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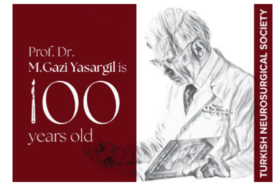

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Original Investigation

Spine and Peripheral Nerves

Comparison of Microsurgical and Biportal Endoscopic Approach in Lumbar Lateral Recess Stenosis Surgery: Single Center Retrospective Analysis

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To watch the surgical videoclip, please visit https://www.turkishneurosurgery.org.tr/uploads/jtn-49538-video.mp4.

ABSTRACT

AIM: To compare the clinical outcomes of microsurgery and biportal endoscopic spinal surgery (BESS) in lateral recess stenosis.

MATERIAL and METHODS: This study evaluated the outcomes of patients with lumbar lateral recess stenosis who underwent microsurgery or BESS between March 2021 and October 2022. Data from 55 patients undergoing simple decompression were analyzed. The parameters assessed included operative time, visual analog scale (VAS) pain score, Oswestry Disability Index (ODI), hemoglobin levels, hospital stay, complication rates, and requirement for postoperative opioids.

RESULTS: Between March 2021 and October 2022, 55 patients with lumbar lateral recess stenosis underwent simple decompression: [BESS: n=35, Microsurgery: n=20; and a total of 65 levels (L5–S1: 13.8%, L4–5: 53.8%, L3–4: 24.6%, L2–3: 7.6%)]. Operative times for both procedures were similar (BESS: 89.05 ± 28 min vs. microsurgery: 92.25 ± 33.02 min; p=0.89). The BESS group experienced significantly lower early postoperative back pain (VAS score: 3.57 ± 1.77 vs. 5.5 ± 1.9; p=0.003), and both groups showed long-term improvements in pain (p=0.001). The alleviation of leg pain was comparable (p>0.05), and the Oswestry Disability Index score improved significantly from 52 ± 13.96 to 27.49 ± 14.2 (p=0.001) in both groups by the third month postoperatively. The BESS group had a smaller drop in hemoglobin levels (0.62 ± 0.53 vs. 2.45 ± 1.74 g/dL; p=0.003), shorter hospital stay (33.97 ± 29.16 vs. 71.4 ± 51.13 hours; p<0.001), and lower postoperative opioid requirements (37.14% vs. 80%; p=0.0021).

CONCLUSION: BESS offers a safe, effective alternative to microsurgery for lumbar lateral recess stenosis, providing comparable outcomes along with benefits such as reduced postoperative pain, bleeding, and shorter hospital stays. This biportal endoscopic approach is a promising option for treating lumbar stenosis.

KEYWORDS: Surgical procedures, Endoscopic spinal stenosis, Lumbar disc disease

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INTRODUCTION

Spinal surgery using microsurgical techniques remains the most widely used approach for treating lumbar lateral recess stenosis when conservative treatments are inadequate. This method was pioneered by Yasargil and Caspar in the 1970s (1,24). During that period, endoscopic methods were widely popular in other surgical specialties, and they were soon adapted for spinal procedures as well. In the 1980s, Kambin and Sampson introduced modern percutaneous endoscopic transforaminal surgery (8), and Ruetten et al. developed percutaneous endoscopic interlaminar surgery in the early 2000s (20). The primary advantage of monoportal endoscopic systems is their ability to provide a magnified, high-definition view of anatomical structures, facilitating surgery through small incisions with minimal muscle disruption and reduced bleeding (8,21). These factors contribute to significantly less postoperative pain and shorter hospital stays. In 1996, De Antoni et al. adapted the classic arthroscopy technique to spinal surgery, creating biportal endoscopic spinal surgery (BESS) (3). BESS allows independent movement of the camera and instruments through two portals, providing almost the same freedom of movement as microsurgery (16,17). Furthermore, the use of standard arthroscopic instruments, widely available in most hospitals, reduces the need for extra budget allocation (9,10).

This study analyzes the effectiveness and advantages of BESS by comparing cases of lumbar lateral recess stenosis treated using BESS with those treated using microsurgery.

MATERIAL and METHODS

This study presents a retrospective analysis of patients who underwent surgery for lumbar lateral recess stenosis between March 2021 and October 2022. The primary aim was to compare the outcomes of microsurgical techniques with those of BESS. All surgeries were performed by a single surgeon (MIO). Only cases involving simple decompression were included in both groups, with a minimum follow-up duration of 2 years postsurgery. Patients were excluded from the study if they 1) showed segmental instability on extension/flexion radiographs, 2) had undergone stabilization/fusion procedures, and 3) were undergoing repeat surgery at the same spinal level. Patient data were obtained with written consent from medical records, discharge summaries, surgical reports, and routine follow-up notes. The data collected included demographic details (age and gender), stenosis level, operation duration (minutes), and pain scores evaluated using the visual analog scale (VAS) for both back and leg pain at preoperative, early postoperative (6 hours), and late postoperative (1 year) timepoints. Preoperative and postoperative ODI scores and postoperative MacNab scores were also recorded. Early and late complications, as well as the need for revision surgery within the first 2 years, were investigated. Changes in preoperative and postoperative hemoglobin levels were documented, along with the length of hospital stay (hours). Ethical approval for retrospective research was obtained from the local board (E1–23–3357) on 08.03.2023. Informed consent was obtained from all patients included in this study.

Surgical Technique

Biportal Endoscopic Group

In the biportal endoscopic group, a skin incision was made at the pedicle level both above and below the targeted intervertebral level while the patient lay in the prone position. Following confirmation via triangulation with lateral and anteroposterior X-rays, the procedure commenced with the insertion of a 30-degree telescope into the viewing port. The soft tissues overlying the bony structures were carefully dissected, and hemostasis was achieved using a radiofrequency probe. After the key bony landmarks, such as the spinous process, lamina, and inferior articular process, were identified, a partial ipsilateral laminectomy was performed using a burr. Subsequently, hypertrophic ligamentum flavum in the lateral recess was excised using Kerrison rongeurs, resulting in decompression of the nerve root and thecal sac (Video 1). To minimize the risk of instability, the facet joints were preserved to the greatest extent possible during this procedure. However, in some cases of severe hypertrophy in the facet joint, a minimal excision was also performed from the superior articular process for root decompression. Neural decompression was confirmed through the observation of pulsatile movement within the tissues (Figures 1-4). If the symptoms were bilateral, the same

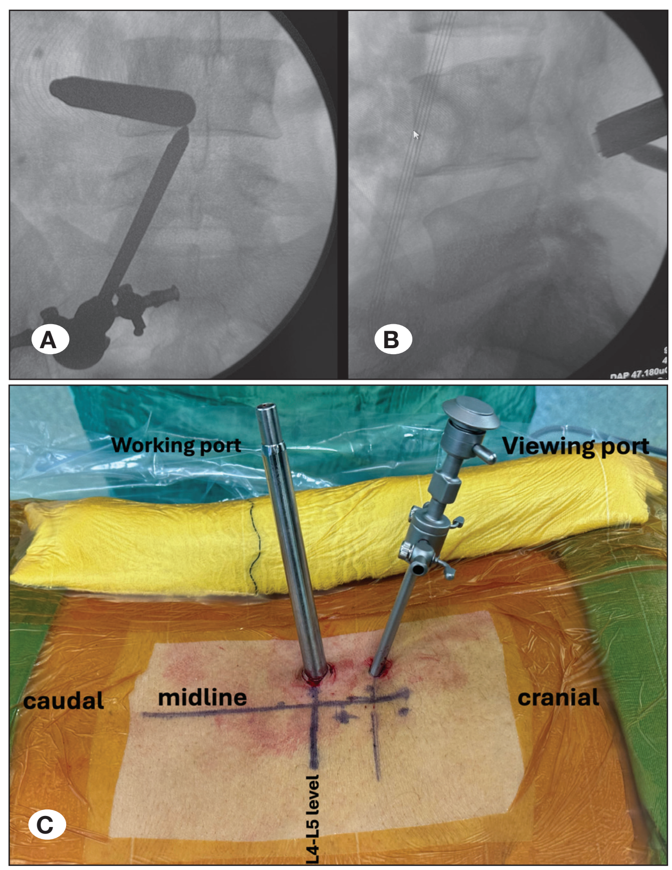

Figure 1: Triangulation stage of the unilateral biportal endoscopic technique. **A)** Anteroposterior fluoroscopic image of the triangulation performed at the left L4–5 spinolaminar junction. **B)** Lateral fluoroscopic image of the triangulation. **C)** Surgical image following triangulation.

procedure was applied to the lateral recess on the contralateral side using a contralateral sublaminar technique from under the spinous process, thus providing contralateral exiting and traversing root decompression (Figures 3, 4).

Microsurgical Group

The patient was asked to lay in the prone position, and the target level was confirmed using fluoroscopy. A midline skin incision, approximately 3–4-cm-long, was made, and the paraspinal muscles on the symptomatic side were dissected and retracted using Meyerding retractors. A unilateral laminotomy was performed via a subspinous approach using a Kerrison rongeur and burr, followed by removal of the hypertrophic ligamentum flavum to decompress the lateral recess on the ip-

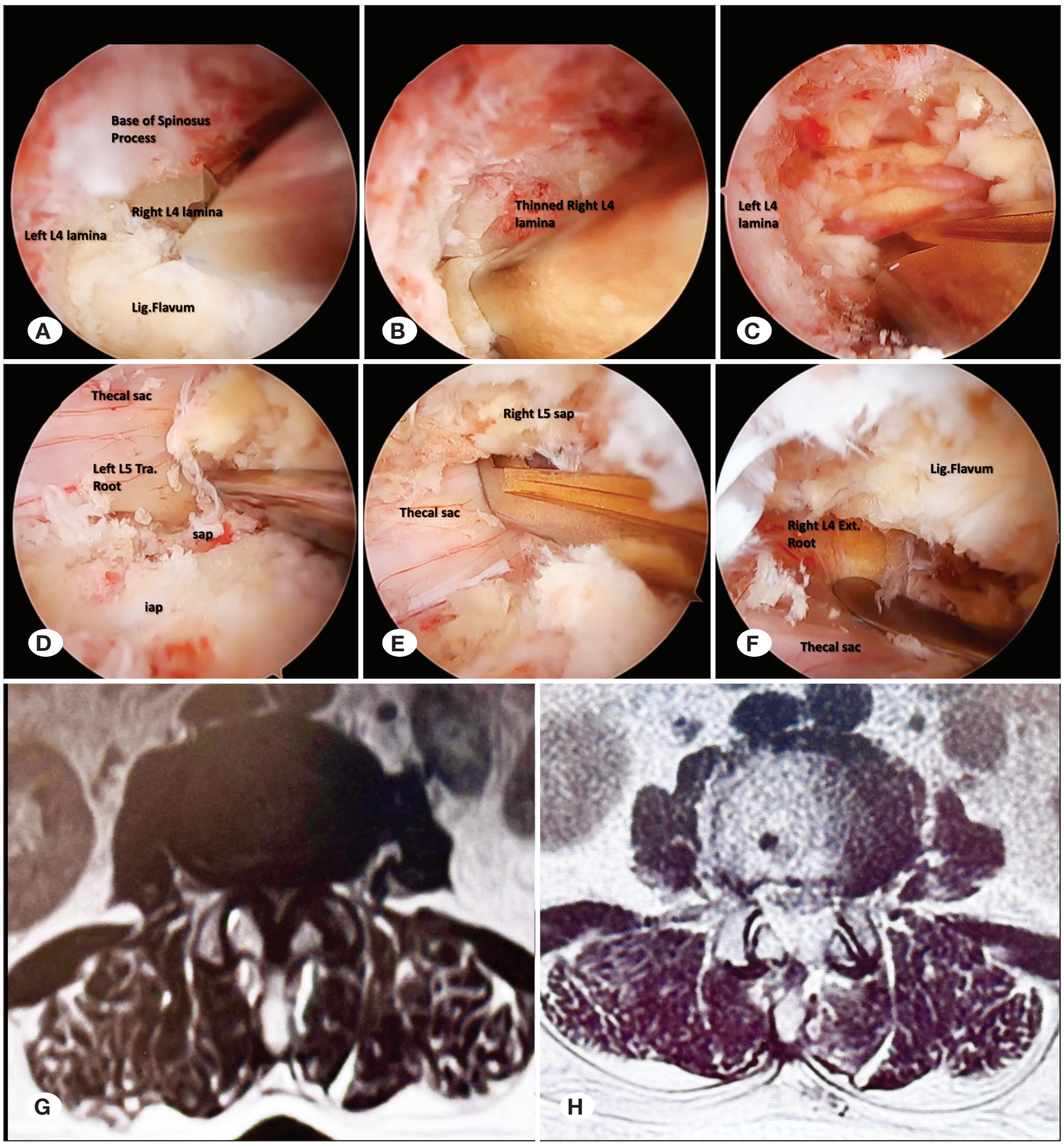

Figure 2: Illustrative case of bilateral lumbar lateral recess stenosis treated using the biportal endoscopic spinal surgery (BESS) technique at the left L4–5 level. A partial laminectomy at the left L4 was first performed to expose the ligamentum flavum. After removing the base of the spinous process, the flavum was dissected from the inner surface of the right L4 lamina. **B)** The right L4 lamina was thinned using a burr, and the flavum, which was freed from the cranial side, was excised using a Kerrison rongeur. **C)** The flavum over the lateral recess on the left side was excised, decompressing the left L4 exiting root at the axillary level. **D)** After removing the flavum from the lateral recess, the superior articular process of the left L5 was partially resected to decompress the left L5 traversing root. **E)** The angled endoscope was then turned to the contralateral side, and the superior articular process of the right L5 was partially resected to decompress the right L5 traversing root. **F)** Hypertrophied flavum at the lateral recess level on the contralateral side was excised, decompressing the right L4 exiting root. Preoperative **(G)** and postoperative **(H)** T2 axial magnetic resonance imagings of the patient.

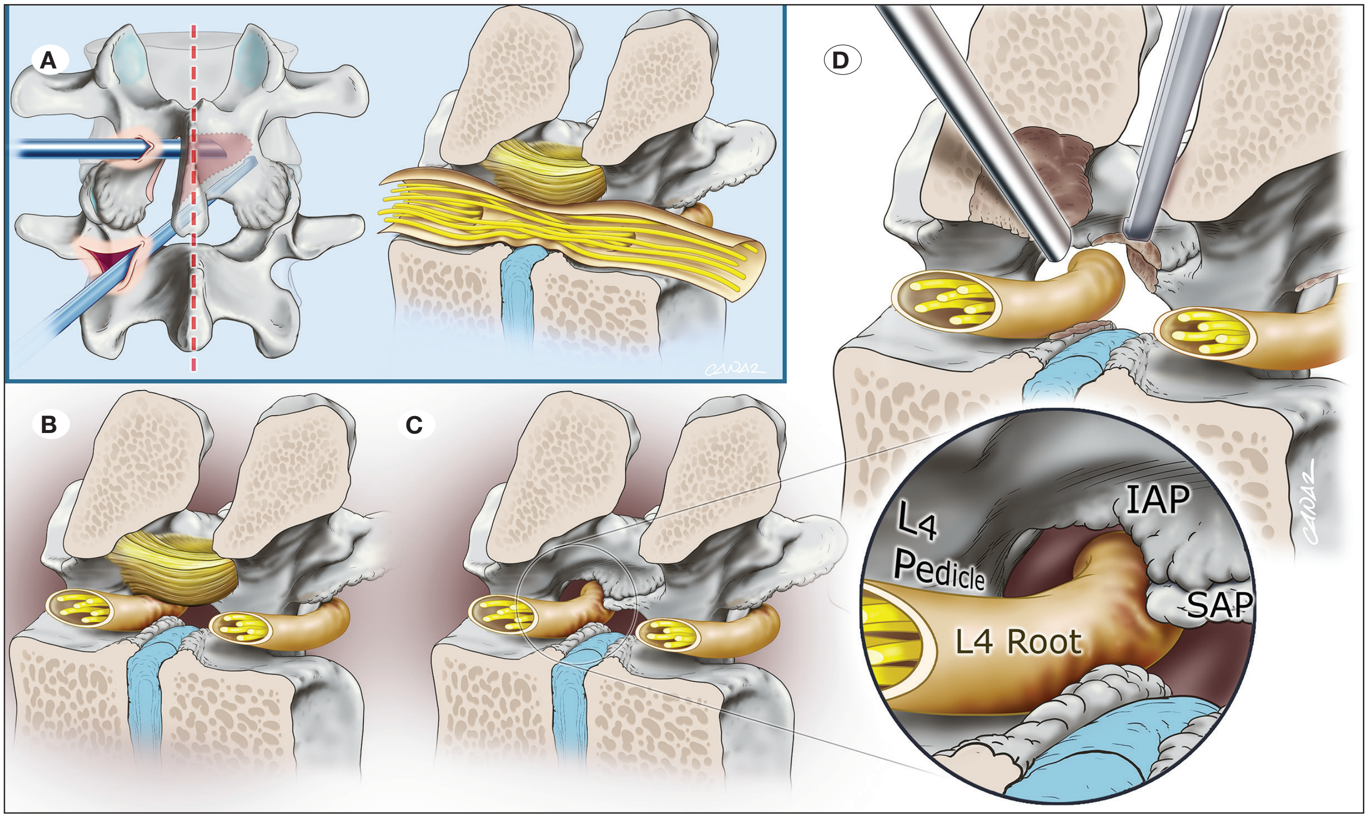

Figure 3: Illustration of lateral recess exiting root decompression on the contralateral side using the biportal technique: **A)** View of the contralateral exiting root after thinning the inner surface of the contralateral lamina with a burr. **B)** Hypertrophied ligament in the lateral recess compressing the contralateral exiting root. **C)** After excision of the hypertrophied ligament, partial decompression of the exiting root was observed, along with compression from the hypertrophied inferior and superior articular processes. **D)** Final decompressed state of the contralateral superior and inferior articular processes after decompression using Kerrison rongeur, chisel, and curette (Illustration by CC Medical Arts. Reproduced with permission).

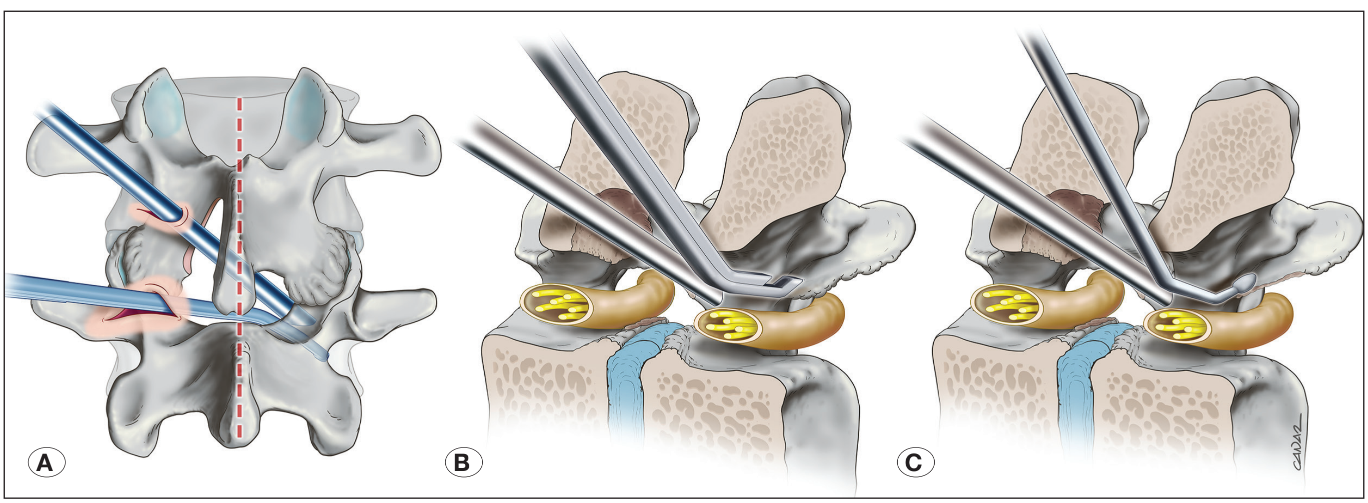

Figure 4: Illustration of contralateral traversing root decompression. **A)** Antero-posterior view of the ports directed toward the caudal side of the foramen. **B)** Osteophytic inferior articular process compressing the traversing root was observed. **C)** Image of the decompressed traversing root after excision of the compressive ligamentous and osteophytic structures using curved Kerrison rongeur, curved chisel, and curettes (Illustration by CC Medical Arts. Reproduced with permission).

silateral side. If contralateral symptoms were present, bilateral decompression was performed through the same unilateral approach by undercutting the base of the spinous process and accessing the contralateral sublaminar space. In cases of facet joint compression, partial excision of the superior articular process was performed. The procedure was completed once adequate decompression was achieved, and efforts were taken to preserve the bony and soft tissue structures to minimize the risk of postoperative instability.

Approach Selection

Starting from March 2022, our clinic adopted biportal endoscopic decompression as the standard surgical approach for lateral recess stenosis. Patients who underwent surgery before March 2022 were treated with conventional microsurgical decompression. This time-based allocation strategy allowed for a natural division of the study population without introducing selection bias. All patients met the same inclusion criteria, and the choice of surgical technique was determined solely by the institutional transition in routine clinical practice.

Statistical Analysis

The normality of continuous variables was assessed using the Shapiro–Wilk test. Two non-normally distributed independent variables were compared using the Mann–Whitney U test, while two normally dıstrıbuted independent variables were compared usıng Student's t-test. Dependent variables with normal distributions were compared using the Wilcoxon signed-rank test. Relationships between categorical variables were analyzed using the chi-square test (or Fisher's exact test, as appropriate). The threshold of statistical significance was set at a p-value of 0.05, and all analyses were performed using SPSS software.

RESULTS

Between March 2021 and October 2022, 55 patients diagnosed with lumbar lateral recess stenosis underwent simple decompression. Of these patients, 35 underwent biportal endoscopic decompression, and 20 underwent microsurgical decompression. A total of 65 level operations were performed on these 55 patients because 10 patients presented with bilateral symptoms. Bilateral decompression was performed in all 10 patients with bilateral symptoms-4 in the biportal endoscopic group and 6 in the microsurgical group. Although a statistical comparison was conducted, the number of bilateral cases was too small to yield a significant difference between the groups.

Of the 55 patients, 28 (50.9%) were women. During the operations, dural tears occurred in five patients (9%), and one patient (1.8%) experienced osteomyelitis. In the postsurgical assessment of MacNab scores, 13 patients (23.6%) achieved an excellent outcome, 26 (47.2%) a good outcome, 14 (25.4%) a fair outcome, and 2 (3.6%) a poor outcome. During the 2 years of follow-up, revision surgery was required in two patients (3.6%)-one due to infection and the other due to the development of instability, which warranted stabilization/fusion surgery.

The average age of the patients was 57.9 ± 11.4 years. The operation duration was 90.21 ± 29.66 minutes. The back pain VAS scores were 5.05 ± 1.95, 4.27 ± 1.9, and 1.94 ± 1.61 at the preoperative, early postoperative (6 hours), and late postoperative (1 year) timepoints, respectively. The leg pain VAS scores were 5.49 ± 1.71, 1.36 ± 1.35, and 1.18 ± 1.24 at the preoperative, early postoperative (6 hours), and late postoperative (1 year) timepoints, respectively. The preoperative ODI score for patients was 52 ± 13.96, which decreased to 27.49 ± 14.2 in the third month postoperatively. The preoperative hemoglobin level was 14.05 ± 1.66 g/dL, which decreased to 12.76 ± 1.85 postoperatively. The average length of hospital stay was 47.58 ± 42.25 hours.

Comparison of the Two Groups

The microsurgical and biportal endoscopic groups did not differ significantly in patient age (p=0.33). The operation durations were 92.25 ± 33.02 minutes for the microsurgical group and 89.05 ± 28 minutes for the biportal endoscopic group (p=0.89). The two groups did not differ significantly in back pain VAS scores at the preoperative and late postoperative (3-month) timepoints (p=0.7, p=0.87, respectively). However, the early postoperative (6-hour) back pain VAS score was significantly higher in the microsurgical group (5.5 ± 1.9) compared with the biportal endoscopic group (3.57 ± 1.77; p=0.003). İn terms of preoperative and postoperative values, back pain improved significantly in both the groups (p=0.001). The two groups did not differ significantly in leg pain VAS scores at the preoperative, early postoperative, and late postoperative (1-year) timepoints (p=0.15, p=0.28, p=0.64, respectively). İn terms of preoperative and postoperative values, leg pain improved significantly in both the groups (p=0.001). The two groups did not differ significantly in preoperative and postoperative ODI scores (p=0.69, p=0.3, respectively). The change in hemoglobin levels between the preoperative and postoperative periods was significantly higher in the microsurgical group (2.45 ± 1.74 g/dL) compared with the biportal endoscopic group (0.62 ± 0.53 g/dL; p=0.003). The length of hospital stay was significantly higher in the microsurgical group (71.4 ± 51.13 hours) compared with the biportal endoscopic group (33.97 ± 29.16 hours; p<0.001; Table I).

The gender distribution of patients was similar between the microsurgical and biportal endoscopic groups (p=0.581). Three patients from the microsurgical group (15%) and three patients from the biportal endoscopic group (8.5%) faced complications (p=0.46). One patient in each group required revision surgery (p=0.68). The MacNab scores of the two groups did not differ sigificantly (p=0.89). A significantly higher proportion of patients required postoperative opioid analgesics in the microsurgical group (n=16, 80%) compared with the biportal endoscopic group (n=13, 37.14%; p=0.0021; Table II).

DISCUSSION

As in other surgical disciplines, minimally invasive techniques are gaining popularity in spinal surgery. In procedures for lateral recess stenosis, preserving the posterior elements that contribute to spinal stability—the muscles, spinous process, lamina, facet joint, and posterior longitudinal ligament—can reduce the long-term complications associated with surgery (5,18). The monoportal endoscopic technique allows decompression through a single 0.5–1-cm-long skin incision with minimal muscle and bone damage (6). De Antoni et al. performed spine arthroscopy for the first time in 1996 by working through two ports. He solved the problem of movement limitation while minimizing muscle and bone damage (3).

In this retrospective study, we compared the data of 55 patients who underwent either microsurgery or BESS for lumbar lateral recess stenosis and were followed up for 2 years. We analyzed the advantages and disadvantages, long-term results, and complication rates of the two techniques.

Early postoperative lower back pain VAS scores were lower in the BESS group, which can be attributed to two possible reasons. First, the paravertebral muscles remain intact during BESS because the procedure uses dilators to create channels between muscle fibers, minimizing injury to posterior

Table I: Comparisons Between Groups

	Microsurgery	**Biportal Endoscopic**	**p-value**
	Mean + SD **Med. (Min–Max)**	**Mean + SD** **Med. (Min–Max)**	
Age (years)	58.8 ± 10.58 63 (37–73)	57.4 ± 12 60 (37–78)	0.33[1]
Operation Duration (minutes)	92.25 ± 33.02 80 (55–180)	89.05 ± 28.00 90 (44–150)	0.89[2]
Back Pain (preoperative VAS)	4.85 ± 2.27 5 (1–9)	5.17 ± 1.77 5 (1–9)	0.70[2]
Back Pain (postoperative 6-hour VAS)	5.5 ± 1.9 5 (2–9)	3.57 ± 1.59 3 (2–8)	**0.003[2]**
Back Pain (postoperative 1-year VAS)	2.15 ± 2.03 1 (0–8)	1.82 ± 1.33 2 (0–6)	0.87[2]
p-value[3]	**<0.001**	**<0.001**	
Leg Pain (preoperative VAS)	5.8 ± 1.64 6 (0–8)	5.31 ± 1.76 5 (1–9)	0.15[2]
Leg Pain (postoperative 1-year VAS)	1.15 ± 1.34 1 (0–6)	1.48 ± 1.35 1 (0–6)	0.28[2]
Leg Pain (postoperative 3-month VAS)	1.35 ± 1.42 1 (0–5)	1.08 ± 1.14 1 (0–5)	0.64[2]
p-value[3]	**<0.001**	**<0.001**	
ODI Preoperative	51.5 ± 10.01 50 (40–80)	52.5 ± 15.92 52.28 (18–82)	0.69[2]
ODI Postoperative 1-year	25.3 ± 14.06 20 (10–64)	28.74 ± 14.33 26 (8–62)	0.30[2]
p-value[3]	**<0.001**	**<0.001**	
Preoperative Hb	14.36 ± 1.74 14.3 (11.8–16.9)	13.88 ± 1.61 13.7 (9.6–16.7)	0.92[2]
Postoperative Hb	11.91 ± 1.82 11.5 (8.8–16)	13.25 ± 1.70 13.15 (9.3–16.4)	0.12[2]
Change in Hb	2.45 ± 1.74 1.6 (0.7–4.7)	0.62 ± 0.53 0.45 (0.1–2.9)	**0.003[2]**
Discharge Time (hours)	71.4 ± 51.13 48 (36–264)	33.97 ± 29.16 27 (14–180)	**<0.001**[2]

*Student's t-test[1], Mann–Whitney U test[2], Wilcoxon test[3]. **SD:** Standart deviation, **Med.:** Median, **VAS:** Visual analogue scale, **ODI:** Oswestry disablity index, **Hb:** Hemoglobin.*

Table II: Comparisons Between Groups

		Microsurgery	Biportal Endoscopic	p-value
		n (%)	n (%)	
Gender (female)		9 (45.0)	19 (54.2)	0.5815[1]
Number of Complication		3 (15.0)	3 (8.5)	0.46[2]
Need for Revision Surgery		1 (5.1)	1 (2.8)	0.6829[2]
MacNab Third Month	Excellent	4 (20.0)	9 (25.7)	0.8904[2]
	Good	9 (45.0)	17 (48.5)	
	Fair	6 (30.0)	8 (22.8)	
	Poor	1 (5.0)	1 (2.8)	
Postoperative Need for Opioid Analgesics		16 (80.0)	13 (37.14)	**0.0021**[2]

***1:** Fisher's Exact test*, ***2:** Chi-square test.*

musculo-ligamentous structures. Second, the 30-degree high-definition endoscope used in the procedure provides a close and clear view, facilitating precision and eliminating the need for unnecessary laminectomy and facetectomy (18). This study demonstrates that although the two groups do not differ in terms of long-term outcomes, patient comfort was higher in the BESS group due to milder lower back pain in the early postoperative period. This is reflected in the observation that narcotic analgesics were required by 80% of the patients in the microsurgery group, compared with 37% in the BESS group. Previous studies employing both BESS and monoportal methods have emphasized that lower back pain in the early postoperative period is milder compared with that after microsurgery (6,20,21,23).

Back pain and discomfort in the early postoperative period are not the only negative consequences of muscle stripping. Prolonged retraction for a wider field of view in microsurgery leads to ischemic damage to the muscle and subsequent scar tissue formation around it. Accelerated muscle atrophy also accelerates spinal degeneration and is thought to invite spinal instability (2,7,14,19,23).

A 30-degree endoscope offers a close view, which can help us precisely locate the site of neural tissue compression. The contralateral sublaminar space can be easily visualized. In this way, the BESS method avoids unnecessary laminectomy and facetectomy, thereby mitigating the risk of instability. The return of dural sac pulsation confirmed the achievement of adequate decompression. The presence of two independent ports allows for a wide range of motion, almost as much as that offered by microsurgery. Therefore, the BESS technique can be regarded as a hybrid technique that offers the advantages of microsurgery and monoportal technique (15).

While no significant difference in operative time was observed between the groups, the operative times for both techniques may decrease with increasing proficiency. The BESS group experienced significantly less bleeding due to saline irrigation pressure on the epidural veins and the absence of paravertebral muscle stripping. This group also had a shorter hospital stay owing to reduced bleeding and less postoperative back pain, with no expected cerebrospinal fluid (CSF) fistula, even in cases of dural tear. Achieving these advantages of the monoportal technique without the added cost of specialized devices enhances the cost-effectiveness of this procedure. Additionally, performing the procedure under continuous irrigation has been suggested to reduce the risk of infection (20–22).

A disadvantage of continuous irrigation is that it may cause increased intracranial pressure because the increased water pressure on the dural sac disrupts CSF circulation between the brain and spinal cord. In the early postoperative period, the patient may experience nuchal/headache, delirium, blurred vision, and even loss of vision due to retinal hemorrhage (4,11-13). To avoid this serious complication, our anesthesia team administered rocuronium bromide IV every half an hour at a dosage of 1 mL/10 mg. This was in addition to the precautions mentioned in the literature, such as placing the table in a reverse trend position, perfecting fluid outflow with accurate triangulation, and cutting the fascia perpendicular to the skin.

Complication rates did not differ significantly between the two groups. In the BESS group, one patient developed an infection, and two exhibited dural rupture without CSF fistula. In the microsurgery group, one patient required fusion surgery owing to instability, and two exhibited dural rupture. Although a CSF fistula was observed in one of these two patients, the discharge was controlled using interventions such as pressure dressing and primary suturing of the wound site. Dural ruptures, a common complication in patients with lumbar stenosis, are no longer a serious threat for patients undergoing BESS. Although infection is rare during endoscopic spine surgery owing to continuous irrigation and minimal soft tissue disruption, one case of postoperative osteomyelitis was recorded during the early phase of our endoscopic practice. At that time, reusable instruments were reprocessed using liquid chemical high-level disinfection (ortho-phthalaldehyde–based solutions). Following this event, we transitioned to ethylene oxide gas sterilization, and no further infections have been recorded ever since.

The biportal endoscopic approach offers a significant economic advantage over traditional microsurgical decompression techniques. Patients undergoing the biportal endoscopic procedure often experience reduced postoperative pain, which manifests in shorter hospital stays and decreased reliance on postoperative medications, such as opioid analgesics. This not only enhances patient comfort but also lowers hospital and medication expenses. The relatively longer hospitalization stay observed in the microsurgical group can be attributed to the routine use of subfascial drains, which were typically removed after 24–48 hours. In accordance with our institutional protocol, patients were discharged following an additional period of postoperative monitoring. The minimally invasive nature of the biportal endoscopic technique facilitates faster recovery times. Patients can often resume daily activities sooner than those undergoing microsurgery, which can reduce indirect costs, such as lost income and productivity during recovery. The biportal endoscopic approach can be performed using a standard arthroscope. This reduces equipment-related costs without compromising the quality of care.

Limitations

This study has some limitations. The sample size was relatively small, and the follow-up period was limited to 2 years. Additionally, this was a retrospective analysis rather than a randomized, double-blind study.

CONCLUSION

In terms of safety, the BESS technique is comparable to microsurgery, which remains the most commonly used surgical approach for lumbar lateral recess stenosis. BESS incorporates the advantages of minimally invasive techniques, including reduced disruption of the posterior musculoskeletal ligamentous structures, minimized bleeding, and shorter hospital stays. Additionally, the use of standard arthroscopic systems makes BESS an affordable option.

Declarations

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Availability of data and materials: The datasets generated and/or analyzed during the current study are available from the corresponding author by reasonable request.

Disclosure: The authors declare no competing interests.

AUTHORSHIP CONTRIBUTION

Study conception and design: OKD, MIO

Data collection: MIO, GU

Analysis and interpretation of results: OKD, MEG

Draft manuscript preparation: OKD, MIO

Critical revision of the article: OKD

All authors (MIO, MEG, GU, OKD) reviewed the results and approved the final version of the manuscript.

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