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ABOUT COVER

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Observational Study

Optimal approach for total endoscopic discectomy and its effect on lumbar and leg function in patients with disc herniation

Zi-Han Zhang, Qian Du, Fu-Jun Wu, Wen-Bo Liao

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Abstract

BACKGROUND

Disc herniation (DH) is a fragment of the disc nucleus that is pushed out of the annulus into the spinal canal due to a tear or rupture in the annulus. It is a common cause of lumbar and leg pains. Substantial advancements have been made to determine the cause of DH and to ensure accurate diagnosis, imaging, and treatment of this condition. Total endoscopic discectomy is an alternative surgical technique that is less invasive.

AIM

To study the optimal approach for a total endoscopic discectomy and its influence on lumbar and leg function in DH patients.

METHODS

This prospective study enrolled 120 patients with lumbar DH who were treated in our hospital from February 2018 to January 2021. All patients were randomly divided into the following two groups: The observation group, comprising 62 patients who underwent surgery using the interlaminar approach, and the control group, comprising 58 patients who were operated through the foramina approach. The treatment effects, perioperative indicators, functional recovery, pain, and quality of life were compared between the two groups.

RESULTS

The treatment effect in the observation group (93.55%) was significantly better than that in the control group (77.59%). There was no difference in the operative time and intraoperative blood loss amount between the two groups ($P > 0.05$). The hospitalization time of the observation group (4.34 ± 1.33 d) was significantly shorter than that of the control group (5.38 ± 1.57 days) ($P < 0.05$). The Japanese

Orthopaedic Association and Oswestry Disability Index scores decreased significantly in both groups after treatment, but the scores were lower in the observation group than in the control group. The visual analog scale scores of the lower back and legs of the two groups were significantly reduced after treatment, but scores were lower in the observation group (2.18 ± 0.88 in the lower back and 1.42 ± 0.50 in the leg) than in the control group (3.53 ± 0.50 in the lower back and 2.21 ± 0.52 in the leg). A short form of the Arthritis Impact Measurement Scales 2 measurement scale (AIMS2-SF) score and Barthel index of the lower back of the two groups increased significantly after treatment, with the observation group having a significantly higher AIMS2-SF score (95.16 ± 1.74) and Barthel index (97.29 ± 1.75) than the control group (84.95 ± 2.14 and 89.16 ± 2.71 , respectively) ($P < 0.05$).

CONCLUSION

Through total endoscopic discectomy with the interlaminar approach, the degree of pain in the waist and leg was reduced, and the lumbar function considerably recovered.

Key Words: Disc herniation; Total endoscopic discectomy; Interlaminar approach; Transforaminal approach; Quality of life; Treatment effect

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Core Tip: To study the optimal approach for a total endoscopic discectomy and its influence on leg and lumbar function in patients with disc herniation. Altogether, 120 patients with lumbar disc herniation were enrolled in this trial, including 62 patients who were operated through the interlaminar approach (observation group) and 58 who were operated through the foramina approach (control group). The therapeutic effect was evaluated according to various indicators, including the visual analog scale scores and Oswestry Disability Index. Our study showed that the treatment effect of total endoscopic discectomy using an interlaminar approach was remarkable.

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INTRODUCTION

Patients with intervertebral disc herniation (DH) mostly show a prominent intervertebral disc, causing certain compression of the spinal cord and then forming edema in the spinal cord area and central region of the lumbar area. At the same time, most patients will experience numbness in both legs and hips and even serious intermittent claudication, greatly influencing the patient's quality of life[1,2]. Percutaneous endoscopic lumbar discectomy is mainly used for the treatment of patients with lumbar DH[3]. This treatment is associated with less injury to the paravertebral muscles and faster preservation and recovery of bony structures. Patients with lumbar DH at the L5-S1 Level have a high iliac crest and a hypertrophic winged L5 transverse process, and the interlaminar and transforaminal approaches are usually performed in the surgical treatment of these patients[4]. In actual clinical treatment, the two treatment measures are mostly selected according to the surgeon's preference. Concurrently, some medical staff adjusts the plan according to the relationship between the patient's intervertebral disc and the anatomical position of the ilium[5]. In the actual treatment, the higher iliac crest, narrow intervertebral foramen, wider protruding joint, and more peripheral dorsal root ganglia restrict the movement of the working channel and optimal resection of the nucleus pulposus tissue during surgery[6]. Therefore, it is important to select the appropriate surgical approach in clinical practice. In this study, the optimal approach for a total endoscopic discectomy and its effect on the severity of lower back and leg pain and lumbar function in patients with DH were analyzed to guide clinical treatment.

MATERIALS AND METHODS

General material

This prospective study enrolled 120 patients with lumbar DH who were treated in our hospital from

February 2018 to January 2021. The ratio of male-to-female patients was 69:51, with an average age of 54.23 ± 5.03 (range: 45–65) years, an average body mass index of (24.11 ± 1.84) kg/m², and an average disease course of 7.53 ± 2.46 mo. Fifty-seven and 63 patients had American Society of Anesthesiologists (ASA) grades of II and III, respectively. The patients were randomly divided into two groups: The observation (62 patients) and control (58 patients) groups. The general data of the two groups were comparable ($P > 0.05$; Table 1). Informed consent was obtained from all patients, and the study protocol was approved by the appropriate institutional ethics committee.

The inclusion criteria were as follows: patients who developed lumbar DH as assessed by magnetic resonance imaging, X-ray, and computed tomography; and no clear history of trauma, clinical manifestations of lower back pain, or limited mobility.

The exclusion criteria were as follows: cardiopulmonary dysfunction, severe fracture-dislocation, thoracolumbar burst fracture, paraplegia or hemiplegia, and severe osteoporosis.

Methods

The observation and control groups' patients underwent surgery *via* the interlaminar and transforaminal approaches, respectively. All patients were treated with visual intervertebral foraminal endoscopy. After local anesthesia, the patients were instructed to keep lateral position. Under the C-shaped arm X-ray, the responsible intervertebral space and spinous process line of the patients were marked in time. The patients in the observation group were injected into the intervertebral lamina of the focus area, and the patients in the control group were treated with intervertebral foraminal approach surgery. The line on the upper edge of the patient's articular process is taken as the safety line, which should not be exceeded during the puncture to prevent injury to the patient's abdominal cavity and other important organs. An 18-gauge needle was used to puncture the anterior and lower edges of the superior articular process of the target segment of the patient's vertebral body, and then the needle core was removed. After the operation, a curved 22-gauge needle was used to puncture the nucleus pulposus or intervertebral space. After fluoroscopy was performed to confirm whether the specific position of the guidewire was correct, the needle was removed and the guidewire was retained. An 8-cm lateral incision was made at the center of the puncture site, and the guide rod was inserted in the direction of the guide wire to enlarge the patient's surgical access step by step. Concurrently, the dilatation catheter was removed, the ring saw was inserted in the direction of the guide rod, and a working cannula was inserted. Under fluoroscopy, the vertebral body in the lesion area was excised. During the removal of the patient's focal area, care should be taken not to overstep the medial border of the patient's pedicle to prevent injury to the patient's nerve tissue and dura. Subsequently, the ring saw was removed. After confirming the specific position of the patient's working cannula under fluoroscopy, the endoscope was placed, and the nucleus pulposus tissue was removed under endoscopic observation. The results of the leg lift test were negative, indicating that the decompression surgery was effective.

Observed indicators

Comparison of treatment outcomes: The therapeutic effect was evaluated according to MacNab evaluation criteria for patients and specific clinical symptoms. A patient with no limitations or pain in movement and who can move and work normally is considered to have excellent outcomes. Patients with good outcomes include those with occasional pain and whose main clinical symptoms are not serious, allowing them to participate in adjusted work. For patients with average outcomes, their motor function has improved to some extent, but they remain unemployed or disabled. Patients with poor outcomes have persistent nerve root damage, and the clinical symptoms after surgery include repeated attacks and those requiring surgical treatment.

Comparison of perioperative parameters: The differences in operative time, length of hospital stay, and intraoperative blood loss amount between the two groups were compared.

Analysis of functional recovery: The Japanese Orthopaedic Association (JOA) score[7] and Oswestry Disability Index (ODI)[8] before treatment and 4 wk after therapy were compared between the two groups. The JOA totals 29 points, with lower scores indicating higher functional limitations. The ODI is mainly evaluated using 10 indicators, such as intensity, self-care, lifting, walking, sitting, standing, interference with sleep, sexual life, social life, and travel life of patients. High scores represent severe dysfunction.

Comparison of pain: The visual analog scale (VAS) of lower back and leg pain was assessed before treatment and at 4 wk after treatment in both groups. A VAS score of 0 indicated no pain, 1–3 indicated mild pain, 4–7 indicated moderate pain, and 8–10 indicated severe pain[9].

Comparison of quality of life: A short form of the Arthritis Impact Measurement Scales 2 (AIMS2-SF) scores were obtained before and after treatment. The AIMS2-SF[10] mainly analyzes the patient's body, symptoms, influence, society, and work, with a total score of 104, which is directly proportional to the patient's quality of life. The assessment of the ability to perform day-to-day activities of life was conducted using the modified Barthel[11] index scoring method (full score of 10 points, including 10 items), with the score directly proportional to the patient's living ability.

Table 1 Comparison of the general demographic characteristics between the control and observation groups

Group	Sex (M/F)	ASA (II/III)	Duration (mo)	Age (yr)	Body mass index
Observation group (<i>n</i> = 62)	35/27	25/37	7.42 ± 2.41	54.13 ± 5.12	23.99 ± 1.22
Control group (<i>n</i> = 58)	34/24	32/26	7.64 ± 2.52	54.34 ± 4.97	24.23 ± 2.33
χ^2/t value	0.058	2.650	0.486	0.234	0.712
<i>P</i> value	0.810	0.104	0.628	0.815	0.478

ASA: American Sociological Association.

Statistical analysis

Statistical analysis was performed *via* SPSS 20.0 using a chi-square test, and enumeration data are expressed as percentages. Measurement data were expressed as mean ± SD, and the *t*-test was used for comparison. *P* < 0.05 was considered statistically significant.

RESULTS

Comparison of the treatment effect

The total effective rate in the observation group (93.55%) was higher than that in the control group (77.59%) (*P* < 0.05; [Table 2](#)).

Comparison of perioperative parameters

There was no difference in the operative time and intraoperative blood loss amount between the two groups (*P* > 0.05), and the hospitalization time was significantly shorter in the observation group than in the control group (*P* < 0.05; [Table 3](#)).

Analysis of dysfunction

In terms of JOA and ODI, there was no difference in the scores before treatment between the two groups (*P* > 0.05), but both groups showed significantly decreased scores after treatment, with the observation group showing significantly lower scores than the control group (*P* < 0.05). Further details are provided in [Table 4](#).

Comparison of pain

There was no difference in the VAS scores of the lumbar back and leg pain before treatment between the two groups (*P* > 0.05), but both scores decreased significantly after treatment, with the observation group showing significantly lower scores than the control group (*P* < 0.05; [Table 5](#)).

Comparison of quality of life

There was no difference in the AIMS2-SF score and Barthel index before treatment between the two groups (*P* > 0.05), but the values increased significantly after treatment in both groups, with the observation group having significantly higher scores than the control group (*P* < 0.05; [Table 6](#)).

DISCUSSION

With the continuous development of minimally invasive techniques, the percutaneous disc approach for DH has become an important means of clinical treatment[11]. In this treatment, the intervertebral space of L5–S1 is one of the larger intervertebral spaces, which can provide sufficient surgical space during the surgical treatment. In the clinical treatment of patients, spinal surgeons are most familiar with the intervertebral foraminal approach to surgery of the affected vertebra, and their working principle is similar to that of open surgery[12]. At the same time, the intraoperative fluoroscopy of patients is less, and the high iliac crest and intervertebral foramen perimeter are rarely limited during this operation [13]. However, in the treatment of patients with L5–S1 DH, due to their large facet joints and narrow intervertebral foramina and the fact that the disc has a certain inclination, some difficulties are encountered during surgery to a certain extent[14]. However, in surgeries using the interlaminar approach, the operation is mainly performed above the iliac crest, with the cephalad side as the approach side. However, the caudal side is inclined, which has a positive significance for tissue removal at the site of the intervertebral disc lesion during surgery[15].

Table 2 Comparison of therapeutic effects between the control and observation groups, *n* (%)

Group	Excellent	Good	Average	Poor	Total effective rate
Observation group (<i>n</i> = 62)	38 (61.29)	12 (19.35)	8 (12.90)	4 (6.45)	58 (93.55)
Control group (<i>n</i> = 58)	19 (32.76)	15 (25.86)	11 (18.97)	13 (22.41)	45 (77.59)
χ^2/U value	3.353				6.279
<i>P</i> value	0.001				0.012

Table 3 Comparison of perioperative indicators between the control and observation groups

Group	Operative time (h)	Intraoperative blood loss (mL)	Hospital stay (d)
Observation group (<i>n</i> = 62)	6.74 ± 1.37	33.21 ± 1.95	4.34 ± 1.33
Control group (<i>n</i> = 58)	6.71 ± 1.51	33.60 ± 1.96	5.38 ± 1.57
<i>t</i> value	0.133	1.097	3.933
<i>P</i> value	0.884	0.275	0.000

Table 4 Analysis of dysfunction in the control and observation groups

Group	JOA (points)		ODI (points)	
	Before therapy	4 wk of therapy	Before therapy	4 wk of therapy
Observation group (<i>n</i> = 62)	7.71 ± 2.05	2.98 ± 1.26	55.68 ± 2.76	11.68 ± 2.53
Control group (<i>n</i> = 58)	7.93 ± 2.12	3.90 ± 1.61	55.95 ± 1.93	14.98 ± 1.86
<i>t</i> value	0.581	3.472	0.619	8.116
<i>P</i> value	0.562	0.001	0.537	0.000

JOA: Japanese Orthopaedic Association; ODI: Oswestry Disability Index.

Table 5 Comparison of pain between the control and observation groups

Group	Lower back VAS (points)		Leg VAS (points)	
	Before therapy	4 wk of therapy	Before therapy	4 wk of therapy
Observation group (<i>n</i> = 62)	6.02 ± 1.81	2.18 ± 0.88	7.87 ± 1.82	1.42 ± 0.50
Control group (<i>n</i> = 58)	6.03 ± 2.79	3.53 ± 0.50	7.78 ± 2.93	2.21 ± 0.52
<i>t</i> value	0.043	10.292	0.215	8.464
<i>P</i> value	0.966	0.000	0.830	0.000

VAS: Visual analog scale.

In this research, the treatment effect in the observation group was better than that of the control group, which was analyzed during the treatment, as compared with patients with lumbar DH at other sites, as there was a certain angle between the nerve root and dura mater at the S1 Lumbar DH site[15]. During the surgery, it was easier for the puncture needle to reach the axillary site of the S1 nerve root. This lesion, in turn, increases the angle between the nerve root and dural sac to some extent and also increases the operative space during surgery. However, in surgery using the transforaminal approach, timely and effective resection of the synaptic disc is performed under the premise of ensuring less contact with the peripheral nerve roots. However, the interlaminar approach may produce residual intervertebral disc and incomplete decompression, further causing cranial or caudal movement of the free intervertebral disc. At this time, it is necessary to incise the posterior longitudinal ligament and further control the free intervertebral disc[16]. However, when comparing the perioperative indicators between the two groups, no statistically significant difference was observed. It is suggested that,

Table 6 Comparison of quality of life between the control and observation groups

Group	AIMS2-SF score (points)		Barthel index (points)	
	Before therapy	After therapy	Before therapy	After therapy
Observation group (<i>n</i> = 62)	57.55 ± 2.57	95.16 ± 1.74	57.63 ± 2.18	97.29 ± 1.75
Control group (<i>n</i> = 58)	58.14 ± 2.54	84.95 ± 2.14	57.02 ± 1.58	89.16 ± 2.71
<i>t</i> value	1.263	28.782	1.751	19.645
<i>P</i> value	0.209	0.000	0.082	0.000

AIMS2-SF: A short form of the Arthritis Impact Measurement Scales 2 measurement scale.

although the operation was complicated by the interlaminar approach, no significant difference in the perioperative indicators was noted between the two groups. However, while analyzing the functional recovery of the two groups, the observation group demonstrated better results than those of the control group, suggesting that the interlaminar approach is more appropriate for decompression of the local lesion site.

Total endoscopic discectomy has lower intraoperative and perioperative nerve damage for patients, and has positive significance for the prognosis of patients. While analyzing the postoperative pain, we found that the observation group had less pain than the control group, suggesting that the observation group had less postoperative nerve damage. In actual surgical treatment, it is necessary to adjust the position of the patient's working tube[17]. If the position of the working tube is unreasonable because the smaller intervertebral disc space and the position of the ilium will increase the difficulty in removing the intervertebral disc[18], the intervertebral plate approach can effectively avoid the abovementioned neurological iatrogenic injury[19]. In the analysis of patients' quality of life, the observation group showed better outcomes than the control group, suggesting that the resection of the DH site improved patients' quality of life.

In short, in patients with DH who underwent total endoscopic discectomy using the interlaminar approach, the degree of lower back and leg pain was reduced, and their lumbar function significantly recovered, suggesting a significant therapeutic effect[20].

CONCLUSION

Patients with DH who were treated with total endoscopic discectomy using an interlaminar approach had a reduced degree of pain in the lower back and significantly recovered lumbar function, indicating that the treatment effect was remarkable. However, this study was limited by its small sample size and short follow-up period, and some patients were lost to follow-up, which may have influenced our results. Further comparative studies are warranted to assess the clinical outcomes.

ARTICLE HIGHLIGHTS

Research background

Disc herniation (DH) is the most common degenerative disease of the spine, and many patients require surgical treatment. Open discectomy *via* the intervertebral foramen was first performed in the early 20th century. Even though full-endoscopic discectomy can be performed *via* either the interlaminar or foraminal approach in most patients with lumbar DH (LDH), it is difficult to determine which approach is better.

Research motivation

Total endoscopic discectomy has become the most commonly performed minimally invasive procedure for DH. There are some studies on full-endoscopic discectomy; however, there are few comparative studies on interlaminar and foraminal approaches in the treatment of DH by a total endoscopic discectomy.

Research objectives

The purpose of this study was to investigate the optimal approach for a total endoscopic discectomy and its influence on lumbar pain, leg pain, and lumbar function in patients with DH.

Research methods

This prospective study enrolled 120 patients with lumbar DH who were treated in our hospital from February 2018 to January 2021. All patients were randomly divided into the following two groups: The observation group, which consisted of 62 patients who underwent surgery using the interlaminar approach, and the control group, which consisted of 58 patients who were operated *via* the foramina approach. The treatment effects, perioperative indicators, functional recovery, pain, and quality of life were compared between the two groups.

Research results

The treatment effect in the observation group was significantly better than that in the control group. The hospitalization time was significantly shorter in the observation group than in the control group. The Japanese Orthopaedic Association score and Oswestry Disability Index decreased significantly in both groups after treatment, but the observation group showed lower scores than the control group. The visual analog scale scores of lower back and leg pain in the two groups were significantly reduced after treatment, with the observation group showing lower scores than the control group. A short form of the Arthritis Impact Measurement Scales 2 measurement scale score and Barthel index of the lower back of the two groups increased significantly after treatment, with the observation group showing significantly higher scores than the control group.

Research conclusions

Patients with DH who were treated with total endoscopic discectomy through an interlaminar approach had a reduced degree of pain in the lower back and leg and significant lumbar function recovery, suggesting that the treatment effect was remarkable.

Research perspectives

Total endoscopic discectomy also has some disadvantages, such as a steep learning curve. Surgeons must master the key techniques of total endoscopic discectomy through study courses and personal experience. In addition, muscles, disc cysts, and ligaments may be difficult to identify endoscopically, increasing the risk of congenital injuries. In a total endoscopic discectomy, if adequate decompression of the herniated disc is not possible because of severe intracanal hemorrhage or anatomic obstruction, conventional surgery should be performed if necessary.

FOOTNOTES

Author contributions: Zhang ZH collected data and wrote and revised the manuscript; Liao WB designed the study; Du Q interpreted and analyzed the data; Wu FJ collected the data; and all authors approved the final version of the manuscript.

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