ORIGINAL RESEARCH

# Clinical Study of Percutaneous Endoscopic Large-channel Fusion and Transforaminal Lumbar Interbody Fusion in the Treatment of Degenerative Lumbar Spinal Stenosis

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**ABSTRACT**

**Context** • Degenerative changes in the lumbar spine more commonly cause spinal stenosis and with the aging of society, its incidence is on the rise. Endoscopic spinal surgery is a minimally invasive technique for decompression. The efficacy of percutaneous, endoscopic, large-channel fusion and transforaminal lumbar interbody fusion (TLIF) need confirmation by more studies.

**Objective** • The study intended to investigate the clinical efficacy of percutaneous endoscopic large-channel fusion and TLIF in the treatment of degenerative lumbar spinal stenosis, to find the best treatment plan.

**Design** • The research team performed a retrospective study.

**Setting** • The study took place at Nanjing Lishui People's Hospital in Nanjing, Jiangsu Province, PR China.

**Participants** • Participants were 100 patients with degenerative, lumbar, spinal stenosis who had been admitted to the hospital between October 2018 and October 2022.

**Intervention** • The research team randomly divided participants into an intervention group and a control group, with 50 participants in each group. The intervention group received percutaneous, endoscopic, large-channel fusion and internal fixation, and the control group received foraminal, lumbar, interbody fusion.

**Outcome Measures** • The research team measured: (1) perioperative indexes, (2) clinical efficacy at a postoperative follow-up at 6 months postintervention, (3) indexes for inflammatory responses at baseline and postintervention, (4) postoperative pain at baseline and at months 3 and 6 postintervention using a visual analog scale (VAS), (6) lumbar function at baseline and months 3 and 6 postintervention using the Oswestry Disability Index (ODI) and the Japanese Orthopedic Association (JOA) scale, and (7) complications.

**Results** • Compared with the control group, the intervention group's perioperatively related and inflammatory-response indexes were significantly better: (1) amount of bleeding— 112.67 ± 17.38 for the control group and 78.62 ± 10.52 for the intervention group ($P = .002$); (2) volume of drainage—79.63 ± 14.21 for the control group and 52.18 ± 8.21 for the intervention group ($P = .001$); (3) ESR at baseline and postintervention—22.41 ± 5.62 and 15.18 ± 5.26, respectively, for the control group and 22.58 ± 5.82 and 10.54 ± 3.18, respectively, for the intervention group, with $P = .013$ postintervention; and (4) CRP at baseline and postintervention—17.42 ± 3.52 and 13.98 ± 3.65 for the control group, respectively, and 18.65 ± 3.78 and 10.14 ± 2.78 for the intervention group, with $P = .008$ postintervention; Also, compared to the control group, the intervention group's: (1) total effective rate was significantly higher ($P = .018$); (2) incidence of postoperative complications was significantly lower ($P = .006$); (3) VAS pain score was significantly lower at months 3 and 6, with $P = .028$ and $P = .021$, respectively; (4) Oswestry Disability Index (ODI) function score was significantly lower at months 3 and 6, with $P = .016$ and $P = .014$, respectively; and (5) postoperative JOA function score was significantly higher at months 3 and 6, with $P = .011$ and $P = .007$, respectively.

**Conclusions** • Both percutaneous, endoscopic, large-channel fusion and TLIF had good therapeutic effects in the treatment of degenerative lumbar spinal stenosis. However, compared with the latter, the former was more effective, with better comprehensive efficacy and more obvious benefits for patients, so it's worthy of clinical promotion and use. (*Altern Ther Health Med.* 2023;29(8):552-557).

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## Degenerative Lumbar Spinal Stenosis

Degenerative lumbar spinal disorder (DLSD) is a common, complex disease with multiple pathogenic factors and requires spinal surgery. Such factors as overuse, trauma, genetic predisposition, and nutritional deficiency can induce or accelerate DLSD.

DLSD mainly refers to the reduction of the effective capacity of the spinal canal or nerve-root canal due to the presence of abnormal bone or fibrous tissues that hyperplasia of the bone or hyperplasia and hypertrophy of the fibrous tissue can cause.[1,2] The narrow sagittal diameter of the spinal canal can cause compression or stimulation of the spinal nerve root or the cauda equina, resulting in dysfunction and a series of symptoms.[3]

Although spinal stenosis can be congenital, degenerative changes in the lumbar spine more commonly cause it, and therefore, it has a higher incidence in older adults. With the aging of society, that incidence is on the rise, bringing difficulty for patients and burdens for society.[4] In recent years, with the aging of the population, the incidence of degenerative lumbar spinal stenosis has been increasing in China, which can have a serious impact on the quality of life of middle-aged and older people.

No clear evidence exists to help medical practitioners and patients choose an ideal conservative treatment plan, and surgery is still the disease's main treatment. Different surgical programs can produce different curative effects.[5]

Traditional posterior spinal surgery requires large incisions and a large amount of muscle dissection, resulting in more bleeding and a large amount of damage to the posterior stable structure, and providing a slow recovery. To achieve the best therapeutic effect, the spinal surgeon has the flexibility to choose between minimally invasive or open surgery, between fusion or internal fixation, depending on the patient and the hospital.[6-8]

### Endoscopic Spinal Surgery

For patients with lumbar disc herniation or lumbar stenosis, endoscopic spinal surgery is a minimally invasive technique for decompression. A number of studies have found that percutaneous, endoscopic, large-channel fusion [9] and transforaminal lumbar interbody fusion (TLIF) can play a huge role in the treatment of degenerative lumbar spinal stenosis, achieving a large clinical effective rate, improving outcomes, and promoting the recovery of lumbar function.[10-13]

In performing percutaneous, endoscopic, large-channel fusion and internal fixation, surgeons can use a variety of posterior, minimally invasive retractors for nerve-root decompression, extraction of the nucleus pulposus, and interbody fusion surgery, so the method has the advantages of less damage, less bleeding, a short period of postoperative pain, a quick recovery, a short hospital stay, and a better prognosis.

In recent years, with the development of internal-fixation devices and imaging techniques, fusion and internal fixation under percutaneous endoscopy through large channels has improved, which has a definite therapeutic value for patients with degenerative lumbar spinal stenosis.[14-16]

### Current Study

The current study intended to investigate the clinical efficacy of percutaneous endoscopic large-channel fusion and TLIF in the treatment of degenerative lumbar spinal stenosis, to find the best treatment plan.

## METHODS

### Participants

The research team performed a retrospective study, which took place at Nanjing Lishui People's Hospital in Nanjing, Jiangsu Province, PR China. Participants were patients with degenerative lumbar spinal stenosis had been admitted to the hospital between October 2018 and October 2022.

The study included participants if: (1) they had persistent neurological symptoms and intermittent claudication in the unilateral or bilateral lower extremities; (2) computerized tomography (CT) and magnetic resonance imaging (MRI) had confirmed the diagnosis; (3) conservative treatment for 3 months had been ineffective; (4) they had lumbar spondylolisthesis and spinal stenosi.

The study excluded participants if they had: (1) simple lumbar-disc herniation; (2) a history of long-term use of analgesics; (3) a slippage greater than 2 degrees; (4) severe heart, liver, kidney, or other organ dysfunction; (5) incomplete information; (6) a malignant tumor; (7) a history of lumbar fracture, tumor, infection, or surgery in the same segment; or (8) scoliosis requiring orthopedic surgery.

150 patients were enrolled and 50 were excluded from the study. All participants signed written informed consent forms. The study's protocols were approved by the Ethics Committee of the hospital and complied with the Helsinki Declaration.

### Procedures

**Data collection.** Patients were contacted by telephone and they went back to hospital. The data were extracted from the hospital.

**Intervention.** The research team randomlydivided participants into an intervention group and a control group randomly. The intervention group received percutaneous, endoscopic, large-channel fusion and internal fixation,[17] and the control group received TLIF.

**Inflammatory testing.** The research team obtained 10-ml samples of peripheral venous blood from both groups, taken in the fasting state in the early morning before surgery, and retained 3 mL of the blood. After centrifugation, the team left the blood for 10 min and detected the inflammatory response in the serum within 24 h of serum separation.

**Outcome measures.** The research team measured: (1) perioperative indexes, (2) clinical efficacy at a postoperative follow-up at 6 months postintervention, (3) indexes for inflammatory responses at before and after intervention, (4) postoperative pain at baseline and at months 3 and 6 postintervention using a visual analog scale (VAS), (6) lumbar function at baseline and at months 3 and 6 postintervention using the Oswestry Disability Index (ODI)[3] and the Japanese Orthopedic Association (JOA) scale[18] and (7) complications.

### Intervention

**Intervention group.** They used: (1) used CT and two-dimensional (2D) reconstruction of the lumbar spine to determine if degenerative changes in the lumbar spine existed; (2) performed general anesthesia, placing patients in a prone position after effective anesthesia and electrophysiological monitoring; (3) after a successful puncture, placed the puncture needle on the ventral side of the superior articular process with the guide wire; (4) then made an incision about 0.7 cm long through the center of the guide wire into the dilated tube; (5) defined the location using a fluoroscope machine (USA) and the ring saw for sanding; and (6) expanded the intervertebral foramen distance and inserted a protective sleeve of 7.5 mm.

Then: (1) with the help of a foraminoscope (USA), used blue forceps to remove the ligaments in the yellow space of the intervertebral disc, (2) fully exposed the nerve roots,

(3) removed the nucleus pulposus for complete decompression, (4) scraped the cartilaginous endplate under a microscope (USA), (5) performed the intervertebral model and bone grafting, (6) inserted the appropriate intervertebral fusion apparatus, and (7) withdrew the endoscopic duct system.

Finally, they (1) performed percutaneous pedicle screw fixation at the marked pedicle locations, using the Sextant system (German) for fixation; (2) used fluoroscopy (German) to determine the good internal fixation location; (3) closed the incisions layer by layer; and (4) sutured the skin.

**Control group.** The control group received TLIF surgery. The preoperative preparation was the same as that of the intervention group. They (1) performed effective anesthesia with an empty abdominal pad with patients in the prone position; (2) made a longitudinal median incision, (3) performed C-arm fluoroscopy (WAVA HUSADA) to determine the lesion segment, (4) removed the bilateral paravertebral muscles; (5) located the mitral ridge; (6) inserted a suitable pedicle screw; (7) clamped off the operative side's inferior articular process and part of the superior articular process; (8) removed part of the yellow ligament and pulled the protective nerve root and dural capsule; (9) exposed the annulus fibrosus; (10) clamped off the nucleus pulposus, (11) scraped the cartilaginous endplate; and (7) desorticated one-third of the anterior intervertebral endplate.

They then: (1) rinsed the intervertebral space; (2) connected and locked the titanium rods; (3) placed the autogenous bone particles saved for decompression in the anterior one-third of the intervertebral space; (4) placed a suitably sized, intervertebral fusion cage filled with bone fragments; (5) desorticated the articular surface of the contralateral facet joint and the lamina; (6) completed the 360° fusion with an autogenous bone graft; (7) after finding no nerve compression, rinsed the wound and placed a negative pressure drainage tube to suture the incision layer by layer.

### Outcome Measures

**Perioperative indexes.** The research team measured operation time, blood loss, drainage volume, and length of hospital stay.

**Clinical efficacy.** The research team compared the treatment effect for the two groups. The research team assigned participants to one of three categories of clinical efficacy: (1) Apparent—participants' symptoms of pain and swelling of the waist and leg had disappeared, their joint function had recovered significantly, the muscle strength of their waists and legs had returned to normal, and they could raise their legs to a straight position of >70°; (2) Effective—participants' waist and leg pain and swelling symptoms had improved, their joint function was better, their waist and leg muscle strength had reached level IV, which indicates straight leg elevation >30° but <70°; (3) Ineffective—participants' had had no relief of waist and leg pain and swelling symptoms, had had no improvement or even had an aggravation related to joint function, had a muscle strength of grade I, which indicates a straight leg elevation of <30°. The total effective rate = (obvious effect + improvement)/total cases ×100%.

**Inflammatory response.** The team measured participants' erythrocyte sedimentation rate (ESR) and the C-reactive protein (CRP).

**Pain degree.** The VAS scores assessed participants' degree of pain in the waist and legs and ranged from 0 to 10.[19] For the VAS scale: 0-3 = no pain; 4-7 = pain; and >7 = severe pain. A higher score indicated more pain than a lower score.

**Lumbar function.** The ODI scoring method evaluates the lumbar spine and measures pain intensity, sleep disturbance, self-care, social life, walking, lifting, standing, sitting, sex life, travel, and a total of 10 questions.[19] Each question has six options; the scores range from 0 to 5 points; the total possible score is 50 points; and the score is proportional to the degree of dysfunction.

The Japanese Orthopedic Association (JOA) scale.[18] which includes scores for low back pain, leg pain and/or numbness, gait, straight-leg elevation, sensory disorders, dyskinesia, and bladder function. It ranges from a high of 29 to a low of 0. A lower score indicates more dysfunction.

**Postoperative complications.** The research team clinically observed participants to evaluate perioperative complications, including bleeding, nerve injury, infection, poor incision healing, and re-protrusion of the nucleus pulposus.

### Statistical Analysis

The research team analyzed the data using the SPSS 25.0 softwar. The team: (1) expressed continuous variables, if they conformed to a normal distribution, as means ± standard deviations (SDs) and used a parametric test to compare the groups; (2) expressed continuous variables, if they didn't conform to a normal distribution, as medians and quartiles (IQR) and used a nonparametric test to compare the groups; (3) expressed categorical variables as numbers (N) and percentages (%) and used the Chi-square ($\chi^2$) test, Fisher's test, or a nonparametric test to compare the groups. $P < .05$ indicated statistical significance.

## RESULTS

### Participants

The research team included and analyzed the data of 100 participants. The control group included 27 males and 23 females aged 43-78 years, with an average age of 59.63 ± 5.21 years. The intervention group included 28 males and 22 females aged 45-76 years old, with an average of 57.35 ± 4.87 years old. No significant differences existed between the groups at baseline ($P > .05$).

### Perioperative Indexes

The intervention group's operation time, at 125.47 ± 10.64 min, and hospital stay, at 7.18 ± 1.45 days, were significantly shorter than those of the control group, at 145.32 ± 25.13 ($P = .021$) min and 9.32 ± 2.64 days ($P = .008$), respectively (Table 1).

**Table 1.** Comparison of Perioperative Monitoring Indexes Between the Intervention and Control Groups Postintervention

| Groups | n | Operation Time, min Mean ± SD | Amount of Bleeding, ml Mean ± SD | Volume of Drainage, ml Mean ± SD | Hospital Stay, d Mean ± SD |
|---|---|---|---|---|---|
| Control group | 50 | 145.32 ± 25.13 | 112.67 ± 17.38 | 79.63 ± 14.21 | 9.32 ± 2.64 |
| Intervention group | 50 | 125.47 ± 10.64 | 78.62 ± 10.52 | 52.18 ± 8.21 | 7.18 ± 1.45 |
| *t* | | 2.314 | 7.253 | 9.647 | 3.589 |
| *P* value | | .021[a] | .002[b] | .001[a] | .008[b] |

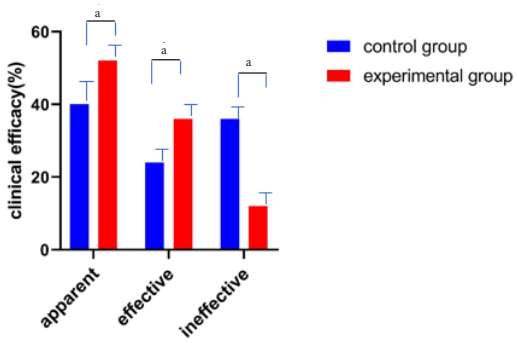
[a]$P < .05$, indicating that the intervention group's operation time was significantly shorter than that of the control group
[b]$P < .01$, indicating that the intervention group's amount of bleeding and volume of drainage were significantly lower and hospital stay was significantly shorter than those of the control group

**Table 2.** Comparison of Clinical Efficacy Between the Intervention and Control Groups Postintervention

| Groups | n | Apparent n (%) | Effective n (%) | Ineffective n (%) | Total Effective Rate n (%) |
|---|---|---|---|---|---|
| Control group | 50 | 20 (40.00) | 12 (24.00) | 18 (36.00) | 32 (64.00) |
| Intervention group | 50 | 26 (52.00) | 18 (36.00) | 6 (12.00) | 44 (88.00) |
| $\chi^2$ | | | | | 7.983 |
| *P* value | | | | | .018[a] |

[a]$P < .05$, indicating that the intervention group's total effective rate was significantly higher than that of the control group postintervention

**Figure 1.** Clinical Efficacy Between the Intervention and Control Groups




*$P < .05$, indicating that the intervention group's number of participants in the apparent and effective categories was significantly higher and that the number in the ineffective category was significantly lower than those of the control group

**Table 3.** Comparison of Inflammatory Response Between the Intervention and Control Groups Postintervention

| Groups | n | ESR, mm/h | | CRP, mg/L | |
|---|---|---|---|---|---|
| | | Baseline Mean ± SD | Postintervention Mean ± SD | Baseline Mean ± SD | Postintervention Mean ± SD |
| Control group | 50 | 22.41 ± 5.62 | 15.18 ± 5.26 | 17.42 ± 3.52 | 13.98 ± 3.65 |
| Intervention group | 50 | 22.58 ± 5.82 | 10.54 ± 3.18 | 18.65 ± 3.78 | 10.14 ± 2.78 |
| *t* | | 1.324 | 2.987 | 1.198 | 3.642 |
| *P* value | | .169 | .013[a] | .214 | .008[a] |

[a]$P < .05$, indicating that the intervention group's ESR was significantly lower than that of the control group postintervention

**Abbreviations:** ESR, erythrocyte sedimentation rate; CRP, C-reactive protein.

The intervention group's amount of bleeding, at 78.62 ± 10.52, and volume of drainage, at 52.18 ± 8.21, were significantly lower than those of the control group, at 112.67 ± 17.38 ($P = .002$) and 79.63 ± 14.21 ($P = .001$), respectively.

## Clinical Efficacy

Table 2 and Figure 1 show that 26 participants in the intervention group had an apparent rating (52.00%), 18 had an effective rating (36.00%), and 6 had an ineffective rating (12.00%), with the total effective rate postintevention including 44 participants at 88.00%.

In the control group, 20 participants had an apparent rating (40.00%), 12 had an effective rating (24.00%), and 18 had an ineffective rating (36.00%), with the total effective rate postintevention including 32 participants at 64.00%. The intervention group's total effective rate postintevention was significantly higher than that of the control group ($P = .18$).

Figure 1 shows that the intervention group's number of participants in the apparent and effective categories was significantly higher and the number in the ineffective category was significantly lower than those of the control group (all $P < .05$).

## Inflammatory Response

At baseline and immediately postintervention (Table 3), the intervention group's ESRs were 22.58 ± 5.82 mm/h and 10.54 ± 3.18 mm/h, respectively, and the control group's ESRs were 22.41 ± 5.62 mm/h and 15.18 ± 5.26 mm/h, respectively. No significant difference existed between the groups at baseline. The intervention group's ESR was significantly lower than that of the control group postintervention.

At baseline and immediately postintervention, the intervention group's CRPs were 18.65 ± 3.78 mg/L and 10.14 ± 2.78 mg/L, respectively, and the control group's CRPs were 17.42 ± 3.52 mg/L and 13.98 ± 3.65 mg/L, respectively. No significant difference existed between the groups at baseline. The intervention group's CRP was significantly lower than that of the control group postintervention.

## Pain

The intervention group's VAS pain scores at months 3 and 6 postintervention were 4.05 ± 1.13 and 3.01 ± 0.64, respectively, and were significantly lower than those of the control group, at 4.62 ± 1.24 ($P = .028$) and 3.62 ± 0.87 ($P = .021$), respectively (Table 4). No significant difference existed between the groups at baseline.

## Lumbar Function

The intervention group's ODI function scores at months 3 and 6 postintervention were 36.23 ± 4.52 and 29.64 ± 3.48, respectively, and were significantly lower than those of the control group, at 42.67 ± 5.18 ($P = .016$) and 35.79 ± 5.89 ($P = .014$), respectively. No significant difference existed between the groups at baseline.

The intervention group's JOA scores at months 3 and 6 postintervention were 18.62 ± 3.25 and 24.87 ± 3.68,

**Table 4.** Comparison of Pain and Lumbar Function Scores at Baseline and Months 3 and 6 Postintervention Between the Intervention and Control Groups

| Groups | n | VAS | | | ODI | | | JOA | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Baseline Mean ± SD | 3 Mos Postintervention Mean ± SD | 6 Mos Postintervention Mean ± SD | Baseline Mean ± SD | 3 Mos Postintervention Mean ± SD | 6 Mos Postintervention Mean ± SD | Baseline Mean ± SD | 3 Mos Postintervention Mean ± SD | 6 Mos Postintervention Mean ± SD |
| Control group | 50 | 7.21±1.42 | 4.62±1.24 | 3.62±0.87 | 48.65±6.18 | 42.67±5.18[a] | 35.79±5.89 | 11.62±1.87 | 15.73±3.12 | 20.64±3.57 |
| Intervention group | 50 | 7.35±1.51 | 4.05±1.13 | 3.01±0.64 | 48.73±6.32 | 36.23±4.52[a] | 29.64±3.48 | 11.53±1.65 | 18.62±3.25 | 24.87±3.68 |
| *t* | | 0.124 | 2.654 | 2.895 | 0.246 | 3.412 | 3.587 | 0.421 | 3.789 | 4.128 |
| *P* value | | .563 | .028[a] | .021[a] | .357 | .016[a] | .014[a] | .112 | .011[a] | .007[b] |

[a]$P < .05$, indicating that the intervention group's VAS and ODI at months 3 and 6 postintervention were significantly lower and JOA at month 3 postintervention was significantly higher than those of the control group
[b]$P < .01$, indicating that the intervention group's JOA at month 6 postintervention was significantly higher than that of the control group

**Abbreviations:** VAS, visual analogue scale; ODI, Oswestry Disability Index; JOA, Japanese Orthopedic Association.

**Table 5.** Comparison of Complication Rate Between the Intervention and Control Groups Postintervention

| Groups | n | Bleeding n (%) | Nerve Injury n (%) | Infection n (%) | Poor Incision Healing n (%) | Nucleus Pulposus Re-protrusion n (%) | Overall Complication Rate n (%) | $\chi^2$ | *P* value |
|---|---|---|---|---|---|---|---|---|---|
| Control group | 50 | 8 (16.00) | 5 (10.00) | 4 (8.00) | 4 (8.00) | 2 (4.00) | 23 (46.00) | 7.644 | .006[a] |
| Intervention group | 50 | 3 (6.00) | 3 (6.00) | 2 (4.00) | 1 (2.00) | 1 (2.00) | 10 (20.00) | | |

[a]$P < .01$, indicating that the intervention group's overall complication rate was significantly lower than that of the control group postintervention

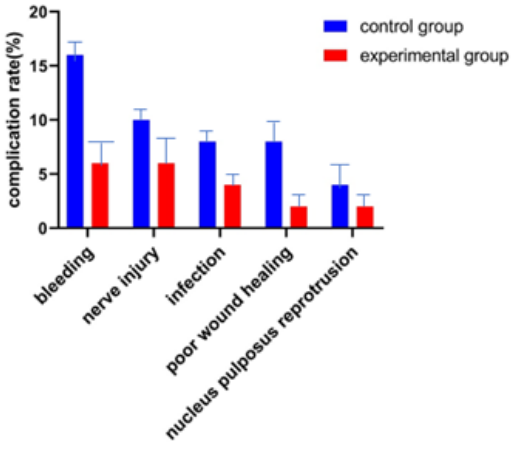
respectively, and were significantly higher than those of the control group, at 15.73 ± 3.12 ($P = .011$) and 20.64 ± 3.57 ($P = .007$), respectively. No significant difference existed between the groups at baseline.

| Group | 3 | 6 |
|---|---|---|
| Control group | 36.23 ± 4.52 | 29.64 ± 3.48 |
| Intervention group | 42.67 ± 5.18 | 35.79 ± 5.89 |

### Complication Rate

In the intervention group, three participants had a hemorrhage (6.00%), three had nerve injury (6.00%), 2 two had an infection (4.00%), one had poor incision healing (16.00%), and one had a nucleus pulposus re-protrusion (2.00%), and the complication rate was 20.00% with 10 participants (Table 5 and Figure 2). In the control group, eight participants had a hemorrhage (16.00%), five had nerve injury (10.00%), four had an infection (8.00%), four had poor incision healing (8.00%), and two patients had a nucleus pulposus re-protrusion (4.00%), with a complication rate of 46.00% with 23 participants. The intervention group's complication rate was significantly lower than that of the control group.

**Figure 2.** Comparison of the Complication Rate Between the Intervention and Control Groups




## DISCUSSION

The current study found that both of the studied surgical methods had good effects in the treatment of degenerative lumbar spinal stenosis; however, in terms of effectiveness and safety, the treatment performance of fusion and internal fixation for percutaneous endoscopic large channel was significantly better. The reason may be that fusion and internal fixation for the percutaneous endoscopic large-channel method has provided major progress in minimally invasive spinal surgery.

This study is a retrospective clinical study. The randomization method ensured that the number of people in the two groups was evenly distributed on the basis of small samples and that no statistically significant differences existed between the intervention group and the control group at baseline, which proves that the randomization was effective.

### Limitations

The study still had some limitations. First, no blinding occurred, and both researchers and patients were aware of the groupings. Due to the subjective factors in the VAS, the measures of clinical efficacy, and other outcome measures, patients in the intervention group may have given higher evaluations due to the effects of psychological suggestion, which can bring bias to a study. However, in this study, it's difficult to achieve double blindness.

Second, the follow-up time was relatively short, and the research team evaluated only clinical efficacy and recovery within a short time after the operation. In the future, researchers should increase the follow-up time to evaluate the long-term efficacy and quality of life of the patients.

Third, the sample size of this study was relatively small, and it was a single-center study, which can bring bias to the research results. In any following studies, the research team needs to increase the sample size and strengthen cooperation with other units. The team should conduct a large-sample, multicenter study to further evaluate the clinical efficacy of percutaneous, endoscopic, large-channel fusion and TLIF in the treatment of degenerative lumbar spinal stenosis.

## CONCLUSIONS

Both percutaneous, endoscopic, large-channel fusion and TLIF had good therapeutic effects in the treatment of degenerative lumbar spinal stenosis. However, compared with the latter, the former was more effective, with better comprehensive efficacy and more obvious benefits for patients, so it's worthy of clinical promotion and use.

### AUTHOR CONTRIBUTIONS

Xianguo Bao and Haitao Lu contributed equally to this work.

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