Percutaneous Endoscopic Lumbar discectomy for Foraminal to Superior Migrated Disc at L5-S1 level using the Contralateral Interlaminar Approach: A Technical Case Report

Keun Lee, M.D.\textsuperscript{1}, Hyeun-Sung Kim, M.D. Ph.D.\textsuperscript{2}, Jee-Soo Jang, M.D. Ph.D.\textsuperscript{2}, Yong-Hun Pee, M.D.\textsuperscript{1}, Jin-Uk Kim, M.D.\textsuperscript{3}, Jun-Ho Lee, M.D.\textsuperscript{3}, Il-Tae Jang, M.D. Ph.D.\textsuperscript{4}

\textsuperscript{1}Department of Neurosurgery, Nanoori Joan Hospital, Incheon, Republic of Korea
\textsuperscript{2}Department of Neurosurgery, Nanoori Suwon Hospital, Suwon, Gyeonggi-do, Republic of Korea
\textsuperscript{3}Department of Neurosurgery, Nanoori Incheon Hospital, Incheon, Republic of Korea
\textsuperscript{4}Department of Neurosurgery, Nanoori Hospital, Seoul, Republic of Korea

Running head: Contralateral Interlaminar Approach to foraminal - superior disc at L5-S1

Corresponding author:

Hyeun-Sung Kim, M.D. Ph.D.

Department of Neurosurgery, Nanoori Suwon Hospital, Suwon, Gyeonggi-do, Republic of Korea.

e-mail:neuros@hanmail.net

Tel: 02-1588-9797

Fax: 032-721-9618

Conflicts of Interest: N/A
Abstract

Objective: In cases of foraminal superior migration of L5-S1 HNP, it is very difficult to access by rigid endoscopic procedure. Thus, we attempted a contralateral interlaminar approach to expose the exiting nerve root and contralateral foramen to remove the symptomatic disc and preserve the functional structures.

Methods: Between January 2013 and January 2014, five patients who received the percutaneous endoscopic lumbar discectomy for foraminal superior migration of L5-S1 lumbar HNP via a contralateral interlaminar approach were included in this study. Through a contralateral interlaminar approach, we could expose the exiting nerve root only, to remove the symptomatic disc without structural damage. We confirmed the radiologic result with an immediate postoperative MRI, and the clinical result was examined using a VAS.

Results: In all cases, the superior migrated disc from the L5-S1 foraminal space was removed completely and demonstrated in the immediate postoperative MRI. The mean preoperative Visual Analogue Score was decreased at the postoperative state, from 7.8 ± 0.84 to 1.4 ± 0.55. Despite the small number of cases, outcomes were satisfactory.

Conclusion: We obtained excellent clinical results in treating foraminal to superior migrated disc herniation at L5-S1 using percutaneous endoscopic lumbar discectomy via a contralateral interlaminar approach.

Keywords: contralateral, disc herniation, foraminal, lumbar, interlaminar
**Introduction**

In the treatment of radiating pain in the lower limbs related to the lumbar disc herniation, lumbar discectomy following laminectomy has been considered the gold standard\(^1\). However, due to the development of relevant equipment, such as the drill, forceps, laser, radiofrequency (RF) probe, and high-resolution optic endoscope, it has become possible to treat most lumbar disc herniations with percutaneous endoscopic lumbar discectomy (PELD)\(^4,5,10,13,14\).

However, in the case of the L5-S1 level, approaches to foraminal lesions are limited due to several anatomical barriers. The high iliac crest, the enlarged L5 transverse process, the hypertrophied facet joint, or the narrow neural foramen, all of which can make the transforaminal approach difficult. Thus, the endoscopic approach, using an interlaminar approach or transiliac approach, has been considered\(^3,5,13\).

In the case of lumbar disc herniation with foraminal to superior migration from the L5-S1 level, both transforaminal and ipsilateral interlaminar approaches have technical difficulties, while an appropriate approach with endoscope has not been discussed. In order to approach the contralateral foramen, which has been considered as the most difficult part to be approached with the endoscope, the authors of this study attempted an approach that passed the interlaminar window from the contralateral side to the lesion. The authors effectively removed the symptomatic ruptured disc that was compressing the exiting nerve root, by approaching through the contralateral foramen to the lesion. This study reports the contralateral interlaminar approach for the first time, as we believe there is no literature showing a method of approaching the disc fragment in superior migration towards the foramen at the L5-S1 level, using a rigid endoscope.
Materials and Methods

This study examined patients with a superior migrated disc from the L5-S1 foraminal space who visited the hospital between January 2013 and January 2014 for radiating pain in a single lower limb. Among these, five patients refractory to conservative treatment for more than six weeks underwent percutaneous endoscopic lumbar discectomy via a contralateral interlaminar approach. The operation was followed by a measurement of pain improvement using a visual analog scale (VAS). Nerve decompression was evaluated with an immediately postoperative MRI.

Operative techniques

Prior to the operation, patients received preventative antibiotic treatment and were prepared in a prone position on a radiolucent table. The operation was undertaken with conscious sedation using midazolam and fentanyl. In order to avoid any injuries to exiting nerve roots and traversing nerve roots during the approach, the operation proceeded with continuous feedback from the patient. C-arm guidance was used to identify the L5-S1 disc space. The skin was marked at the level of the disc space in the midline. Discography was conducted in advance for a transforaminal approach; 0.8% indigo carmine (Carmine, Korea United Pharmaceutical, Yoenki, Korea) mixed with contrast (Iobrix injection, Taejoon Pharm, Korea) was injected.

Using an 18-gauge spinal needle, from a point 2–3 cm away on the contralateral side of the midline, the needle was inserted at an approximately 45-degree angle passing the middle of the interspinous ligament. The 18-gauge spinal needle was docked targeting the medial border of the inferior facet. Following the needle, a guide wire was inserted, which was followed by the insertion of an obturator, working channel, and an endoscope, just beyond the ligamentum
flavum (Fig.1). With maximum preservation of surrounding structures, the ligamentum flavum was divided with a probe, and then the bevel of the working channel penetrated through the gap of the ligamentum flavum and was rotated.

When the ligamentum flavum was divided, the contralateral foraminal area was exposed (Fig.2). The divided ligamentum flavum was pushed down, protecting the traversing nerve root and limiting additional injuries due to the approach. Having reached the foraminal area of the lesion, the epidural fat was dissected with an RF electrode (Ellman International, Hewlett, NY). The blue-stained ruptured disc, which had been intensely compressing the exiting nerve root, was removed with endoscopic forceps (Fig.3). Having confirmed the decompression of the exiting nerve root, the scope was removed after bleeding control.

Immediately after the operation, the decompression of exiting nerve root was confirmed with postoperative MRI. On the operation day, the patient had reduced pain and no problem in walking.

**Results**

The average age of the five patients was 55.8 ± 10.04. Three of them were male, two female. All cases were confirmed through MRI inspection immediately after the operations; they showed that the ruptured discs had been successfully removed. The average VAS was reduced from 7.8 ± 0.84 preoperatively to 1.4 ± 0.55 postoperatively (Table 1). As this was a technical case report, the number of cases was small, but the results were satisfying in all of cases. There were no complications such as dysthesia, hematoma, or infection. None of the cases needed any additional open surgery.
Illustrative case

A 43-year-old man presented with an intense left lower limb radiation pain, which had not responded to more than 6 weeks of conservative treatment (Fig. 4A). On the MR images, a ruptured disc, which had migrated superiorly from the left foramen at the L5-S1 level, was compressing the left L5 nerve root (Fig. 4B). Employing the contralateral interlaminar approach, a working channel and endoscope were inserted at a spot 2.5 cm to the right of the midline, towards the medial border of the inferior articular process of the lesion. The ligamentum flavum was divided, which was followed by removal of the ruptured disc that had been blue-stained (Fig. 4C). The MRI scan, which immediately followed the operation, showed that the ruptured disc had been successfully removed and that the left L5 nerve root was well decompressed (Fig. 4D).

Discussion

Since Kambin et al. first introduced lumbar disc decompression via a posterolateral approach, there have been remarkable advances in PELD\(^7\). With the development of various instruments related to spinal endoscopy, now nearly all symptomatic lumbar HNP can be operated on via endoscope. Among them, as L5-S1 level has characteristic anatomical features, such as the iliac crest, a large facet joint, a narrow foramen, and a wide interlaminar space; therefore, several approaches to ruptured discs at the L5-S1 level have been studied, such as transforaminal, ipsilateral interlaminar, and transiliac approaches\(^3,6,13\). Choi et al. compared the transforaminal approach to the interlaminar approach in detail depending on the location of the lesion, but limited the lesion to intracanal disc herniation and did not examine foraminal discs\(^6\). In particular, it is difficult to approach ruptured discs that have migrated from the foraminal to the superior in the L5-S1 level with rigid endoscopes, and such approaches have not been reported yet.
Some researchers have studied the use of the contralateral approach to remove inferior-migrated ruptured disc fragments. Kim et al. succeeded in removing down-migrated ruptured discs at the L4-5 level via a contralateral transforaminal approach. Yeom et al. also succeeded in removing ruptured disc fragments that were distally migrated from L3-4 and L4-5 to below the midpedicle level via a contralateral transforaminal approach without excessive pivoting of the rigid endoscope to the cranial side.

Although the traditional ipsilateral transforaminal approach can be taken for nerve root compression due to superior migration, the same approach is difficult for cases of superior migration in the foramen at the L5-S1 level due to anatomical barriers, such as the high iliac crest, large L5 transverse process, or hypertrophy of the facet joint. Using an excessive cranial to caudal skin entry point due to the high iliac crest increases the possibility of encountering an existing nerve root injury, further hindering the approach to the superior migration disc fragment. It is also difficult to approach superior migrated disc fragments in the foramen via the ipsilateral interlaminar approach due to the inferior facet and laminar. Thus, traditionally, microscopic lumbar discectomy via the paramedian transmuscular approach has been used for this type of lesion. However, microscopic approaches require partial facetectomy; if more than 40–50% is removed, instability may arise, inducing and maintaining postoperative pain.

The discs, facet joints, supraspinous ligament, and paraspinal muscles of the lumbar spine are important structures that maintain the stability of segmental motion, and instability can be increased when these structures and surrounding muscles and ligaments are damaged. For ruptured disc fragments that were foraminal to superior migrated at L5-S1, percutaneous endoscopic lumbar discectomy via a contralateral interlaminar approach can maximally preserve these structures and minimize muscle, laminar, and facet injury, while enabling the surgeon to approach the lesion-side foramen, remove the migrated disc fragments, and decompress with a direct view of the exiting nerve root.
If the interlaminar space is relatively narrow, it might render an approach to superior migration difficult, as the contralateral laminar would block the path. In such a case, an approach trajectory can be acquired by undercutting the inferior margin of the lesion-side facet using an endoscopic drill, dilator, or reamer. Fortunately, in the present cases, we were able to approach the contralateral foramen and remove the ruptured disc fragments without using an endoscopic drill. If the ligamentum flavum is split after docking at the medial border of the contralateral inferior facet, the contralateral foramen and lateral recess are exposed. When the bevel of the working channel is rotated 180 degrees, the split ligamentum flavum is inferiorly displaced, naturally protecting the traversing nerve root and preventing additional approach-induced injury.

Since directly approaching the working channel at a sharp angle may cause injury to the thecal sac, it is important to safely perform docking of the working channel to the medial border of the inferior facet of lesions at an approximately 45-degree angle in the beginning. In addition, when dissection is carried out in order to split the ligamentum flavum without clarifying the boundaries of the bone and ligamentum, this may cause exiting nerve root injury, thereby requiring attention.

Conclusion

This study achieved a good result through a contralateral interlaminar approach for the foraminal superior migrated L5-S1 Lumbar HNP. This can be a considerable option for the treatment of ruptured discs that had previously been difficult to approach with a rigid endoscope.
References


10. Mayer HM, Brock M: Percutaneous endoscopic discectomy: surgical technique and
preliminary results compared to microsurgical discectomy. J Neurosurg 78: 216-225, 1993


Figure legends

Fig. 1. Docking of working channel at the medial border of inferior facet

Fig. 2. Endoscopic view of contralateral interlaminar approach (LF: splitted ligamentum flavum, RD: ruptured disc, FT: fatty tissue, EXR: exiting nerve root)

Fig. 3. Removal of foraminal to superior migration disc with endoscopic forcep

Fig. 4. Illustrative case (A: Preoperative X-ray, B: Preoperative MRI, C: Removed rupture disc, D: Postoperative MRI)
Table 1. Patients Demographics

<table>
<thead>
<tr>
<th>Patients</th>
<th>Age</th>
<th>Sex</th>
<th>Level</th>
<th>Migration</th>
<th>VAS</th>
<th>Complication</th>
<th>Hospital Days</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>L5-S1 Foraminal</td>
<td>Lt Superior</td>
<td>9</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>B</td>
<td>47</td>
<td>F</td>
<td>L5-S1 Foraminal</td>
<td>Lt Superior</td>
<td>8</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>C</td>
<td>61</td>
<td>M</td>
<td>L5-S1 Foraminal</td>
<td>Rt Superior</td>
<td>8</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>D</td>
<td>64</td>
<td>F</td>
<td>L5-S1 Foraminal</td>
<td>Lt Superior</td>
<td>7</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>E</td>
<td>64</td>
<td>M</td>
<td>L5-S1 Foraminal</td>
<td>Lt Superior</td>
<td>7</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>
Fig. 1. Docking of working cannula at the medial border of inferior facet
Fig. 2. Endoscopic view of contralateral interlaminar approach (LF: splitted ligamentum flavum, RD: ruptured disc, FT: fatty tissue, EXR: exiting nerve root)
Fig. 3. Removal of foraminal to superior migration disc with endoscopic forcep
Fig. 4. Illustrative case (A: Preoperative X-ray)
Fig. 4. Illustrative case (B: Preoperative MRI)
Fig. 4. Illustrative case (C: Removed rupture disc)
Fig. 4. Illustrative case (D: Postoperative MRI)