Original Article

Clinical Results of Percutaneous Endoscopic Lumbar Discectomy in Patients with Lumbar Disc Herniation: A Consecutive Prospective Study

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Objective: The objective was to evaluate clinical outcomes and complications of post percutaneous endoscopic lumbar discectomy [PELD] in patients with lumbar disc herniation.

Materials and Methods: One hundred and one patients with lumbar disc herniation who underwent PELD between October 2013 and February 2017 were included in the present study. The Visual analog scale [VAS] at rest and during activity, the Thai version of the modified Oswestry Disability Index [ODI] and complications were recorded preoperatively and 1 day, 2 months, 6 and 12 months postoperatively. Repeated measures ANOVA was used to compare the mean of clinical outcomes.

Results: Postoperative resting VAS and activity VAS declined clinically and statistically significant ($p = 0.001$). The Oswestry Disability Index score increased significantly ($p = 0.001$). Of the 101 patients, 8 patients (7.92%) had revision surgery. Of those, 4 cases (3.96%) were due to recurrence of lumbar disc herniation and 4 case (3.96%) were due to spinal instability. Eleven patients (10.89%) still had leg pain, 15 patients (14.85%) had paresthesia, and 15 patients (14.85%) had a slight motor deficit which completely disappeared during the follow-up period.

Conclusion: PELD is a safe and effective minimally invasive spine surgery technique. However, this technique has a steep learning curve. In addition to selection of appropriate patients, successful surgery depends on high levels of surgical skills and expertise.

Keywords: Percutaneous endoscopic lumbar discectomy, Minimal invasive spine surgery, Lumbar disc herniation, PELD

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Lumbar disc herniation is the most common cause of low back pain and sciatica in adolescences[1,2]. There are several treatment options. Non-surgical treatment options include absolute bed rest, medication, and physical therapy. Surgical treatment options include open surgery, micro endoscopic discectomy, and percutaneous endoscopic discectomy. Most patients with lumbar disc herniation recover with non-surgical treatment; only 1 to 5% of cases require surgery[1-4]. In recent years, interest in endoscopic spinal surgery has increased. Advantages of the minimally invasive procedure include preservation of bony structures and lumbar mobility, minimal blood loss, rapid recovery, reduced hospital stay, and low rates of postoperative morbidity[3,5-7]. Percutaneous endoscopic lumbar discectomy [PELD] is a novel minimally invasive spine surgery technique for decompression of the lumbar disc space and removal of nucleus pulposus via either the posterolateral or the interlaminar approach. To date, few prospective clinical studies of this technique have been conducted. The objective of the present study was to evaluate clinical outcomes and complications of post PELD in patients with lumbar disc herniation.

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Materials and Methods

The present study reviewed 128 patients with lumbar disc herniation who underwent spinal surgery at Chaiyaphum Hospital from October 2013 to February 2017 of whom 101 met the inclusion criteria. The inclusion criteria were patients with lumbar disc herniation for whom conservative treatment lasting more than 6 weeks had failed, patients with progressive neurological deficits, and patients with cauda equina syndrome. The exclusion criteria were patients with a migrated (sequestrated) disc above or below the mid-pedicle level and patients with spinal instability, spinal stenosis, recurrent lumbar disc herniation, or previous back surgery. The patients had been diagnosed by clinical findings and MRI. The present study was approved by the Chaiyaphum Hospital Ethics committee and informed consent was obtained in all cases. All patients were evaluated pre-operatively for muscle strength, visual analogue pain scale [VAS], and the Thai version of the Oswestry Disability Index [ODI]. All patients underwent PELD by a single surgeon who had successfully completed the intensive training program for PELD conducted by Dr. S. Rutten. After the PELD operation, patients received training from a physiotherapist on core stabilization exercises, appropriate lifting techniques, and ambulation. Follow-up evaluation was conducted 1 day, 2, 6, and 12 months postoperatively to evaluate pain using VAS and ODI. Data at each follow-up were compared to baseline data and recorded by an independent observer. Post-surgery complications were recorded at each follow-up visit.

Statistical analysis

Quantitative data distributions were analyzed using the Kolmogorov-Smirnov test. Mean and SD were used to describe continuous data. Percentage was used for describing categorical data. Repeated measures ANOVA was used to compare the means of clinical outcomes. Differences were considered statistically significant at $p<0.05$.

Results

One hundred twenty-eight patients with lumbar disc herniation underwent spinal surgery of whom 101 met the inclusion criteria for PELD and were included in the present study. Twenty-three patients who had lumbar disc herniation with spinal stenosis, 3 patients with spine surgery at more than 1 level, and one patient who had previously undergone spinal surgery were excluded. The mean follow-up period was 11.56 months (range 2 to 24). The mean age of the patients was 43.42 years (range 21 to 68). The mean time of onset of symptoms before surgery was 3.56 months (range 0.5 to 12). The mean surgical time was 52.38 minutes (range 18 to 170) and the mean hospital stay was 3.70 days (range 1 to 17) (Table 1).

Both resting and activity VAS declined significantly postoperatively ($p = 0.001$). Ninety patients (89.11%) had significant reduction of leg pain immediately after surgery and were able to walk within 6 hours. ODI scores increased significantly ($p = 0.001$). Eight patients (7.92%) required revision surgery, 11 patients (10.89%) still had leg pain, 15 patients (14.85%) had developed paresthesia, and 15 patients (14.85%) had developed transient motor deficit but those symptoms disappeared within the follow-up period (Figure 3). All patients were discharged from the hospital on the third or fourth day after surgery. Eighty-six patients (84.15%) reported no post-operation complications and exhibited excellent outcomes.

Discussion

The present study provides additional evidence that percutaneous endoscopic lumbar discectomy is a safe and effective method for lumbar disc herniation treatment. In this prospective consecutive study of 101 patients who underwent PELD, 90 patients (89.11%) had significant improvement in leg pain immediately and most could stand and walk immediately after surgery. PELD relives leg pain and paresthesia by reducing the pressure on nerves resulting from a herniated disc and patients are able to move immediately after surgery. The results of PELD

Table 1. Demographic data and surgical characteristics of participants

	n	%
Sex		
Male	50	49.50
Female	51	50.49
Approach used		
Interlaminar [IL]	62	61.38
Transforaminal [TF]	39	38.61
Spine level of surgery		
L2-L3	2	1.98
L3-L4	4	3.96
L4-L5	63	62.37
L5-S1	32	31.68
Side of surgery		
Right	35	34.65
Left	66	65.34

surgery are equivalent to conventional open discectomy, the current gold standard [5,8]. Results of the present study are similar to previous studies of the PELD technique, e.g., Rutten et al[5] reported that 84% of patients who underwent full endoscopic resection of lumbar disc herniation via the interlaminar and transforaminal approach no longer had leg pain. Preliminary results of full endoscopic uniportal lumbar discectomy reported by Kuonsongtum et al[7] stated that 93.5% of patients had significant reduction in sciatica pain immediate after surgery, and 87.4% had excellent or good outcomes as assessed by the Modified McNab criteria. Advantages of this minimal spinal surgery technique include minimal tissue trauma, reduced of blood loss, decreased risk of infection, less post-surgical scarring, and reduced length of hospital stay.

In the present study, the authors found that following surgery 11 patients (10.89%) had some degree of residual leg pain. Eight patients (7.92%) required revision surgery and 4 patients (3.96%) had recurrent disc herniation. Those 8 cases were again operated on using the same PELD technique with good clinical outcomes. Four cases (3.96%) had lumbar disc herniation with spondylolithesis grade I due to inappropriate case selection. All revision surgeries were performed within on patients in the first 30 cases using PLED. Results of the present study are consistent with the short term clinical results of 163 patients reported by Sencer et al. which found that after PELD 18% of patients had occasional pain and 12% had no improvement. In addition, 8 patients (4.90%) required revision surgery for recurrence or for residual fragments and 6 patients (2.25%) had a dural tear. Recurrence of lumbar disc herniation is a problem in both open and endoscopic surgery. Reported recurrence rate of lumbar disc herniation open surgery has ranged from 5 to 11%[15] versus 6 to 7% with PELD[5,9,11,12,15].

In the present study, 15 patients (14.85%) had paresthesia and 15 patients (14.85%) had a slight motor deficit, but all had complete symptomatic recovery within the 2 to 6 month follow-up period. Paresthesia was more common in patients who had undergone PELD via the transforaminal approach than the interlaminar approach. The authors hypothesized that the difference was due to rotation of the working sleeve through the neural foramen which can result in compression of or injury to the existing nerve root. Among the first 30 PELD operations, there was a slight improvement in motor deficit from grade 5 to grade 4 or from grade 4 to grade 3. Most of those patients had undergone PELD via the interlaminar approach rather than the transforaminal approach, and most had had surgery in lumbar spine levels 4 and 5 due to narrow spaces while rotating the working sleeve to avoid nerve root compression in the spinal canal.

In subsequent operations following the first

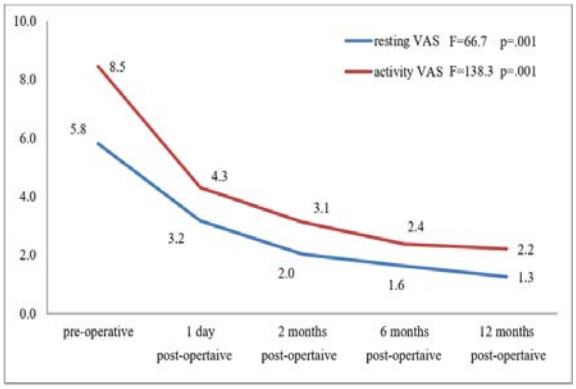

Figure 1. Mean pre-operative and post-operative of resting VAS and activity VAS scores.

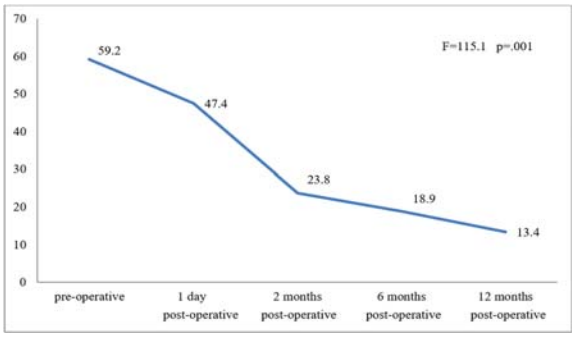

Figure 2. Mean pre- and post-operative of oswestry disability index.

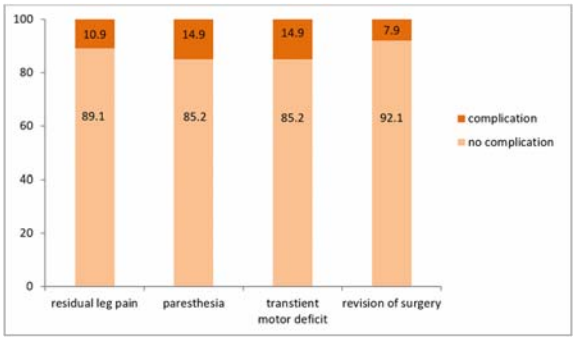

Figure 3. Complication rate following percutaneous endoscopic lumbar discectomy.

30 cases, the authors partially removed the descending and ascending facet joint to increase the working space for inserting the working sleeve. With that modification in surgical procedure there were no further cases of motor deficit. In the opinion of the authors, when performing PELD via the interlaminar approach the descending and ascending facet on the lumbar vertebral column level 4 to 5 or above should be partially removed to reduce the chance of nerve compression. The association of alternative surgical techniques and different postoperative complications should be studied further.

There were no serious complications in this study, e.g., cauda equine syndrome, dural tear, or severe pain after surgery. PELD is a safe and effective alternative treatment for lumbar disc herniation and provides the many benefits of minimally invasive surgery.

Conclusion

PELD is a minimally invasive spinal surgical technique which provides many benefits. This present study showed that it is possible to achieve a leg pain free status by removing fragmented disc material using PELD. However, the PLED operating technique involves a steep learning curve. Intensive surgical training and proper patient selection are key to success.

What is already known on this topic?

PELD is a safe and effective method for lumbar disc herniation treatment. The advantages of minimal spinal surgery were minimal less tissue trauma, less of blood loss, decreased chance of infections, less post-surgical scar and reduce length of hospital stay. The keys successes of PELD are intensive surgical training and proper patient selection.

What this study adds?

The post-operative complications found paresthesia and slightly motor deficit. Paresthesia was found in patients who had undergone PELD via transforaminal approach more than interlaminar approach. For the motor dificits, the author thought that it's due to rotation of the working sleeve through the neural foramen which there was a chance for the existing nerve root compression or injury. Partial removed facet joint to increase working space to insert working sleeve to reduce the chance of compression on the nerves, so that no motor deficit was occurred after that. Surgical techniques affect to different postoperative complications should be a further study.

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Potential conflicts of interest

The authors declare no conflict of interest.

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