assessed preoperatively and at 3 months postoperatively using the Oswestry Disability Index (ODI) and Roland–Morris Disability Questionnaire (RMDQ). Clinical success was defined as an ODI reduction ≥15%. Patient satisfaction and postoperative complications, including reoperation, implant-related issues, adjacent segment degeneration, and infection, were documented. Statistical analysis was performed using paired t-tests, with significance set at p<0.05.* ***Results****: The mean age was 60.3 ± 11.4 years, with 81.6% female and 63.2% single-level stenosis. Mean ODI decreased significantly from 48.6 ± 12.4 preoperatively to 24.3 ± 10.2 postoperatively (p<0.001), and RMDQ scores improved from 15.2 ± 4.3 to 7.1 ± 3.5 (p<0.001). Clinically successful outcomes were achieved in 63.16% of patients, and 94.74% reported satisfaction. Complications were minimal, with reoperation in 5.26% and other complications ≤2.63%.* ***Conclusion****: Posterior decompression with instrumented fusion provides significant functional improvement and high patient satisfaction with an acceptable safety profile, supporting its use in carefully selected LSS patients.*

Keywords: *Lumbar spinal stenosis, posterior decompression, instrumented fusion, Oswestry Disability Index, functional outcome, patient satisfaction.*

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INTRODUCTION

Lumbar spinal stenosis (LSS) is a degenerative spinal disorder characterized by narrowing of the lumbar spinal canal, lateral recess, or neural foramina, leading to compression of neural and vascular structures and resulting in characteristic clinical symptoms such as neurogenic claudication and radiculopathy [1,2]. This structural encroachment is a primary driver of functional disability in aging populations and remains the most common indication for spinal surgery in adults over 65 years of age [2]. The global prevalence of clinical LSS in the general adult population is approximately 11%, affecting over 103 million individuals worldwide [1]. In Asian populations, the prevalence of symptomatic LSS increases sharply with age, reaching up to 10% to 11.2% in individuals aged 70 and older [3]. In Bangladesh, degenerative lumbar conditions account for a massive proportion of the country's chronic low back pain burden, which has an estimated point prevalence of 18.6% among adults [4]. The primary etiological factors contributing to LSS include degenerative disc disease, hypertrophy of the facet joints, thickening and calcification of the ligamentum flavum, osteophyte formation, and degenerative spondylolisthesis [5,6]. These structural changes result in progressive narrowing of the spinal canal and compression of neural structures, leading to clinical manifestations such as lower back pain, neurogenic claudication, lower-limb numbness, radicular pain, weakness, and reduced walking tolerance [7]. Symptoms typically worsen with lumbar extension and improve with flexion, reflecting dynamic changes in canal dimensions during movement [8]. As the disease progresses, functional impairment and reduced quality of life may significantly affect patients' daily activities and mobility [9]. Surgical treatment is generally considered when conservative management fails to relieve symptoms or when significant neurological deficit develops. Posterior decompression remains the cornerstone of surgical management because it relieves neural compression by removing hypertrophied ligamentum flavum, lamina, or other compressive elements [10]. In many patients, particularly those with spinal instability or degenerative spondylolisthesis, decompression alone may not provide sufficient mechanical stability; therefore, instrumented fusion using pedicle screw fixation is often performed in combination with decompression [11]. Posterior decompression with instrumented fusion can provide improved spinal stability, higher fusion rates, and potentially better functional outcomes in selected patients [12]. However, the addition of fusion also has disadvantages including longer operative time, increased blood loss, higher surgical cost, and risk of complications such as infection or adjacent segment degeneration [13,14]. Although several clinical studies and randomized trials have investigated surgical outcomes in lumbar spinal stenosis, there remains

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considerable debate regarding the optimal surgical approach and the precise indications for instrumented fusion. Many studies have reported variable functional outcomes due to differences in patient selection, surgical technique, and outcome measurement tools [9,15]. Furthermore, most evidence originates from Western populations, while region-specific data from South Asian countries, including Bangladesh, remain scarce. This lack of locally generated clinical evidence limits the ability to evaluate surgical outcomes in the context of regional patient characteristics and healthcare settings. Therefore, this study aimed to evaluate the functional outcome after posterior decompression and instrumented fusion in patients with lumbar spinal stenosis.

METHODS & MATERIALS

This prospective observational study was conducted at the Department of Orthopedic Surgery, Bangladesh Medical University, Dhaka, Bangladesh from January 2024 to December 2024. A total of 38 patients diagnosed with lumbar spinal stenosis and scheduled for posterior decompression with instrumented fusion were consecutively enrolled.

Inclusion Criteria

- Adults aged ≥18 years with symptomatic lumbar spinal stenosis confirmed by MRI.
- Patients with persistent neurogenic claudication or radicular pain refractory to conservative treatment for at least 6 months.
- Patients providing informed consent for surgical intervention and follow-up assessments.

Exclusion Criteria

- Previous lumbar spine surgery.
- Active infection, malignancy, or severe comorbid conditions precluding surgery.
- Patients with spondylolisthesis greater than Grade I.

Data Collection

Baseline demographic and clinical characteristics, including age, gender, income status, smoking history, comorbidities, and duration of symptoms, were documented for all participants. Preoperative functional status was evaluated using the Oswestry Disability Index (ODI) and Roland–Morris Disability Questionnaire (RMDQ). All patients underwent posterior decompression and instrumented fusion under general anesthesia. Intraoperative parameters, including operative time, estimated blood loss, and hospital stay, were recorded. The level of stenosis was determined preoperatively through imaging and confirmed intraoperatively, categorized as either single-level or multi-level stenosis. Functional outcomes were reassessed at 3 months using ODI and RMDQ scores. Clinical success was defined as an ODI reduction ≥15%. Patient satisfaction was classified as good/satisfied or fair/poor. Postoperative complications—including reoperation, adjacent segment degeneration, implant-related complications, and deep wound infection—were carefully documented.

Statistical Analysis

Data were analyzed using SPSS version 26. Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables as frequency and percentage. Pre- and postoperative functional scores were compared using paired t-tests. A p-value <0.05 was considered statistically significant.

RESULT

The study included 38 patients with lumbar spinal stenosis, with a mean age of 60.3 ± 11.4 years. More than half of the participants (55.26%) were classified as having low income, and (34.21%) patients reported comorbidities. Smoking history was present in 10.53% patients, while the majority of patients (57.89%) experienced symptoms for more than 1 year (*Table I*).

Table I: Baseline characteristics of study participants (*n*=38)

Variable	Frequency (n)	Percentage (%)
Age (years), Mean ± SD	60.3 ± 11.4	
Low income	21	55.26
Smoking History	4	10.53
Comorbidities	13	34.21
Duration of Symptoms > 1 year	22	57.89

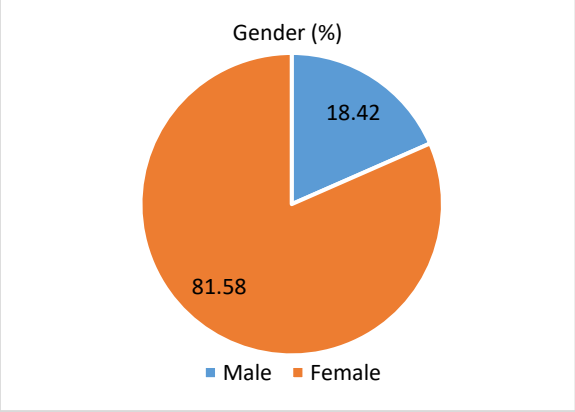

Figure 1: Gender distribution among respondents (*n*=38)

Gender distribution showed a predominance of female patients (81.58%) compared to males (n=7, 18.42%) (*Figure 1*).

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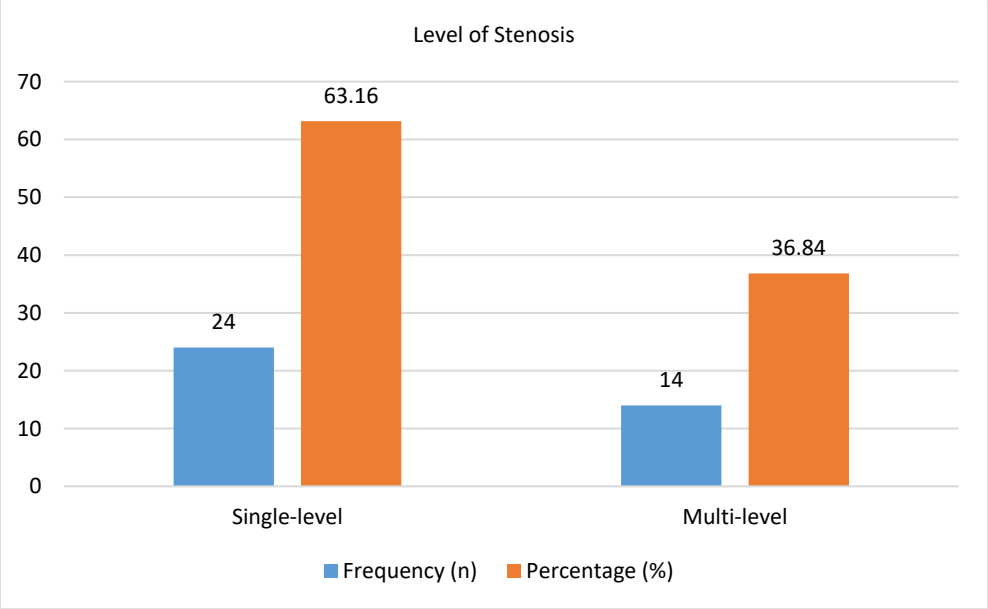

Figure 2: Level of stenosis among respondents (*n*=38)

Regarding the extent of stenosis, the majority of patients had single-level involvement (63.16%), while 36.84% patients had multi-level stenosis (*Figure 2*). The mean operative time was 145 ± 32 minutes, with an estimated blood loss of 320 ± 110 mL. Postoperative hospitalization averaged 6.5 ± 2.1 days (*Table II*).

Table II: Surgical parameters of the study population (*n*=38)

Parameter	Mean ± SD
Operative Time (minutes)	145 ± 32
Estimated Blood Loss (mL)	320 ± 110
Hospital Stay (days)	6.5 ± 2.1

The mean Oswestry Disability Index (ODI) score decreased from 48.6 ± 12.4 preoperatively to 24.3 ± 10.2 postoperatively (p<0.001). Similarly, the Roland–Morris Disability Score showed a reduction from 15.2 ± 4.3 to 7.1 ± 3.5 after surgery (p<0.001) (*Table III*).

Table III: Functional outcome scores before and after surgery

Outcome Measure	Preoperative, Mean ± SD	Postoperative, Mean ± SD	p-value
Oswestry Disability Index (ODI)	48.6 ± 12.4	24.3 ± 10.2	<0.001
Roland–Morris Disability Score	15.2 ± 4.3	7.1 ± 3.5	<0.001

Clinically, 63.16% patients achieved a successful outcome, defined as an ODI reduction of ≥15%, while 36.84% patients had an unsuccessful outcome. Patient satisfaction was high, with 94.74% patients reporting good or satisfactory outcomes, and only 5.26% patients rating their satisfaction as fair or poor (*Table IV*).

Table IV: Clinical outcome and patient satisfaction after surgery (*n*=38)

Variables	Frequency (n)	Percentage (%)
Clinical Outcome		
Successful outcome (ODI reduction ≥15%)	24	63.16
Unsuccessful outcome	14	36.84
Satisfaction Level		
Good / Satisfied	36	94.74
Fair / Poor	2	5.26

5.26% patients required reoperation, while adjacent segment degeneration, implant-related complications, and deep wound infection were each observed in 2.63% patient each (*Table V*).

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Table V: Postoperative complications among patients (*n*=38)

Complication	Frequency (n)	Percentage (%)
Reoperation	2	5.26
Adjacent segment degeneration	1	2.63
Implant-related complications	1	2.63
Deep wound infection	1	2.63

DISCUSSION

Lumbar spinal stenosis is a common degenerative condition causing neurogenic claudication and functional impairment, often necessitating posterior decompression and instrumented fusion to restore mobility and quality of life [15]. The present study assessed functional outcomes following posterior decompression and instrumented fusion in patients with lumbar spinal stenosis. The mean age of participants was 60.3 ± 11.4 years, highlighting that lumbar spinal stenosis predominantly affects the elderly population, which aligns with previous studies by Kalichman et al. and Yabuki et al., who reported the mean age was 52.6±10.8 years and 60.0±10.9 years which shows that the peak prevalence is found in the sixth and seventh decades of life [16,17]. Females comprised the majority of our cohort (81.58%), consistent with previous study by Akbar et al., which shows the female prevalence is 59%. This evidence suggests a higher incidence of degenerative lumbar stenosis among women, likely due to differences in bone mineral density and ligamentous laxity [18]. Regarding disease characteristics, single-level stenosis was observed in 63.16% of patients, whereas multi-level involvement accounted for 36.84%. This pattern mirrors prior observations by Adilay & Guclu (2018), where single-level stenosis predominated, yet multi-level disease was associated with more severe preoperative disability [19]. The mean duration of symptoms exceeding one year in 57.89% of participants emphasizes the chronicity of lumbar stenosis and the tendency for delayed surgical intervention, which has been associated with reduced postoperative improvement if the duration exceeds 12 months [20]. Surgical parameters in our study, including a mean operative time of 145 ± 32 minutes, estimated blood loss of 320 ± 110 mL, and mean hospital stay of 6.5 ± 2.1 days, were comparable to previously reported series by ŠÁMAL et al., reflecting the efficiency and safety of posterior instrumented fusion in experienced hands [21]. Postoperative functional assessment demonstrated a marked and statistically significant improvement, with mean Oswestry Disability Index (ODI) scores decreasing from 48.6 ± 12.4 preoperatively to 24.3±10.2 postoperatively ($p<0.001$). Similarly, Roland–Morris Disability Questionnaire scores showed a substantial reduction from 15.2 ± 4.3 to 7.1 ± 3.5 ($p<0.001$), reflecting meaningful gains in patient function and reduction in disability. These findings are in line with the results reported by Karlsson et al., who observed comparable improvements in both pain intensity and functional disability following posterior decompression and instrumented fusion for lumbar spinal stenosis. The consistency of these outcomes reinforces the efficacy of surgical intervention in significantly improving quality of life for affected patients [22]. Clinically, 63.16% of patients achieved a successful functional outcome, defined as a reduction of 15% or more in the Oswestry Disability Index (ODI), while an even higher proportion, 94.74%, reported overall satisfaction with the procedure. These results highlight the substantial positive impact of posterior decompression and instrumented fusion on patients' quality of life, demonstrating not only measurable improvements in disability scores but also high levels of patient-perceived benefit and satisfaction following surgical intervention [23]. Our complication rate was relatively low, with only a small proportion of patients experiencing minor implant-related issues (2.63%) and a slightly higher proportion requiring reoperation (5.26%). These findings are consistent with current literature, which underscores the relative safety and efficacy of instrumented fusion procedures when performed with careful preoperative planning, precise surgical technique, and thorough intraoperative attention to detail [24].

LIMITATIONS

This study is limited by its single-center design and relatively small sample size, which may restrict the generalizability of the findings. The short-term follow-up of 3 months does not capture long-term functional outcomes, fusion rates, or late-onset complications such as adjacent segment degeneration. Additionally, the observational design without a control group limits the ability to compare the effectiveness of decompression with fusion versus decompression alone. Future studies with multicenter enrollment, larger cohorts, and extended follow-up are warranted to validate and expand upon these results.

CONCLUSION

Posterior decompression combined with instrumented fusion provides significant functional improvement in patients with lumbar spinal stenosis, as demonstrated by the substantial reduction in ODI and RMDQ scores at 3 months postoperatively. The majority of patients achieved clinically meaningful improvement, and overall satisfaction was high, indicating that this surgical approach effectively addresses both neural decompression and spinal stability in carefully selected patients. The procedure demonstrated an acceptable safety profile, with a low incidence of complications and reoperations. These findings support the continued use of posterior decompression with instrumented fusion as a reliable surgical option for symptomatic LSS, particularly in patients with multi-level involvement or degenerative instability who are refractory to conservative management.

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CONFLICT OF INTEREST

None declared

ETHICAL APPROVAL

The study was approved by the Institutional Ethics Committee.

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