Analysis of the Characteristics and Clinical Outcomes of Percutaneous Endoscopic Lumbar Discectomy for Upper Lumbar Disc Herniation

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BACKGROUND: **Lumbar disc herniations at the L1–L2 and L2–L3 levels have unique characteristics that result in worse surgical outcomes after traditional microdiscectomy compared with herniation at L3–L4. The purpose of this study was to evaluate the characteristics, clinical presentation, and outcomes of patients who underwent percutaneous endoscopic lumbar discectomy (PELD) at L1–L2 and L2–L3, compared with those who underwent PELD at L3–L4.**

METHODS: **We retrospectively evaluated the clinical data from 55 patients who underwent PELD for single-level lumbar disc herniation between 2008 and 2014, at a mean follow-up of 29.9 ± 16.4 months (12-month minimum; effective rate, 89.1%). Surgical duration; length of postoperative hospital stay; hospitalization cost; recurrence rate; Macnab criteria assessment; visual analog scale (VAS) of back pain, leg pain, and numbness; Japanese Orthopedic Association (JOA) low back pain score; and Oswestry Disability Index (ODI) before and after surgery were evaluated.**

RESULTS: **In the L1–L3 group, 76.9% of the patients had a positive femoral stretch test, compared with only 42.8% of those in the L3–L4 group ($P < 0.05$). Of the 49 patients with adequate follow-up, 17 (34.7%) exhibited excellent improvement, 23 (46.9%) had good improvement, and 6 (12.2%) had fair improvement according to the Macnab criteria. The VAS scores for back pain, leg pain, and numbness decreased significantly postoperatively in both groups, as did all other outcome measures ($P < 0.05$).**

CONCLUSIONS: **PELD is a safe and effective treatment for upper lumbar disc herniation and may compare favorably with the same procedure for lower lumbar disc herniation. In addition, the positive femoral stretch test was a relatively good diagnostic method for disc herniation at L1–L2 and L2–L3, compared with herniation at L3–L4.**

INTRODUCTION

Owing to the unique characteristics of the upper lumbar spine, upper lumbar disc herniation is associated with more severe clinical symptoms and a higher rate of misdiagnosis compared with lower lumbar disc herniation. The definition of "upper lumbar" remains controversial. Some authors consider upper lumbar discs to be L1–L2 and L2–L3,[1-4] whereas others have expanded the definition to include T12–L1 and L3–L4.[2,5-8] Approximately 5% of lumbar disc herniations occur at the L1–L2, L2–L3, and L3–L4 levels.[1,5,9] In multiple series of patients with "upper lumbar disc herniation," 70%–83% of herniations were at the L3–L4 level.[1,5,8-11] Data comparing the clinical features and outcomes of patients with L3–L4 herniation with those with L1–L2 and L2–L3 herniation are lacking, however.

Generally, compared with lower lumbar disc herniation, upper lumbar disc herniation at L1–L2 or L2–L3 has specific characteristics that result in less favorable outcomes after microdiscectomy surgery.[1] For instance, the surgical outcome of back and radicular pain is worse for herniation at L1–L2 and L2–L3 compared with that at L3–L4, and the former group is more likely to have undergone previous lumbar surgery and more likely to require fusion. Previous reports of upper lumbar disc herniation that include a preponderance of L3–L4 cases may mask the true characteristics of L1–L2 and L2–L3 disc herniation, and herniation at the L3–L4 level is more similar to those occurring at L4–L5 and L5–S1.

Recent advances in endoscopic technology have made selective epidural discectomy for an extruded disc feasible under local

Key words
- Percutaneous endoscopic lumbar discectomy
- Surgical outcome
- Upper lumbar disc herniation

Abbreviations and Acronyms
JOA: Japanese Orthopedic Association
ODI: Oswestry Disability Index
PELD: percutaneous endoscopic lumbar discectomy
VAS: Visual analog scale

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anesthesia via the transforaminal approach. Percutaneous endoscopic lumbar discectomy (PELD) has demonstrated efficacy in the treatment of lumbar degenerative disease.[12-17] The potential advantages of PELD include less soft tissue injury and blood loss, shorter length of hospital stay, and earlier recovery while resulting in similar clinical outcomes as in the equivalent open procedure. Nevertheless, the clinical and radiologic features of upper lumbar disc herniation differ from those of lower lumbar disc herniation, and most of the previous studies of PELD have been performed in patients with lower lumbar disc herniation. There are few reports of the outcomes of PELD for upper lumbar disc herniation.[16]

We performed a retrospective, single-institution study of patients treated with PELD to compare the characteristics, clinical presentations, and outcomes of the patients with lumbar disc herniation at L1–L2 or L2–L3 and those with herniation at L3–L4. Here we discuss our results in the context of previous reports in the literature.

MATERIALS AND METHODS

Patients and Outcome Assessment

We retrospectively reviewed the medical records of 55 patients (27 males and 28 females) who had undergone single-level PELD at the L1–L2, L2–L3, or L3–L4 level at our hospital between December 2008 and October 2014. Inclusion criteria were soft disc herniation at the L1–L2, L2–L3, or L3–L4 level, as demonstrated by computed tomography and magnetic resonance imaging, and a lack of response to extensive conservative treatment. Exclusion criteria were the presence of a significant unrelated spinal abnormality, recurrent lumbar disc herniation after previous surgery, a behavioral disorder that could impair patient cooperation, presence of bony metastasis, and spinal stenosis.

Hospital charts of the patients meeting the study inclusion criteria were further reviewed for information on relevant characteristics (age, sex, body mass index, duration of symptoms before surgery, and type of herniation). Clinical outcomes, including visual analog scale (VAS) scores for low back pain, leg pain, and numbness; Japanese Orthopedic Association (JOA) low back pain score; Oswestry Disability Index (ODI) score; recurrence rate; and Macnab assessment criteria, were assessed. Recurrence was defined as disc herniation at the same level, regardless of ipsilateral or contralateral herniation, with a pain relief interval of >6 months. Surgical parameters, including duration of surgery, length of postoperative stay, cost of hospitalization, and positive femoral stretch test, were recorded as well. A minimum interval of 7 months after surgery was required for patients to be considered in analyses of clinical outcomes. Postoperative complications and symptom recurrence requiring reoperation were assessed through review of medical record documentation and/or telephone interviews with patients.

All procedures in this study involving human participants were performed in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. Informed consent was obtained from each participant. For this type of study, formal consent is not required.

Surgical Technique

The procedure was performed with the patient in the prone position and under local anesthesia. Blood pressure, pulse rate, oxygen saturation, and electrocardiographic signals were monitored. After induction of local anesthesia (with 1% lidocaine), an 18-gauge spinal needle was placed through the Kambin triangle to the herniation site under fluoroscopic guidance, and a 9-mm working channel and a 7.5-mm endoscope were placed. The different between the upper lumbar and L3–L4 levels is that the optimal skin entry point is more medial (6–9 cm) and the needle insertion angle is steeper (35°–45°), which can guarantee adequate working space without neural damage owing to the concave spinal canal. After discectomy, patients were generally monitored for 3 additional hours in the wards and then mobilized.

The theoretical basis for percutaneous endoscopic discectomy for upper lumbar disc herniation can be summarized as an anatomically modified transforaminal percutaneous approach and selective targeted discectomy after annular release under direct endoscopic visualization.[16,18] Patients are allowed to ambulate on the first postoperative day, and are discharged as soon as they are able to walk independently. A representative case is shown in Figure 1.

Statistical Analysis

Statistical analyses of the data were performed using SPSS 13.0 (SPSS, Chicago, Illinois, USA). The Student t test and relevant nonparametric tests were performed for the continuous variables, and χ^2 analysis and the Fisher exact test (contingency table analyses) were used for categorical variables, depending on sample size. A P value < 0.05 was considered to indicate statistical significance.

RESULTS

Patient Characteristics

Characteristics were compared between the patients with disc herniation at L1–L2 or L2–L3 (L1–L3 group) and those with herniation at L3–L4 (L3–L4 group) (Table 1). The rate of a positive femoral stretch test was higher in the L1–L3 group had compared with the L3–L4 group ($P < 0.05$). There was a significant difference between the 2 groups in terms of sensory deficit, but no significant difference in motor deficit. No patients of either group had cauda equina syndrome.

VAS, ODI, and JOA Scores and Macnab Criteria Assessment

Patient charts were further reviewed to obtain measures of clinical outcomes (Table 2). Significant differences in preoperative back pain were noted between the L1–L3 and L3–L4 groups. There were no significant differences between the 2 groups in regard to postoperative VAS scores or in the degree of improvement after surgery. The VAS scores for low back pain, leg pain, and numbness improved significantly in both groups after surgery, as did the JOA and ODI scores. However, there were no significant differences between the 2 groups in terms of the preoperative, postoperative, and final follow-up JOA and ODI