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Study on the effect of percutaneous intervertebral foraminoscopic discectomy in the treatment of lumbar disc herniation

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Abstract

This study explored the effect of percutaneous intervertebral foraminoscopic discectomy (PIFD) in the treatment of lumbar disc herniation (LDH).

This retrospective study collected a total of 88 patient cases for inclusion. Epidemiological and clinical data of patients with LDH at the First Affiliated Hospital of Jiamusi University between May 2017 and January 2020 were retrospectively analyzed. Of those, 44 patients received PIFD and were allocated to an intervention group. The other 44 patients administrated fenestration discectomy (FD), and were assigned to a control group. We compared surgery time (minute), incision length (cm), duration of hospital stay after surgery (day), pain intensity (as checked by Visual Analogue Scale (VAS), health-related quality of life (as examined by Oswestry Disability Index, ODI), and complications between 2 groups.

There were not significant differences in surgery time (minute) ($P = .56$), VAS ($P = .33$) and ODI ($P = .46$) after surgery between 2 groups. However, there were significant differences in incision size (cm) ($P < .01$) and length of hospital stay (day) ($P < .01$) after surgery between 2 groups. When compared before the surgery, patients in both groups had significant improvements in VAS ($P < .01$) and ODI ($P < .01$) after the surgery. Moreover, both groups had similar safety profiles ($P > .05$).

The findings of this study showed that both PIFD and FD benefit patients with LDH. However, PIFD can benefit patients more than FD in the incision size and duration of hospital stay after surgery.

Abbreviations: FD = fenestration discectomy, LDH = lumbar disc herniation, ODI = Oswestry Disability Index, PIFD = percutaneous intervertebral foraminoscopic discectomy, SD = standard deviation, VAS = Visual Analogue Scale.

Keywords: fenestration discectomy, lumbar disc herniation, percutaneous intervertebral foraminoscopic discectomy

1. Introduction

Lumbar disc herniation (LDH) results from a displacement of disc tissue (nucleus pulposus or annulus fibrosis) between discs and compression of peripheral nerve roots.[1–5] Its symptoms manifest as radicular symptoms, paresthesia, lower back and lumbocrural pain.[6–10] Its incidence is high and it affects about 2% to 3% of the general population around the world.[11] In China, its incidence is about 7.62%.[2] Other studies has suggested that over 90% of elderly and middle-aged people with LDH have mechanical problems resulting from the issues of spinal and muscle tissues.[12] If it is not managed effectively and timely, it may develop to lower limb paralysis and incontinence.[13]

Currently, its managements mainly include surgical and conservative interventions.[14–16] It has been reported that about 15% to 20% patients with LDH need surgery because of the serious neurological symptoms.[17] Fenestration discectomy (FD) is a common used management for LDH with promising effect.[18–19] However, due to the paravertebral muscle stripping, and prolonged traction and excessive resection of the posterior structure of the lumbar spine during the surgery, it often results in severe complications, such as lumbar instability and back pain.[18–19] Percutaneous intervertebral foraminoscopic discectomy (PIFD) is a type of advanced surgery for the treatment of LDH.[20–25] However, there is still insufficient evidence of PIFD in treating LDH. Thus, this retrospective study aimed to investigate the effect of PIFD for the treatment of patients with LDH.

2. Methods

2.1. Ethical considerations

This retrospective study has approved by the Medical Ethics Review Board of the First Affiliated Hospital of Jiamusi

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QHJ and YX contributed equally to this study.

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The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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University. Written informed consent was waived in this study, because all data analyzed from completed patient records.

2.2. Study design

This study was designed as a retrospective study. We collected and analyzed a total of 88 patient records. Forty-four patients underwent PIFD, and they were assigned to an intervention group. The other 44 patients received FD, and were allocated to a control group. Outcomes were appraised and compared after surgery between 2 groups. All patients, investigators and outcome assessors were not blinded. However, data analyst was blinded in this study.

2.3. Patients

This study retrospectively collected the data of patients with LDH and hospitalized in the First Affiliated Hospital of Jiamusi University between January 2012 and June 2019 by retrieving medical records. Included patients met the following criteria:

1. between 18 and 75 years old;
2. confirmed diagnoses of LDH.

Exclusion criteria:

1. surgical contraindications;
2. lumbar intervertebral infectious disc disease (such as intervertebral discitis, lumbar tuberculosis);
3. accompanied by severe scoliosis and spine spondylolysis, spondylolisthesis, lumbar instability, and lumbar fractures;
4. history of lumbar surgery;
5. lumbar tumor or cancer; and
6. incomplete information of patient records.

2.4. Treatment regimen

In the intervention group, all 44 patients received PIFD. Its procedure was as follows: patients received PIFD in a prone position, and the affected location of lumbar spine was determined by C-arm X-ray machine. The puncture point was selected at 12 to 14 cm next to the midline of the spinous process by the guide of fluoroscopy. The needle tip was in the upright position. It was located on the inner edge of the pedicle, and the lateral position was on the posterior part of the vertebral body. The guide wire was inserted through the puncture needle. After that, the needle was withdrawn. Then, a 0.8 cm incision was made at the puncture point, and placed an expandable sleeve along the guide wire step by step. The ventral and upper facet joints were removed with a trephine; expanded the intervertebral foramen; and inserted the working sleeve and intervertebral foramen (TESSYS Spinal Foramina Endoscopic System, Jiomax Company, German). With the help of nucleus forceps or laser radiofrequency, the affected annulus and nucleus pulposus of the intervertebral disc were resected. The nerve roots were exposed and free intervertebral disc tissue was cleaned. Then, we performed complete decompression of the nerve roots, and pulsation of the dura mater. Radiofrequency was used to stop bleeding thoroughly, flushing locally. Finally, working cannula was pulled out, the incision was sutured and covered the applicator.

In the control group, all 44 patients received FD. After epidural anesthesia, patients received FD in a prone position. About 4 cm skin incision was cut at the midpoint of attacked spinous process. Then, cut the subcutaneous tissue and deep fascia, peeled off the sacral spinal muscles along the affected side edge of the spinous process and the lamina to remove the surgical segment. The upper and lower lamina and facet joints were fully exposed and removed with gun-like forceps, and part of the lamina was fenestrated. The extradural ligamentum flavum was removed, and the dura mater and nerve roots were exposed. Used the retractor to pull the nerve root and dura mater to the inside, and fully exposed the herniated intervertebral disc tissue and cut the longitudinal band and annulus fibrosus. The protruding nucleus pulposus tissue and the intervertebral disc were removed. The residual degeneration of the nucleus pulposus tissue was cleared. Explored the spinal canal and nerve roots tube again, and loosen the nerve root. Finally, we flushed the incision, stopped bleeding, kept one root drainage tube, and sutured the incision.

2.5. Clinical evaluations

The outcomes were surgery time (minute), incision length (cm), duration of hospital stay after surgery (day), pain intensity (as measured by Visual Analogue Scale, VAS),[26–27] health-related quality of life (as assessed by Oswestry Disability Index, ODI),[28] and complications. VAS scale varies from 0 (no pain) to 10 (worst pain), with higher score suggesting worse pain.[26–27] ODI index comprises of 10 aspects, and each item rates from 0 (no symptom) to 5 (worst symptom), with higher score meaning worse symptom.[28] All those outcomes were measured and analyzed after treatment.

2.6. Statistical analysis

We performed all analysis using SAS package (Version 9.1; SAS Institute Inc., Cary, North Carolina). Categorical data was expressed as proportion, and was analyzed using Pearson Chi-Squared test or Fisher exact test. Continuous data was estimated as means and standard deviation (SD), and was analyzed by *t* test or Wilcoxon test. A $P < .05$ (2-side) was considered statistically significant.

3. Results

3.1. Patient characteristics

From January 2012 to June 2019, there were a total of 88 eligible patient cases enrolled in the analysis. Table 1 summarizes the patient characteristics in both groups. Of the 88 patients, 27 (61.4%) were men and 17 (38.6%) were women, and the mean age (SD) was 47.3 ± 14.3 years in the intervention group; and 30 (68.2%) were men and 14 (31.8%) were women, and the mean age was 57.3 ± 13.2 years in the control group. All patients were Asian (China) in both groups. The mean LDH duration SD was 38.8 ± 12.3 months in the intervention group, and that was 40.2 ± 13.5 months in the control group. There were not significant differences in all patient characteristics between 2 groups (Table 1).

3.2. Efficacy

The patients in the intervention group achieved better outcome improvements in incision length (cm) (0.4 ± 0.3) and length of hospital stay (day) (7.4 ± 2.2), than those of incision length (cm)

Table 1

Patient characteristics at baseline.

Characteristics	Intervention group (n = 44)	Control group (n = 44)	P
Mean age (yr)	55.7 (12.9)	57.3 (13.2)	.57
Gender			
Male	27 (61.4)	30 (68.2)	.50
Female	17 (38.6)	14 (31.8)	–
Ethnicity (Asian China)	44 (100.0)	44 (100.0)	–
Education background			
Elementary school or below	13 (29.5)	11 (25.0)	.63
Secondary school	16 (36.4)	19 (42.2)	.51
High school	10 (22.7)	12 (27.3)	.62
College or university	5 (11.4)	2 (4.5)	.25
Occupation status			
Employment	13 (29.5)	16 (36.4)	.50
Unemployment	3 (6.8)	4 (9.1)	.69
Retired	28 (63.4)	24 (54.5)	.39
Marriage status			
Single	3 (6.8)	4 (9.1)	.69
Married	36 (81.8)	33 (75.0)	.44
Divorced	5 (11.4)	7 (15.9)	.57
LDH duration (month)	38.8 (12.3)	40.2 (13.5)	.61
Attacked location			
$L_{3/4}$	5 (11.4)	4 (9.1)	.73
$L_{4/5}$	33 (75.0)	35 (79.5)	.61
L_5/S_1	6 (13.6)	5 (11.4)	.75
Type of disc herniation			
Central	5 (11.4)	6 (13.6)	.75
Paracentral	30 (68.2)	28 (63.6)	.65
Lateral	9 (20.4)	10 (22.8)	.80

Data are present as mean ± standard deviation or number (%), LDH = lumbar disc herniation.

(3.2 ± 0.5; $P < .01$) and length of hospital stay (day) (10.6 ± 3.6; $P < .01$) in the control group (Table 2). However, as for surgery time (minute), there was not significant differences between 2 groups ($P = .56$; Table 2).

Patients in both groups had greater relief of pain intensity (VAS, $P < .01$; Table 3) and health-related quality of life (ODI, $P < .01$; Table 4), than them before the surgery. After surgery, there were not significant differences in pain intensity (VAS, $P = .33$; Table 3) and health-related quality of life (ODI, $P = .46$; Table 4) between 2 groups.

3.3. Complications

Complications in both groups are presented in Table 5. There were not significant differences in nerve root sleeves rupture, infection, hematoma, rebound of leg pain, and residual or recurrence between 2 groups ($P > .05$; Table 5).

Table 2

Comparison of primary outcomes between 2 groups.

Primary outcomes	Intervention group (n = 44)	Control group (n = 44)	P
Surgery time (min)	80.5 (33.2)	76.1 (37.8)	.56
Incision length (cm)	0.4 (0.3)	3.2 (0.5)	<.01
Length of hospital stay (day)	7.4 (2.2)	10.6 (3.6)	<.01

Data are present as mean ± standard deviation.

Table 3

Comparison of pain intensity at 2-month after surgery between 2 groups.

VAS	Intervention group (n = 44)	Control group (n = 44)	P
Before surgery	8.2 (1.0)	7.9 (1.3)	.22
After surgery	1.0 (0.8)	1.2 (1.1)	
Change from prior surgery	−7.2 (−8.1, −6.7)*	−6.7 (−7.6, −5.6)*	
Difference		−0.5 (−0.8, −0.2)	.33

Data are present as mean ± standard deviation (range), VAS = Visual Analogue Scale.
* $P < .01$, compared with treatment before surgery.

4. Discussion

LDH is common disorder in the orthopedic clinic.[1–5] If it is not treated fairly, it can proceed to the lower limb paralysis and incontinence.[13] Although a variety of conservative managements are reported to treat this condition, their efficacy is still not satisfied, especially for patients with severe symptoms of LDH. Thus, surgery is recommended to treat LDH. PIFD and FD are commonly used therapies for the treatment of patients with LDH. However, there is limited evidence to compare the efficacy and complications between both of them.

This retrospective study compared the efficacy and complications of PIFD and FD for the management of LDH. The results showed that PIFD exerted better outcomes in incision length and length of hospital stay in the intervention group, than those of patients in the control group. In addition, both PIFD and FD had better improvements in pain relief and health-related quality of life than those before the surgery. On the other hand, there were not significant differences in enhancement of pain relief and health-related quality of life between 2 groups. It indicates that PIFD may benefit for patients with LDH on the incision length of operation and length of hospital stay. However, no significant pain relief and health-related quality of life were identified at 2-month after surgery between 2 managements.

As for safety, no severe complications and deaths were recorded in both groups. No significant differences in all complications were detected between 2 groups. It means that both treatments had similar safety profiles.

This study exists several restrictions. First, this is a retrospective study, so biases may affect the results of this study. Second, follow-up time was restricted for the long-term efficacy and complications. Third, compared with prospective study, this retrospective study did not apply procedures of randomization and blind to both patients and researches, which may impact the selection bias in this study. Fourth, all patient cases were collected

Table 4

Comparison of health-related quality of life at 2-month after surgery between 2 groups.

ODI	Intervention group (n = 44)	Control group (n = 44)	P
Before surgery	37.4 (11.5)	36.6 (11.1)	.74
After surgery	10.6 (3.3)	11.3 (5.30)	
Change from prior surgery	−26.8 (−33.6, −19.5)*	−25.3 (−31.9, −18.8)*	
Difference		−1.5 (−2.2, −0.7)	.46

Data are present as mean ± standard deviation (range), ODI = Oswestry Disability Index.
* $P < .01$, compared with treatment before surgery.

Table 5

Comparison of complications between 2 groups.

Complications	Intervention group (n = 44)	Control group (n = 44)	*P*
Nerve root injury	0 (0)	0 (0)	–
Nerve root sleeves rupture	0 (0)	1 (2.3)	.50
Dural sac rupture	0 (0)	0 (0)	–
Infection	1 (2.3)	0 (0)	.50
Hematoma	1 (2.3)	2 (4.5)	.56
Rebound of leg pain	2 (4.5)	3 (6.8)	.65
Residual or recurrence	1 (2.3)	0 (0)	.50

Data are present as number (%).

from only 1 center of the First Affiliated Hospital of Jiamusi University. Future studies should recruit patients from multi-centers.

5. Conclusion

This study found that both PIFD and FD had similar efficacy and safety. However, PIFD benefits more than FD at recovery in patients with LDH.

Author contributions

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Correction

Originally, the award ID appeared incorrectly as 2020-KYYWF-1388 and has been corrected to 2020-KYYWF-0290.

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