

Original Article

The Outcome of Laminectomy versus Laminoforaminotomy in Terms of Claudication Distance in Lumbar Spinal Stenosis

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ABSTRACT

Objectives: Spinal stenosis involving the lumbar region is more common in the elderly population. Adapting less invasive procedures not only reduces surgical morbidity but also hospital costs. The study aimed to compare the surgical outcome of two different procedures for lumbar spinal stenosis. It helped us in the decision-making to go for less invasive procedures, as compared to conventional laminectomy in lumbar spinal stenosis patient patients.

Materials and Methods: An interventional randomized controlled trial was conducted in the department of neurosurgery, Shaheed Zulfiqar Ali Bhutto Medical University, PIMS Islamabad. A total of 158 adult patients aged between 35 to 55 years with an established diagnosis of lumbar stenosis and claudication distance of fewer than 100 meters were enrolled. Patients were randomly included into two equal groups via the computerized method. In Group A laminectomy was done and in Group B laminoforaminotomy was adopted. The outcome was measured in terms of claudication distance at 4 weeks after the procedure, and compared in both groups.

Results: The mean age of the patients was 44.92 ± 6.28 years. Poor outcome was significantly lower in the Laminoforaminotomy group as compared to the Laminectomy group, at 4 weeks after the procedure. The frequency of claudication distance > 500m (good) at 4 weeks was found to be 62 (78.5%) in the Laminectomy group and it was found in 74 (93.7%) patients in the Laminoforaminotomy group ($p = 0.022$).

Conclusions: The study concluded that the laminoforaminotomy is superior to laminectomy, in terms of claudication distance at four weeks after the procedure.

Keywords: Claudication distance; Laminoforaminotomy; Laminectomy; Lumbar spinal stenosis.

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INTRODUCTION

A healthy vertebra will almost certainly deteriorate with age and result in neural compression, which is one of the most frequent causes of back and leg discomfort in the senior population. This condition is called lumbar spinal stenosis (LSS).¹ In spinal stenosis, the spinal canal may constrict centrally, laterally, or both. The cauda equina and the theca are both impacted by the central kind of constriction. The primary cause of facet joint disease in the lateral type of stenosis is the nerve root in the lateral recess or the neural foramen or both.²

The causes of spinal stenosis include disc degeneration, ligamentum flavum hypertrophy, and facet joint arthrosis. Back pain, neurogenic claudication, and radiculopathy are the three traditional presenting symptoms of spinal stenosis.⁴ Pain, paraesthesia, or cramping in one or both legs are symptoms of neurogenic claudication caused by stenotic alterations that cause posture-related compression of the neural and microvascular components of the lumbosacral nerve roots and cauda equine. Generally, prolonged standing and walking or spine extension increase symptoms, which are alleviated by sitting or forward bending (shopping cart sign).⁵

MRI with both T1 and T2 weighted images in axial and sagittal planes is the optimum diagnostic method for evaluating lumbar spinal stenosis.⁶ The intraspinal canal area is less than 100 mm² and 76 mm² in the moderate to severe types respectively. Less than 10mm is the diameter that is utilized at the anteroposterior level. Although it is employed as a cutoff, it only gives a partial picture of the anatomic illness.⁷

Treatment of lumbar spinal stenosis can be both conservative and surgical. The surgical treatment includes laminectomy and laminoforaminotomy. Microendoscopic procedures such as unilateral laminectomy bilateral decompression (ULBD) or interspinous

decompression devices such as X-STOP are introduced as an alternative to laminectomy.⁸

A study done to compare the outcome of laminoforaminotomy vs. laminectomy in lumbar spinal stenosis in terms of claudication distance showed that 15.2% of laminectomy and 5.6% of laminoforaminotomy patients have a poor outcome, while 75.8% and 83.3% have a good outcome in laminectomy and laminoforaminotomy group, respectively. Those having excellent outcomes were 9.1% in the laminectomy group and 11.1% in the laminoforaminotomy group.⁹

Limited data is available on comparing the outcome of laminoforaminotomy with laminectomy in lumbar spinal stenosis in terms of claudication distance. This study aims to compare the surgical outcome of two different procedures for lumbar spinal stenosis. It helps us decide to go for less invasive procedures compared to conventional laminectomy in lumbar spinal stenosis patients.

MATERIALS AND METHODS

Study Design & Setting

This Randomized control trial has been conducted in the department of neurosurgery, Shaheed Zulfiqar Ali Bhutto Medical University, PIMS, Islamabad from March 2018 to March 2019. Ethical approval has been taken from the institutional review board (IRB) committee of PIMS, Islamabad.

Sample Size & Technique

After informed written consent, a total of 158 patients with moderate to severe lumbar stenosis not responding to 3 months of conservative treatment were selected on a volunteer basis. WHO calculator has been used for sample size calculation in terms of the following parameters; the rate of poor outcome in the laminectomy group (P1) 15.2% and the rate of poor outcome in

the laminoforaminotomy group (P2) 5.6%, the level of significance 5% and power of the test was 80%.⁹Patients fulfilling the inclusion criteria has been selected by simple random sampling technique in the trial all patients presented in even numbers were added to group A while all presented in an odd number were allocated to group B. Single blinded technique was used and allocated the included patients in groups.

Inclusion Criteria

Patients of either gender with single level, moderate to severe lumbar stenosis confirmed on MRI lumbosacral spine, with claudication distance less than 100 meters, and patients aged between 35 – 55 years were included in the study.

Exclusion Criteria

Patients with a history of surgery on the lumbar spine, history of any previous intrathecal injection, history of any malignancy, spondylolisthesis, patients with backache and history of infection like spinal tuberculosis, comorbidities like uncontrolled diabetes and hypertension, ischemic heart disease were excluded in this study.

Clinical Management

The investigator thoroughly went through the case history and detailed neurological examination including the sensory-motor status of limbs along with a straight leg raising (SLR) test. The selected patients were equally allocated to the laminectomy group (A) and laminoforaminotomy group (B) via the computerized method. Claudication distance was measured in both groups, preoperatively and postoperatively with the help of a treadmill machine. The lumbosacral spine of all patients was scanned using magnetic resonance imaging to look for both central and lateral spinal stenosis. This was accomplished by measuring the spinal canal diameter at the stenotic level in comparison

to nearby, unaffected levels, looking for neuronal structures that were being impinged upon in the lateral recess and neural foramina, and checking for a loss of CSF signal on T2 weighted images.¹⁰

Surgical Management

All patients underwent surgery according to their respective groups. Both groups had surgery while prone, under general anesthesia, with the affected level being identified by fluoroscopy. When anesthesia was induced, third-generation cephalosporin was used as antibiotic prophylaxis. In the laminoforaminotomy group, a midline incision was made at the level of the involved segment, and all procedures up to the subperiosteal dissection and exposure of the posterior elements were the same in both groups. However, in laminoforaminotomy spinous process is usually not removed. To decompress the lateral recess, the ligamentum flavum was completely removed along with minimal lamina and medial surfaces of superior facets on both sides.

In the laminectomy group, a midline incision was made followed by lumbodorsal fascia division and localized paraspinal musculature from the spinous process and laminae and retracted bilaterally. Spinous process, lamina, ligamentum flavum removal along with partial facetectomy was carried out in this group.

Data Collection & Analysis

The data was collected on predesigned patient proforma which included the type of operation and claudication distance. Patients were mobilized on the second postoperative day and were discharged on the third postoperative day. The follow-up was done at 4 weeks and pain-free walking distance was calculated with the help of a treadmill. Patients were categorized into having poor, good, and excellent outcomes in each group. The outcome in terms of postop walking distance was categorized as excellent (1000m), good (500 – 1000m), and poor (500m).¹¹

With SPSS version 24, data analysis was carried out. Shapiro-test Wilk's of normality and uniformity was used to assess the normality of the data, depending on whether a parametric or nonparametric test was applied to determine within-group and between-group differences

between two groups. We performed the chi-square test to examine the claudication distance between the two groups. Stratification regulated effect modifiers like gender and claudication. The chi-square test was used after stratification. P values less than 0.05 were regarded as significant.

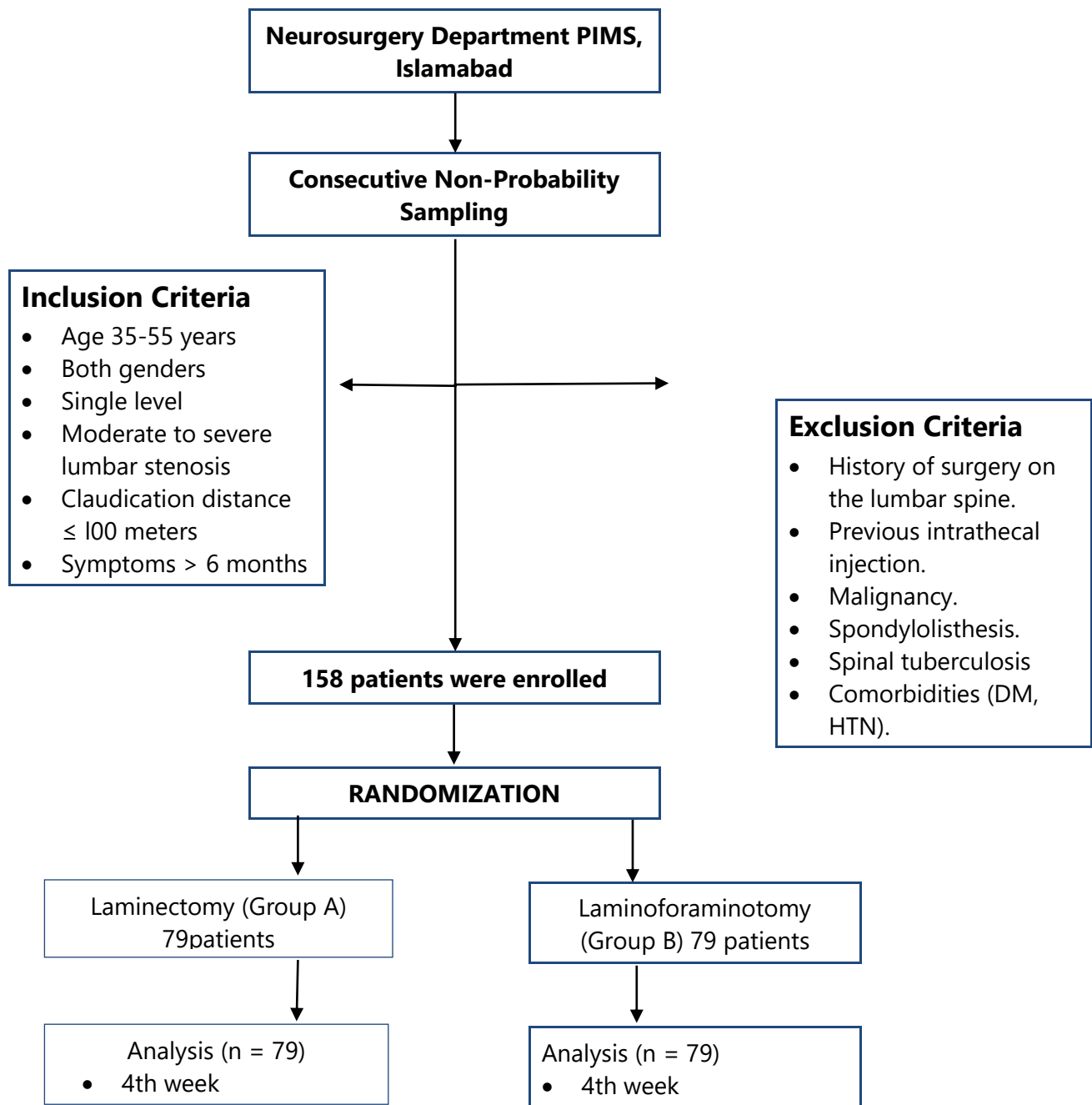


Figure 1: Consort diagram.

RESULTS

Age & Gender Distribution

The total number of patients was 158 with 79 in each group. The demographic characteristics of patients were studied (Table 1) and the Shapiro-Wilk test was used for normative data (p -value ≥ 0.05). The mean age of the patients was 44.92 ± 6.28 years. There were 58 male and 21 female patients in group A out of 79. There were 57 male and 22 female patients out of 79 in group B. A maximum number of patients (56%) with stenosis level of L5 – S1 in group A and with L4 – L5 in group B (51%). Severe disease was reported in 70% of patients in group A and 60% in group B. See Table 1 for details.

Outcomes

The frequency of "poor" outcome (claudication distance < 500 m at 4 weeks) was found to be 17 (21.5%) in the Laminectomy group and it was found in 5 (6.3%) patients in the Laminoforaminotomy group (Table 2). Poor outcome was significantly lower in the

Laminoforaminotomy group as compared to the Laminectomy group, at 4 weeks after the procedure.

Comparative Results

We determined the claudication distance in both groups by gender-based stratification. In group A (Laminectomy), the total numbers of male and female patients were 58 and 21 respectively. Out of 58 male patients, 13 (22.4%), 19 (32.8%), and 26 (44.8%) had poor, good, and excellent claudication distances respectively. Whereas out of 21 female patients, 4 (19.1%), 10 (47.6%), and 7 (33.3%) had poor, good, and excellent respectively. In group B (Laminoforaminotomy), the total numbers of male and female patients were 57 and 22 respectively. Out of 57 male patients, 4 (7%), 24 (42.1%), and 29 (50.9%) had poor, good, and excellent claudication distances respectively. Whereas out of 22 female patients, 1 (4.5%), 9 (41%), and 12 (54.5%) had poor, good, and excellent respectively. Male-to-female stratification was insignificant ($p = 0.064$ & 0.207 , respectively).

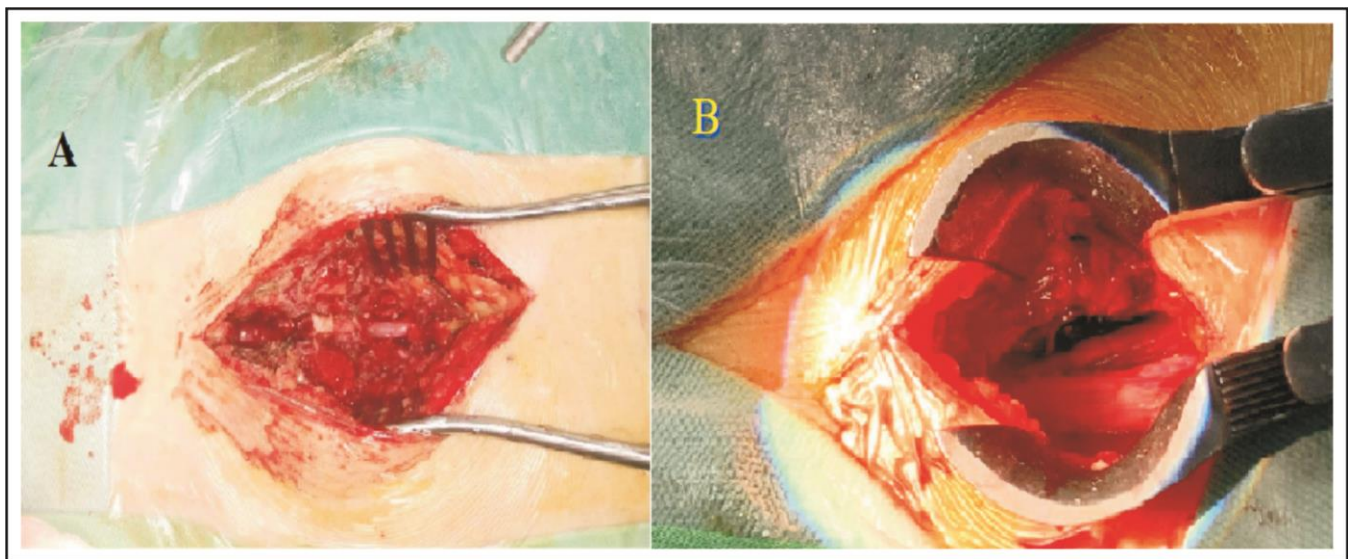


Figure 2: A, decompression along with Laminectomy and removal of the inter-spinous, supra-spinous ligaments, and spinous process. B, laminoforaminotomy, showing thecal sac and decompressed nerve root (images used with permission).

Table 1: Demographic characteristics of both groups, n = 158.

		Group A (Laminectomy) n = 79	Group B (Laminoforaminotomy) n = 79	Total	p-value
Age (years)		44.65 ± 6.31	45.18 ± 6.25	44.915 ± 6.28	1.000
Gender	Male	58 (73.4%)	57 (72.2%)	57.5 (72.8%)	0.852
	Female	21 (26.6%)	22 (27.8%)	21.5 (27.2%)	
Level of stenosis	L3-L4	2 (2.5%)	1 (1.3%)	1.5 (1.9%)	0.051
	L4-L5	33 (41.8%)	40 (50.6%)	36.5 (46.2%)	
	L5-S1	44 (55.7%)	38 (48.1%)	41 (51.9%)	
Severity of disease	Moderate	24 (30.4%)	32 (40.5%)	28 (35.45%)	0.002
	Severe	55 (69.6%)	47 (59.5%)	51 (64.55%)	

Table 2: Mean claudication distance at pre & post-operative at 4 weeks in both groups and cross-tabulation of outcome in two groups, n=158.

Claudication Distance (meters)	Groups		Total
	Laminectomy	Laminoforaminotomy	
Pre-operative (mean)	92.3 ± 7.1	91.9 ± 5.8	92.1 ± 6.45
Post-operative (mean), at weeks	819.7 ± 265.5	876.7 ± 194.9	848.2 ± 230.2
The outcome of the study			
Poor	17 (21.5%)	5 (6.3%)	22 (13.9%)
Good	62 (78.5%)	74 (93.7%)	136 (86%)
Total	79	79	158

The association between the outcome of both procedures is significant i.e., p-value = 0.022

which shows that the minor surgery is better than the conventional surgery.

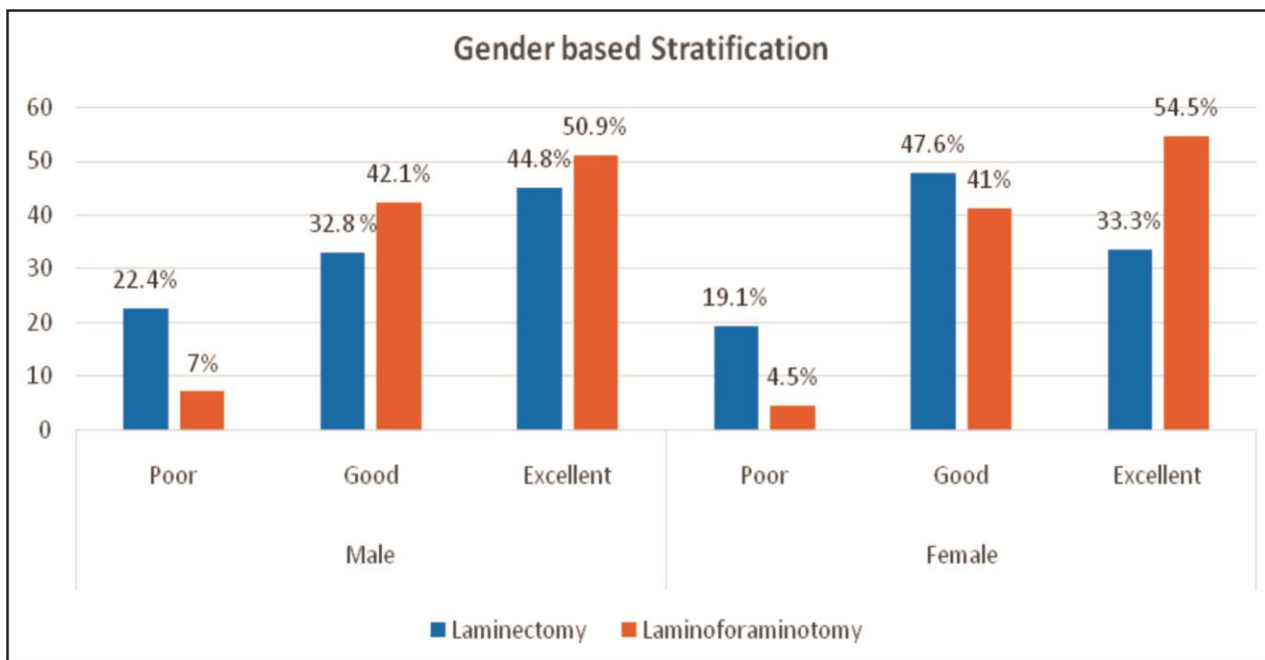


Figure 3: Gender-based stratification of claudication distance, n = 158.

The association between gender and prognosis in terms of post-operative claudication is insignificant as the p-value for males is 0.064 and the p-value for females is 0.207. Which shows that there is no association between gender and outcome.

DISCUSSION

The present study was designed to compare two techniques i.e., laminectomy versus laminoforaminotomy in terms of claudication distance in patients with lumbar spinal stenosis. Our results showed that the frequency of "poor" (claudication distance < 500 m at 4 weeks) was found to be 17 (21.5%) in the Laminectomy group and it was found in 5 (6.3%) patients in the Laminoforaminotomy group ($p = 0.022$).

Our study results are similar to other reports in the literature. In related research, Gori SA et al.⁹ found that patients undergoing laminectomy and laminoforaminotomy experienced good postoperative walking distance (501 – 1000m) in 76% and 83% of cases, respectively, and excellent walking distance (> 1000 m) in 9% and 11% of cases. In the laminoforaminotomy group, 30 patients (94%) showed an overall improvement in postoperative walking distance (outstanding), as opposed to 25 patients (85%) in the laminectomy group. The two techniques did not, however, show any statistically significant differences (p -value = 0.7). Male patients with laminoforaminotomy had better results than female patients, who did better with laminectomy. However, in the present study, there is a significant difference across both genders.

Thomas NW, et al,¹⁰ conducted research and concluded that the patient who underwent laminotomies have only statistical differences among the interventional groups. Poor outcome was due to emotional health on activity participation.

Fu YS.,¹¹ performed the study and reported that 89% (68/76) of the patients' overall results

were best and rated as good to outstanding. Equally, decent 11% (8/76) and subpar 0%. On the other hand, group B's overall outcomes at final evaluation were good to outstanding in 63% (48/76) of the patients, fair in 30% (23/76), and bad in 7% (5/76) of the patients. Finally, the conclusion of the abovementioned is, the laminoforaminotomy technique considered as best surgical treatment which provides long terms satisfactory impacts with minor complications. It is a standardized low-cost treatment that is used for degenerative spinal stenosis and slight congenital spinal stenosis.

According to Rompe JD et al study¹² group (I) had 36% of findings that were good to outstanding, whereas groups (II) and (III) had 30.8% and 23.8%, respectively ($P > 0.05$). Whereas, in our study, the claudication distance outcome good to excellent in groups A and B was, 36.7% vs. 41.8% and 41.8% vs. 51.9% ($p \leq 0.05$) respectively.

Although there is a lack of well-designed trials that compare the two techniques, available evidence studies suggest laminoforaminotomy is as effective as conventional laminectomy in the treatment of lumbar spinal stenosis.¹³⁻¹⁶ In the present study, we have similar results that the laminoforaminotomy technique showed a better outcome in terms of claudication distance. We suggest further trials with longer duration of follow-ups and also compare the complications rate for both techniques.

CONCLUSION

Four weeks following surgery, patients in the laminoforaminotomy group saw a considerably decreased incidence of poor results compared to those in the laminectomy group, as measured by the claudication distance. Patients with Thoraco-Lumbar stenosis should often be advised to have laminoforaminotomy for the sake of a more favorable prognosis.

LIMITATION

This was a single-center study.

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Additional Information

Disclosures: Authors report no conflict of interest.

Ethical Review Board Approval: The study was conformed to the ethical review board requirements.

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.

AUTHORS CONTRIBUTIONS

Sr.#	Author's Full Name	Intellectual Contribution to Paper in Terms of:
1.	Niaz Ahmed Khan	1. Study design and methodology.
2.	Muhammad Assad Javed	2. Paper writing.
3.	Nafees Ahmed	3. Data collection and calculations.
4.	Muhammad Anees Awan	4. Analysis of data and interpretation of results.
5.	Faisal Sultan	5. Literature review and referencing.
6.	Daniyal Ahmed	6. Editing and quality insurer.