RESEARCH ARTICLE

pISSN: 0126-074X | eISSN: 2338-6223
https://doi.org/10.15395/mkb.v57.4128
Majalah Kedokteran Bandung. 2025;57(3):220–224

Majalah Kedokteran Bandung (MKB)

Received: September 30, 2024
Accepted: May 23, 2025
Available online: September 30, 2025

Functional Outcome of Biportal Endoscopy Spine Surgery for Lumbar Disc Herniation Diseases

Ajid Risdianto,[1,2] Happy Kurnia,[2] Krisna Tsaniadi,[2] Dody Priambada,[2] Eri Andar,[2] Zaenal Muttaqien,[2] Yuriz Bakthiar,[2] M. Thohar Arifin[2]

[1]Doctoral Study Program at Medical Science and Health Science, Universitas Diponegoro, Indonesia
[2]Department of Neurosurgery, Faculty of Medicine Universitas Diponegoro/Dr. Kariadi Hospital Semarang, Indonesia

Abstract

Biportal endoscopic spine surgery (BESS) is an innovative, minimally invasive technique to treat lumbar disc herniation (LDH). BESS provides superior surgical visualization with minimal tissue dissection. However, its application requires a thorough understanding of endoscopic anatomy and adaptation of endoscopy equipment, which are key factors in achieving optimal functional outcomes post-surgery. This study aimed to evaluate the functional outcomes and complications of BESS performed on 49 patients between 2020 and 2022 at Dr. Kariadi Hospital, Semarang, Indonesia. The majority of patients (53%) had herniation at the L4-5 level, followed by L5-S1. Pain assessment using the Visual Analog Scale (VAS) demonstrated a significant reduction in pain, from 4.26 to 1.5, post-surgery. Functional outcomes, as evaluated using MacNab's Criteria, revealed that 93.8% of patients achieved a satisfactory condition, with 36.7% reporting no pain and 57.1% experiencing occasional pain that did not affect their daily activities. Complications were minimal, with two cases of dural tears and intraoperative bleeding. The study concludes that BESS is a safe and effective procedure for LDH, resulting in significant pain relief and functional improvement, although certain technical challenges persist.

Keywords: Biportal endoscopy, lumbar disc herniation, MacNab scale score, visual analog scale

Introduction

Lumbar disc herniation (LDH) is a leading cause of lower back pain and sciatica, affecting millions of people worldwide.[1]Traditional open spine surgeries, though effective in addressing LDH, are often associated with significant drawbacks, including extensive soft tissue damage, prolonged recovery periods, and higher risks of complications such as dural tears and infection.[2] These limitations underscore the need for more refined, minimally invasive approaches to spine surgery.[2]

In recent years, the development of endoscopic spine surgery (ESS) has emerged as a promising solution to these issues.[3] Techniques such as full-endoscopic discectomy and percutaneous endoscopic lumbar discectomy have shown improved outcomes with less tissue damage, shorter hospital stays, and faster recovery times.[4] Among these advancements, biportal endoscopic spine surgery (BESS) has gained traction for its unique approach, which involves two independent portals, offering enhanced visualization and maneuverability around neural structures.[5] Despite these benefits, BESS presents technical challenges, such as limited working space and the steep learning curve required to achieve proficiency.[6]

This study evaluates the functional outcomes and complications of BESS in the treatment of LDH, based on clinical data from 49 patients who underwent the procedure at Dr. Kariadi Hospital, Semarang, between 2020 and 2022. By focusing on pain reduction and functional recovery, this study seeks to provide further insights into the efficacy and safety of BESS for treating lumbar disc herniation, offering a clearer understanding of its advantages and limitations.

The primary objectives of this research are to assess functional outcomes using MacNab's Criteria, evaluate pain reduction through

Corresponding Author:
Ajid Risdianto
Division of Neurospine Surgery Department of Neurosurgery, Faculty of Medicine, Universitas Diponegoro/ Kariadi Hospital, Semarang, Indonesia
Email: ajidrisdianto@lecturer.undip.ac.id

the Visual Analog Scale (VAS), and identify complications associated with the Biportal Endoscopic Spine Surgery (BESS) technique. The findings aim to inform future advancements in minimally invasive spine surgery and enhance patient care.

The novelty of this study lies in providing new clinical data on the use of BESS for treating Lumbar Disc Herniation (LDH), specifically from a cohort of patients treated at Kariadi Hospital.

Methods

This study was conducted as an observational analysis of 49 patients diagnosed with lumbar disc herniation (LDH) and treated with biportal endoscopic spine surgery (BESS) at Dr. Kariadi Hospital, Semarang, between 2020 and 2022. Ethical approval was obtained from the Health Research Ethics Committee of Dr. Kariadi Hospital (approval number 2019–852). Written informed consent was obtained from all patients. Patients were eligible for inclusion if: 1) had a prolapsed lumbar disc with unilateral radiculopathy; 2) tested positive for the straight leg raise (SLR) or femoral stretch test; 3) had magnetic resonance imaging (MRI) confirming a single nerve root lesion; and 4) had undergone at least six weeks of conservative therapy, including bed rest, activity modification, physiotherapy, and medication, with persistent symptoms.
Exclusion criteria were: 1) multilevel disc prolapse or root involvement; 2) diagnosis of cauda equina syndrome; 3) discrepancy between clinical and radiological findings. All patients underwent BESS discectomy under general anesthesia. BESS involves two independent portals: one for the endoscope and another for surgical instruments. The procedure was performed using a saline irrigation system to maintain clear visualization. A combination of endoscopic instruments was used to perform the discectomy and decompress the affected nerve root.

Pain was evaluated using the Visual Analog Scale (VAS) both preoperatively and postoperatively. Pain and functional outcomes were assessed at a postoperative follow-up period of 1 months, which allowed for an early evaluation of surgical success and complication rates. However, longer-term follow-up is recommended in future studies to evaluate the durability of these outcomes. Functional outcomes were assessed postoperatively using MacNab's Criteria, classifying patients into one of four categories: 1) Excellent (no pain, unrestricted activity), 2) Good (occasional pain, no interference with activities), 3) Fair (improved but with intermittent pain that interferes with work or leisure), 4) Poor (no improvement or worsened condition).

Statistical analysis was performed using SPSS software. Pre- and postoperative VAS scores were compared with the Student's t-test, with $p<0.05$ considered statistically significant.

Results

A total 49 patients were included in this study, the majority of whom were women (51%), with a mean age of 46.7 years. The most frequently herniated vertebral segments were L4-5 (53.1%), followed by L5-S1 (32.7%) and L3-4 (14.3%). The majority of herniations occurred on the left side (77.6%) (Table 1).

Evaluation of the pain carried out before and after the BESS procedure showed a significant decrease ($p<0.001$) from a mean of 4.26 to 1.5 (Table 2). There was a substantial decrease in the VAS pain scale between pre-operative and post-operative BESS.

Further subgroup analysis was conducted to compare VAS score improvements across different herniation levels. Patients with L4-5 herniation exhibited the most significant mean VAS reduction (from 4.3 to 1.3), followed by those with L5-S1 (from 4.2 to 1.6), and L3-4 (from 4.1 to 1.8). Although all groups showed improvement, the L4-5 group demonstrated the

Table 1 Demographic and Lumbar Disc Herniation Characteristics

Demographic and Characteristics	n (%)	Mean (min-max)
Gender		
Male	24 (49)	-
Female	25 (51)	
Age		46.7 (18–65)
Level of vertebrae		
Lumbar 3–4	7 (14.3)	
Lumbar 4–5	26 (53.1)	
Lumbar 5–Sacral 1	16 (32.7)	
Location		
Left side	38 (77.6)	
Right side	11 (22.4)	

Table 2 Pain Evaluation Pre- and Post-Surgery

Variable	Mean
VAS Pre-surgery	4.26
VAS Post-surgery	1.5
p-value	<0.001

greatest overall pain reduction.

Additionally, a comparison based on herniation side showed that left-sided herniations (n=38) experienced a VAS reduction from 4.25 to 1.4, while right-sided herniations (n=11) showed a reduction from 4.27 to 1.7. Though both groups experienced statistically significant improvements, patients with left-sided herniations showed slightly better outcomes.

Table 3 shows an evaluation of functional outcomes after the BESS procedure based on MacNab criteria. The results showed that the majority of patients met criterion 2 (57.1%; occasional back pain or leg pain not interfering with the ability to perform regular work, or to enjoy leisure activity), followed by criterion 1 (36.7%; no pain, no restriction of activity) and criterion 3 (6.4%; improved functional capacity but handicapped by intermittent pain of sufficient severity to curtail or modify work of leisure activities).

Table 3 Functional Evaluation After BESS Surgery

MacNab Criteria	n (%)
Criteria 1 (no pain, unrestricted activity)	18 (36.7)
Criteria 2 (occasional pain, no interference)	28 (57.1)
Criteria 3 (intermittent pain, activity limitation)	3 (6.4)

Discussion

This study evaluated the functional outcomes and complications associated with biportal endoscopic spine surgery (BESS) for lumbar disc herniation (LDH). A total of 49 patients who underwent BESS were analyzed, with a focus on patient demographics, pain reduction, and functional outcomes.

The majority of patients in this study were women (51%) with a mean age of 46.7 years. This aligns with other studies that suggest women are slightly more prone to LDH, where women accounted for 52.6% of LDH cases.[7] The most common herniation site was at the L4-L5 vertebrae (53.1%), followed by L5-S1 (32.7%). These findings are consistent with the global pattern of lumbar disc herniation, which predominantly affects the L4-L5 and L5-S1 levels due to the higher mechanical stress these segments endure. Sedighi et al. also reported similar distributions of herniation sites in their study.[8,9]

Pain outcomes demonstrated a significant reduction in mean VAS scores from 4.26 preoperatively to 1.5 postoperatively ($p<0.001$). Patients with L4-5 herniations showed the most substantial decrease in VAS scores, which may be attributed to the high prevalence of this level in the cohort and its relatively accessible anatomy during endoscopic procedures. The L3-4 group exhibited slightly less improvement, possibly due to more complex anatomical constraints or smaller sample size. Moreover, laterality seemed to influence outcomes. Left-sided herniations had a marginally greater VAS improvement than right-sided ones. While the clinical relevance remains to be fully clarified, this could be partially attributed to the surgeon's right-handedness, which might facilitate better access and control during decompression on one side. Future studies with detailed documentation of surgeon handedness and operative technique may help validate this observation.

A significant reduction in pain levels postoperatively as demonstrated in Table 2. The mean VAS score dropped from 4.26 preoperatively to 1.5 postoperatively, highlighting the effectiveness of BESS in relieving pain. This result is statistically significant ($p < 0.001$) and consistent with the findings of Kim et al., where patients reported significant pain relief after undergoing BESS.[10] The ability of BESS to reduce pain while minimizing soft tissue damage has made it an attractive option compared to traditional open surgery, which typically involves longer recovery times and more extensive postoperative pain.

Functional outcomes were measured using MacNab's Criteria, as shown in table 3. The majority of patients (57.1%) achieved MacNab Grade 2 (occasional pain, no significant

interference with daily activities), while 36.7% of patients were classified as Grade 1 (no pain, no restriction of activity). Only 6.4% fell into Grade 3 (improved but with intermittent pain affecting activities). These outcomes are consistent with previous study that reported 87% of patients treated with BESS achieved either excellent or good results according to MacNab's Criteria.[11]

The results of this study align closely with previous research on BESS and other minimally invasive spine surgery techniques. Similar positive outcomes in patients with spinal stenosis treated with BESS, with 81% achieving good or excellent results and significant improvements in functional outcomes after BESS procedures.[12,13] The reduction in postoperative pain and improved functionality found in this study further reinforce the growing body of evidence that BESS is an effective technique for the treatment of lumbar disc herniation.

However, while the outcomes are promising, the complication rate must also be considered. In this study, two cases of dural tears and intraoperative bleeding were reported, which corresponds to a 4% complication rate. This is in line with other studies such as those where dural tears and minor intraoperative bleeding were among the most commonly reported complications during BESS procedures.[10,14] Despite these complications, the minimally invasive nature of BESS offers a significant advantage over traditional open surgeries, which are often associated with higher rates of infection, blood loss, and prolonged recovery times.[5]

Another important consideration is the anatomical characteristics of the disc bulging itself. The size of the bulge may play a critical role in the likelihood of complications, such as dural tears and intraoperative bleeding, as observed in two cases in this study. Larger or more protrusive disc bulges can make surgical access more challenging, increase manipulation of neural structures, and thereby raise the risk of iatrogenic injury.

Additionally, the spatial relationship between the herniated disc and the adjacent nerve root deserves attention. Depending on whether the nerve root is displaced laterally, compressed centrally, or lies directly over the bulging disc, the complexity of the surgical procedure and the risk of complications may vary. Discussing these anatomical nuances could help in preoperative planning and in anticipating technical difficulties during BESS procedures.

A key strength of this study is the detailed analysis of both pain reduction and functional recovery, which provides a comprehensive evaluation of the BESS technique. Additionally, the use of objective criteria such as the VAS for pain and MacNab's Criteria for functionality ensures that the outcomes are both measurable and comparable to previous research.

However, this study has several limitations. First, the sample size of 49 patients, while adequate for a preliminary analysis, is relatively small compared to larger studies. A larger patient population would allow for more generalizable conclusions. Additionally, the follow-up period was not extensive, limiting the ability to assess long-term outcomes and potential late complications. Future studies should aim for a longer follow-up to evaluate the durability of the surgical results over time. Finally, while this study highlights the efficacy of BESS, it does not address the steep learning curve associated with mastering the technique. Surgeons unfamiliar with BESS may experience higher complication rates until they achieve proficiency.

In conclusion, BESS is a highly effective and minimally invasive approach for treating lumbar disc herniation. Significant reductions in pain and improvements in functional outcomes were observed, with a relatively low complication rate. Despite the technical challenges and steep learning curve, BESS offers several advantages over conventional open spine surgeries, including reduced tissue damage, faster recovery, and lower complication rates. However, to enhance the understanding and safety of the procedure, future studies should incorporate additional findings such as the size and anatomical positioning of the disc bulge, as well as the spatial relationship of the nerve root to the herniated disc. These factors may have critical implications for complication risks and surgical strategy, and their inclusion could greatly benefit preoperative planning and overall outcomes in BESS.

References

1. Greenberg MS. Handbook of neurosurgery. 6th ed. New York: Thieme; 2006.
2. Kang KB, Shin YS, Seo EM. Endoscopic Spinal Surgery (BESS and UESS) versus microscopic surgery in lumbar spinal stenosis: systematic review and meta-analysis. Global Spine J. 2022;12(8):1943–55. doi:10.1177/21925682221083271
3. Kwon H, Park JY. The role and future of endoscopic spine surgery: a narrative

review. Neurospine. 2023;20(1):43–55. doi:10.14245/ns.2346236.118
4. Han H, Song Y, Li Y, Zhou H, Fu Y, Li J. Short-term clinical efficacy and safety of unilateral biportal endoscopic transforaminal lumbar interbody fusion versus minimally invasive transforaminal lumbar interbody fusion in the treatment of lumbar degenerative diseases: a systematic review and meta-analysis. J Orthop Surg Res. 2023;18(1):656. doi: 10.1186/s13018-023-04138-0
5. Awuah WA, Adebusoye FT, Alshareefy Y, Cheng Ng J, Tomas Ferreira AL, Abdus Salam AL, et al. Biportal endoscopic surgery for lumbar spine herniated discs: a narrative review of its clinical application and outcomes. Annals Medicine Surgery. 2023;85(8):3965–73. doi: 10.1097/ms9.0000000000001053
6. Choi CM. Biportal endoscopic spine surgery (Bess): Considering merits and pitfalls. J Spine Surg. 2020;6(2):457–65. doi: 10.21037/jss.2019.09.29
7. Azharuddin A, Aryandono T, Magetsari R, Dwiprahasto I. Predictors of the conservative management outcomes in patients with lumbar herniated nucleus pulposus: A prospective study in Indonesia. Asian J Surg. 2022;45(1):277–83. doi:10.1016/j.asjsur.2021.05.015
8. Sedighi M, Haghnegahdar A. Lumbar disk herniation surgery: outcome and predictors. Global Spine J. 2014;4(4):233–43. doi:10.1055/s-0034-1390010
9. Battié MC, Videman T, Parent E. Lumbar disc degeneration. Spine (Phila Pa 1976). 2004;29(23):2679–90. doi:10.1097/01.brs.0000146457.83240.eb
10. Kim JE, Choi DJ. Unilateral biportal endoscopic decompression by 30° endoscopy in lumbar spinal stenosis: Technical note and preliminary report. J Orthop. 2018;15(2):366–71. doi:10.1016/j.jor.2018.01.039
11. Soliman HM. Irrigation endoscopic decompressive laminotomy. A new endoscopic approach for spinal stenosis decompression. Spine J. 2015;15(10):2282–9. doi:10.1016/j.spinee.2015.07.009
12. Kim HS, You JD, Ju C Il. Predictive scoring and risk factors of early recurrence after percutaneous endoscopic lumbar discectomy. Biomed Res Int. 2019;2019(13):9–12. doi:10.1155/2019/6492675
13. Eum JH, Heo DH, Son SK, Park CK. Percutaneous biportal endoscopic decompression for lumbar spinal stenosis: A technical note and preliminary clinical results. J Neurosurg Spine. 2016;24(4):602–7. doi:10.3171/2015.7.SPINE15304
14. Choi DJ, Kim JE. Efficacy of biportal endoscopic spine surgery for lumbar spinal stenosis. CiOS Clinics in Orthopedic Surgery. 2019;11(1):82–8. doi:10.4055/cios.2019.11.1.82