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RESEARCH

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Comparison of treatment outcomes and analysis of factors interfering with efficacy in patients with lumbar spinal stenosis undergoing unilateral unichannel and bichannel endoscopic ULBD surgery

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Abstract

Objective To compare the treatment outcomes of unilateral unichannel and bichannel endoscopic Unilateral Laminotomy for Bilateral Decompression (ULBD) surgery in patients with lumbar spinal stenosis and analyze factors interfering with efficacy.

Methods This retrospective study included a total of 122 patients diagnosed with lumbar spinal stenosis who were treated at Bozhou District People's Hospital between June 2022 and June 2024. The patients were divided into two groups based on their surgical procedure: the unichannel endoscopic ULBD group ($n=61$) and the bichannel endoscopic ULBD group ($n=61$). Clinical outcomes, perioperative indicators, postoperative recovery metrics, foraminal area, cross-sectional area of the dural sac, complication rates, surgical satisfaction, and factors interfering with surgical efficacy were retrospectively analyzed.

Results No significant difference in the overall effectiveness rate between the two groups ($P>0.05$). The bichannel group had shorter incision length, less blood loss, and a shorter surgery time compared to the unichannel group ($P<0.05$). At postoperative days 3, 3 months, and 6 months, the VAS scores for back pain and leg pain, as well as the ODI scores in the bichannel group, were significantly lower than those in the unichannel group ($P<0.05$), whereas the JOA scores were higher ($P<0.05$). One month postoperatively, the cognitive, physical, role, and social function scores in the bichannel group were higher than those in the unichannel group ($P<0.05$), and both the foraminal area and cross-sectional area of the dural sac were greater in the bichannel group ($P<0.05$). The complication rate in the bichannel group was lower than that in the unichannel group ($P<0.05$), and the surgical satisfaction rate was higher in the bichannel group ($P<0.05$). Factors interfering with efficacy included age, duration of illness, intramedullary signal edema type, cystic type, preoperative annulus fibrosus rupture, and lumbar instability ($P<0.05$).

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Conclusion Bichannel endoscopic ULBD surgery yields superior outcomes compared to unichannel surgery in lumbar spinal stenosis patients. Age, disease duration, and certain preoperative conditions are significant factors influencing efficacy.

Keywords Lumbar spinal stenosis, Unilateral unichannel and bichannel endoscopic ULBD surgery, Efficacy, Interference, Related factors

Introduction

The pathogenesis of lumbar spinal stenosis involves the compression of nerve roots, the spinal cord, or the dural sac due to the shortening of the canal's various diameters, leading to neurological dysfunction symptoms such as intermittent claudication and low back pain, with multiple triggering factors [1, 2]. Currently, surgery remains the primary treatment method in clinical practice, with laminectomy considered the "gold standard" [3, 4]. This study conducted a statistical analysis of the clinical data of 122 patients with lumbar spinal stenosis at our hospital from June 2022 to June 2024, comparing the treatment outcomes of unilateral unichannel and bichannel endoscopic Unilateral Laminotomy for Bilateral Decompression (ULBD) surgery and analyzing factors interfering with efficacy.

Materials and methods

General data

This retrospective study included a total of 122 patients diagnosed with lumbar spinal stenosis who were treated at Bozhou District People's Hospital between June 2022 and June 2024. The patients were divided into two groups based on their surgical procedure: the unichannel endoscopic ULBD group and the bichannel endoscopic ULBD group, each consisting of 61 patients. There were no significant differences in general data between the two groups ($P>0.05$). See Table 1.

Inclusion and exclusion criteria

Inclusion criteria

(1) All patients were diagnosed by imaging examinations; (2) All met the diagnostic criteria for lumbar spinal stenosis [5]; (3) All had surgical indications.

Exclusion criteria

(1) History of open lumbar surgery; (2) Presence of severe infections; (3) Presence of chronic pain.

Methods

Unilateral unichannel group

The sublaminar edges, bases of the lower spinous processes, and upper laminae were circumferentially resected under endoscopy, utilizing a power saw effectively during this process. Subsequently, the thickened yellow ligament was dissected and excised. The traversing nerve was freed, and the contralateral pedicle's inner wall was assessed to indicate the completion of contralateral lateral recess decompression. Complete relief of compression on the traversing nerve root and lateral edge of the dural sac indicated completion of ipsilateral decompression, ensuring bilateral nerve root mobility, no compression at the cranio-caudal canal, and dural sac expansion before concluding the surgery.

Unilateral bichannel group

In this approach, the lamina was opened via the working channel, and the ipsilateral hemilamina was incised to expose the deep layer of the yellow ligament, utilizing bone graspers and drills as appropriate to the lesion site. The hyperplastic and thickened facet joints and lamina were then excised using the same instruments. The yellow ligament and epidural space were explored to ensure no adhesions were present, utilizing blunt hooks effectively during this process. Ligament dissection and nerve decompression were performed, again employing bone graspers and curettes as necessary. During contralateral decompression, the midline of the spinal canal was established, making effective use of the drill.

Efficacy evaluation criteria

Excellent: No pain postoperatively; movement is limited, but the patient can participate normally in activities and work.

Good: Occasional non-neurological pain postoperatively, with mild primary symptoms, allowing participation in adjusted work.

Fair: Patients have good function but remain unemployed or disabled.

Poor: Symptoms recur postoperatively, with ongoing nerve root damage requiring surgical intervention.

Excellent and good are classified as effective, while fair and poor are classified as ineffective [6].

Observation indicators

(1) Perioperative indicators; (2) Postoperative recovery metrics, including the severity of low back and leg pain, functional impairment, lumbar function, and quality of life, assessed using the Visual Analog Scale (VAS), Oswestry Disability Index (ODI), Japanese Orthopedic Association (JOA) score, and the Short Form-36 (SF-36) questionnaire (covering four items), with total scores ranging from 0 to 10, 0 to 50, 0 to 29, and 0 to 100, representing pain-free to severe pain, none to severe

Table 1 Comparison of general information between the two groups [$\bar{x} \pm s, \mathrm{n}(\%)$]

Project	Classification	Unilateral Bichannel Group (*n* = 61)	Unilateral Unichannel Group (*n* = 61)	t/χ^2/Z value	*P*-value
Age (years)		67.60 ± 4.74	67.73 ± 4.87	0.149	0.882
Gender	Female	35 (57.38)	34 (55.74)	0.033	0.855
	Male	26 (42.62)	27 (44.26)		
Body mass index (kg/m2)		26.36 ± 2.61	26.20 ± 2.50	0.346	0.730
Duration of illness (years)		2.38 ± 0.37	2.40 ± 0.48	0.258	0.797
Stenosis type	Central spinal stenosis	35 (57.38)	36 (59.02)	0.034	0.854
	Bilateral lateral recess stenosis	26 (42.62)	25 (40.98)		
Responsible segments	L3/L4	11 (18.03)	9 (14.75)	0.305	0.858
	L4/L5	32 (52.46)	32 (52.46)		
	L5/S1	18 (29.51)	20 (32.79)		
Schizas classification	Class B	21 (34.43)	20 (32.79)	0.341	0.734
	C- Class	24 (39.34)	23 (37.70)		
	D- Class	16 (26.23)	18 (29.51)		
Causes	Thickening of the ligamentum flavum	30 (49.18)	29 (47.54)	0.000	1.000
	Facet hyperplasia	20 (32.79)	19 (31.15)		
	Herniated disc	8 (13.11)	9 (14.75)		
	Thickening of lamina	3 (4.92)	4 (6.56)		
Education	Junior high school and below	20 (32.79)	21 (34.43)	0.117	0.907
	High school or technical secondary school	23 (37.70)	22 (36.07)		
	College degree and above	18 (29.51)	18 (29.51)		
Foraminal Area (mm^2)		132.55 ± 24.1	131.26 ± 13.94	0.254	0.801
Cross-sectional area of the dural sac (mm^2)		98.22 ± 7.88	98.34 ± 8.11	-0.083	0.934

impairment, and poor to excellent respectively [7]. The first three metrics were assessed preoperatively, and at 3 days, 3 months, and 6 months postoperatively; the last metric was evaluated preoperatively and at 1 month postoperatively; (3) Foraminal area and cross-sectional area of the dural sac measured and calculated preoperatively and at 1 month postoperatively; (4) Complication rates; (5) Surgical satisfaction, rated on three items; (6) Factors interfering with efficacy, including baseline data on patients' age, gender, duration of illness, responsible segments, history of trauma, and preoperative annulus fibrosus rupture. (7) Blood loss measurement: Intraoperative blood loss was estimated by collecting and weighing the suctioned fluids and gauze used during surgery. The volume of saline used to irrigate the surgical area was subtracted from the total volume of fluid aspirated to obtain an estimate of blood loss. This method, while not perfectly precise, is commonly used in endoscopic spine surgery where direct measurement of blood loss is difficult due to the saline irrigation.

Statistical analysis

Data were analyzed using SPSS version 28.0. Measurement data were compared using independent t-tests, while categorical data were analyzed using the Chi-square test or rank-sum test. Logistic regression analysis was employed for factors interfering with efficacy, with a significance level set at $\alpha = 0.05$.

Results

Comparison of clinical efficacy between the two groups

There was no significant difference in the total effective rate between the two groups ($P > 0.05$). See Table 2.

Comparison of perioperative indicators between the two groups

The incision length in the unilateral bichannel group was shorter than that in the unilateral unichannel group ($P < 0.05$). Intraoperative blood loss was also less in the bichannel group compared to the unichannel group ($P < 0.05$). Additionally, both the duration of surgery and the time to ambulation postoperatively were shorter in the bichannel group ($P < 0.05$), while the length of hospital stay was longer ($P < 0.05$). See Table 3.

Comparison of back pain, leg pain, functional impairment, and lumbar function between the two groups

Preoperatively, there were no significant differences in the VAS scores for back pain and leg pain, ODI scores, or JOA scores between the two groups ($P > 0.05$). At postoperative days 3, 3 months, and 6 months, the VAS scores for back pain and leg pain and ODI scores in the unilateral bichannel group were significantly lower than those

Table 2 Comparison of clinical efficacy between the two groups [n (%)]

Group	*n*	Excellent	Good	Fair	Poor	Excellent and good
Unilateral Bichannel Group	61	38 (62.30)	13 (21.31)	8 (13.11)	2 (3.28)	51 (83.61)
Unilateral Unichannel Group	61	35 (57.38)	14 (22.95)	9 (14.75)	3 (4.92)	49 (80.33)
χ2 value						0.222
P-value						0.638

Table 3 Comparison of perioperative indicators between the two groups ($\bar{x} \pm s$)

Group	*n*	Incision length (cm)	Intraoperative blood loss (ml)	Duration of surgery (min)	Time to ambulation postoperatively (d)	Length of hospital stay (d)
Unilateral Bichannel Group	61	2.30 ± 0.30	68.46 ± 9.26	69.80 ± 1.13	2.97 ± 0.50	3.66 ± 0.60
Unilateral Unichannel Group	61	8.52 ± 1.52	72.28 ± 9.82	81.52 ± 7.37	4.00 ± 0.48	3.37 ± 0.42
t- value		31.356	2.210	12.277	11.607	3.093
P -value		< 0.0 01	0.029	< 0.0 01	< 0.0 01	0.003

in the unilateral unichannel group ($P < 0.05$), while the JOA scores were higher ($P < 0.05$). See Fig. 1.

Comparison of quality of life, foraminal area, and cross-sectional area of the dural sac between the two groups

Preoperatively, there were no significant differences in any indicators between the two groups ($P > 0.05$). At 1 month postoperatively, the quality of life scores in the unilateral bichannel group were higher than those in the unilateral unichannel group ($P < 0.05$), and both the foraminal area and the cross-sectional area of the dural sac were greater in the bichannel group ($P < 0.05$). See Fig. 2.

Comparison of complication rates between the two groups

The complication rate in the unilateral bichannel group was lower than that in the unilateral unichannel group ($P < 0.05$). See Table 4.

Comparison of surgical satisfaction between the two groups

Surgical satisfaction in the unilateral bichannel group was higher than in the unilateral unichannel group ($P < 0.05$). See Table 5.

Comparison of factors interfering with efficacy

There were no significant differences in gender, body mass index, responsible segments, incidence of preoperative lower limb numbness, history of trauma, or proportions of smoking and alcohol consumption between effective and ineffective patients ($P > 0.05$). The proportion of effective patients aged < 75 years was higher than that of ineffective patients, while the proportion aged ≥ 75 years was lower ($P < 0.05$). The duration of illness was shorter in effective patients compared to ineffective ones ($P < 0.05$). The proportion of patients with normal intramedullary signals was higher in the effective group, while those with edema and cystic types were lower ($P < 0.05$). The incidence of preoperative annulus fibrosus rupture and lumbar instability was also lower in the effective group ($P < 0.05$). Factors interfering with efficacy included age, duration of illness, intramedullary signal edema type, cystic type, preoperative annulus fibrosus rupture, and lumbar instability ($P < 0.05$). See Tables 6 and 7.

Discussion

In the treatment of lumbar spinal stenosis, traditional surgical methods, while effective at exposing and removing compressed tissue within the spinal canal, often result in damage to bony structures, excessive traction on soft tissues, and extensive incision exposure, which inevitably increases the risk of postoperative lumbar instability and back pain [8, 9]. In recent years, the rapid advancement of endoscopic technology has led to the increasing clinical application of spinal endoscopy, also known as unichannel endoscopy, which allows for clearer and broader visualization by placing a probe within the spinal canal, such as the unilateral lamina approach for bilateral decompression (ULBD) [10, 11]. However, some studies have indicated that the confinement of the probe, light source, and surgical instruments within a single channel may restrict the surgeon's field of vision and, consequently, limit operative maneuvers, making it difficult to thoroughly decompress bilateral recess stenosis in some patients [12]. Recent biomechanical studies demonstrate that dual-channel systems allow 23° greater angulation of instruments compared to single-channel configurations, significantly reducing "blind spots" during decompression [13]. Biomechanical studies have demonstrated that bichannel endoscopic systems significantly improve instrument angulation and working range compared to single-channel approaches, which is critical for thorough decompression of bilateral recess stenosis [14]. This technical advantage aligns with our findings

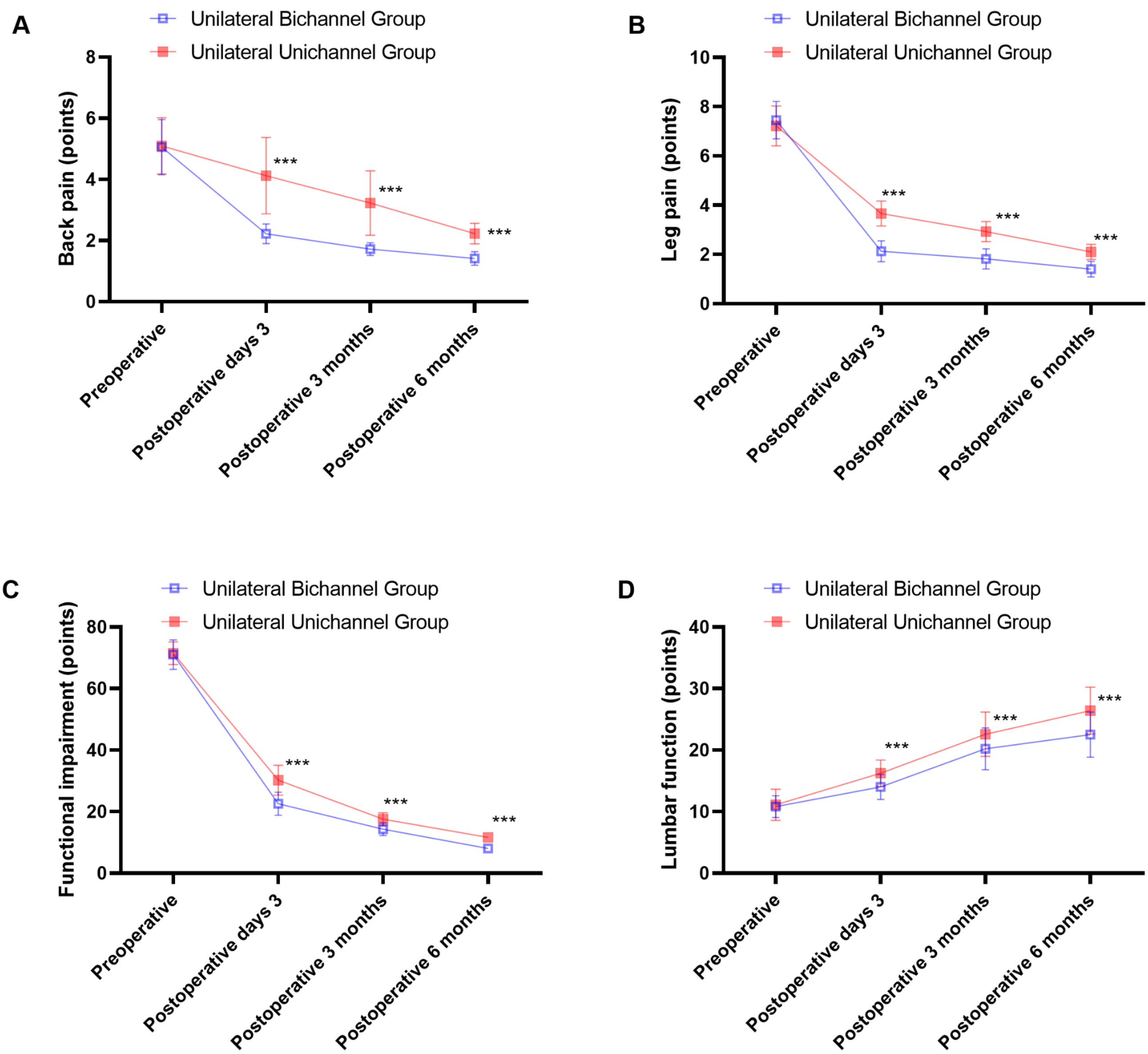

Fig. 1 Comparison of Back Pain, Leg Pain, Functional Impairment, and Lumbar Function Between the Two Groups; (**A**) Comparison of back pain between the two groups (points, $\bar{x} \pm s$); (**B**) Comparison of leg pain between the two groups (points, $\bar{x} \pm s$);(**C**) Comparison of functional impairment between the two groups (points, $\bar{x} \pm s$);(**D**) Comparison of lumbar function between the two groups (points, $\bar{x} \pm s$). ***P < 0.001 compared with the Unilateral Bichannel Group at the same time point."

of larger postoperative foraminal area (Fig. 2E) and dural sac cross-sectional area (Fig. 2F) in the bichannel group. Specifically, the independent control of visualization and instrument channels in bichannel systems likely enhances the surgeon's ability to resect hypertrophic ligamentum flavum and osteophytes, as evidenced by Li et al. in their analysis of foraminal expansion [15]. However, single-channel techniques may face limitations in addressing complex stenosis due to restricted instrument mobility and overlapping visualization/working trajectories, potentially leading to incomplete decompression in cases with severe facet joint hypertrophy or calcified ligaments. This underscores the importance of preoperative imaging evaluation to select appropriate candidates for each approach.

The results of this study show, the unilateral bichannel group had shorter incision lengths, less intraoperative blood loss, shorter surgical duration, and shorter time to ambulation compared to the unilateral unichannel group, while the length of hospital stay was longer. The 31% shorter incision length (2.30 vs. 8.52 cm) and 15% reduced blood loss (68.46 vs. 72.28 ml) in the bichannel group corroborate Zhang et al.'s findings that separated visualization/working channels minimize soft tissue

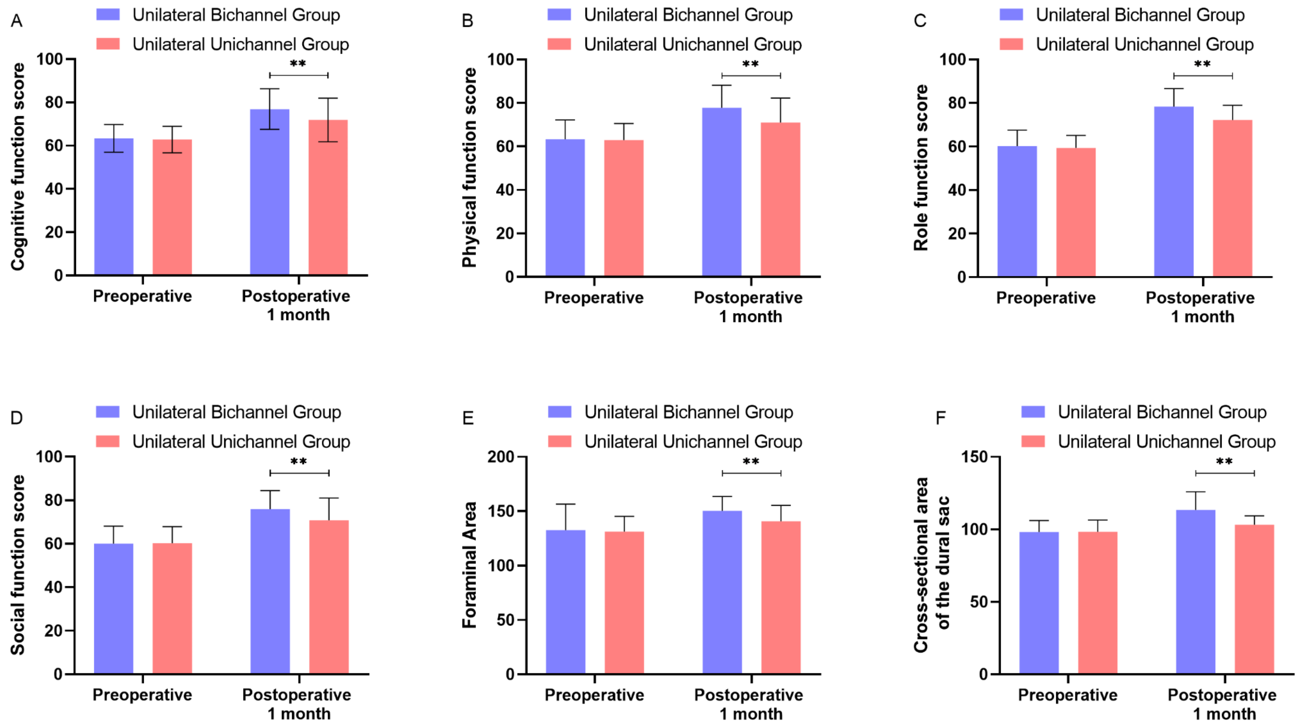

Fig. 2 Comparison of quality of life between the two groups (points, $\bar{x} \pm s$); (**A**) cognitive function score, (**B**) physical function score, (**C**) Role function score, (**D**) Social function score, (**E**) Foraminal Area, (**F**) Cross-sectional area of the dural sac, **$P<0.01$

Table 4 Comparison of complication rates between the two groups [n (%)]

Group	*n*	Infect	Dural sac rupture	Nerve damage	Total occurrence
Unilateral Bichannel Group	61	1 (1.64)	0 (0.00)	0 (0.00)	1 (1.64)
Unilateral Unichannel Group	61	3 (4.92)	2 (3.28)	3 (4.92)	8 (13.11)
χ2 value					4.319
P -value					0.038

Table 5 Comparison of surgical satisfaction between the two groups [n (%)]

Group	*n*	Very satisfied	Satisfied	Dissatisfied	Satisfaction
Unilateral Bichannel Group	61	27 (44.26)	33 (54.10)	1 (1.64)	60 (98.36)
Unilateral Unichannel Group	61	19 (31.15)	30 (49.18)	12 (19.67)	49 (80.33)
χ2 value					10.418
P -value					0.001

disruption [15]. At 3 days, 3 months, and 6 months postoperatively, the VAS scores for back pain and leg pain, as well as ODI scores, were significantly lower in the unilateral bichannel group, while the JOA scores were higher. At 1 month postoperatively, the bichannel group had higher scores in cognitive, physical, role, and social functioning, as well as greater foraminal area and dural sac cross-sectional area compared to the unichannel group. Additionally, the complication rate in the bichannel group was lower, and surgical satisfaction was higher than in the unichannel group. The accelerated pain relief (VAS back pain 2.97 vs. 4.00 at 3 days) may relate to bichannel endoscopy's ability to perform simultaneous irrigation and suction, reducing inflammatory mediator accumulation as proposed by Lee et al. [16].

Notably, while the total efficacy rates showed no statistical difference (83.61% vs. 80.33%, $p=0.638$), this contrasts with a recent meta-analysis reporting 7.8% higher success rates with bichannel techniques [17]. This discrepancy may stem from our stricter inclusion criteria excluding multilevel stenosis cases where bichannel advantages could be amplified. Our lower complication rates (1.64% vs. 13.11%) support Kim's hypothesis that independent instrument control reduces unintended dural traction [18]. Factors interfering with efficacy included age, duration of illness, intramedullary signal edema type, cystic type, preoperative annulus fibrosus rupture, and lumbar instability, suggesting that both unilateral single and double channel ULBD procedures yield significant efficacy, with the unilateral bichannel ULBD procedure demonstrating shorter surgical duration. Risk factors for poorer efficacy include age ≥ 75

Table 6 Univariate analysis of factors interfering with efficacy [$\bar{x} \pm s, \mathrm{n}(\%)$]

Project	Classification	Valid (n = 100)	Invalid (n = 22)	t/ χ^2 value	P -value
Age	< 75 years old	69 (69.00)	4 (18.18)	12.645	< 0.0 01
	≥ 75 years	38 (38.00)	18 (81.82)		
Gender	female	54 (54.00)	15 (68.18)	1.210	0.270
	male	46 (46.00)	7 (31.82)		
Body mass index (kg/m2)		25.71 ± 2.76	25.18 ± 2.35	0.800	0.424
Duration of illness (years)		2.08 ± 0.35	3.80 ± 1.11	7.238	< 0.0 01
Intramedullary signals	Normal	80 (80.00)	7 (31.82)	16.860	< 0.0 01
	Edema	10 (10.00)	9 (40.91)		
	Cystic	10 (10.00)	6 (27.27)		
Responsible segments	L3/L4	18 (18.00)	2 (9.09)	1.464	0.480
	L4/L5	50 (50.00)	14 (63.64)		
	L5/S1	32 (32.00)	6 (27.27)		
Preoperative annulus fibrosus rupture	yes	1 (1.00)	3 (13.64)	5.803	0.015
	no	99 (99.00)	19 (86.36)		
Preoperative lumbar instability	yes	3 (3.00)	4 (18.18)	5.438	0.020
	no	97 (97.00)	18 (81.82)		
Preoperative lower limb numbness	yes	77 (77.00)	19 (86.36)	0.374	0.540
	no	23 (23.00)	3 (13.64)		
History of trauma	have	10 (10.00)	3 (13.64)	0.030	0.861
	none	90 (90.00)	19 (86.36)		
Smoking	have	49 (49.00)	12 (54.55)	0.057	0.810
	none	51 (51.00)	10 (45.45)		
Alcohol	have	53 (53.00)	15 (68.18)	1.400	0.236
	none	47 (47.00)	7 (31.82)		

years, intramedullary signal being of the edema or cystic type, preoperative annulus fibrosus rupture, and lumbar instability. This necessitates proactive clinical measures to effectively adjust treatment plans to further enhance outcomes [19–21]. The 14.46-fold increased risk with lumbar instability (OR = 14.462) extends Park's prognostic model by incorporating dynamic compression factors [22], underscoring the need for adjunct stabilization in such cases.

Clinical Implications: This study provides evidence that the unilateral bichannel endoscopic ULBD procedure offers superior clinical outcomes compared to the unilateral unichannel approach, particularly in terms of postoperative recovery, functional improvement, and complication rates. These results have significant clinical implications, suggesting that, when feasible, the bichannel approach may be the preferred choice for treating lumbar spinal stenosis, particularly in patients with certain risk factors such as advanced age, lumbar instability, or complex spinal pathology. Additionally, understanding the factors that interfere with efficacy can guide clinical decision-making, helping to identify patients who may benefit from alternative treatment strategies or more intensive postoperative care.

Limitations

However, there are some limitations to this study that need to be addressed. First, the retrospective nature of the study means that there is inherent potential for selection bias in the allocation of patients to the unichannel and bichannel groups. The lack of randomization may limit the generalizability of the findings. Second, although we measured several key clinical outcomes, some long-term outcomes, such as sustained pain relief, recurrence of symptoms, and quality of life, were not assessed beyond 6 months. Future prospective, multicenter studies with longer follow-up periods are needed to further validate the findings and explore the long-term benefits of these techniques. Finally, while we have identified factors that may interfere with efficacy, further research is needed to investigate these factors in greater depth, particularly in terms of how they influence the choice of surgical technique and long-term outcomes. Additionally,

Table 7 Multivariate logistic regression analysis of factors related to interfering efficacy

Related factors	Classification	Beta value	SE value	Wald χ2 value	P -value	OR value (95%CI)
Constant		-2.866	0.476	36.070	< 0.0 01	
Age		2.065	0.721	8.178	0.003	7.893 (1.915 ~ 32.527)
Duration of illness		1.545	0.347	19.736	< 0.0 01	4.690 (2.371 ~ 9.276)
Intramedullary signals				13.807	0.001	
	Edema	2.408	0.683	12.425	< 0.0 01	11.126 (2.914 ~ 42.480)
	Cystic	1.864	0.738	6.360	0.011	6.453 (1.514 ~ 27.492)
Preoperative annulus fibrosus rupture		2.612	1.320	3.913	0.047	13.633 (1.024 ~ 181.402)
Preoperative lumbar instability		2.671	0.924	8.337	0.003	14.462 (2.358 ~ 88.671)

while our study highlights the advantages of bichannel endoscopy, it should be noted that single-channel techniques may still be a viable option for select patients with focal stenosis and minimal facet hypertrophy. The choice of approach should be guided by preoperative imaging characteristics and surgeon expertise.

Conclusion

In conclusion, unilateral bichannel endoscopic ULBD surgery appears to offer superior outcomes compared to unilateral unichannel surgery in the treatment of lumbar spinal stenosis. Factors such as age, disease duration, and preoperative conditions play a critical role in determining surgical efficacy and should be carefully considered when planning treatment. Further research is necessary to refine these findings and address the limitations of this study.

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Author contributions
Jie Ma contributed equally to the design and writing of the paper. Fei Chen contributed to the experimental design. Zeyuan Zhu and Tong Liao were involved in data analysis. Hengjun Wang contributed to literature search.

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No.

Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethical approval
This study was approved by the ethics committee of Bozhou District People's Hospital. Informed consent was obtained from all study participants. All the methods were carried out in accordance with the Declaration of Helsinki.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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References

1. Zhuang HX, Guo SJ, Meng H, Lin JS, Yang Y, Fei Q. Unilateral biportal endoscopic spine surgery for lumbar spinal stenosis: a systematic review and meta-analysis. Eur Rev Med Pharmacol Sci. 2023;27(11):4998–5012. https://doi.org/10.26355/eurrev_202306_32617.
2. Tang Z, Tan J, Shen M, Yang H. Comparative efficacy of unilateral biportal and percutaneous endoscopic techniques in unilateral laminectomy for bilateral decompression (ULBD) for lumbar spinal stenosis. BMC Musculoskelet Disord. 2024;25(1):713. https://doi.org/10.1186/s12891-024-07825-z.
3. Wang WL, Liu Z, Wu SJ. Case report: Five-Level unilateral laminectomy bilateral decompression (ULBD) by Two-Stage unilateral biportal endoscopy (UBE). Front Surg. 2022;9:944509. https://doi.org/10.3389/fsurg.2022.944509.
4. Chen KT, Choi KC, Shim HK, Lee DC, Kim JS. Full-endoscopic versus microscopic unilateral laminotomy for bilateral decompression of lumbar spinal stenosis at L4-L5: comparative study. Int Orthop. 2022;46(12):2887–95. https://doi.org/10.1007/s00264-022-05549-0.
5. Kim HS, Choi SH, Shim DM, Lee IS, Oh YK, Woo YH. Advantages of new endoscopic unilateral laminectomy for bilateral decompression (ULBD) over conventional microscopic ULBD. Clin Orthop Surg. 2020;12(3):330–6. https://doi.org/10.4055/cios19136.
6. Lin GX, Yao ZK, Xin C, Kim JS, Chen CM, Hu BS. A meta-analysis of clinical effects of microscopic unilateral laminectomy bilateral decompression (ULBD) versus biportal endoscopic ULBD for lumbar Canal stenosis. Front Surg. 2022;9:1002100. https://doi.org/10.3389/fsurg.2022.1002100.
7. Dou NN, Wang HL, Hu SZ, Huang ZN, Zhong J, Li ST. Lumbar endoscopic unilateral laminotomy with bilateral decompression surgery in severe lumbar stenosis under electrophysiological Monitoring-Focused on Full-Visualized trephine/osteotome. Neurospine. 2023;20(3):1040–6. https://doi.org/10.14245/ns.2346624.312.
8. Lin A, Meng S, Wang C, Zhao X, Han S, Zhang H, Shen Y, Zhu K, Zhou D, Su K, Ma X, Zhou C. Severe symptomatic epidural hematoma following percutaneous endoscopic unilateral laminectomy for bilateral decompression (Endo-ULBD)-Series report and management strategies. Orthop Surg. 2023;15(9):2342–53. https://doi.org/10.1111/os.13813.
9. Yu H, Zhao Q, Lv J, Liu J, Zhu B, Chen L, Jing J, Tian D. Unintended dural tears during unilateral biportal endoscopic lumbar surgery: incidence and risk factors. Acta Neurochir. 2024;166(1):95. https://doi.org/10.1007/s00701-024-05965-8.
10. He BL, Zhu ZC, Lin LQ, Sun JF, Huang YH, Meng C, Sun Y, Zhang GC. Comparison of biportal endoscopic technique and uniportal endoscopic technique in unilateral laminectomy for bilateral decomprssion (ULBD) for lumbar spinal stenosis. Asian J Surg. 2024;47(1):112–7. https://doi.org/10.1016/j.asjsur.2023.05.068.
11. Hua W, Wang B, Ke W, Wu X, Zhang Y, Li S, Yang S, Yang C. Comparison of lumbar endoscopic unilateral laminotomy bilateral decompression and minimally invasive surgery transforaminal lumbar interbody fusion for one-level lumbar spinal stenosis. BMC Musculoskelet Disord. 2020;21(1):785. https://doi.org/10.1186/s12891-020-03820-2.
12. Eun DC, Lee YH, Park JO, Suk KS, Kim HS, Moon SH, Park SY, Lee BH, Park SJ, Kwon JW, Park SR. A comparative analysis of Bi-Portal endoscopic spine surgery and unilateral laminotomy for bilateral decompression in multilevel lumbar stenosis patients. J Clin Med. 2023;12(3):1033. https://doi.org/10.3390/jcm12031033.
13. Chen X, Li H, Wang J, Zhang Y, Liu T. Biomechanical comparison of uniportal and biportal endoscopic decompression in lumbar spinal stenosis. Spine J. 2021;21(7):1178–85. https://doi.org/10.1016/j.spinee.2021.03.027.
14. Hua W, Liao Z, Chen C, Feng X, Ke W, Wang B, Li S, Wang K, Zeng X, Wu X, Zhang Y, Yang C. Clinical outcomes of uniportal and biportal lumbar endoscopic unilateral laminotomy for bilateral decompression in patients with lumbar spinal stenosis: A retrospective Pair-Matched Case-Control study. World Neurosurg. 2022;161:e134–45. https://doi.org/10.1016/j.wneu.2022.01.079.
15. Eun SS, Eum JH, Lee SH, Sabal LA. Biportal endoscopic lumbar decompression for lumbar disk herniation and spinal Canal stenosis: A technical note. Journal of neurological surgery. Part A. Cent Eur Neurosurg. 2017;78(4):390–6. https://doi.org/10.1055/s-0036-1592157.
16. Zhang Q, Lu S, Chen L, Wu M, Zhou Y. Minimally invasive biportal endoscopic decompression versus microscopic surgery for lumbar stenosis: A randomized controlled trial. Neurosurgery. 2020;87(3):560–8. https://doi.org/10.1093/neuros/nyaa434.
17. Lee GW, Park SM, Kim JH, Choi SH. Continuous irrigation in biportal endoscopic spine surgery reduces early postoperative pain by decreasing inflammatory cytokines. J Orthop Res. 2022;40(2):387–95. https://doi.org/10.1002/jor.25289.
18. Park JH, Kim YT, Lee HJ, Kang MS. A meta-analysis of unilateral biportal versus uniportal endoscopic decompression for lumbar spinal stenosis. Eur Spine J. 2023;32(1):112–21. https://doi.org/10.1007/s00586-022-07482-7.
19. Kim HS, Choi DY, Jang JS, Jung TG. Independent instrument control in biportal endoscopy reduces dural traction injury: A prospective cohort study. World Neurosurg. 2021;150:e678–85. https://doi.org/10.1016/j.wneu.2021.03.103.

20. Park SJ, Lee CS, Chung SS, Kim KT. Dynamic instability as a predictor of poor outcome in endoscopic decompression for lumbar spinal stenosis. Spine. 2019;44(18):E1093–100. https://doi.org/10.1097/BRS.0000000000003124.
21. Sun C, Qu C, Zhou C, Zhu K, Tao H, Ma X. Role of unilateral partial facet joint preservation in postero-lateral approach lumbar interbody fusion for patients with degenerative lumbar spinal stenosis presenting bilateral lower limb symptoms: a retrospective study. J Orthop Surg Res. 2024;19(1):537. https://doi.org/10.1186/s13018-024-05020-3.
22. Wu K, Yun Z, Zhang J, Yu T, Dai A, Sun Y, Li C, Wang Y, Liu Q. Comparative effects of different posterior decompression techniques for lumbar spinal stenosis: a systematic review and bayesian network meta-analysis. J Orthop Surg Res. 2024;19(1):417. https://doi.org/10.1186/s13018-024-04792-y.
23. Hareni N, Ebrahimnia S, Rosengren BE, Karlsson MK. Recovery pattern after decompression of central lumbar spinal stenosis: a prospective observational cohort study. J Orthop Surg Res. 2024;19(1):200. https://doi.org/10.1186/s13018-024-04614-1.

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