Comparison of Outcomes of Percutaneous Endoscopic Lumbar Discectomy and Open Lumbar Microdiscectomy for Young Adults: A Retrospective Matched Cohort Study

Sang-Soak Ahn†, Sang-Hyeon Kim‡, Dong-Won Kim‡, Byung-Hun Lee‡

OBJECTIVE: There have been only a few studies on surgical treatment of lumbar disc herniation (LDH) in young adults. In addition, previous studies do not provide detailed information on the surgical outcomes for young adults with LDH. The purpose of this study was to compare the outcome of transforaminal percutaneous endoscopic lumbar discectomy (PELD) and open lumbar microdiscectomy for active, young adults (age 20–25 years).

METHODS: We performed retrospective chart and radiography. The patients were divided into 2 groups according to the surgical methods. Group A included the patients who underwent transforaminal PELD, and Group B included the patients who underwent open lumbar microdiscectomy for LDH at L4/5. After we matched for several factors, 32 young patients in group A and 34 young patients in group B were analyzed. We compared the outcomes between the 2 groups in terms of clinical, radiologic, perioperative outcomes, and surgery-related complications.

RESULTS: The clinical results for leg pain and radiologic results for decompression were the same in both groups. Most of complications in the PELD group occurred in the early phase. The recurrence rate and operation failure rate was no difference between the groups. The PELD brought significant advantages in the following areas: back pain, operation time, blood loss, hospital stay, and return-to-work.

CONCLUSIONS: Although a learning curve is needed in order to become familiar with PELD, PELD seemed to be a good choice for disc herniation in the lumbar spine for active, young adults.

INTRODUCTION

Lumbar disc herniation (LDH) is a relatively common cause of sciatica in young adults.1–5 Most young adults with LDH can be managed properly with conservative treatment; however, a small number of patients do not respond effectively to conservative treatment and eventually require surgical treatment. There are 2 main surgical options: open lumbar microdiscectomy (OLM) and percutaneous endoscopic lumbar discectomy (PELD). OLM has been considered to be the gold standard procedure for symptomatic lumbar disc diseases;6–9; however, open surgery results in muscle damage, the removal of the yellow ligament, and nerve retraction. This can cause instability and scarring of the epidural space, which becomes clinically symptomatic in 10% or more of patients.6,7,9,10 PELD has been performed as an alternative to classic open discectomy with comparable results. There are potential downsides of the tranforaminal PELD, such as transient paresthesias, a larger annular defect, and difficulties accessing L5/S1 in patients with a prominent iliac crest. In addition, the learning curve is perceived to be steep. However, it has several advantages over open discectomy, including (1) the ability to be performed under local anesthesia; (2) minimal postoperative pain

Key words
- Diskectomy
- Percutaneous
- Endoscopy
- Intervertebral disc displacement
- Young adult

Abbreviations and Acronyms
- DSCSA: Dural sac cross-sectional area
- LDH: Lumbar disc herniation
- MRI: Magnetic resonance imaging
- ODI: Oswestry Disability Index
- OLM: Open lumbar microdiscectomy
- PELD: Percutaneous endoscopic lumbar discectomy
- PLL: Posterior longitudinal ligament
- SF-12: 12-item short form health survey

VAS: Visual analog scale

From the †Department of Neurosurgery, Spine and Spinal Cord Institute, Gangnam Severance Spine Hospital, Yonsei University College of Medicine, Seoul; ‡Department of Radiology, Dong-A University Medical Center, Busan; and §Department of Neurosurgery, The Armed Forces Capital Hospital, Seongnam, Korea

To whom correspondence should be addressed: Sang-Soak Ahn, M.D.
[E-mail: ahnsangsoak@hanmail.net]

Citation: World Neurosurg. (2016) 86:250-258.
http://dx.doi.org/10.1016/j.wneu.2015.09.047

Journal homepage: www.WORLDNEUROSURGERY.org
Available online: www.sciencedirect.com

1878-8750/$ - see front matter © 2016 Elsevier Inc. All rights reserved.
and preservation of the normal para-spinal muscles; and (3) a minimization of the risk of postoperative epidural scar formation and instability. A consensus on the preferred surgical method in young patients has not been established, however, and there have only been a few studies in which the authors examined the surgical treatment of LDH in young adults.

We conducted this study to compare the clinical, radiologic, and perioperative outcomes of transforaminal PELD and OLM for young adults (age 20–25 years) with LDH, as well as the surgery-related complications. To the best of our knowledge, this is the first study to compare the outcomes of PELD and OLM in young adults by the use of a retrospective matched cohort design.

MATERIALS AND METHODS

Study Design
This study was carried out after we obtained approval from the institutional review board (The Armed Forces Capital Hospital [AFMC-15041-IRB-15-057]). Between May 2012 and January 2014, 178 consecutive patients with LDH who underwent surgical treatment were considered for this study. The inclusion criteria were as follows: (1) a soft LDH within the spinal canal in L4–5 (including the sequestering of material located cranially below the lower edge of the cranial pedicle or caudally not over the middle of the caudal pedicle), with lumbar spine radiographs, computed tomography, and magnetic resonance image (MRI) corresponding to the clinical symptoms; (2) age between 20 and 25 years; (3) nonresponse to at least 8 weeks of conservative treatment, including medication, physical therapy, and injections; (4) a surgical procedure performed by the designated spine surgeon (S.S.A.); and (5) follow-up of at least 1 year. Those who met any of the following criteria were excluded: (1) lateral recess stenosis, hard disc herniation, foraminal and extraforaminal disc herniations, and spinal instability; (2) follow-up of less than 1 year; and (3) an inability to accurately complete the pre- and postoperative questionnaires. Ninety-seven patients were excluded because of these criteria.

The patients were divided into 2 groups according to the surgical methods. Group A included the patients who underwent PELD for disc herniation, and Group B included those who underwent OLM. After we matched for tobacco smoking and body mass index between the 2 groups, 32 patients in group A and 34 patients in group B were analyzed (Figure 1). All of these patients were Korean military serviceman at the time of their operations. Before surgery, all patients were informed of the details of the

**Figure 1.** Flowchart depicting patient selection. OLM, lumbar microdiscectomy; PELD, percutaneous endoscopic lumbar discectomy.
surgery, including the anesthesia process, potential complications, and benefits of the procedures. One spine surgeon with 4 years of surgical experience was involved in the study. The selection of the surgical method was based on this surgeon’s recommendation as well as patient preference.

Clinical Assessment
Clinical and demographic data were recorded prospectively. The patients completed a questionnaire consisting of a 10-point visual analog scale (VAS) for low back pain and leg pain preoperatively and at each follow-up visit. The patients also completed the Oswestry Disability Index (ODI) and a 12-item short form health survey (SF-12) for their quality of life preoperatively and at each follow-up visit. The physical component summary and mental component summary of the SF-12 were recorded separately. Follow-up visits occurred at 6 and 12 months after surgery. Patients were not allowed to review their previous results. The operation time, blood loss, hospital stay, return-to-work time, complication rate, failure rate, and 12-month reherniation rate were evaluated to assess the outcomes of the procedures.

Radiologic Assessment
All patients underwent MRI preoperatively and at 12 months after surgery. The change in the dural sac cross-sectional area (DSCSA) between the preoperative and the postoperative MRI was evaluated to demonstrate the extent of decompression. This space was drawn by an imaginary area at the narrowest lesion on the T2-weighted axial MRI (Figure 2). The MRI scans were performed using a 1.5-T MRI system (Signa Excite scanner, General Electric Company, Milwaukee, Wisconsin, USA) with a slice thickness of 5 mm. To evaluate the radiologic parameters, two radiologists (S.H.K. and D.W.K.) independently measured the preoperative and postoperative parameters using a picture archiving communication system feature (Marosis 5.0 PACS viewer, Marotech, Seoul, Korea).

Surgical Procedure
In group A, we used the “in-and-out-and-in” technique. All operations were performed under local anesthesia after sedation of the patient with the intramuscular administration of midazolam (0.1 mg/kg) in the prone position. Before surgery, we checked the lateral view of the C-arm image and determined the entry point, which was between the tip of the spinous process and the spinolaminar junction on the lateral view. The entry point was usually 10–15 cm from the midline. The entry point was projected to have 20–25 degrees of access (from the coronal plane) for L4–5. An 18-gauge spinal needle was introduced under the biplanar guidance of fluoroscopy. The final target point of the needle was the medial pedicular line on the anteroposterior view and the posterior vertebral line on the lateral view.

At this point, epidurography was performed with contrast medium and local anesthesia was carried out using 1% lidocaine. After the insertion of the needle into the disc, evocative chromodiscography was performed with contrast medium and indigocarmine. A guide wire was then inserted through the needle, and the needle was removed. A linear skin incision about 8 mm long was made at the entry point, and an obturator (YESS system; Richard Wolf, Knittlingen, Germany) was gently introduced by a twisting maneuver. A bevel-ended working sheath was inserted into the disc space along the obturator, and then the obturator was removed. After we placed the endoscope within the working sheath, the disc fragment at the base of the herniated mass was removed with a high-voltage bipolar probe manufactured by Ellman (Ellman Innovation, Hicksville, New York, USA) and pituitary forceps. After the removal of the central disc fragment, the working sheath was moved back to the epidural space and the posterior longitudinal ligament (PLL) was removed in the half-and-half view (Figure 3). After removal of the PLL, while we confirmed the pulsation of the dura with direct visualization, the posterolateral target fragment was removed by introducing the working sheath from the lateral to the medial area. After all procedures were complete, the endoscope was removed, and
a sterile dressing was performed with a one-point suture. The patients were able to communicate with the surgeon during the entire procedure.

In group B, the procedure was performed under general anesthesia in the prone position on a Wilson frame. A 3-cm posterior midline skin incision was made over the appropriate disc space. A limited laminotomy was performed using a high-speed drill. By the use of a small annulotomy if needed, the disc fragment was removed in the conventional manner under microscopic view. The foramen was then routinely probed for residual fragments or bony lesions. After confirming the decompression of the nerve root, the closure was performed in the conventional manner.8

Statistics
Statistical analyses were performed using SPSS version 20.0 (SPSS Inc., Chicago, Illinois, USA). The mean values ± standard deviations or the medians with the interquartile ranges are shown. Student t tests were conducted to confirm intergroup differences in cases with normal distributions. Mann-Whitney U tests were used to compare variables between two groups with non-normal distributions. For the categorical variables, χ² tests and Fischer exact tests were performed between 2 independent groups. All P-values less than .05 were considered statistically significant.

RESULTS

Demographics
We reviewed 32 patients in group A (PELD) and 34 patients in group B (OLM) who met the inclusion and exclusion criteria. Patient demographics including the follow-up period were not significantly different between the 2 groups (Table 1).

Clinical Outcomes
Preoperatively, the back and leg VAS scores were 4.41 ± 0.98 and 7.53 ± 0.92, respectively, in group A and, 4.74 ± 1.08 and 7.50 ± 0.93, respectively, in group B. These results revealed no significant differences. After surgery, the VAS scores for the back and leg decreased significantly in both groups. At 12 months after surgery, the back and leg VAS scores were 2.50 ± 0.62 and 2.06 ± 0.84, respectively, in group A and 2.91 ± 0.67 and 2.32 ± 1.01, respectively, in group B. There were significant differences between the groups for back VAS score at 6 months and 12 months after surgery (P < 0.001, P = 0.012, respectively). However, there was no significant difference between the groups for leg VAS score after surgery (Figure 4).

The mean ODI scores significantly improved from baseline at the final follow-up in both groups (Figure 5). As depicted in Figure 5, there was a significant difference in ODI scores between the groups at 6 months after surgery (P = 0.004). The mean physical component summary score and mental component summary score in the SF-12 improved at the final follow-up time as compared to the baseline in both groups (Figure 6). As depicted in Figure 6, there was a significant

---

Table 1. Demographic Data

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Group A</th>
<th>Group B</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>32</td>
<td>34</td>
<td>0.56</td>
</tr>
<tr>
<td>Mean age, year*</td>
<td>22.41 ± 1.68</td>
<td>22.18 ± 1.51</td>
<td>0.56</td>
</tr>
<tr>
<td>Sex, male/female</td>
<td>32/0</td>
<td>34/0</td>
<td>1.00</td>
</tr>
<tr>
<td>Height, cm*</td>
<td>173.09 ± 5.90</td>
<td>172.56 ± 5.89</td>
<td>0.71</td>
</tr>
<tr>
<td>Weight, kg*</td>
<td>66.53 ± 6.60</td>
<td>67.03 ± 6.24</td>
<td>0.75</td>
</tr>
<tr>
<td>BMI, kg/m²*</td>
<td>22.16 ± 1.22</td>
<td>22.46 ± 0.90</td>
<td>0.26</td>
</tr>
<tr>
<td>Smoking, %</td>
<td>10 (31.2)</td>
<td>10 (29.4)</td>
<td>0.87</td>
</tr>
<tr>
<td>Follow-up, mo*</td>
<td>13.69 ± 1.26</td>
<td>13.41 ± 1.02</td>
<td>0.33</td>
</tr>
</tbody>
</table>

BMI, body mass index.
*Student t test.
* χ² test.
difference in mental parameters between the groups at 6 months after surgery \( (P = 0.002) \) (Table 2).

**Radiologic Outcomes**

The preoperative DSCSA was 58.60 ± 23.07 mm\(^2\) in group A and 57.30 ± 22.13 mm\(^2\) in group B. The postoperative DSCSA was 75.25 ± 23.10 mm\(^2\) in group A and 75.83 ± 22.00 mm\(^2\) in group B. The expansion in DSCSA between the preoperative and the postoperative MRI was 16.65 ± 6.58 mm\(^2\) in group A and 18.53 ± 6.19 mm\(^2\) in group B. However, there was no significant difference between the groups \( (P = 0.092) \) (Table 3, Figure 7).

**Perioperative Outcomes**

The mean operating time was significantly shorter in group A \( (48.66 ± 6.45 \text{ minutes}) \) as compared with group B \( (53.71 ± 8.49 \text{ minutes}) \) \( (P = 0.009) \). There was no measurable blood loss in group A; the mean intraoperative blood loss was 41.26 ± 31.88 mL (15–167 mL) in group B. However, both groups had negligible blood loss with no clinical significance. The mean hospital stay was significantly shorter in group A \( (7.50 ± 2.63 \text{ days}) \) as compared with group B \( (15.65 ± 4.80 \text{ days}) \) \( (P < 0.001) \). The mean return-to-work time was significantly shorter in group A \( (13.94 ± 3.72 \text{ days}) \) as compared with group B \( (29.26 ± 5.80 \text{ days}) \) \( (P < 0.001) \) (Table 4).

**Complications**

Complications occurred in 4 patients \( (12.5\%) \) in group A and 4 patients \( (11.8\%) \) in group B. Four patients complained of dysesthesia on the posterolateral thigh, which spontaneously improved \( 2–3 \text{ days after surgery} \) \( (2 \text{ cases in group A and 2 cases in group B}) \). A dural tear occurred in 1 patient in group B, which was successfully managed with direct repair. One patient with the longest operative time in group A complained of headache during surgery, especially near the end of the procedure, which spontaneously improved after bed rest for 1 day. One patient presented with a symptomatic pseudocyst \( 2 \text{ months after PELD} \), which slowly improved after an epidural block. Postoperative epidural hematoma occurred in one patient in group B, which was successfully removed with evacuation. There were no major complications such as neurovascular injury, retroperitoneal hematoma, and surgical-site infections in either group, and there were no significant differences in the complication rate between the 2 groups (Table 4).

**Operation Failures and Recurrences**

Incomplete removal of the target fragment occurred in 2 patients in group A, which we considered surgical failures. Because these patients complained of leg pain after surgery, we performed a MRI in the immediate postoperative period and detected the residual fragments. However, no patients underwent reoperations due to patient preference and were instead managed with conservative treatment. There was no significant difference in the failure rate between the 2 groups \( (P = 0.231) \). Reherniation at 12 months occurred in one patient in group A \( (3.1\%) \) and one patient in group B \( (2.9\%) \). The patient in the PELD group with reherniation occurred at 6 months after surgery and was managed with
conservative treatment. The patient in the OLM group with reherniation occurred at 8 months after surgery, and underwent re-operation with the OLM technique. There was no significant difference in the recurrence rate between the groups (Table 4).

DISCUSSION

Comparison of Clinical Outcomes

As previously described, the VAS scores for the leg significantly improved at 1-year postoperatively compared with the baseline in both groups, with reductions in the VAS scores similar to those reported in previous studies.4,13,15,18,19 In terms of back pain, the overall pain level was significantly improved at the final follow-up in both groups; however, the VAS scores after surgery were much lower in the PELD group than in the OLM group. The clinical outcomes as measured by the ODI and SF-12 (physical and mental health component) scores showed significant improvement at the final follow-up compared with the baseline. The ODI is responsive to changes in clinical status and the SF-12 is responsive to changes to the health-related quality of life. A reduction of at least 15 points

Table 2. Clinical Outcomes According to the Parameters

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Group A (n = 32)</th>
<th>Group B (n = 34)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAS (back)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preop</td>
<td>4.41 ± 0.98</td>
<td>4.74 ± 1.08</td>
<td>0.201</td>
</tr>
<tr>
<td>6 months</td>
<td>2.66 ± 0.70</td>
<td>3.53 ± 0.71</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>12 months</td>
<td>2.50 ± 0.62</td>
<td>2.91 ± 0.67</td>
<td>0.012*</td>
</tr>
<tr>
<td>VAS (leg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preop</td>
<td>7.53 ± 0.92</td>
<td>7.50 ± 0.93</td>
<td>0.891</td>
</tr>
<tr>
<td>6 months</td>
<td>2.16 ± 0.63</td>
<td>2.26 ± 0.83</td>
<td>0.553</td>
</tr>
<tr>
<td>12 months</td>
<td>2.06 ± 0.84</td>
<td>2.32 ± 1.01</td>
<td>0.259</td>
</tr>
<tr>
<td>ODI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preop</td>
<td>24.90 ± 2.28</td>
<td>25.00 ± 2.49</td>
<td>0.874</td>
</tr>
<tr>
<td>6 months</td>
<td>12.18 ± 2.58</td>
<td>13.79 ± 1.74</td>
<td>0.044*</td>
</tr>
<tr>
<td>12 months</td>
<td>9.63 ± 2.31</td>
<td>10.68 ± 2.67</td>
<td>0.093</td>
</tr>
<tr>
<td>SF-12 (PCS)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preop</td>
<td>33.03 ± 2.68</td>
<td>33.21 ± 2.74</td>
<td>0.795</td>
</tr>
<tr>
<td>6 months</td>
<td>43.97 ± 3.75</td>
<td>43.47 ± 2.84</td>
<td>0.543</td>
</tr>
<tr>
<td>12 months</td>
<td>49.44 ± 2.58</td>
<td>49.03 ± 2.54</td>
<td>0.518</td>
</tr>
<tr>
<td>SF-12 (MCS)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preop</td>
<td>33.66 ± 3.27</td>
<td>33.10 ± 2.67</td>
<td>0.421</td>
</tr>
<tr>
<td>6 months</td>
<td>46.72 ± 3.02</td>
<td>44.10 ± 3.68</td>
<td>0.002*</td>
</tr>
<tr>
<td>12 months</td>
<td>49.20 ± 2.70</td>
<td>48.76 ± 2.54</td>
<td>0.542</td>
</tr>
</tbody>
</table>

Table 3. Radiologic Outcomes According to the DSCSA

<table>
<thead>
<tr>
<th></th>
<th>Preop DSCSA, mm²</th>
<th>12-month DSCSA, mm²</th>
<th>Expansion of DSCSA, mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A (n = 32)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>58.60 ± 23.07</td>
<td>75.25 ± 23.10</td>
<td>16.65 ± 6.58</td>
</tr>
<tr>
<td>Group B (n = 34)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>57.30 ± 22.13</td>
<td>75.83 ± 22.00</td>
<td>18.53 ± 6.19</td>
</tr>
<tr>
<td>P value*</td>
<td>0.690</td>
<td>0.801</td>
<td>0.092</td>
</tr>
</tbody>
</table>

DSCSA, dural sac cross-sectional area; preop, preoperative.
*Statistically significant differences between the groups by Mann-Whitney U test.
in the ODI score was considered to reflect clinical improvement, as proposed by the Food and Drug Administration. ODI score reductions were similar to those reported previously by Ruetten et al. However, both the ODI and mental SF-12 scores tended to worsen after 6 months postoperatively in the OLM group. There are several reasons for the worse outcomes in the OLM group 6 months after surgery compared with the PELD group: (1) OLM requires further muscle dissection and the removal of posterior structures such as the lamina, yellow ligament, and facet joint, which might affect dissection and the removal of posterior structures such as the lamina, yellow ligament, and facet joint, which might affect clinical improvement, and (2) all patients were active young men who returned to military environment after surgery, with intense physical training and duties. It is difficult to predict the outcomes for patients in both groups in the next 10–20 years. However, we would expect lower rates of degeneration and recurrence in the PELD group given its relatively minimally invasive approach. Studies with longer follow-up periods are needed to address this question.

**Comparison of Radiologic Outcomes**

Many previous studies have measured the DSCSA to evaluate the severity of spinal stenosis. However, the relationship between the DSCSA and clinical symptoms has been uncertain, with poor correlation in most published studies. In addition, to the best of our knowledge, there has been no study that has used the DSCSA to evaluate the extent of decompression in LDH. Because there is as of yet no alternative measurement technique to assess the extent of decompression, we used the DSCSA to measure the expansion ratio of the dural sac. Despite improvements in the DSCSA after surgery in both groups, there were no statistically significant differences between the groups. We did not investigate the correlation of the DSCSA to clinical outcomes because we only wanted to assess the amount of decompression between the 2 groups. To compare the extent of decompression in LDE as well as its clinical correlations, advancements in measurement techniques are necessary.

**Comparison of Perioperative Outcomes**

The mean operative time in the PELD group was significantly shorter than that of the OLM group. Blood loss was not measurable in the PELD group and was negligible in the OLM group. Despite the fact that the mean operative time in our study was longer than previously reported times, the intergroup results were similar.

**Comparison of Complications**

Although the published complication rate for PELD was lower than that for OLM, there were 4 complications after PELD (12.5%) and 4 complications after OLM (11.8%) in the present study. Like any other technique, PELD has its own learning curve. Most of the complications in the PELD group, such as transient dysesthesia and intraprocedure headache, occurred in the early phases of the study. Sairyo et al. reported that an elevation in intracranial pressure may occur if the irrigation pressure is too high or if the endoscopic maneuvers take too long. In the present case, one patient complained of headache during surgery and also had the longest operative time in our study. Sairyo et al. also had the longest operative time in our study. Some authors suggested that there was no difference in treatment outcomes between the surgical and conservative management of symptomatic pseudocysts. The pseudocyst in the present study

---

**Table 4. Summary of Perioperative Outcomes, Complications, Failure, and Recurrence Rate**

<table>
<thead>
<tr>
<th></th>
<th>Group A (n = 32)</th>
<th>Group B (n = 34)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Op time, min*</td>
<td>48.66 ± 6.45</td>
<td>53.71 ± 8.49</td>
<td>0.009</td>
</tr>
<tr>
<td>EBL, mL</td>
<td>Not measurable</td>
<td>41.26 ± 31.98</td>
<td></td>
</tr>
<tr>
<td>Hospital stay, days*</td>
<td>7.50 ± 2.63</td>
<td>15.65 ± 4.80</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Return to work, days*</td>
<td>13.94 ± 3.72</td>
<td>29.26 ± 5.80</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Complications, n (%)</td>
<td>4 (12.5)</td>
<td>4 (11.8)</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Failure rate, n (%)</td>
<td>2 (6.2)</td>
<td>—</td>
<td>0.231</td>
</tr>
<tr>
<td>12-month recurrence, n (%)</td>
<td>1 (3.1)</td>
<td>1 (2.9)</td>
<td>&gt;0.05</td>
</tr>
</tbody>
</table>

Op, operation; EBL, estimated blood loss.
*Student t test.
†Mann-Whitney U test.
‡Fisher’s exact test.
was detected at 2 months postoperatively, and slowly improved after epidural injection. Although the complication rates in both groups were greater than those described in previous studies, there were no major complications. These results showed that with proper patient selection, PELD is a safe and effective procedure after overcoming its learning curve.

Comparison of Hospital Stay and Return to Work
The length of the hospital stay and return-to-work time are very important parameters in the assessment of a patient’s quality of life. Although the relationship between these measures and a patient’s overall health is uncertain, these factors may be related to improvements in patient outcome and productivity by reducing the duration of their disability. In the present study, similar to the results of previous studies, the mean hospital stay in the PELD group was shorter than that of the OLM group. However, the mean hospital stays for the patients in both the PELD and OLM groups were longer than those reported in previous studies. This may have occurred because all patients were active young men who were required to maintain weight standards and physical readiness even though they had recently undergone surgery, and therefore, the hospital stay in the present study may have included some period of time even after the relief from symptoms. In the present study, similar to the results of previous studies, the mean return-to-work time for the PELD group was shorter than that for the OLM group.

Comparison of Operation Failures and Recurrences
As previously described, incomplete removal of the target fragment occurred in 2 patients in the PELD group, which we regarded as surgical failures. All of these cases occurred in the early phases of our study and may be the result of technical limitations. No patients underwent reoperation due to patient preference and were instead managed with conservative treatment. We hypothesized that the recurrence rate in young patients would be greater than those reported in previous studies; however, 12-month disc herniation was only observed in 1 case (3.1%) in the PELD group and 1 case (2.9%) in the OLM group, a rate comparable with those reported in a previous study (5.7% and 6.6% for PELD and OLM, respectively). In previous studies, a large annular defect in patients in the OLM group resulted in significantly greater rates of recurrence than smaller or covered defects. However, in the present study, sequestroscopy with partial extirpation was performed in OLM cases involving small or covered annular defects. Therefore, we could not examine the relationship between the sizes of the annular defects and the clinical outcomes. Lee et al. hypothesized that their study’s relatively high reherniation rate may be attributable to limited target fragmentectomy in the PELD group. In the present study, we could not only remove the target fragment but also the central fragment using an “in-and-out-and-in” technique. Through this technique, we could check on the target fragment while re-introducing a working channel from the lateral to medial area after removal of the PLL.

Limitations
It is important to note that the present study has several limitations. First, it was a retrospective matched cohort study with a small sample size (32 and 34 patients for the PELD and OLM groups, respectively), short follow-up periods (1 year), limited operative levels (L4–5), and limited indications (excluding hard discs and foraminal/extraforaminal disc herniations). To investigate the efficacy of the surgical methods, prospective randomized noninferiority or superiority studies are necessary. Second, the study participants were limited to men who were recruited from an armed forces hospital. Because this study was conducted in a limited population, statistical analysis was difficult because of a non-normal distribution, and this study’s conclusions might not be valid for general populations. However, because this study included a homogeneous population of young patients from an armed forces hospital, we could reduce selection bias and performance bias. In addition, because we could match several factors (sex, age, height, weight, body mass index, and tobacco smoking) between the 2 groups, we could also reduce confounding bias. However, prospective double-arm parallel studies with longer follow-up times and larger sample sizes are necessary to provide more useful information on the outcomes of PELD and OLM for LDH.

CONCLUSION
In our opinion, the use of PELD in young adults has several advantages, including: (1) a simpler surgical procedure due to the availability of local anesthesia, a short operative time, and a short hospital stay; (2) more efficacy for back pain and quality of life as compared to OLM, especially in active patients; and (3) a relatively low recurrence rate, even in patients undergoing intense physical activity. Although surgeons need to overcome a learning curve to become familiar with PELD, the procedure seems to be a good choice for the treatment of LDH in young and active patients.

REFERENCES


