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Research Article

Innovative Approach to Unilateral Laminotomy for Bilateral Decompression: Overcoming Challenges with Minimal Resources in Iraq

Khalid S. Mahmood[1*]

[1] Department of Neurosurgery, College of Medicine, University of Sulaymaniyah ,Zanko Street, Sulaymaniyah, Iraq

* Corresponding author's email: khalid.mahmood.shoukr@gmail.com

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ABSTRACT

Background: Unilateral laminotomy for bilateral decompression procedure for lumbar spinal stenosis has been increasingly accepted as an effective and safe alternative to conventional open decompression techniques. This approach aims to reduce postoperative instability by maintaining both facet joints, the neural arch, and the muscles of the contralateral side.

Subjects and Methods: Seventy patients were included in this study. All underwent unilateral laminotomy for bilateral decompression of the lumbar spinal canal through unilateral interlaminar fenestration without using advanced surgical equipment. Patient demographics and clinical characteristics were reviewed.

Results: The current study included 51 female and 19 male patients, with a mean age of 47.46 ± 10.52 years. Out of the total number of patients, 67.1% (n=47) had involvement in a single spinal level, 22.9% (n=16) had involvement in two levels, and 10% (n=7) had involvement in three levels. An excellent outcome after surgery was observed in 61.4% of patients. Good and fair outcomes after surgery were observed in 27.1% and 8.6% of the patients, respectively. Only two patients (2.9%) showed no improvement after the surgery.

Conclusions: The lumbar 'over-the-top' unilateral laminotomy for bilateral decompression, performed without advanced surgical equipment, was feasible and associated with favorable clinical outcomes and substantial pain improvement.

Introduction

Lumbar spinal stenosis (LSS) is defined as narrowing in the central canal, lateral recess, or the neural foramina of the lumbar vertebra. Compression occurs either due to intervertebral disc protrusion, facet joint arthropathy, ligamentum flavum hypertrophy, or osteophytes formation [1].

LSS is a common cause of low-back pain. A recent systematic review by Buser Z et al. reported the pooled prevalence of LSS to be 11% in the general population, with 25% to 39% having symptomatic LSS [2]. LSS impacts around 100 million individuals globally[3]. Approximately 20% of elderly individuals have been found to have lumbar stenosis, with only about 20% of them experiencing symptoms [4]

Clinical presentation of LSS includes low-back pain, although patients may also report gluteal region pain, radiculopathy symptoms, neurological claudication, as well as numbness or even muscle weakness [5-8]. It is reported that around 43% of affected individuals experience weakness [8].

The etiology of LSS can be either acquired (degenerative) or congenital [8]. In degenerative LSS, intervertebral disc degeneration and loss of disc height lead to altered spinal biomechanics and increased loading of the facet joints. These changes promote osteophyte formation, facet joint hypertrophy, and ligamentum flavum hypertrophy, all of which contribute to narrowing of the spinal canal and neural foramina. Aging, chronic wear-and-tear, and trauma are the most significant risk factors for degenerative LSS.

On the other hand, in congenital lumbar spinal stenosis, narrowing of the lumbar spinal canal throughout or more frequently segmental involvement of the L3, L4, and L5 vertebrae. Congenital lumbar spinal stenosis is characterized by short pedicles, which leads to a reduction in the anteroposterior diameter of the spinal canal [8, 9].

Central spinal canal stenosis may develop due to ligamentum flavum hypertrophy and posterior intervertebral disc bulging, which lead to compression of the dural sac and neural elements, which can manifest as bilateral radiculopathy. In contrast, lateral recess stenosis results from facet joint hypertrophy and osteophyte formation, compressing the traversing nerve root within the lateral recess. Foraminal stenosis arises from loss of disc height, foraminal disc protrusion, or osteophyte formation, all of which contribute to narrowing of the intervertebral foramen and compression of the exiting nerve root [10].

Another form of lumbar spinal stenosis is extraforaminal stenosis, which is most often associated with far-lateral disc herniation. In such cases, nerve root compression occurs lateral to the intervertebral foramen after the nerve has exited the spinal canal [10].

LSS is most prevalent at the L4 to L5 level, followed by L3 to L4, with occurrence rates of 92% and 66%, respectively [11]. LSS is considered the most common spinal surgery indication in elderly patients over 65 years [12, 13].

Despite the significant clinical impact of LSS globally, a universally accepted definition and radiological diagnostic criteria have yet to be established [8]. However, Kalichman et al. described a morphological classification based on the midsagittal diameter of the lumbar spinal canal, defining relative stenosis as a canal diameter <12 mm and absolute stenosis as a diameter <10 mm [14].

The diagnosis of LSS relies on history and physical exam, confirmed using imaging tools such as Computed Tomography and Magnetic Resonance Imaging, which are considered the gold standard for evaluating patients with LSS [15-17].

One way to manage LSS non-surgically is to modify activities, such as encouraging a flexion position [18]. Several studies have investigated the first-line medications for pain management: non-steroidal anti-inflammatory drugs (NSAIDs) for the treatment of low-back pain in LSS, but their effectiveness remains uncertain [18]. Neuropathic analgesics like gabapentin have been proven to have advantages by reducing back and leg pain by 2.1 points on the visual analog scale (VAS) [19]. Moreover, recent studies have investigated the effectiveness of epidural steroid injections, showing that a placebo effect may contribute to pain relief [20]. While conservative care is advised for some patients, no specific treatment has yet been proven to be the best option.

If non-surgical management fails or the symptoms are severe enough, decompressive surgery may be required for selected patients [11]. Various surgical techniques and methods are reported for treating LSS.

The primary goal of decompressive surgery is to alleviate symptoms and improve functional status by decompressing pressure on nerve roots and the spinal canal. Preserving midline components such as the spinal process, the supraspinous and interspinous ligaments is essential to avoid instability resulting from altered spinal biomechanics [21].

Possible complications of surgery include dural tear, bleeding, infections, progression of spondylolisthesis, and failed back surgery syndrome [11, 22-24]. Regarding the decompression procedure, conventional posterior open laminectomy causes significant damage to the paraspinal muscles, possibly resulting in pain [25]. The procedure causes damage to the midline tissues, supraspinous ligament, and interspinous ligament, resulting in postoperative destabilization and facet joint injury [12]. One solution to this issue is to do a unilateral window procedure to decompress both sides of the spine [26]. Spetzger et al. [26] introduced a method that effectively achieves adequate decompression through a unilateral window.

Lately, unilateral laminotomy for bilateral decompression (ULBD) which is also called “over-the-top” procedure was first reported by Young et al. in 1988 [27]. This minimally invasive procedure involves unilateral exposure and muscle retraction to reduce damage to the paraspinal muscles, the midline structures (including the spinous process and interspinous ligament), maintaining the facet joints, the neural arch, and the muscles of the contralateral side contralateral side, which may reduce postoperative spinal instability and lead to improved clinical outcomes. [27-31]. This approach significantly decreases soft tissue damage, intra-operative blood loss, and hospital stay. Patients usually have improved pain score and are typically able to be mobilized early [12]. Furthermore, the ULBD can decrease dead space, resulting in a reduction of postoperative complications [32, 33].

Moreover, an advancing technique of endoscopic ULBD was reported by Hyeun-Sung Kim et al. [34]. Nevertheless, the steep learning curve is considered as an important downside of this technique [11].

In this study, the author performed bilateral “over-the-top” decompression of the lumbar spinal canal through unilateral interlaminar fenestration without using advanced surgical tools and according to the available facilities in the local hospitals. However, no microscope, endoscope or high-speed drill were used. The equipment used in this study consisted of surgical loupes and a standard laminectomy instrument set.

To our knowledge, there is limited literature specifically evaluating ULBD performed primarily with surgical loupes and standard spinal instruments without the use of a high-speed drill, microscope, or endoscope [27, 34]. Therefore, this study contributes additional evidence regarding the feasibility of performing minimally invasive decompression in resource-limited healthcare settings.

Subjects and Methods

Originally, eighty-two patients underwent bilateral “over-the-top” decompression of the lumbar spinal canal through unilateral interlaminar fenestration. They were followed up for 12 months. Twelve patients were lost to follow-up because they could not be contacted. Seventy patients provided informed consent and they were included in the final data analysis. Demographic, clinical, and surgical data were documented and analyzed.

Inclusion criteria included MRI-confirmed LSS (central or lateral recess) with or without intervertebral disc herniation from L2 to S1, in symptomatic patients who did not respond to conservative therapies.
Exclusion criteria included previous lumbar surgery, instability, spinal infections or tumors.
In this study, the surgical procedure was performed using a limited instrument set consisting of 4× ZEISS EyeMag Medical loupes with a coaxial headlight, a Williams spinal discectomy retractor, and a standard laminectomy instrument set.
Regarding surgical technique, all surgical procedures were performed solely by the author. With the patient under general anesthesia and secured in the knee-chest position, a bilateral “over-the-top” decompression of the lumbar spinal canal was performed via a unilateral interlaminar fenestration. Notably, the procedure was accomplished without advanced or complex instrumentation such as an operating microscope, endoscope, or high-speed drill. Visual optimization and illumination were achieved using 4× headband ZEISS EyeMag Medical Loupes integrated with a coaxial headlight.
Retraction and instrumentation were maintained using a Williams spinal discectomy retractor alongside a standard laminectomy instrument set. Intraoperative fluoroscopy was utilized to precisely localize the target stenotic level.
A skin incision was made slightly lateral to the midline. Electrocautery was used to incise the lumbar fascia and elevate the paraspinal muscles from the ipsilateral surface of the spinous processes and laminae. The musculature was then retracted laterally up to the level of the facet joints using the Williams retractor.
The rostral lamina was resected up to the anatomical insertion of the ligamentum flavum. To detach the ligamentum flavum caudally, approximately 2 mm of the caudal lamina was resected. Excision of the ligamentum flavum proceeded from a central to a lateral direction, effectively decompressing the ipsilateral spinal canal and lateral recess. The medial border of the pedicle served as the definitive anatomical landmark to ensure adequate lateral decompression.
Following visualization of the lateral border of the dural sac, decompression was finalized by undercutting the roof of the neural foramen. Throughout this stage, meticulous identification and preservation of the pars interarticularis were prioritized to minimize the risk of iatrogenic fractures. Adequacy of the decompression was mechanically verified by palpating the neural foramen with a blunt instrument.
To visualize the contralateral side, the operating table was tilted contralaterally, and the Williams retractor was angled back toward the surgeon. Exposure of the contralateral ligamentum flavum and facet joint was initiated by removing the base of the spinous process with a 3-mm or 4-mm Kerrison rongeur, which facilitated clear identification of the superior articular process of the contralateral facet.
Subsequently, the contralateral ligamentum flavum was resected using a Kerrison rongeur, extending from the midline until both the contralateral pedicle and the lateral border of the dural sac were clearly identified. Any prominent stenosis within the contralateral lateral recess was resolved with a Kerrison rongeur.
By adjusting the line of sight "over the top" of the dural sac, the surgeon performed a comprehensive decompression of the contralateral side down to the neural foramen, ensuring complete patency and freedom of the contralateral nerve root.
For patients presenting with isolated lumbar spinal stenosis requiring decompression alone, a left-sided surgical approach was universally adopted. This was done to accommodate the right-handed operating surgeon, unless clinical presentation and radiological findings demonstrated predominant right-sided stenosis. For patients presenting with concomitant disc prolapse alongside stenosis, a supplemental discectomy was performed; in these combined cases, the side of the surgical approach was determined strictly by the laterality of the disc herniation. Figure 1 illustrates the surgical approach. Figures 2 and 3 illustrate MRI findings in two cases, both preoperative and postoperative after ULBD

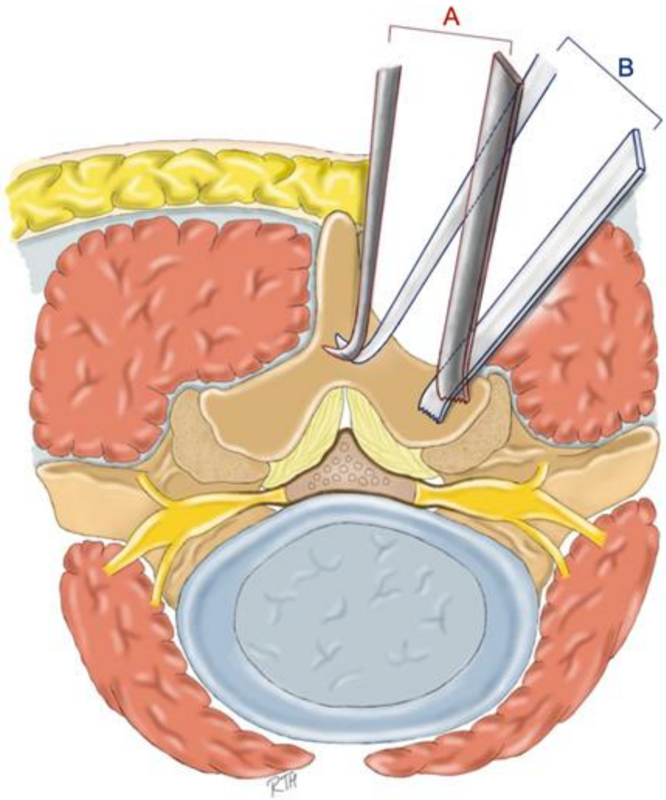

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Figure 1. Illustration of the surgical approach. (A) demonstrates the position of Williams retractors to decompress the ipsilateral spinal canal and lateral recess and to perform discectomy if needed. (B) demonstrates the tilted position of the retractors to decompress the contralateral spinal canal and lateral recess.

Outcomes were assessed using Modified Macnab Criteria and visual analog scale (VAS) at 1-month, 3-month, and 12-month follow-up periods.
Clinical outcome grading was based on patient-reported overall pain satisfaction and functional improvement at follow-ups using 5-point Likert scale (35). Outcomes were categorized as Excellent (near-complete symptom relief and return to normal activities), Good (marked improvement with minor residual symptoms), Fair (partial

improvement with persistent symptoms), Same (no meaningful change), or Worse (deterioration after surgery).

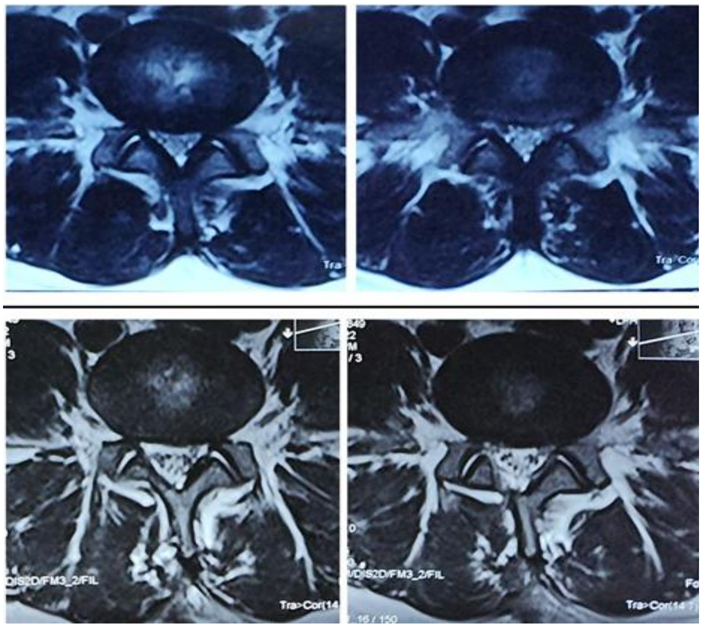

Figure 2: Spine MRI of a 33-year-old female. The top MRI shows L4-L5 stenosis preoperatively and the bottom MRI shows the postoperative decompression through right ULBD.

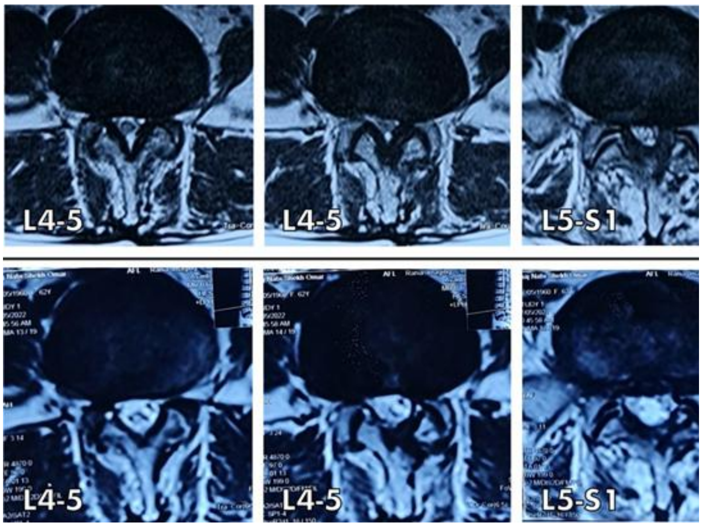

Figure 3: Spine MRI of a 62-year-old female. The top MRI shows L4-L5-S1 stenosis preoperatively and the bottom MRI shows the postoperative decompression through left ULBD.

This study was approved by the Ethics Committee of the College of Medicine, University of Sulaimani (Approval number: 103, dated 19/03/2025). The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki (36). Informed consent was obtained from all participants for the surgical procedure and use of anonymized data for research purposes.

Statistical Package for the Social Sciences (SPSS) version 29.0.2.0 was used for statistical analyses with continuous variables were summarized as mean ± standard deviation (SD) or standard error (SE). Normality was assessed prior to parametric testing as the categorical variables were presented as frequencies and percentages. Changes in Visual Analog Scale (VAS) scores across time points (preoperative, 1-month, 3-month, and 12-month follow-up) were analyzed using repeated measures analysis of variance (ANOVA), with post hoc pairwise comparisons when appropriate. Between-group comparisons were performed using independent samples t-tests for continuous variables and Pearson's chi-square test for categorical variables. Associations between continuous variables and VAS changes were evaluated by Pearson correlation. Variables demonstrating potential association were further assessed using ordinal logistic regression analysis to identify independent predictors of clinical outcome. All tests were two-tailed, and a p-value < 0.05 was considered statistically significant.

Results

A total of 70 patients underwent unilateral laminotomy for bilateral decompression. Baseline patients' characteristics are illustrated in table 1. The mean age was 47.5 ± 10.5 years (range 24–70). The patients were predominantly female (72.9%), and most patients were non-smokers (88.6%). Baseline anthropometric characteristics demonstrated a mean BMI of 27.91 ± 4.47 kg/m², with 48.6% of patients classified as overweight.

Preoperative pain severity was high, with a median preoperative Visual Analog Scale (VAS) score of 10 with IQR (8-10), reflecting severe baseline symptom burden.

Table 1: Baseline Demographic and Clinical Characteristics (n = 70)

Variables		Value
Age (years), mean ± SD		47.5 ± 10.5
Gender, n (%)	Female	51 (72.9%)
	Male	19 (27.1%)
Weight (kg), mean ± SD		78.33 ± 11.38
Height (m), mean ± SD		1.67 ± 0.08
BMI (kg/m²), n (%)	mean ± SD	27.91 ± 4.47
	Overweight	34 (48.6%)
	Obese	18 (25.7%)
	Normal weight	18 (25.7%)
Smoking Status, n (%)	Non-smoker	62 (88.6%)
	Smoker	8 (11.4%)
Employment status, n (%)	Employed	54 (77.1%)
	Unemployed	16 (22.9%)
Preoperative VAS, median (IQR)		10 (8-10)

Of the 70 patients, 67.1% (n=47) had single-level involvement, 22.9% (n=16) had two-level involvement, and 10% (n=7) had three-level involvement. Thirty-three patients (47.1%) had involvement at the

L4–L5 level, making it the most frequently affected level. Decompression combined with discectomy was performed in 55.7% of cases. Table 2 illustrates the surgical characteristics of patients

Table 2: Surgical Characteristics of Patients

Variables		n (%)
Number of levels involved	Single-level	47 (67.1%)
	Two-level	16 (22.9%)
	Three-level	7 (10.0%)
Level(s) involved	L4-L5	33 (47.1%)
	L3-L4-L5	14 (20.0%)
	L5-S1	6 (8.6%)
	L3-L4	5 (7.1%)
	L2-L3-L4-L5	4 (5.7%)
	L2-L3	3 (4.3%)
	L3-L4-L5-S1	2 (2.9%)
	L2-L3 and L4-L5-S1	1 (1.4%)
	L4-L5-S1	1 (1.4%)
	L2-L3-L4	1 (1.4%)
Surgical procedure	Spinal decompression without discectomy	31 (44.3%)
	Spinal decompression and discectomy	39 (55.7%)
Side	Right	17 (24.3%)
	Left	53 (75.7%)

Pain scores improved significantly at all postoperative intervals. Estimated marginal means demonstrated progressive reduction using repeated measures ANOVA, as presented in table 3.

Table 3: VAS Over Time during follow-up

Time Point	Median	Mean ± SE	95% CI	Overall p-value
Preoperative VAS	10	8.96 ± 0.15	8.66 – 9.25	<0.001
1-month VAS	3	3.03 ± 0.22	2.58 – 3.48	
3-month VAS	2	2.33 ± 0.21	1.91 – 2.74	
12-month VAS	2	1.97 ± 0.21	1.56 – 2.39	

The magnitude of improvement is represented as:
VAS_improvement=Preoperative VAS-VAS_(12-month)

Pairwise Bonferroni-adjusted comparisons showed statistically significant improvement between all time points (all p-values < 0.05), indicating both early and sustained pain relief. The progressive reduction in mean VAS scores over time is illustrated in Figure 4.

The mean percentage improvement was 78.5% ± 18.1%, with median of 80% and ranged between 20-100%, according to the following formula:

$$\mathit{Percent\ Improvement} = \frac{\mathit{Preoperative\ VAS} - \mathit{VAS}_{12-month}}{\mathit{Preoperative\ VAS}} \times 100$$

At final follow-up, the clinical outcomes were as presented in table 4.

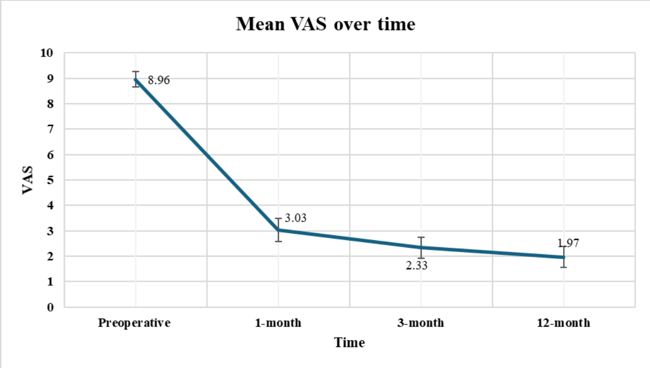

Figure 4: Line graph of Mean VAS change over time with 95% CI error bars.

Table 4: Final Clinical Outcomes

Outcomes	n (%)
Excellent	43 (61.4%)
Good	19 (27.1%)
Fair	6 (8.6%)
Same	2 (2.9%)
Worse	0 (0%)

No major perioperative or postoperative complications were observed during the follow-up period. Specifically, there were no cases of dural tear, cerebrospinal fluid leakage, surgical site infection, epidural hematoma, neurological deterioration, nerve root injury, reoperation, or clinically evident postoperative instability.

Mean VAS improvement was 6.68 ± 1.90 (decompression only), compared to 7.23 ± 1.61 (decompression + discectomy). Independent t-test showed no statistically significant difference [t(68) = −1.32, p-value = 0.193; Cohen's d = −0.32]. Thus, both techniques demonstrated comparable pain reduction.

Mean improvement in VAS for those with 1 level was 6.94, for those with 2 levels was 7.06, and for those with 3 levels 7.14. One-Way ANOVA showed no significant difference (F = 0.062, p-value = 0.941), indicating that multilevel decompression did not adversely affect pain outcomes.

Ordinal logistic regression analysis revealed no statistically significant independent predictors of outcome (p-value > 0.05).

BMI showed a non-significant trend toward worse outcomes (p-value = 0.088). Model McFadden R^2 = 0.0975.

No statistically significant associations were observed between outcome and smoking (χ^2 = 7.16, p-value = 0.067), BMI (χ^2 = 6.55, p-value = 0.365), or surgical procedure (χ^2 = 6.38, p-value = 0.094)

Preoperative VAS was positively correlated with VAS improvement (Pearson's r = 0.361, p-value = 0.002). This indicates that patients with more severe baseline pain experienced greater absolute improvement.

No significant correlation was observed between age or BMI and improvement (p-value > 0.05).

Twelve of the original 82 patients (14.6%) did not complete the formal follow-up schedule and were therefore excluded from the primary analysis. The lost-to-follow-up group included 10 females (83.3%) and 2 males (16.7%), with a mean age of 47.0 years.

Available clinical records demonstrated substantial postoperative improvement in these patients. Mean VAS improved from 8.73 preoperatively to 2.00 at 1 month, 1.27 at 3 months, and 1.18 at the latest available follow-up assessment. The mean absolute VAS improvement was 7.55 points, corresponding to an average improvement of 87.3%. These findings were comparable to those observed in the analyzed study sample.

Discussion

This retrospective study evaluated the safety and clinical outcomes of patients who underwent unilateral laminotomy for bilateral decompression (ULBD) in a resource-limited setting. Seventy patients with lumbar spinal stenosis (LSS) underwent minimally invasive "over-the-top" decompression by unilateral interlaminar fenestration with one-year follow-up. Notably, procedures were performed without the use of a microscope, endoscope, or high-speed drill, reflecting real-world surgical constraints in developing healthcare systems. Despite these limitations, outcomes were highly favorable.

The unilateral laminotomy concept was first introduced by Young et al., while Spetzger et al. later standardized the ULBD technique [37]. It was developed to minimize tissue disruption while achieving bilateral neural decompression. Compared with conventional laminectomy, ULBD preserves contralateral musculature, spinous process integrity, and posterior ligamentous structures while achieving bilateral neural decompression, potentially reducing the risk of postoperative instability and facilitating faster recovery [38-40]. While ipsilateral muscle detachment may still cause some multifidus injury [41], overall tissue preservation remains superior to open techniques. A recent systematic review by Algarni et al. [11] confirmed that ULBD consistently demonstrates excellent functional outcomes with low complication rates, though it remains technically demanding and associated with a learning curve.

In the present study, pain improvement was substantial and sustained through the 12-month follow-up period. Mean VAS decreased from 8.96 preoperatively to 1.97 at 12-month, corresponding to marked clinical benefit. These findings align with Yang et al. [42], who reported VAS reduction from 7.5 to 1.2 at 12-month following minimally invasive decompression. Similarly, randomized and cohort studies comparing ULBD with open laminectomy demonstrate equivalent or superior pain and functional outcomes [23, 43-45]. Importantly, 88.5% of patients achieved good-to-excellent outcomes, and 97.1% achieved at least fair outcomes, exceeding the 85.3% favorable outcome rate reported by Ulrich et al. [45].

Although minimally invasive decompression is generally associated with excellent results, a subset of patients may experience persistent or recurrent symptoms. Failed back surgery syndrome (FBSS), reported in 10–40% of spine surgery cases [46], remains multifactorial in etiology. However, insufficient decompression following ULBD appears uncommon, with reported rates of 2–5% [23, 42-45, 47, 48]. In our series, only a small minority demonstrated unsatisfactory results, supporting adequacy of decompression even without advanced instrumentation.

Long-term outcomes following ULBD have generally been favorable. Several comparative studies have demonstrated that minimally invasive decompression techniques provide earlier mobilization, reduced postoperative pain, and shorter recovery periods compared with conventional laminectomy [49]. However, long-term functional outcomes and pain relief often become similar between minimally invasive and conventional approaches after several years of follow-up.

A recent randomized clinical trial by Sangbong Ko and Taebum Oh [43] in 2019 with 50 patients followed-up for 2 years postoperatively, observed no significant differences in terms of spine-related pains over time and functional outcomes.

In this study, no postoperative complications (dural tear, cerebrospinal fluid leakage, surgical site infection, postoperative hematoma, neurological deterioration, reoperation, or clinically evident postoperative instability) were observed during the follow-up period.

In a recent systematic review by Algarni et al. [11] in 2023 reported overall complication rate between 18% to 20%. The most common reported complications after ULBD include infection, dural tear, urinary retention, and nerve root injury.

An additional advantage observed in this series was the favorable perioperative profile. Operative time ranged from approximately 35–40 minutes for single-level procedures, 45–50 minutes for two-level procedures, and about 60 minutes for three-level decompressions. Estimated blood loss was low, averaging 15–20 mL per decompressed level. Early mobilization was encouraged, with most patients ambulating approximately four hours after surgery. Furthermore, the majority of patients were discharged on the day of surgery, reflecting the minimally invasive nature of the procedure and its potential to reduce healthcare utilization and hospitalization costs.

Demographic variables did not significantly influence surgical outcome. Age and sex were not associated with postoperative improvement status, consistent with prior studies [23, 42-45, 47, 48]. However, increasing age correlated with greater number of stenotic levels, reflecting the degenerative nature of LSS [50, 51].

The present study included patients with a mean age of 47.5 ± 10.5 years with a range from 24 to 70 years for patients who underwent ULBD for LSS. In terms of age distribution, 4 patients (5.7%) were between 24–29 years, 12 (17.1%) between 30–39 years, 27 (38.6%) between 40–49 years, 16 (22.9%) between 50–59 years, 10 (14.3%) between 60–69 years, and 1 patient (1.4%) was 70 years old. Additionally, patients aged over 40 years represented 77.1% of the studied population.

The relatively young mean age of our study population is lower than that reported in many LSS series from Western populations, in which affected patients are frequently older than 60 years. For instance, Arai et al. (47) reported a mean age of 69.5 ± 8.7 years, Yang et al. (42) 73.0 ± 5.9 years, Ko et al. (43) 68.1 ± 10.7 years, McGrath et al. (44) 62.0 ± 1.3 years, Ulrich et al. (45) 72.9 ± 7.9 years, Mobbs et al. (23) 72.7 ± 10.4 years, and Knio et al. (48) 65.0 ± 9.2 years.

In contrast, Kelani and Ragaee from Egypt reported a comparatively younger age range of 40–60 years with a mean of 52.5 ± 6.62 years [52], which is closer to the findings of the current study.
This difference may reflect demographic characteristics of the local population and earlier presentation of symptomatic degenerative spinal disease. Moreover, in this study, some patients who had moderate lumbar canal stenosis had been addressed by this procedure because they had symptomatic unilateral intervertebral disc herniation which is a disease that is more common in younger people [53, 54].
Smoking status did not significantly affect outcome in our study, although this contrasts with findings from the Swedish Spine Register, where smokers demonstrated less improvement two years postoperatively [55]. This discrepancy may reflect sample size limitations or demographic differences.
Similarly, BMI was not an independent predictor of outcome in our analysis. While prior multicenter data (SPORT trial) suggested obese patients may experience slightly inferior functional recovery [56], several minimally invasive ULBD studies have not demonstrated BMI-dependent differences [23, 42-45, 47]. These findings suggest that minimally invasive decompression may mitigate some obesity-related surgical disadvantages.
Preoperative pain severity demonstrated positive correlation with magnitude of postoperative improvement, indicating that patients with greater baseline pain experienced larger absolute VAS reduction. This pattern has been observed in other ULBD studies and likely reflects greater symptomatic reserve for improvement [23, 42-45, 47, 48].
Neither the number of decompressed levels nor the specific level of stenosis influenced postoperative outcomes, consistent with McGrath et al. [44] and Knio et al. [48]. L4–L5 was the most frequently affected level in our study, in agreement with established biomechanical understanding that this segment bears maximal motion and axial load, predisposing it to degenerative stenosis [11, 57].
Thirty-nine patients underwent decompression with concomitant discectomy. No significant difference in outcome was observed between decompression alone and decompression with discectomy, consistent with recent findings by Cho et al. [58], who demonstrated comparable radiological and clinical outcomes regardless of discectomy addition when appropriately indicated.
The most distinctive contribution of this study lies in demonstrating that ULBD can be performed safely and effectively without reliance on advanced microsurgical tools. The procedure remained minimally invasive despite relying only on magnification loupes and conventional instruments. In resource-constrained healthcare systems, cost and equipment availability remain major barriers to minimally invasive spine surgery. Our findings suggest that with appropriate technique and surgical expertise, excellent outcomes can still be achieved, expanding accessibility of modern decompression strategies.
This study is limited by its retrospective design, and modest sample size. Additionally, absence of follow-up beyond one year prevents assessment of long-term prognosis. Although 12 patients did not complete the formal follow-up protocol, review of available clinical records demonstrated postoperative pain improvement comparable to that observed in the analyzed sample. Nevertheless, incomplete follow-up remains a limitation and some degree of attrition bias cannot be completely excluded. Future prospective studies should validate outcome measures to allow more comprehensive assessment and comparison with existing literature.

Conclusion

The ULBD approach can be performed using surgical loupes and standard spinal instruments for the treatment of LSS. In this retrospective study, the procedure was feasible and associated with favorable clinical outcomes, substantial pain improvement, and no major complications at one-year follow-up. These findings support ULBD as a practical treatment option for selected patients with lumbar spinal stenosis in resource-limited settings, although prospective comparative studies are needed to further evaluate its effectiveness.

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Conflict of Interest

The author declares no conflicts of interest related to this work.

Data availability

Data are available upon reasonable request.

Author Contributions

The author contributed to the conception and design of the study, data acquisition, analysis and interpretation, drafting, revision, and proofreading of the manuscript. The author approved the final version, met the ICMJE criteria for authorship, and agreed to be accountable for all aspects of the work.

ORCID

Khalid S. Mahmood 0009-0002-6204-6138

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