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# A Retrospective Study of Microscope-Assisted Discectomy *versus* Open Fenestration Discectomy for Lumbar Disc Herniation

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## Abstract

**Objective:** This study aims to research the clinical outcome differences between micro discectomy and open fenestration discectomy in the treatment of lumbar disc herniation.

**Methods:** A retrospective study was carried out in two randomly allocated Groups totaling 467 patients with lumbar disc herniation, the micro discectomy Group A and the conventional discectomy Group B. Patient profiles between the two groups was not significant (P>0.05). JOA scores and modified MacNab criteria were used to evaluate clinical outcomes. Operation time, approach incision length, intra-operative blood loss, hospital stay and total average costs were analyzed.

**Results:** There were statistically significant differences of the indicators such as operative time and bleeding volume etc. in the two groups. There were no position errors and other complications such as nerve root injury, cauda equina injury and infection. No significant difference of JOA score improvement rate or the excellent and good rates was found between the two groups (P>0.05).

**Conclusion:** Both methods can obtain the same satisfactory results of therapy, but the microscope methods have a number of advantages, such as minimal invasion, less blood loss, shorter operation time, shorter hospitalization time and fewer medical expenses etc., which can be one of the ideal minimal invasive operations.

**Keywords:** Microscope; Lumbar disc herniation; Lumbar discectomy; Minimally invasive

## Introduction

Lumbar disc herniation is a common and frequently occurring disease whose conventional discectomy has got curative effect. With the continuous development of minimally invasive surgery, its applications in spinal surgery are increasingly accepted. It has advantages such as smaller incision, less tissue damage, clearer operation field, faster recovery, as effective as traditional open surgery and so on [1]. The microscope-assisted discectomy (Microsurgery lumbar discectomy, MSLD) was first reported by Yasargi [2] and Caspar [3]. Now it become one of the main surgical procedures for lumbar disc herniation and has been considered as the gold standard in Europe and the USA due to the small trauma and the satisfactory results. But retrospective comparative studies between the conventional and microscope-assisted discectomy are not so such [4-6]. Therefore, we compared these two operation methods by randomly selecting 467 cases with lumbar disc herniation into two groups from February 2003 to March 2011.

## Materials and Methods

### Ethical statement

All study procedures were reviewed and approved by the Institutional Ethics Review Board at the First Affiliated Hospital of Guangxi Medical University and conducted according to the principles expressed in the Declaration of Helsinki. Informed consent was exempted by the board due to the retrospective nature of this research. Patient records/information were anonymized and de-identified prior to analysis.

1. All cases met the following criteria:
2. Patients with different degrees of back pain, or with unilateral or bilateral lower extremity pain and numbness.
3. Severe symptoms and strict non-surgical treatment was ineffective for more than 3 months; or conservative

treatment failed to alleviate the symptoms, and became worse or more frequently.

4. The cauda equina symptoms was caused by central herniation.
5. Patients with short-period symptom couldn't get relieved after a break and the severe pain strongly affect the daily life work and activities.
6. There were positive signs of nerve root dysfunction in physical examination.
7. X-ray of lumbar extension didn't show the following features: lumbar small joint cohesion, severe reduction of intervertebral height, lumbar instability, spondylolisthesis and congenital stenosisosseous, stenosis indirect signs. The imaging diagnosis such as CT, MRI were all confirmed as lumbar disc herniation.

## Patients

The micro discectomy Group A (n=232) and the conventional discectomy Group B (n=235). In Group A, there were 129 males and 103 females, and the average age was 44 years (16-80 years), while the average disease duration was 54 months (5-360 months). Cause of the disease: degeneration (189 cases), injury and trauma (136 cases), cumulative strain (longtime standing or sedentary) (112 cases), acute violence (lifting heavy objects, falling, inappropriate massage, etc.) (41 cases), family history of genetic predisposition (9 cases), with onset after pregnancy (5 cases). The diagnosis of lumbar disc herniation had been confirmed by CT and MRI examination. Clinical manifestations: 189 cases with low back pain with unilateral or bilateral sciatica, 20 cases with simply lower extremity pain and/or numbness, and 23 cases with perineal numbness and/or stool and urine dysfunction. Combining imaging results and clinical manifestations, the target protruding parts were determined. There were 21 cases with lumbar disc herniation at L3-4,137 cases at L4-5 and 141 cases with L5-S1. There were 158 segments disc prominent on left side, 160 segments on the right side and 20 segments on central herniation. 71 cases had nerve root canal stenosis. The average preoperative JOA score [7] was 11.7 points (5 to 19 points).

In Group B, there were 127 males and 98 females. The average age was 46 years (15-79 years), and the average disease duration was 53 months (7-336 months). Cause of the disease: degeneration (191 cases), injury and trauma (139 cases), cumulative strain (longtime standing or sedentary) (114 cases), acute violence (lifting heavy objects, falling, inappropriate massage, etc.) (38 cases), family history of genetic predisposition (7 cases), with ONSETS after pregnancy (6 cases). The diagnosis of lumbar disc herniation had also been confirmed by CT and MRI examination. Clinical manifestations: 192 cases with low back pain with unilateral or bilateral sciatica, 25 cases with simply lower extremity pain and/or numbness, 21 cases with lower limbs pain, perineal numbness and/or stool and urine dysfunction. Combining imaging results and clinical manifestations, the target protruding parts were determined. There were 23 cases with lumbar disc herniation at L3-4, 140 cases at L4-5 and 146 cases at L5-S1. There were 160 segments disc prominent on left side, 163 segments on the right side and 24 segments on central herniation. 76 cases had nerve root canal stenosis. The average preoperative JOA score was 12.2 points (6 to 18 points).

No significant difference between two groups in terms of the general information such as sex ratio, the average age, duration, segment herniation and herniation type and preoperative JOA score (P>0.05) **(Table 1)**.

**Table 1** Comparison of two groups of patients before treatment

| Group | Gender | | Age (xs, years) | Duration (x ± s, months) | Segment herniation | | | Preoperative JOA score (x ± s, score) |
|---|---|---|---|---|---|---|---|---|
| | Male | Female | | | L3-4 | L4-5 | L5-S1 | |
| A(232) | 129 | 103 | 44 ± 5.16 | 54 ± 25 | 21 | 137 | 141 | 11.7 ± 2.35 |
| B(235) | 127 | 98 | 45 ± 6.21 | 53 ± 21 | 23 | 140 | 146 | 12.2 ± 3.53 |
| P value | 0.8563 | | 0.0592 | 0.6398 | | | | 0.0726 |

## Operation Methods

After epidural anesthesia put the patient in prone position. Protection was necessary for the eyes, anterior iliac crest and belly etc. C-arm X-ray machine preoperatively and during operation were used for accurate positioning. Group A: with the microscope assistance, 3.5~6.8 cm small incision was made in the center as the anchor point. Poke the paraspinal muscles along the spinous process, and use laminectomy retractor to expose the up and down vertebral lamina of the target segment as well as the small joints. Adjust the microscope angle to reveal the gap of the vertebral plates and fenestrate a small window. The yellow ligament, retract and be careful of the nerve root and intraspinal venous plexus should be cut off, and the nucleus pulposus should be removed. For nerve root canal stenosis cases, all the soft tissue and osteoarthritis which caused pressure were resected to achieve full decompression. Check the dural membrane and nerve root to confirm no compression. 3 to 5 mm free movement of the nerve root was satisfactory results. Pressing or electricity burning were put into use to completely stop the bleeding. Repeatedly rinse and leave a drainage tube at the operation site. From the second

day after the operation, patients started to carry out legs raising excise in supine position. After three to six days, patients could leave the bed. After one week, patients could be discharged and restart the daily life activities.

Group B: After epidural anesthesia, 4 to 9 cm longitudinal incision was made along the vertebral spine process. Strip the paraspinal muscles and use laminectomy retractor to reveal the gap of the lumbar vertebral plates, fenestrate a traditional open window, remove the yellow ligament, retract to protect the nerve root and remove the target nucleus pulposus. All the other procedures were the same as Group A, except that patients were allowed to leave the bed after the fifth day after surgery.

## Clinical evaluation and Standard

The operation time, intraoperative blood loss, and the length of approach incision, hospital stay and total average medical costs were recorded in both groups. JOA scores and modified MacNab criteria were used to evaluate clinical outcomes. Calculation of the RIS (the rate of improved JOA score): [(postoperative score minus preoperative score)/(29 minus preoperative score)] × 100%. The curative standard: excellent, RIS>75%; good, 50% ≤ RIS <75%; fair, 25% ≤ RIS <50%; poor, RIS<25%.

## Statistical analysis

Data are presented as mean ± standard of deviation, SPSS 11.0 statistical analysis software package are used for statistical analysis.

Measurement data between groups and within groups were analyzed using independent sample t-test and paired t-test, *chi-square* test with count data. For all statistical tests, P<0.05 was considered significant.

# Results

Patients in both groups were successfully operated. Operative time: (60 ± 12) min in Group A and (82 ± 8) min in B group: bleeding volume: (41 ± 5) mL in Group A, (72 ± 9) mL in Group B; the length of incision: (4.3 ± 1.5) cm in Group A and (6.7 ± 1.2) cm in Group B; hospital stay: (4.6 ± 2.3) d in Group A and (8.5 ± 2.7) d in Group B; the total average medical costs: (5.8 ± 1.7) thousand yuan in Group A and (6.7 ± 1.9) thousand yuan in Group B. The differences of the above indicators between the two groups were statistically significant **(Table 2** and **3)**.

**Table 2** Comparison of two Groups of surgical indicators (mean ± SD)

| Group | N | Operation time (min) | Blood loss (ml) | The length of incision (cm) | IME to post-operation |
|---|---|---|---|---|---|
| A | 232 | 60 ± 12* | 41 ± 5* | 4.3 ± 1.5* | 4.6 ± 2.3 |
| B | 235 | 82 ± 8 | 72 ± 9 | 6.7 ± 1.2 | 8.5 ± 2.7 |
| Note: Compared with the B Group: *p<0.05 | | | | | |

All cases achieved ideal wound healing. There were no positioning errors and other complications such as nerve root injury, cauda equina injury and infection. 212 cases of Group A were followed up for 12 to 40 months, with an average of 28 months. 215 cases of Group B got followed up for 12 to 42 months, with an average of 30 months.

**Table 3** Comparing the cost of disease between the two groups (mean ± SD)

| Group | n | Costs of Disease (thousands) |
|---|---|---|
| A | 232 | 5.8 ± 1.7* |
| B | 235 | 6.7 ±1.9 |
| Note: Compared with the B Group: *p<0.05 | | |

After 12 months the JOA score was 22 to 29 points in group A, with an average of 25.3 points and 23~30 points, with an average of 25.5 points in group B. There was significant difference between pre-operation and post-operation (P<0.05), while there were no statistical differences between the two groups (P>0.05). JOA score improvement rate or curative satisfactory rate has no significant difference between two groups (P>0.05). The standards RIS were used for investigation. In Group A, there were 136 excellent cases, 63 good cases, fair in 10 cases and 3 poor cases. The excellent and good rate was 93.9%. In Group B, there were 139 excellent cases, 61 good cases, fair in 11 cases and 4 poor cases. The excellent and good rate was 93.0%. There was no significant difference between two groups (P>0.05) **(Table 4)**. There were 2 cases recurrence postoperative 2 years in Group A and cured after surgery. There were 4 cases recurrence and suffered from spine instability in group B postoperative 3 years, which were achieved successful fusion and bony union by fusion of intra-lumbar process fixation.

**Table 4** Evaluated by RIS (mean)

| Group | n | Excellent | Good | Fair | Poor | Good rate |
|---|---|---|---|---|---|---|
| A | 232 | 136 | 63 | 10 | 3 | 93.9% |
| B | 235 | 139 | 61 | 11 | 4 | 93.0% |
| Note: Compared with the B Group: *p<0.05 | | | | | | |

There were significant differences between two groups in operation time, the length of approach incision, intra-operative blood loss, hospital stay and total average medical

costs (P<0.05), however there were no significant differences between two groups in evaluation of the rate of improved JOA score (P>0.05).

## Discussion

Lumbar disc herniation is a clinical common disease, accounting for about 1/3 patients with low back pain, and 10% to 20% patients require surgical treatment [8]. The syndrome of low back and low extremity pain, weakness and numbness [9] results from the oppression for the nerve root and dural sac. Due to dehydration, flexibility decrease and severe damage to the normal function, while the pressure loaded on the lumber spine increases could cause annular fibrosus damage and intervertebral disc herniation [10]. The surgery aims to relieve compression of nerve root caused by herniated disc and eliminate nerve root irritation, and maintain the stability of the vertebral body to improve the patient's quality of life and ability to work. To achieve long-run satisfied clinical outcome, it is of importance to diagnose accurately, strictly control the surgical indications and choose the most appropriate methods for patients [11]. With further researches, it is reported that after traditional surgery the scar formation around epidural and nerve root has high risk causing spinal stenosis. Since the incision is larger and the surgeon needs to be separate the large-area back muscles, the patients also maybe suffer from postoperative low back muscle weakness and atrophy as well.

Several kinds of minimally invasive methods have been applied to the treatment of lumbar disc herniation since the first report of discectomy in 1934 [12]. The minimally invasive technique is the development trend of modern surgery. Microendoscope discectomy (MED) is the two-dimensional images showed on the screen for a variety of operation [13], the hands and eyes coordination requires longer training time and longer learning curve. Some studies suggest that it needs at least 30 cases of experience to master the technology [14]. There are certain disadvantages and indication limitations in MED, but since the image under the micro-scope is 3-dimentional, the hand-eye coordination is relatively easier. Microdiscectomy is more advantageous since it's much easier to handle and has wider indications, the complications rate is lower and the learning curve is shorter. More and more studies believe that the microscopy technique is much easier to learn and applied for most doctors [4,15-18].

Microscope-assisted surgery is the combination of traditional posterior fenestration and microsurgical techniques. It has the following advantages: (1). It can focus the light into the surgical field to get a better vision of surgery, so that it has a zoom effect and the nerve roots, venous plexus, epidural could get higher resolution [19]. (2) It can clearly show the relationship of the spinal canal structure in the same side or on the opposite side of the spinal canal. The local anatomy could be showed more clearly. During the operation it can reduce the risk of iatrogenic muscle damage to avoid the excessive incision, stripping and stretch of vertebral muscles. It plays an important role to maintain the stability of the spine. It also has a positive significance for the recovery of patient, and shows the advantages of minimally invasive surgery by reducing the rates of complications [20]. (3) It can clearly distinguish different anatomical structures, since there was no nerve damage and other serious complications in Group A, this proved that the surgical method is safe. Many doctors have performed this procedure in the outpatient department in the USA [21]. In our retrospective study we compared microdiscectomy and open fenestration discectomy for the treatment of lumbar disc herniation. The results showed that there were significant differences between two groups in operation time, intra-operative blood loss, the length of approach incision, hospital stay and total average medical costs (P<0.05). There are obvious advantages in Group A such as small incision, less trauma, less blood loss, faster postoperative recovery, shorter hospital stay time, fewer medical expenses, etc. The curative satisfactory rate was 93.9% that it's similar to the reports of Peng et al. [16].

Our conclusion will be summarized as: a good control of the indications is the basis, accurate positioning is the prerequisite, protecting well the nerve is the key, the complete discectomy is the guarantee, full decompression is the fundamention and all the factors work together to make minimally invasive perfect. The significance of minimally invasive surgery under the microscope is reducing the blood loss, complications and iatrogenic injury, shorter hospital stays, lower medical costs, and promoting a fast recovery. So as to get the same even better efficacy compared with traditional surgery. The most common complications are nerve damage, vascular injury, dural tear, infection and recurrence and so on. And strict surgical indication, accurate surgical positioning and skilled and careful operation can reduce the incidence of complications. Accurate surgical positioning requires doctors must be familiar with anatomy because there were different locations of the intervertebral space with their corresponding laminar space. For example, L4-5 intervertebral space slightly close to the above than its laminar space, L5-S1 intervertebral space is near the bottom. Therefore, the positioning during operation should be adjusted according to the different surgical site. We should also pay attention to the following points in order to improve the efficacy of surgery: (1). operation should begin from the side of relatively obvious symptoms. It can prevent the damage of endorachis and nerve when it begins from the resection of upper and lower lamina and then removing the yellow ligament, and it needs to use the neural stripper to stripe carefully and gently if there are adhesions between the yellow ligament and dura (2). When exposing the disc where the nucleus pulposus would be removed, we should find a breakthrough from prominent place, then use both the equipment of neural dissection stripping to reveal it at the same time, and put brain cotton piece around to separate and avoid vein plexus burst bleeds. (3). Stopped bleeding fully and thoroughly intra-operative by combined the application of gelatin sponge, thrombin, brain cotton piece with adrenaline; bone wax closed the open bleeding bone surface and bipolar of electricity. We were used to use gelatin sponge for oppression, under the pressure to lift the bleeding often stops itself. Bipolar electricity for stopping bleeding and pulling the nerve root inside if bleeding is still. (4)

It can reduce postoperative radicular pain, and prevent postoperative infection and remove inflammatory mediators, crispy crack organization and bone debris by physiological saline repeated flushing, Surg Take (Sodium carboxy amino polysaccharide glucohexaose biological colloid) soaking. (5) Full decompression intra-operative and probed the nerve root free loose. Tension disappears and it becomes relaxed means that it is a satisfied decompression. The surgery mainly aim to expand the channels of nerve root. It requires exposing the nerve root under direct vision operation when expanding the lateral recess. We follow the above principles to obtain satisfied results.

Wen et al. [22] consider that the choice of surgical method depends on the preference of doctors and personal ability; Chi et al. [23] pointed out that it has been the goal to maintain lumbar stability under the premise of ensuring the efficacy with the orthopedic surgeon damage to the lumbar spine of normal structure as little as possible. Choose minimally invasive surgery in order to achieve a truly minimally invasive based on the traditional surgery. The study demonstrates that microscope-assisted minimally invasive surgery and traditional surgery can obtain the same satisfied results of therapy and overcome the defects of traditional surgery with advantages of minimal invasion, less trauma, less blood loss, shorter hospital stay, faster recovery, less medical expenses, fewer complications, which is one of the ideal minimal invasion operation nowadays. And it is worthy of clinical application because it is easy to grasp and wide indications.

## Conclusion

The two methods of micro discectomy and open fenestration discectomy in the treatment of lumbar disc herniation can obtain the same satisfactory results of therapy, but the microscope methods have advantages of minimal invasion, less blood loss, shorter operation time, shorter hospitalization time, fewer medical expenses etc, which can be one of the ideal minimally invasive operations.

## Limitations of the Study

Some limitations exist in the research, such as relatively short time in the study few selected cases of patients, and some patients unwilling to return to the hospital to reexamine again. Meanwhile, because of the limited funding, the number of selected cases is not enough to attain the representative research results. Therefore, we strongly hope to have more research funding, in order to make the research results more representative.

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