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Biportal Endoscopic Decompression of Exiting and Traversing Nerve Roots Through a Single Interlaminar Window Using a Contralateral Approach: Technical Feasibilities and Morphometric Changes of the Lumbar Canal and Foramen

Kutbuddin Akbary[1,2], Jin-Sung Kim[2], Cheul Woong Park[1], Su Gi Jun[1], Jae Ha Hwang[1]

BACKGROUND: **Endoscopic surgery for lumbar stenosis is gaining acceptance because of the minimal muscle damage, short recovery times, reduced blood loss, and good clinical results. We report a novel technique of decompressing contralateral traversing and exiting nerve roots through a single interlaminar window, avoiding separate incision for foraminal decompression with minimal damage to facet joints and comparing morphometric changes after decompression.**

METHODS: **Between March and December 2017, 30 patients were evaluated retrospectively for clinical, radiologic, and morphometric outcomes. Patients with unilateral radiculopathy and magnetic resonance imaging (MRI) showing spinal stenosis at 2 levels (lateral recess and cranial level foraminal compression) were included. Clinical evaluation used a numerical rating scale (NRS) for leg pain and Oswestry Disability Index (ODI) scores, and radiologic evaluation used MRI. For morphometric analysis, the cross-sectional area of the intervertebral foramen (CSA-IVF), spinal canal (CSAC), and facet joint (CSA-FJ) was measured on MRI.**

RESULTS: **Thirty levels were decompressed (no adverse events). NRS leg pain and ODI scores improved from 7.5 $\pm$ 0.86 and 67.9 $\pm$ 9.7 preoperatively to 1.53 $\pm$ 0.86 and 15.7 $\pm$ 6.6 at last follow-up, respectively. CSAC improved from 99.34 $\pm$ 34.01 to 186.83 $\pm$ 41.41, indicating good canal decompression. CSA-IVF improved from 56.40 $\pm$ 19.28 to 97.60 $\pm$ 28.46, indicating good foraminal decompression. CSA-FJ improved from 231.37 $\pm$ 62.53 to 194.96 $\pm$ 50.56, indicating good foraminal decompression with less damage to facet joint. Morphometric changes were statistically significant ($P < 0.05$).**

CONCLUSIONS: **Biportal endoscopic decompression of the lateral recess and cranial foramen through a single interlaminar window can be performed using a contralateral approach. In view of the good clinical and radiologic outcomes of patients, with notable improvements in morphometric measurements at stenosed segments, this surgical technique is worthy of further evaluation and application.**

INTRODUCTION

Endoscopic surgery for lumbar stenosis is gaining acceptance. After various reports of decompression of the stenosis through biportal and uniportal approaches with good results,[1-6] the procedure is being used more frequently for the management of degenerative pathologies. The minimal damage to the paraspinal muscles, coupled with short recovery times, reduced blood loss, and good clinical results with endoscopic decompressions, are its major advantages.[1-6]

The advantages of the biportal endoscopic system over the uniportal system is in the visualization of the intracanalicular region

Key words
- Biportal decompression
- Endoscopic decompression
- Foraminal decompression
- Lateral recess decompression
- Single interlaminar window

Abbreviations and Acronyms
CSA: Cross-sectional area
CSAC: Cross-sectional area of the spinal canal
CSA-FJ: Cross-sectional area of the facet joint
CSA-IVF: Cross-sectional area of intervertebral foramen
LF: Ligamentum flavum
MRI: Magnetic resonance imaging
NRS: Numerical rating scale
ODI: Oswestry Disability Index
RF: Radiofrequency

From the [1]Department of Neurosurgery, Daejeon Woori Hospital, Daejeon; and [2]Seoul St. Mar»s Hospital, Spine Centre, Department of Neurosurgery, College of Medicine, The Catholic University of Korea, Seoul, South Korea

To whom correspondence should be addressed: Cheul Woong Park, M.D., Ph.D. [E-mail: woorispine@naver.com]

Kutbuddin Akbary and Jin-Sung Kim contributed equally to the article and are considered co-first authors.

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of the lumbar spine. It affords a wider view with more degrees of freedom to manipulate the instruments, whereas the uniportal endoscope restricts the motion of the instruments and obscures visualization, especially in difficult-to-see areas around the lateral recess.[1-5]

Using this advantage of more freedom to manipulate instruments with biportal endoscopy, we report a novel technique of accessing 2 contralateral nerve roots, one at the lateral recess and another nerve root cranial (superior) to this in its foraminal region, through a single interlaminar window in patients with clinically correlated unilateral radiculopathy. There are reports in the literature regarding lateral recess and central decompression of 1 level through the interlaminar window with biportal endoscopy; however, no reports have addressed 2-level nerve roots at the same side using a contralateral approach (one nerve root at the lateral recess at the same level as the interlaminar window and one nerve root at the cranial [superior] level in its foraminal region) through the same interlaminar window. To our knowledge, this report is the first to describe such a procedure.

The advantage of this approach is in avoiding a separate surgical incision for creating another surgical approach to decompress the foraminal nerve root cranial (superior) to the previous level being decompressed. Our technique further decreases the iatrogenic damage to the posterior elements, especially at the cranial (superior) level, while causing minimal damage to the facet joints. The adequacy of decompression is confirmed by the postoperative magnetic resonance imaging (MRI) and good clinical outcomes of the patients and relief in their symptoms.

This study was conducted to evaluate the technical feasibilities of the biportal decompression of exiting and traversing nerve roots using a contralateral approach through a single interlaminar window, and studying the morphometric changes associated with this technique.

MATERIALS AND METHODS

We searched our medical records and found 30 patients who underwent operations using this technique between March and December 2017. These patients were then evaluated retrospectively for their clinical and radiologic outcomes, along with morphometric changes in the spinal canal after decompression. Inclusion criteria were: complaints of unilateral radiculopathy with associated neurogenic claudication; a diagnosis of degenerative lumbar spinal stenosis at 2 contiguous levels (one level having lateral recess compression and the cranial [superior] level having foraminal compression), which correlated to the neurologic distribution of pain and dysesthesia, thus indicating that both lesions were pathologic; and having undergone all conservative measures for a minimum of 6 weeks with no alleviation of symptoms. Exclusion criteria (when selecting patients for surgery) were: degenerative spondylolisthesis grade II or more, degenerative scoliosis greater than 15 degrees, significant axial back pain, bilateral leg pain, frank segmental instability on dynamic radiographs, and complaints of claudication pain caused by vascular stenosis.

We evaluated the demographic data in terms of age, sex, and associated comorbidities. The clinical evaluation was done preoperatively and postoperatively using a numerical rating scale (NRS) for leg pain and Oswestry Disability Index (ODI) scores. Radiologic evaluation of these patients was done with preoperative MRI and radiography to check for extent of central and lateral recess compression and spondylolisthesis, if any. Postoperative MRI was done to evaluate the adequacy of decompression within 3 days after surgery.

For the morphometric analysis, cross-sectional area (CSA) of intervertebral foramen (CSA-IVF), CSA of the spinal canal (CSAC), and the CSA of the facet joint at the level of the foraminal decompression (CSA-FJ) were measured with T2-weighted MRI (**Figure 1**). All these parameters were assessed on the preoperative and immediate postoperative MRI. CSAC was measured using an imaginary line encircling the area between the facet and lamina. CSA-IVF was measured using an imaginary line around the neural foramen on the symptomatic side on the parasagittal cuts. CSA-FJ was measured using an imaginary line surrounding the facet joint at the affected foraminal compression (**Figure 1**). All the areas were expressed in square millimeters.

Quantitative variables were expressed as mean ± standard (SD) deviation. Continuous variables were compared using a paired-sample *t* test. Statistical calculations were performed using SPSS version 23.0 (SPSS, Chicago, Illinois, USA) for Windows, and $P < 0.05$ was considered statistically significant.

RESULTS

Thirty patients were evaluated. The mean age of the patients enrolled in the study was 61 years (range, 38—80 years) and the male/female ratio was 15:15. The mean follow-up was 5.67 ± 3.5 months (range, 1—10 months). All patients had 2-level compressions only (one lateral recess compression and one adjacent foraminal). A total of 30 levels were decompressed in 30 patients: 12 patients (40%) undergoing decompression at L4-L5, 9 patients (30%) at L5-S1, 7 patients (23.33%) at L3-L4, and 2 patients at L2-L3 (0.067%). None of the patients had dural tears or any other adverse events during the surgeries. The mean surgical time was 102.5 ± 43.66 minutes (range, 45 minutes to 3 hours), average estimated blood loss was 49.3 ± 60.76 mL (ranging from uncountable blood loss to 200 mL) and average hospital stay was 8.79 ± 3.39 days (range, 3—15 days). The longer hospital stays are not related to any postoperative pain or complications but are due to the low cost of hospital stays and social culture in the author's country.

The mean preoperative NRS score for leg pain on the affected side was 7.5 ± 0.86 (range, 6—9), and the mean postoperative NRS score for leg pain improved at last follow-up to 1.53 ± 0.86 (range, 1—4). The NRS score for the back pain was less than 3 in all the patients, and there was no worsening of back pain in any of the patients postoperatively. Mean ODI scores improved from 67.9 ± 9.7 (range, 50—88) preoperatively to 15.7 ± 6.6 (range, 10—20) postoperatively at the last follow-up.

Postoperative MRI showed decompression of the pathologic segment in all the patients (**Figures 2** and **3**). The morphometric measurements are shown in **Table 1**.

The difference in the measurements of the change in the surface area after decompression was found to be statistically significant