

## Retrospective Study

# Comparison of microendoscopic discectomy and open discectomy for single-segment lumbar disc herniation

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**Institutional review board**

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**Informed consent statement:**

Patients were not required to give informed consent to the study because the analysis used anonymous clinical data that were obtained after each patient agreed to treatment by written consent.

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## Abstract

### BACKGROUND

Lumbar disc herniation is a common disease. Endoscopic treatment may have more advantages than traditional surgery.

### AIM

To compare the clinical efficacy and safety of microendoscopic discectomy (MED) and open discectomy with lamina nucleus enucleation in the treatment of single-segment lumbar intervertebral disc herniation.

### METHODS

Ninety-six patients who were operated at our hospital were selected for this study. Patients with single-segment lumbar disc herniation were admitted to the hospital from March 2018 to March 2019 and were randomly divided into the observation group and the control group with 48 cases in each group. The former group underwent lumbar discectomy and the latter underwent laparotomy and

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nucleus pulpectomy. Surgical effects were compared between the two groups.

## RESULTS

In terms of surgical indicators, the observation group had a longer operation time, shorter postoperative bedtime and hospital stay, less intraoperative blood loss, and smaller incision length than the control group ( $P < 0.05$ ). The excellent recovery rate did not differ significantly between the observation group (93.75%) and the control group (91.67%). Visual analogue scale pain scores were significantly lower in the observation group than in the control group at 1 d, 3 d, 1 mo, and 6 mo after surgery ( $P < 0.05$ ). The incidence of complications was significantly lower in the observation group than in the control group (6.25% *vs* 22.92%,  $P < 0.05$ ).

## CONCLUSION

Both MED and open discectomy can effectively improve single-segment lumbar disc herniation, but MED is associated with less trauma, less bleeding, and a lower incidence of complications.

**Key words:** Lumbar intervertebral discectomy; open discectomy with fenestrated windows; Single-segment lumbar disc herniation; Nerve root; Nucleus pulposus; Pain

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**Core tip:** Microendoscopic discectomy has less trauma, less bleeding, and a lower incidence of complications compared with open discectomy in the treatment of single-segment lumbar disc herniation. Patients were able to get out of bed faster, with reduced pain, and recovered sooner.

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## INTRODUCTION

Of all orthopedic diseases, lumbar disc herniation is a common joint disease. It is mainly caused by degenerative changes of the lumbar intervertebral disc; external forces; or nerves, horsetails and other nerves. Patients exhibit back pain, lower limb radiation neuralgia and neurological dysfunction. If the disease is serious, it may cause paralysis<sup>[1]</sup>. In clinical practice, the main treatment methods are conservative treatment and surgical treatment. Patients in whom treatments are ineffective for 3 mo or those who have lumbar disc herniation with lumbar spinal stenosis, cauda equina paralysis, single nerve palsy, or severe pain should be treated promptly<sup>[2,3]</sup>. Related studies have found that for patients with single-segment lumbar disc herniation, the success rate of surgical treatment is 80%-98%. Among the surgical treatments performed, open discectomy with lamellar fenestration is widely used and can release compressed nerve roots in whole or in part, thereby reducing pain symptoms. However, surgical treatment causes serious trauma, it is not easy to recover after surgery, and complications such as lumbar instability can easily occur.

Currently, the continuous development of endoscope technology and minimally invasive technology has gradually improved spinal minimally invasive surgical instruments, especially microendoscopic discectomy (MED), which can be performed with a microscreen to obtain a clearer surgical field of view and to ensure surgical accuracy. This technique can completely relieve the pressure on nerve roots; at the same time, it can reduce the number of surgical incisions and surgical trauma, and patients recover faster after surgery<sup>[4]</sup>.

To clarify the clinical effects of discectomy and open discectomy, 96 patients who received treatment from March 2018 to March 2019 were selected for a comparative study.

## MATERIALS AND METHODS

### Baseline information

The subjects in this study were selected from 96 patients with single-segment lumbar disc herniation who underwent surgery in our hospital from March 2018 to March 2019. The digital table method was used for random grouping. The observation group (48 cases) consisted of 17 women and 31 men. The patient's age range was 29-69 years, with an average age of (45.28 ± 6.43) years; the disease duration was 5 mo to 6 years, with an average of (2.15 ± 0.63) years; prominent type: 5 cases of free type, prolapse. There were 16 cases of type and 27 cases of prominent type. The affected segments in 20 cases was L5S1 and in 28 cases was L4,5. The control group (48 cases) consisted of 16 women and 32 men, aged 27 to 67 years, average (45.18 ± 6.29) years; the disease duration was 6 mo to 5 years, average (2.03 ± 0.47) years; prominent type: 4. There were three types of free type, 15 types of prolapsed type, and 29 types of protruding type; the protruding part in 18 cases was L5S1, and in 30 cases was L4,5. When comparing the basic data of the two groups of subjects, there were no significant differences ( $P > 0.05$ ), which meets the comparison requirements.

The inclusion criteria were as follows: Disease confirmed by computed tomography, magnetic resonance imaging, or lumbar spine X-ray examination; after conservative treatment for more than three months, all symptoms such as unilateral lower extremity pain and low back pain are difficult to relieve; patients met the relevant indications for the nucleus pulposus; patients or their families voluntarily signed a written informed consent. The hospital ethics committee approved the study.

The exclusion criteria were as follows: Patients without strict non-surgical treatment; patients with pelvic inflammatory disease, tuberculosis, spinal stenosis, lumbar spine tumors, lumbar spondylolisthesis, lumbar spine instability, *etc.*; patients with lumbar disc degeneration and multi-segment recurrence; patients with skin damage or skin diseases; patients with serious medical diseases and mental diseases.

### Methods

**Observation group (MED):** During the operation, the patient was placed in the prone position, the abdomen was suspended using a U-shaped positioning pad, epidural anesthesia was performed during the operation, and the syringe needle space was inserted 1 cm near the midline of the target surgical vertebra. For the laminae, the location of the lesion was determined using C-arm X-ray fluoroscopy; a 0.5-1 cm length incision was made next to the midline of the intervertebral space, the lower back fascia was cut, and the cannula was gradually expanded to establish a surgical channel, and the free arm was used to fix the surgical site channel and operating table; the soft tissue on the surface of the yellow ligament and lamina was removed under direct vision, and the channel tube was organized so that the medial edge of the lower articular process, yellow ligaments and upper lamina could be clearly seen. The lumbar discoscope was inserted, the focal length and direction of the field of view were adjusted to confirm that the surgical channel was correctly placed under fluoroscopy. Layered forceps were used to bite the lower edge of the lamina and cut the ligament longitudinally. The occlusion was removed, the nerve root and dura mater fully exposed, while traction protected the medial side, the protruding disc was exposed, the annulus fibrosus cut, and the diseased nucleus pulposus tissue was removed. The condition of the spinal canal in the saline pressure gap was checked to ensure that the compressed nerve root was completely released. A satisfactory standard of release was achieved when the nerve root was moved about 1 cm. A hemostatic gelatin sponge and hemostatic electrocoagulation can be used to treat intraspinal bleeding. The surgical site was flushed with saline several times to avoid inflammation or adhesion of the intervertebral disc. Following surgery, a rubber tube was placed for drainage, and the incision was sutured layer by layer.

**The control group (open discectomy):** The patient was placed in the prone position during surgery, the abdomen was suspended using a U-shaped cushion, epidural anesthesia was performed during the operation 5-8 cm in the middle of the target intervertebral space. An incision was made, the skin was cut layer by layer, in addition to the subcutaneous and lower back fascia, the paravertebral muscle tissue was peeled down the spinous process lamina, and the ligamentum flavum and lamina were fully exposed. At about 3 o'clock, the hyperplastic adhesive articular process or ligamentum flavum was removed. If necessary, the nerve root canal was dilated and decompressed. The nerve root was pulled inward and protected to expose the protruding intervertebral disc and the fibrosis was cut open. The ring was removed or protruding nucleus pulposus tissue, allowing the compressed nerve root to move

inward by 8 mm or more to make it completely decompressed, repeatedly rinsing with physiological solution a drainage tube was inserted and the incision was sutured layer by layer.

Postoperative treatment consisting of antibiotics, hormones, and dehydrating drugs were routinely used in both groups at 24-48 h postoperatively: (1) Observation group: rubber drainage strips were removed 24 h postoperatively, and lower limb and other basic activities were performed after symptoms appeared to reduce leg pain. Kick training; back muscle training 5 d after surgery was performed; stitches were removed 7 d after surgery; normal activities and work gradually resumed 6-8 wk after surgery; and (2) Control group: Postoperative drainage was < 50 mL/d. At that time, the drainage tube was removed, and the indwelling time did not exceed 48 h. After alleviating the symptoms of lower back pain, basic activities such as kick training for the lower limbs were performed; lumbar and back muscle training was performed 7 d after the operation; sutures were removed 10 to 14 d after the operation; normal work was resumed three months after the operation.

### **Observation indicators and efficacy evaluation**

(1) Surgical indicators in the two groups of patients were compared, including the operation time, the amount of blood loss during the operation, the length of the incision, the length of time spent in bed, and the length of hospital stay. The Japanese Orthopedic Association has the highest score for lumbar spine disease with 29 points - excellent: Recovery rate greater than 90%; good: Recovery rate 75%-89%; general: Recovery rate 50%-74%; poor: Recovery rate less than 49%; (2) In order to assess the pain level in the two groups of patients, the visual analog scale (VAS) was used to evaluate the pain scores at 1 d, 3 d, 1 mo and 6 mo before and after surgery using a score of 0-10 points, the higher the score, the greater the pain; and (3) Intraoperative and postoperative complications in both groups of patients were determined, including dura rupture, nerve root injury, wound infection, lumbar spine instability, and postoperative recurrence.

### **Statistical analysis**

SPSS 21.0 software was used to compile the research data. The count data were expressed as [*n* (%)], and the  $\chi^2$  test was performed. Measured data (mean  $\pm$  SD) were analyzed using the *t*-test, and the grade data were analyzed using a non-parametric test. *P* < 0.05 indicated that the difference was statistically significant.

## **RESULTS**

### **Comparison of the surgical indicators in the two groups of patients**

In the observation group, the operation time was longer than that in the control group, blood loss during surgery was less than that in the control group, and the length of the incision was shorter than that in the control group. Postoperative bed time and hospitalization time were also shorter than those in the control group, and the difference between the two groups was statistically significant (*P* < 0.05, [Table 1](#)).

### **Comparison of the excellent and good recovery rate of the two groups of patients**

The excellent recovery rate of patients in the observation group 6 mo after the operation was 93.75%, and was 91.67% in the control group. There was no significant difference between the two groups (*P* > 0.05, [Table 2](#)).

### **Comparison of VAS pain scores before and after surgery in the two groups of patients**

There was no significant difference in preoperative VAS pain score between the two groups (*P* > 0.05). The VAS pain scores at 1 d, 3 d, 1 mo and 6 mo in the observation group were lower than those in the control group. The difference between the two groups was statistically significant (*P* < 0.05, [Table 3](#)).

### **Comparison of intraoperative and postoperative complications between the two groups of patients**

A total of 3 patients in the observation group had various degrees of complications during and after surgery, with an incidence rate of 6.25%. A total of 11 patients in the control group had various degrees of complications, with an incidence rate was

**Table 1 Comparison of the surgical indicators in the two groups of patients (mean ± SD)**

Group	Number of cases	Operation time (min)	Intraoperative blood loss (mL)	Incision length (mm)	Bed time after operation (d)	Hospital stay (d)
Observation group	48	72.64 ± 6.32	35.42 ± 8.16	2.25 ± 0.34	3.36 ± 2.18	7.25 ± 3.64
Control group	48	52.87 ± 4.34	60.25 ± 11.24	6.82 ± 0.41	4.79 ± 1.86	10.86 ± 4.25
<i>t</i>		17.866	12.385	59.444	3.457	4.469
<i>P</i> value		0.00	0.000	0.000	0.001	0.000

**Table 2 Comparison of the postoperative recovery rate between the two groups of patients, *n* (%)**

Group	Number of cases	Excellent	Good	Fair	Difference	Excellent rate
Observation group	48	40 (83.33)	5 (10.42)	3 (6.25)	0 (0.00)	45 (93.75)
Control group	48	37 (77.08)	7 (14.58)	4 (8.33)	0 (0.00)	44 (91.67)
$\chi^2$						0.154
<i>P</i> value						0.695

**Table 3 Comparison of the visual analogue scale pain score in the two groups of patients before and after surgery (mean ± SD, min)**

Group	Number of cases	Before surgery	1 d after operation	3 d after operation	1 mo after operation	6 mo after operation
Observation group	48	6.87 ± 1.56	2.75 ± 1.36	2.52 ± 1.42	2.01 ± 1.68	1.52 ± 1.24
Control group	48	7.04 ± 2.13	3.41 ± 1.76	3.13 ± 1.35	2.69 ± 1.49	2.13 ± 1.58
<i>t</i>		0.446	2.056	2.157	2.098	2.104
<i>P</i> value		0.657	0.043	0.034	0.039	0.038

22.92%. The difference between the two groups was statistically significant ( $P < 0.05$ , Table 4).

## DISCUSSION

In the clinic, approximately 20% of patients have lumbar and leg pain symptoms that are caused by lumbar disc herniation. This is because people over the age of 20 years will begin to experience degenerative changes in their intervertebral disc tissue due to increased activity. If patients are overweight, there will be negative consequences: Intervertebral disc tissues will be damaged, and the annulus fibrosis will be damaged. The nucleus pulposus mechanically compresses the nerve root, causing symptoms such as waist and leg pain and restricted mobility<sup>[5]</sup>. Due to poor reparability of the intervertebral disc tissue and poor blood supply, targeted treatment can restore health; otherwise, patients can easily become disabled. Most patients with single-segment lumbar disc herniation can obtain better rehabilitation results through conservative treatment, such as medicine, acupuncture and massage, as this type of treatment results in low pain levels, low costs and strong resistance<sup>[6-8]</sup>. Patient acceptance of this treatment is high. However, in approximately 10%-20% of patients after formal and systematic conservative treatment, the condition still worsens or the condition does not improve; then, surgical treatment is required.

The conventional surgical methods are open discectomy and lamellar fenestration. The effect is better with these methods than with open surgery<sup>[9]</sup>. Decompression is thorough and suitable for patients with different types of single-segment lumbar disc herniation<sup>[10]</sup>. In addition, surgery provides excellent vision and a wide range of exploration in the spinal canal. It can avoid the omission of free nucleus pulposus, reduce damage to the nerve root and dura mater during surgery, and expand the nerve root and lateral crypt more conveniently. However, surgery can cause greater trauma to the body and cause massive bleeding during the operation. The long bed-

**Table 4 Comparison of intraoperative and postoperative complications between the two groups of patients, *n* (%)**

Group	Number of cases	Dural rupture	Nerve root injury	Wound infection	Lumbar instability	Postoperative recurrence	Total incidence
Observation group	48	0 (0.00)	0 (0.00)	0 (0.00)	2 (4.17)	1 (2.08)	3 (6.25)
Control group	48	3 (6.25)	1 (2.08)	1 (2.08)	4 (8.33)	2 (4.17)	11 (22.92)
$\chi^2$							5.352
<i>P</i> value							0.021

rest period after surgery can also easily induce low back pain, lumbar instability and recurrence. In addition, open discectomy can cause hyperplasia and adhesion of scar tissue, can cause nerve root adhesion and spinal stenosis, and can reduce patient prognosis. This is not ideal, and there are certain limitations in its clinical application. At present, increasing attention is focused on the stability, integrity and postoperative complications after spinal surgery. Therefore, surgical methods are constantly being updated. With the improvement in surgical instruments, disc nucleus pulposus excision can address lesions such as crypt stenosis, nerve root adhesion, disc tissue dislocation and protrusion under direct vision and has a wide range of indications; therefore, it has broad application prospects for clinical use. Furthermore, the use of the camera system and endoscope can visualize the surgical area, can clearly show the tissue anatomy, and can avoid nerve roots during surgery<sup>[4]</sup>; however, the various procedures involved in this operation are carried out in a working channel with a size of approximately 1.6 cm. This channel exists when exploring the spinal canal, and limitations will affect the expansion of spinal stenosis<sup>[11]</sup>.

In this study, 48 patients undergoing lumbar discectomy and nuclear enucleation in the observation group and 48 patients undergoing open discectomy and nuclear enucleation in the control group were followed for 6 mo. The excellent and good recovery rate in the observation group was 93.75% and the rate in the control group was 91.67%, and there was no significant difference between the two groups ( $P > 0.05$ ). The two surgical methods achieved the same degree of recovery. The reason for this is that both surgical methods were performed directly. Both methods completely removed the nucleus pulposus and reduced the pressure on the nerve roots; thus, the symptoms associated with movement disorders, gait, and lower back pain were significantly reduced, resulting in good recovery.

In addition, in this study, compared with the control group, the observation group had a shorter bed-rest time and hospital stay, less blood loss during surgery, and shorter incision lengths. In terms of the postoperative VAS pain scores at 1 d, 3 d, 1 mo, and 6 mo, the scores were low, and the differences between the two groups were statistically significant ( $P < 0.05$ ). Lumbar discectomy achieved a higher quality of surgery, had faster healing and reduced pain more quickly after surgery. In addition, the rate of complications in this group was 6.25%, which was lower than the rate of 22.92% in the control group. The difference between the two groups was statistically significant ( $P < 0.05$ ). The application of a lumbar discoscope can reduce various complications during and after surgery<sup>[12,13]</sup>. The reason for this is that the dorsal branch of the spinal nerve dominates the paravertebral muscles and lumbar spine joints, and the lumbar spine joint is dominated by more than two spinal cord segments<sup>[14,15]</sup>. If this nerve is injured, the patient will have symptoms of back pain. During open discectomy, the paraspinal muscles adjacent to the laminae are extensively dissected, and inevitably, the neurovasculature of the lower joints and paravertebral muscles are inevitably injured during the operation. At the same time, during the operation, the hook will compress the paravertebral muscles for a long time, which will cause ischemic injury to the paravertebral muscles. In severe cases, the symptoms of low back pain cannot be effectively improved. During lumbar discectomy, it is not easy to place an expansion tube in the paravertebral muscles to establish a working channel, and it is not necessary to dissect the paravertebral muscles on a large scale. Damage to nerves and blood vessels that dominate facet joints and paravertebral muscles is apparent<sup>[16]</sup>. In addition, lumbar discectomy can enlarge local tissue through the monitor, improve the accuracy of the operation, and reduce the degree of damage to the paravertebral muscles. Postoperative pain is less severe, recovery is faster, lumbar spine and back function training can be started early, wound infections are reduced, as well as lumbar instability and other complications, and hospital stay is shortened<sup>[17,18]</sup>. However, all operations under MED are performed

in narrow passages, which will reduce the scope of the operation and increase the difficulty of the operation<sup>[19]</sup>. This requires surgeons with strong operating skills and surgical experience. The removal of lamellar nuclei is also a reason for the longer operation time<sup>[20,21]</sup>.

In summary, for the treatment of single-segment lumbar disc herniation, MED and open discectomy have similar clinical effects, but MED has less trauma and less bleeding. The incidence of complications is low. Patients can resume activities faster, pain is relieved faster, and patients can recover faster. The prognosis is good, and this treatment is worthy of comprehensive clinical application.

## ARTICLE HIGHLIGHTS

### Research background

Among all orthopedic diseases, lumbar disc herniation is a common joint disease.

### Research motivation

Endoscopic technology and minimally invasive technology has gradually improved spine minimally invasive surgical instruments, especially microendoscopic discectomy (MED).

### Research objectives

Clarify the clinical effects of discectomy and laminar nucleus pulpectomy.

### Research methods

A total of 96 patients with single-segment lumbar disc herniation who underwent surgical treatment were selected. The observation group underwent lumbar discectomy, and the control group underwent lamina excision.

### Research results

In terms of surgical indicators, the observation group had a longer operation time than the control group, the postoperative bedtime and hospital stay were shorter, the intraoperative blood loss was less, and the incision length was shorter. In terms of pain, the visual analogue scale pain scores were lower in the observation group compared to the control group at 1 d, 3 d, 1 mo, and 6 mo after surgery, and the difference was statistically significant. The incidence of complications was also lower in the observation group.

### Research conclusions

MED allows patients to get out of bed faster, reduces pain more quickly, and patients can recover sooner. It has a good prognosis and is worthy of all-round promotion and application in the clinic.

### Research perspectives

Minimally invasive technology will gradually become the mainstream treatment method.

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