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Comparative Effects of Endoscopic and Minimally Invasive Transforaminal Lumbar Interbody Fusion in Geriatric Lumbar Disc Herniation

Xiangjie Su[1], Xiaoyan Zuo[2], Shaorong Yi[3], Yang Zhang[3]*

[1]Department of Orthopedics, The 921st Hospital of the People's Liberation Army, The Second Affiliated Hospital of Hunan Normal University, Changsha, Hunan, 410003, China

[2]The Third Hospital of Changsha City, Changsha, Hunan, 410003, China

[3]Department of Orthopedics, Clinical Medical College, Hunan Normal University, Changsha, Hunan, 410003, China

ABSTRACT

Objective: To analyze and compare the therapeutic effects and surgical parameters of Minimally Invasive Transforaminal Lumbar Interbody Fusion (MIS-TLIF) versus Endoscopic Transforaminal Lumbar Interbody Fusion (Endo-TLIF) for treating elderly patients with lumbar disc herniation. Methods: This study enrolled eighty elderly patients diagnosed with lumbar disc herniation who received treatment between January 2023 and December 2024. Based on the surgical procedure performed, patients were allocated into two equal groups. The control group included forty patients who underwent Minimally Invasive Transforaminal Lumbar Interbody Fusion, and the study group consisted of forty patients treated with Endoscopic Transforaminal Lumbar Interbody Fusion. The clinical efficacy and perioperative metrics were compared between the two groups. Results: The study group exhibited significantly less intraoperative blood loss, shorter surgical time, and a reduced period of postoperative bed rest relative to the control group ($P < 0.05$). However, the study group required a greater number of intraoperative fluoroscopy exposures ($P < 0.05$). There were no statistically significant differences between the two groups, either before or after treatment, regarding the Japanese Orthopaedic Association scores (JOA), the Oswestry Disability Index (ODI), the Visual Analog Scale scores (VAS), range of motion, or intervertebral space height ($P > 0.05$). Moreover, the patient satisfaction rate was significantly higher in the study group at 92.5 percent, compared to 75.0 percent in the control group ($P < 0.05$). Conclusion: For treating lumbar disc herniation in elderly patients, both Endoscopic Transforaminal Lumbar Interbody Fusion and Minimally Invasive Transforaminal Lumbar Interbody Fusion demonstrate comparable efficacy in functional recovery and pain intensity reduction. However, the endoscopic technique is associated with significantly shorter operative times and substantially higher patient satisfaction rates.

KEYWORDS

Elderly; Lumbar disc herniation; Minimally invasive surgery; Spinal endoscopy; Transforaminal lumbar interbody fusion

1 Introduction

Lumbar Disc Herniation, or LDH, has become a highly prevalent clinical condition, particularly within the elderly population. It is a clinical syndrome resulting from neural element compression due to nucleus pulposus protrusion, annular fiber rupture, and degenerative disc disease, representing a primary cause of low back and leg pain [1]. For patients with severe LDH symptoms, lumbar interbody fusion is often the indicated treatment. However, conventional open lumbar fusion is associated with a considerable risk of complications and potential iatrogenic nerve injury. With advancements in surgical techniques and instrumentation, minimally invasive spine technologies such as Minimally Invasive Transforaminal Lumbar Interbody Fusion, known as MIS-TLIF, and Endoscopic Transforaminal Lumbar Interbody Fusion, referred to as Endo-TLIF, have been increasingly adopted for the management of LDH. The MIS-TLIF procedure, being substantially less invasive than its open counterpart, has emerged as a mainstream surgical approach. The Endo-TLIF technique is characterized by a high safety profile and a low incidence of surgical complications [2]. Both MIS-TLIF and Endo-TLIF possess distinct advantages and limitations. Elderly patients with LDH often present with more complex bone conditions, which necessitate higher standards for both surgical safety and efficacy. This study was therefore designed to compare the therapeutic effects and surgical parameters of MIS-TLIF and Endo-TLIF for treating elderly patients with LDH, aiming to provide valuable guidance for clinical practice.

2 General information and methods

2.1 Patient demographics

A total of eighty elderly patients diagnosed with lumbar disc herniation were enrolled in this study. All patients were admitted for treatment between January 2023 and December 2024. Upon admission, they were allocated into two groups of forty patients each based on the surgical procedure. The control group comprised 22 males and 18 females, with a

* **Corresponding Author:** Yang Zhang, 915506329@qq.com

mean age of 68.31 ± 2.64 years and a mean body mass index of 21.86 ± 1.17 kg/m ^{2}. The study group consisted of 24 males and 16 females, with a mean age of 68.87 ± 2.13 years and a mean body mass index of 22.16 ± 1.42 kg/m ^{2}. There were no statistically significant differences in these baseline characteristics between the two groups ($P > 0.05$). The inclusion criteria were: age of 60 years or older, clear surgical indications for lumbar fusion, fulfillment of the diagnostic criteria for lumbar disc herniation [3], and provision of written informed consent. The exclusion criteria included malignant tumors, severe diseases of major organs, psychiatric disorders, or a history of other significant orthopedic conditions.

2.2 Methods

Patients in the control group underwent MIS-TLIF. Following the induction of general anesthesia, patients were placed in the prone position. A tubular retractor system was inserted to provide surgical access. Under direct visualization, a unilateral laminectomy and medial facetectomy were performed for neural decompression. A complete discectomy was then conducted, and the anterior intervertebral space was packed with autologous bone graft. A polyetheretherketone, or PEEK, cage was inserted. Subsequently, pedicle screws of appropriate dimensions were placed percutaneously via the same incision. The wound was then closed in layers.

Patients in the study group underwent Endo-TLIF. After the induction of general anesthesia, patients were positioned prone. A guidewire was inserted via a puncture needle, followed by sequential dilation and placement of a working cannula. Under endoscopic visualization, relevant anatomical structures were identified, followed by spinal canal decompression and discectomy. A fusion cage was then optimally positioned in the intervertebral space under fluoroscopic guidance. After withdrawing the endoscopic instruments, guidewires were inserted for the percutaneous placement of pedicle screws. Bilateral connecting rods were attached and secured by tightening the set screws. Finally, the incision was irrigated and sutured.

2.3 Outcome measures

Primary and secondary outcomes were evaluated as follows. First, key surgical parameters were compared between the two groups. These included intraoperative blood loss, the number of intraoperative fluoroscopy exposures, the operative duration, and the length of postoperative bed rest. Second, functional disability and pain intensity were assessed. The Japanese Orthopaedic Association (JOA) score was used to evaluate functional status, covering aspects such as bladder function, limitations in daily activities, clinical signs, and subjective symptoms. The JOA is scored on a 29-point scale, with lower scores indicating more severe disability [4]. The Oswestry Disability Index (ODI) was employed to assess low back pain-related functional limitation on a 50-point scale, where higher scores correspond to greater disability [5]. Pain intensity was quantified using the Visual Analog Scale (VAS), which ranges from 0 for no pain to 10 for the most severe pain imaginable [6]. These assessments were conducted before treatment and again at three months postoperatively. Third, radiographic indicators were measured. Lumbar spine X-rays were used to evaluate the segmental range of motion (ROM) and the intervertebral space height index. Measurements were taken preoperatively and repeated three months after the surgical procedure. Fourth, patient satisfaction and the incidence of complications were recorded. Upon discharge, patients completed a custom satisfaction survey. Satisfaction was rated on a 10-point scale and categorized as unsatisfied for scores of 4 or less, moderately satisfied for scores between 5 and 7, and highly satisfied for scores from 8 to 10. The occurrence of any complications during the treatment period was systematically documented.

2.4 Statistical analysis

All statistical analyses were performed using SPSS version 24.00. Normally distributed continuous data were expressed as mean ± standard deviation. Intergroup comparisons of these data were conducted using an independent samples t-test, while intragroup comparisons were made using a paired t-test. Categorical data were presented as frequencies and percentages and were compared between groups using the chi-square test. The P value of less than 0.05 was considered to indicate statistical significance.

3 Results

3.1 Comparison of surgical parameters

Relative to the control group, the study group experienced significantly less intraoperative blood loss, required a greater number of intraoperative fluoroscopy exposures, and had a shorter operative time as well as a reduced postoperative bed rest period. All these differences were statistically significant ($P < 0.05$). These data are presented in Table 1.

Table 1 Comparison of perioperative parameters between study and control groups (Mean ± SD)

Group	n	Intraoperative blood loss	Intraoperative fluoroscopy frequency	Operative time	Postoperative bed rest time
		(mL)	(times)	(min)	(days)
Control Group	40	46.32 ± 6.31	6.84 ± 1.32	80.92 ± 9.07	2.48 ± 0.77
Study Group	40	31.44 ± 4.46	7.64 ± 1.48	76.34 ± 8.41	1.13 ± 0.42
t		12.18	2.55	2.34	9.73
P-value		<0.001	0.013	0.022	<0.001

3.2 Comparison of functional and pain outcomes

Before the intervention, there were no statistically significant differences between the two groups in their baseline JOA scores, ODI, or VAS scores ($P > 0.05$). Following treatment, both groups demonstrated significant improvements compared to their preoperative status, evidenced by a significant increase in JOA scores and a significant decrease in both ODI and VAS scores ($P < 0.05$ for all intragroup comparisons). However, when comparing the postoperative outcomes between the groups, no statistically significant differences were found for any of these functional and pain metrics ($P > 0.05$). These findings are detailed in Table 2.

Table 2 Comparison of functional disability and pain scores between groups (Mean ± SD)

Group	n	JOA Score		ODI Index		VAS Score	
		Preoperative	Postoperative	Preoperative	Postoperative	Preoperative	Postoperative
Control Group	40	15.76 ± 1.74	27.28 ± 5.23*	28.93 ± 2.57	12.23 ± 1.62*	8.44 ± 1.31	3.96 ± 1.42*
Study Group	40	15.42 ± 2.05	26.86 ± 4.81*	29.24 ± 2.46	11.58 ± 1.37*	8.56 ± 1.28	4.07 ± 1.36*
t		0.8	0.37	0.55	1.94	0.41	0.35
P-value		0.426	0.709	0.583	0.056	0.68	0.724

* indicates a significant difference compared to before treatment, P < 0.05;

3.3 Comparison of radiographic indicators

There were no statistically significant differences observed between the control and study groups in terms of segmental range of motion or the intervertebral space height index, either at the preoperative baseline or at the postoperative follow-up assessment ($P > 0.05$). These results are presented in Table 3.

Table 3 Comparison of radiographic parameters between groups (Mean ± SD)

Group	n	ROM		Intervertebral Space Height Index	
		Preoperative	Postoperative	Preoperative	Postoperative
Control Group	40	9.08 ± 0.15	9.14 ± 0.17	0.36 ± 0.04	0.36 ± 0.06
Study Group	40	9.06 ± 0.14	9.14 ± 0.14	0.36 ± 0.03	0.36 ± 0.07
t		0.62	0.00	0.00	0.00
P-value		0.539	1.000	1.000	1.000

3.4 Comparison of patient satisfaction and complications

The overall patient satisfaction rate was significantly higher in the study group at 92.50 percent compared to 75.00 percent in the control group ($P < 0.05$), as detailed in Table 4. Regarding complications, one patient in the control group experienced a dural tear postoperatively, whereas no complications were observed in the study group. The difference in the overall incidence of complications between the two groups was not statistically significant ($P > 0.05$).

Table 4 Comparison of Patient Satisfaction Between Groups [n (%)]

Group	n	Dissatisfied	Moderately Satisfied	Highly Satisfied	Total Satisfaction
		(≤4 points)	(5-7 points)	(8-10 points)	(≥5 points)
Control Group	40	10 (25.00)	14 (35.00)	16 (40.00)	30 (75.00)
Study Group	40	3 (7.50)	12 (30.00)	25 (62.50)	37 (92.50)
χ^2-*value*			-		4.501
P-value			-		0.034*

4 Discussion

Both MIS-TLIF and Endo-TLIF have become established as mainstream surgical treatments for lumbar disc herniation [7].

In the present study, the Endo-TLIF group demonstrated less intraoperative blood loss, shorter operative time, and a reduced period of postoperative bed rest, although it required more frequent intraoperative fluoroscopy. These findings suggest that Endo-TLIF offers greater surgical efficiency and facilitates an earlier postoperative recovery. This may be attributed to the procedural characteristics of Endo-TLIF, which involves smaller incisions and a less disruptive access corridor for the fusion implant. This approach minimizes iatrogenic damage and pressure on adjacent paraspinal muscles, eliminating the need for extensive muscle retraction. The ability to perform key steps under direct endoscopic visualization likely contributes to its higher efficiency and reduced surgical trauma [8].

Our results show that both groups achieved significant clinical improvement postoperatively compared to their preoperative status, as evidenced by increased JOA scores and decreased ODI and VAS scores. However, there were no statistically significant differences in these functional and pain metrics between the two groups after treatment. This indicates that for elderly patients with lumbar disc herniation, MIS-TLIF and Endo-TLIF are comparable in their effectiveness at improving quality of life, restoring function, and alleviating pain. Notably, the overall patient satisfaction rate was significantly higher in the study group at 92.50 percent compared to 75.00 percent in the control group. A potential explanation for this is that the less invasive nature of the Endo-TLIF procedure may reduce patient apprehension and postoperative discomfort, thereby leading to a more positive patient experience. Furthermore, no significant intergroup differences were found in the radiographic outcomes of segmental range of motion and intervertebral space height, either preoperatively or postoperatively. Similarly, the complication rates did not differ significantly between the groups. This suggests that both surgical techniques are effective in restoring intervertebral height without negatively impacting normal spinal kinematics, and both exhibit a high safety profile with few adverse events.

In conclusion, for the treatment of elderly patients with lumbar disc herniation, Endo-TLIF and MIS-TLIF provide similar benefits regarding functional improvement and pain relief. However, the Endo-TLIF approach is associated with enhanced surgical efficiency and a significantly higher degree of patient satisfaction.

About the Author

1. Xiangjie Su, male, Han ethnicity, from Huizhou, Guangdong Province, holds a master's degree, research focus: orthopedics.

2. Yang Zhang, male, Han ethnicity, from Miluo, Hunan Province, holds a master's degree, research focus: Orthopedics.

References

[1] Wang B, Tuo YF, Wang THS, et al. [Efficacy of percutaneous transforaminal endoscopic surgery for lumbar disc herniation combined with lumbar spinal stenosis]. J North Sichuan Med Coll. 2024;39:1056-8, 1063. (in Chinese).

[2] Lin WG, Hu YS, Yao JL, et al. [Efficacy of lumbar discectomy combined with unilateral dynamic stabilization for lumbar disc herniation]. J Clin Orthop. 2022;25:464-7. (in Chinese).

[3] Wang JB, Cheng YD, Wu J. [Clinical study on the treatment of lumbar disc herniation with lumbar instability using autologous bone graft and interbody fusion cages]. China Med Sci. 2020;10:182-4, 244. (in Chinese).

[4] Zhang ZC, Zhang Y, Zhang LZ, et al. [A comparative study of Dynesys dynamic stabilization via small-incision muscle-sparing approach versus fusion surgery for lumbar disc herniation]. Chin J Bone Joint. 2020;9:762-6. (in Chinese).

[5] Yang P. [Clinical efficacy of posterior thoracolumbar internal fixation with interbody bone graft fusion for lumbar disc herniation complicated with lumbar instability]. Chin J Disabil Med. 2019;27:24-5. (in Chinese).

[6] Wu B, Li YQ, Wang Z. [Efficacy analysis of unilateral biportal endoscopy for the treatment of sequestrated lumbar disc herniation]. J Clin Surg. 2022;30:991-3. (in Chinese).

[7] Sun MM, Pan YL. [Analysis of high-risk factors for recurrence after percutaneous spinal endoscopy for lumbar disc herniation]. J Qiqihar Med Univ. 2021;42:1407-10. (in Chinese).

[8] Geng TJ, Wang HH. [An investigation on the efficacy of full-endoscopic discectomy via interlaminar approach for L4-S1 lumbar disc herniation]. J Harbin Med Univ. 2021;55:187-90. (in Chinese).