Endoscopic decompression combined with interspinous process implant fusion for lumbar spinal stenosis

LIU Gang, ZHAO Jian-ning, and Akira Dezawa*

Objective: To propose a new technique to treat lumbar spinal stenosis with median approach endoscopic decompression combined with interspinous process implant fusion and evaluate the initial clinical outcome.

Methods: This study involved 30 patients who had neurogenic commitment claudication over 2 years and were resistant to conservative therapy. All cases were treated using the median approach endoscopic decompression combined with interspinous process implant fusion in 2006. Clinical signs and radicular pain were noted and evaluated preoperatively and at the 1st month and 3rd month postoperatively. Japanese Orthopedic Association (JOA) score was used to evaluate leg and back pain. X-ray films at flexion and extension were applied to evaluate the range of motion at involved segments.

Results: There was a significant increase in JOA score postoperatively, but no significant difference preoperatively or postoperatively between the two groups. The range of motion at involved segments was significantly higher in the control group.

Conclusions: The median approach endoscopic decompression is an ideal method for bilateral radiculopathy resulting from lumbar spinal canal stenosis. The combination with interspinous process implant fusion can stabilize the spine. The initial clinical outcome is excellent. Preservation of adjacent level disease can be assessed only in long-term follow-up.

Key words: Decompression, surgical; Spinal stenosis; Endoscopy

The median approach endoscopic decompression may be the most suitable technique for bilateral radiculopathy caused by lumbar spinal canal stenosis, but the resection of interspinous ligament inevitably compromise the dynamic integrity of spinal posterior column. Decompression combined with interspinous process implant fusion is proposed for this situation.

Along with the mean lifetime lengthening, patients with lumbar spinal canal stenosis gradually take a large proportion in outpatient service. For the patients who have poor physical condition or work everyday, it is crucial to reduce the duration of hospital stays, alleviate postoperative pain and minimize surgical injury. Even we can say that shortening the hospital stays is the request of society.

Therefore, we developed a minimally invasive surgery composed of decompression and interspinous fusion for lumbar spinal canal stenosis with bilateral radiculopathy.

METHODS

Patient selection

Thirty patients who had neurogenic commitment claudication for over 2 years and were resistant to conservative therapy were involved in this study. All cases were treated using the median approach endoscopic decompression combined with interspinous process implant fusion from January 2005 to June 2006. Patients' eligibility in the study was based on the following key inclusion and exclusion criteria.

As for key inclusion criteria, patients had to be at least 50 years old and have leg, buttock or groin pain that was relieved during flexion. All patients had bilateral symptoms.

As for key exclusion criteria, patients could not have a fixed motor deficit, cauda-equina syndrome, or spondy-
lolisthesis greater than grade I on a scale of I to IV in the affected level(s) or disc herniation.

Clinical and radiographic evaluation criteria

Clinical data were collected preoperatively and 1 month and 3 months after operation until the last follow-up. Complication analysis included the intraoperative and immediate postoperative period.

Clinical results were investigated by Japanese Orthopedic Association (JOA) scale for back and leg pain.

Radiographic examination included anteroposterior and sagittal plain radiographs of lumbar spine in the neutral or standing position. The range of motion (ROM) was measured using the method of Ono et al.1

Statistical analysis

All measurements were made by an independent radiologist and comparisons were performed using Student’s t test with a level of significance of 0.05.

Surgical technique

After induction of general anesthesia, a patient was placed in a prone position on an operating table avoiding hyperlordosis of the lumbar spine. A 2-cm-long skin incision was made. The muscle was sharply dissected lateral to the supraspinous ligament well preserving the entire thickness of supraspinous ligament, then the supraspinous ligament was dissected subperistally and preserved as a thick cuff and retracted laterally. The interspinal ligament was incised and the nearby spinal processes was partly excised, and the retractor was then placed and “docked” in the midline. Under the endoscopy, the ligamentum flavum was resected and lamina was undercut bilaterally, relieving all points of neural compression. Artificial bone (20100BZZ0259000, Japan) was inserted between the interspinous process via impaction utilizing a mallet and then was fastened by artificial polyethylene cable (27B1XOOO17, Alfiesa Co. Japan).

RESULTS

All patients were instructed to answer the questionnaire. The results were collected and analyzed by one doctor.

Mean JOA score was 15±2.7 before operation and 21±2.2 at the 1 month follow-up. There was a statistically significant improvement (P<0.05). At the last follow-up, mean JOA score was 23±2.9, which had no statistical significance in comparison with that at 1 month follow-up (P>0.05).

The mean ROM before operation and at postoperative 1 month and 3 months were 2.1°±4.1°, 1.8°±3.6° and 1.6°±2.4°, respectively. There was no statistically significant difference before and after operation.

![Fig.1. Method of calculation of sagittal rotation angle by Ono et al.](image)

Sagittal rotation angle= \( \beta - (\alpha + \gamma) \)

![Fig.2. The axial view of the involved vertebrae. The left showed spinal canal stenosis before operation and the right showed the canal got well decompressed with facet and laminar preservation.](image)

![Fig.3. The lateral view of the involved vertebrae. The left was the scheme preoperatively and the right showed interspinous fusion after the interspinal ligament was incised.](image)
DISCUSSION

In conventional laminectomy for lumbar canal stenosis, bilateral paraspinal muscles are dissected and detached extensively from the spinous process and laminae. Furthermore, the posterior midline ligaments such as the supra- and interspinous ligaments lose their original attachments when the spinous processes are removed. Such intraoperative damage to these posterior lumbar have potentially serious consequences. Kim et al. demonstrated a decrease in paraspinal muscle strength with concomitant atrophy on postoperative computed tomography scans. See and Kraft found long-term alterations in electromyographic evaluation up to 4 years after surgery. Sihvonen et al. noted similar computed tomography and electromyographic abnormalities and correlated these with the postoperative failed back syndrome because the wide stripping of the multifidus not only devastates vessel supply but also has risks of muscular denervation.

The described technique of microdecompression we performed limits ipsilateral retraction to the level of medial facet border. Contralaterally, no elevation or retraction of the paraspinal musculature is undertaken, thereby minimizing the risk of iatrogenic muscular trauma. Meanwhile, the fact that JOA score dramatically increased after surgery has demonstrated that this technique has good clinical outcome.

Furthermore, interspinous implants also produce ideal outcome. The advantages are listed as follows:

1. It can be done in minimally invasive way without high requirement of demanding technique. It also has no need for complicated instruments and equipments.

2. The surgery can avoid interspinous dead space after removal of interspinous ligaments. Postoperative dead space has serious potential consequences. Increased volume results in increased blood loss and provides an ideal bacterial culture medium, which may increase the infection rate. The region is inevitably replaced with scar tissue, thereby complicating or necessitating secondary surgical interventions. Application of the interspinous implant could significantly decrease the volume of dead space and its consequent damage.

3. The surgery could maintain the intervertebral height, especially the height of lumbar posterior column, which is very important for the patients with spinal canal stenosis. As for this concern, the function of surgery is similar to that of X-Stop. Richards et al. quantified the spinal canal and neural foramina dimensions of cadaver lumbar spines during flexion and extension using magnetic resonance imaging before and after the placement of an interspinous process implant. He found that in extension, the implant significantly increased canal area by 18% (231-273 mm²), subarticular diameter by 50% (2.5-3.7 mm), canal diameter by 10% (17.8-19.5 mm), foraminal area by 25% (106-133 mm²), and foraminal width by 41% (3.4-4.8 mm).

4. The surgery can restore the lumbar posterior integrity. The excision of interspinous or supraspinous ligament complex inevitably alters a pathological biomechanic milieu. Goel et al. found that under normal conditions, supraspinous ligament experienced the greatest force when exposed to an external flexion across an anatomic segment. Hindle et al. also demonstrated load with flexion in the supra- and interspinous ligaments. Prestar had similar findings and concluded that, in regions lacking the ligamentous support, the paraspinal musculature must need the aid of stability. Unfortunately, the pathologic setting of severe degenerative disease may increase the demands placed on these posterior ligaments. Loss of lordosis, disc degeneration with segmental instability, altered facet joint biomechanics, laxity of the facet joint capsules and postoperative insufficiency of paraspinal musculature can make the role of posterior ligamentous complex more important. Accordingly, we should make each effort...
to preserve this complex in this setting. The described technique of microdecompression can achieve this goal.

Although the initial clinical outcome is excellent, we do not know exactly the impact of the relatively rigid interspinous fusion on the whole lumbar biomechanics. Therefore, long-term observation is further needed.

REFERENCES


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