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Original Article

Percutaneous endoscopic lumbar discectomy versus open lumbar microdiscectomy for treating lumbar disc herniation: Using the survival analysis

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Abstract

Objectives: This study compared the risk of symptomatic recurrent disc herniation and clinical outcomes of percutaneous endoscopic lumbar discectomy (PELD) versus open lumbar microdiscectomy (OLM) for lumbar disc herniation with 2 years of follow-up. **Materials and Methods:** We analyzed 23 patients who underwent PELD and 32 patients who underwent OLM for lumbar disc herniation. The numeric rating scale of back and leg pain, Oswestry Disability Index (ODI), and Roland–Morris Disability Questionnaire (RMDQ) were assessed before and at 12 and 24 months after the surgery. The wound pain and complications were also recorded. Survival analysis was performed to estimate the risk of symptomatic recurrent disc herniation. **Results:** In the comparison of groups, the reductions in back and leg pain, ODI, and RMDQ were not significantly different at 12 and 24 months. For patients who underwent PELD, the wound pain was significant lower at the day of surgery. The survival rate of patients who were free from symptomatic recurrent disc herniation at 24 months was 0.913 in PELD and 0.875 in OLM, and the log-rank test revealed no significant difference between the two survival curves. The incidence of complication was not significantly different between groups. **Conclusion:** Both PELD and OLM are effective treatments for lumbar disc herniation because they have similar clinical outcomes. PELD provided patients with less painful wounds. The survival analysis revealed that the risk of symptomatic recurrent disc herniation in 2 years of follow-up was not different between PELD and OLM.

Keywords: *Lumbar disc herniation, Open lumbar microdiscectomy, Percutaneous endoscopic lumbar discectomy, Survival analysis*

Introduction

Open lumbar microdiscectomy (OLM) is the gold standard treatment for lumbar disc herniation [1]. However, surgeons have recently tended to perform percutaneous endoscopic lumbar discectomy (PELD) for lumbar disc herniation because of its several strengths compared with OLM; for example, PELD minimizes muscle damage, requires only local anesthesia, and enables fast recovery after surgery. Studies have reported that both PELD and OLM are effective treatments for lumbar disc herniation, with no significant difference in clinical outcomes discovered between PELD and OLM [2-12].

To comprehensively compare PELD with OLM in lumbar disc herniation, time to recurrence should be considered as well as pain relief, functional recovery, complications, and proportion of recurrent disc herniation. Some of previous studies have calculated recurrence rate without considering the time factor, resulting in a lack of information about the risk of recurrence at different time points during the follow-up period. Survival analysis could provide an accurate estimate for the risk of recurrent disc herniation that enables more reliable comparison of various surgeries [13,14].

The present study aimed to perform a survival analysis to compare the risk of symptomatic recurrent disc herniation of PELD and OLM for lumbar disc herniation with 2 years of follow-up.

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Materials and Methods

This was a retrospective cohort study conducted in a single hospital. From August 2014 to October 2017, a total of 66 consecutive patients with lumbar disc herniation underwent PELD or OLM, with the surgery performed by a single, senior spine surgeon. Patients who met any of following criteria were excluded: had significant spinal stenosis or spondylolisthesis, had undergone multiple levels of discectomy, had received spinal instrumentation or fusion, and a follow-up period <24 months. Patients with extraforaminal disc herniation were excluded from OLM group. Among the rest, patients with central or paramedian disc herniation at L4-5 and L5-S1 level underwent interlaminar PELD. Moreover, transforaminal PELD was used for patients with disc herniation at higher lumbar level as well as extraforaminal disc. Finally, 55 patients were included for analysis. According to the surgical method, these patients were divided into two groups: the PELD group, comprising 23 patients, and the OLM group, comprising 32 patients.

The surgical techniques are described briefly herein. Two approaches to PELD are available: transforaminal and interlaminar. Transforaminal PELD is performed under local anesthesia. The patient maintains the prone position on a radiolucent table. A guidewire is placed 12.0–14.0 cm lateral to the midline of the lumbar spine, aiming obliquely under the fluoroscope at the target disc. The surgeon must be aware of and protect exiting and trespassing roots, while the endoscope or other instrumentation is introduced and disc material is removed. In the interlaminar approach, the patient again maintains the prone position but is under general anesthesia. A guidewire and an endoscope are introduced to the interlaminar space slightly lateral to the midline. Limited laminectomy, which involves removal of the ligamentum flavum and facet joint capsule, is necessary. The working channel can then be introduced and discectomy performed. OLM is conducted under general anesthesia. The patient maintains the prone position. The incision is 1.5 cm paramedian and 3.0 cm long above the interlaminar space. After subperiosteal stripping, an adequate retractor is placed. During the procedure, a headlight is required but a magnifying loupe or microscope may not be. Patients without adverse events and complications were discharged the next day after surgery and instructed to wear a lumbar corset for 1 month.

The primary outcomes were the risk of symptomatic recurrent disc herniation and clinical outcomes. We performed survival analysis using the Kaplan–Meier method to calculate the risk of symptomatic recurrent disc herniation during follow-up period. Symptomatic recurrent disc herniation was defined as the occurrence of sciatica with a proof of magnetic resonance imaging showing herniated disc material at the same level that required revision surgery or epidural steroid injection. The clinical outcomes were pain relief and functional recovery, assessed using the numeric rating scale (NRS, 0–10), Oswestry Disability Index (ODI, 0–100), and Roland–Morris Disability Questionnaire (RMDQ, 0–24). Assessments were performed at three time points: before and at 12 and 24 months after the surgery. The primary outcomes were collected from medical records. Age, sex, body mass index (BMI), smoking status, educational attainment, occupation (proportion of manual laborers), operation time, length of hospital stay, wound pain, and complications were also obtained from medical records. The complications were defined as the occurrence of dural tear, nerve root injury, infection, dysesthesia, diskitis, and epidural hematoma.

The two-sample *t*-test was used to compare continuous variables between groups, and the Chi-square test or Fisher's exact test was used to compare discrete variables. Analyses of repeated measures were performed using the generalized estimating equation method. The log-rank test was used to compare the survival distributions of the two groups. All analyses were performed using IBM SPSS 21.0 (IBM, Armonk, NY, USA).

Ethics approval and consent to participate

All procedures performed in the current study were in accordance with the 1964 Helsinki declaration and its later amendments. The study design was approved by Ditmanson Medical Foundation Chia-Yi Christian Hospital's institutional review board (approval no. 104113).

Results

Table 1 presents the patient characteristics. Similar distributions were discovered between the two groups in terms of age, sex, BMI, educational attainment, the proportion of manual laborers, operation time, and length of hospital stay. The proportion of current smokers was higher in the OLM group. L4 − L5 and L5 − S1were commonly treated levels in both the groups.

Table 1: Patient characteristics

	OLM, *n* (%)	PELD, *n* (%)	*P*
Number of patients	32	23	
Age	56.7±18.4	49.3±19.6	0.163
Male	17 (53.1)	13 (56.5)	1.000*
BMI (kg/m^2)	26.8±4.8	27.0±4.8	0.884
Smoking habit			
Current smokers	15 (46.9)	5 (21.7)	0.088*
Non- and ex-smokers	17 (53.1)	18 (78.3)	
Educational attainment			
College	11 (34.4)	6 (26.1)	0.419*
High school	19 (59.4)	13 (56.5)	
Less than high school	2 (6.3)	4 (17.4)	
Manual laborers	6 (18.8)	5 (21.7)	1.000*
Disc herniation level			
L2−L3	1 (3.1)	0 (0.0)	0.493*
L3−L4	6 (18.8)	3 (13.0)	
L4−L5	17 (53.1)	10 (43.5)	
L5−S1	8 (25.0)	10 (43.5)	
Approach			
Interlaminar	−	15 (65.2)	
Transforaminal	−	8 (34.8)	
Operation time (min)	125.8±32.2	118.0±35.8	0.267
Length of hospital stay (days)	3.7±1.0	3.4±1.1	0.401

*Fisher's exact test. OLM: Open lumbar microdiscectomy, PELD: Percutaneous endoscopic lumbar discectomy, BMI: Body mass index

Before the surgery, the mean NRS for back and leg pain was 7.1 ± 1.6 and 6.7 ± 2.3 in the OLM group, respectively, and 6.7 ± 2.3 and 7.0 ± 1.9 in the PELD group [Table 2]. After surgery, the mean NRS for back and leg pain was significantly decreased in both the groups at the 12-month follow-up, and this lasted until the 24-month follow-up. In the group comparison, the improvements of NRS from baseline to 12 months and 24 months were not different between the two groups. The ODI and RMDQ scores revealed significant improvements in the OLM group at 12- and 24-month follow-ups, and a similar trend was also discovered in the PELD group. The improvements of ODI and RMDQ scores were not different between groups. The wound pain was significant lower at the day of surgery in the PELD group. We did not observe complications in either group. A total of four patients were identified with symptomatic recurrent disc herniation in the OLM group and two patients in the PELD group [Figure 1]. In the OLM group, the recurrence occurred in weeks 13, 15, 18, and 90, respectively. All of four cases underwent OLM for revision and a complete relief of symptoms was achieved. In the PELD group, symptomatic recurrent disc herniation occurred in two cases, after 9 and 36 weeks, respectively. Of the two cases, one case underwent PELD for revision and a complete relief of symptoms was achieved, and in the other case, epidural steroid injection was performed and relieved the residual discomfort.

Figure 2 presents Kaplan–Meier curves for PELD and OLM, and the result of the log-rank test revealed no intergroup difference between the two survival curves. The survival rate at 2 years after surgery was 0.875 in the OLM group and 0.913 in the PELD group [Table 3]. The mean survival time in the OLM and PELD groups was 95.3 and 96.9 weeks, respectively, and the median survival time was 104 weeks in both the groups.

Table 2: Clinical outcomes

	OLM	PELD	*P*
Back pain (0−10) (months)			
Preoperative	7.1±1.6	6.3±2.0	0.099
12	2.0±2.2	1.5±1.5	0.537
24	2.0±2.7	1.4±1.5	0.687
Leg pain (0-10) (months)			
Preoperative	6.7±2.3	7.0±1.9	0.605
12	1.6±2.7	1.2±2.3	0.300
24	1.7±3.0	1.0±2.3	0.174
ODI (0-100) (months)			
Preoperative	57.0±14.9	54.9±18.8	0.658
12	20.2±19.5	15.6±22.2	0.645
24	19.3±20.9	15.0±23.6	0.676
RMDQ (0-24) (months)			
Preoperative	14.1±4.5	14.2±5.2	0.932
12	3.0±4.3	2.6±4.3	0.733
24	3.5±4.8	2.9±4.8	0.704
Wound pain (0-10)			
Day of surgery	2.5±0.9	1.9±1.0	0.008*
Day 1 after surgery	1.5±1.1	1.5±1.0	0.790*
Recurrent disc herniation, *n* (%)	4 (12.5)	2 (8.7)	1.000†
Complications, *n* (%)	0	0	1.000†

*Mann-Whitney *U*-Test. †Fisher's exact test. OLM: Open lumbar microdiscectomy, PELD: Percutaneous endoscopic lumbar discectomy, ODI: Oswestry Disability Index, RMDQ: Roland–Morris Disability Questionnaire

Table 3: The survival rate during the follow-up period

Follow-up time points (weeks)	OLM	PELD	*P*
8	1.000	1.000	0.670
12	1.000	0.957	
16	0.938	0.957	
20	0.906	0.957	
52	0.906	0.913	
104	0.875	0.913	

OLM: Open lumbar microdiscectomy, PELD: Percutaneous endoscopic lumbar discectomy

Discussion

Our results indicated that the risk of symptomatic recurrent disc herniation was not significant difference between OLM and PELD in 2 years of follow-up. At follow-up visits, similar pain and functional scores were observed in the two groups, and no significant difference was discovered between the groups in pain and function improvements. In the period of hospitalization, patients who underwent PELD experienced less wound pain at the day of surgery.

Previous studies have reported a proportion of recurrent disc herniation from 0.0% to 14.6% in patients who underwent OLM and from 3.1% to 8.6% in patients who underwent PELD [4,5,7,9-12,15-17]. In this study, the proportion of recurrent disc herniation was 12.5% (4/32) in the OLM group and 8.7% (2/23) in the PELD group. Our result was comparable with these reports. Certain complications after OLM and PELD have been reported, including dura tear, nerve root injury, wound infection, dysesthesia, diskitis, and epidural hematoma. To compare the incidence of complications between OLM and PELD, meta-analyses have been performed in three recent studies, and no significant difference has been discovered [18-20]. In our study, we did not observe any of the aforementioned complications.

A randomized clinical trial reported that although the proportion of reoperation among patients who underwent PELD did not significantly differ from that for those who underwent OLM, the time from initial discectomy to reoperation was much shorter in patients who underwent PELD (OLM: 60.0 ± 1.0 weeks vs. PELD: 46.0 ± 16.0 weeks; $P = 0.02$) [11]. A similar finding was reported in a population-based study conducted in South Korea (2003 cohort); patients aged 57 years and older had a significantly higher risk of reoperation after PELD until 3.4 years postoperation [21]. However, another population-based study performed in South Korea (2005–2007 cohort) reported a nonsignificant difference in the risk of reoperation between OLM and PELD at any time point over a 10-year follow-up, indicating that PELD did not increase the risk of reoperation in the short term [22]. In the present study, we could not compare the time from initial discectomy to recurrent disc herniation due to a wide variation of values in both the groups. The findings of the survival analysis indicated that the risk of symptomatic recurrent disc herniation in a 2-year

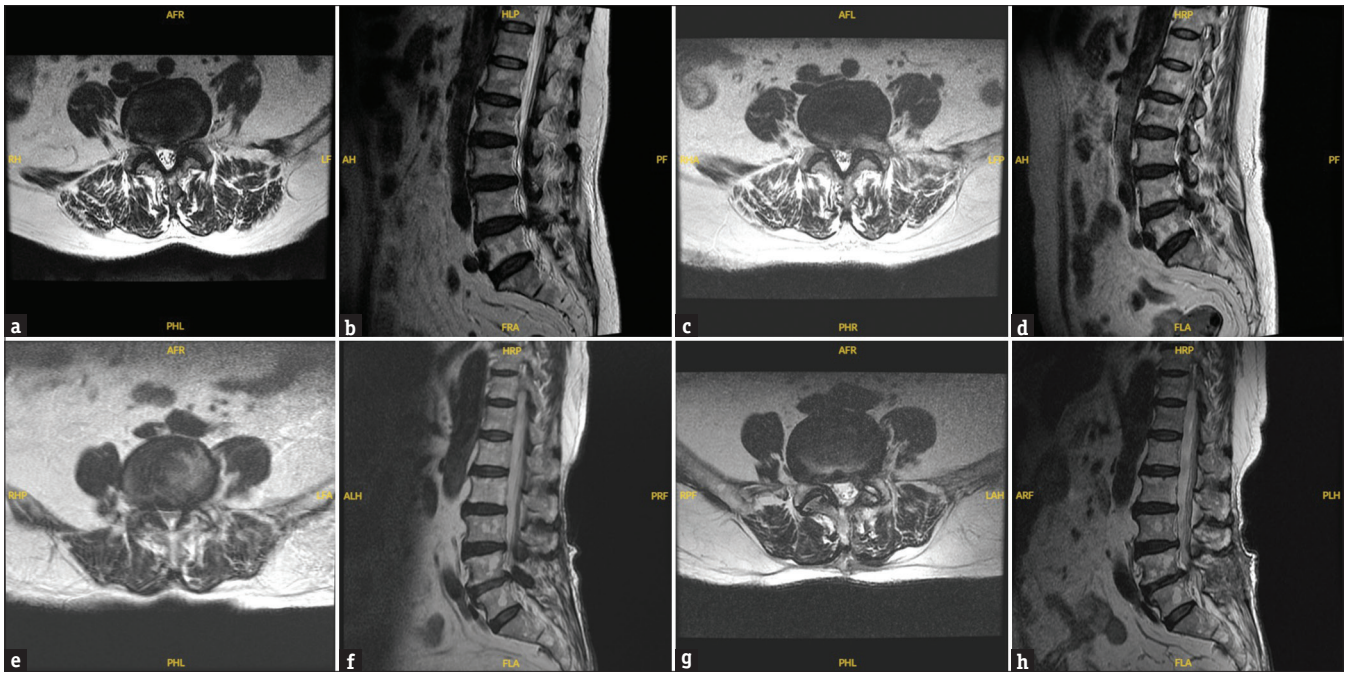

Figure 1: A 72-year-old male with L4 − 5 recurrent disc herniation after PELD. (a) Preoperative axial view, (b) preoperative sagittal view, (c) axial view before revision, and (d) sagittal view before revision. A 79-year-old female with L4 − 5 recurrent disc herniation after OLM. (e) Preoperative axial view, (f) preoperative sagittal view, (g) axial view before revision, and (h) sagittal view before revision. PELD: Percutaneous endoscopic lumbar discectomy; OLM: Open lumbar microdiscectomy

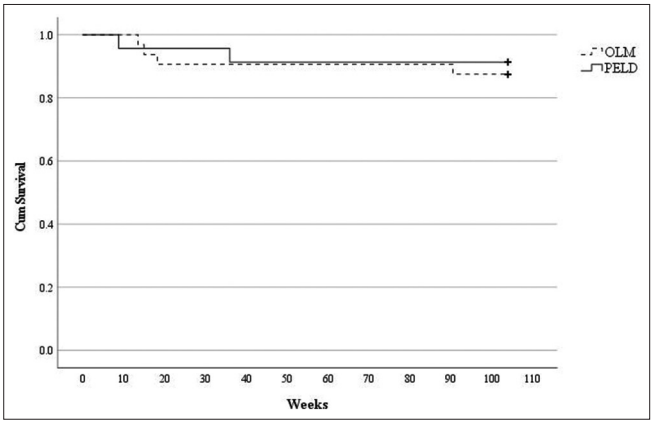

Figure 2: Kaplan–Meier curves for PELD and OLM. PELD: Percutaneous endoscopic lumbar discectomy, OLM, Open lumbar microdiscectomy

follow-up was not higher among patients who underwent the PELD procedure.

Because of the minimal invasive technique, PELD provided patients with a shorter duration of the time return to work and a lower incidence of wound complications than OLM [18]. In our series, the wound was about 0.7 cm and 3.0 cm long in PELD and OLM, respectively. Therefore, patients who underwent PELD experienced less painful wounds than OLM and might start mobilization earlier. We allow patients to return to work with a lumbar corset within 1 month in the PELD group and 3 months in the OLM group. In general, the cost of OLM is lower than PELD because it was paid by the National Health Insurance Administration. However, PELD is an alternative choice as it provides a rapid recovery, and the clinical outcomes are comparable to OLM.

Some limitations of this study should be noted. First, the matched-group design was not employed, which decreased the comparability of the two groups. The confounding factors might lead to an overestimate or underestimate of results and mask the true relationship between clinical outcomes and operative procedures. However, it was not appropriate to evaluate and adjust confounding bias using methods of stratification and regression analysis in this study because of the small sample size. Because most of the patient characteristics were similar, the risk of confounding bias is likely to be acceptable. Second, patients were followed up for 2 years. Therefore, the outcomes are not generalizable to long term. Third, we included patients with two different approaches in the PELD group, which decreased the homogeneity of cases. However, a recent meta-analysis study has reported comparable clinical outcomes and complication between the two approaches [23]. Fourth, the analysis of risk factors is not performed due to the limited number of the recurrent disc herniation.

Conclusions

In this study, we compared the clinical outcomes of patients who underwent PELD or OLM using several parameters and employed a 2-year follow-up. The results revealed that PELD may provide similar outcomes to OLM in patients who require discectomy. Patients who underwent PELD experienced less painful wounds at the day of surgery. According to the survival analysis, the risk of symptomatic recurrent disc herniation in a 2-year follow-up was not different between PELD and OLM.

Data availability statement

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

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Conflicts of interest

There are no conflicts of interest.

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