Short-term results of microendoscopic posterior decompression for lumbar spinal stenosis

Technical note

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Object. The authors applied the technique of microendoscopic discectomy to posterior decompression procedures for lumbar spinal stenosis. The purpose of this study was to determine the feasibility of using an endoscopic technique to treat lumbar spinal stenosis and to evaluate the clinical and radiographic results of microendoscopic posterior decompression (MEPD).

Methods. Microendoscopic posterior decompression, which involves a unilateral endoscopic approach for bilateral decompression, was performed in 47 patients. Clinical and radiographic/neuroimaging results were evaluated during the follow-up period (minimum duration 1 year). The clinical results were compared with those of the conventional laminotomy. Radiographic instability and the degree of surgical invasion of the facet joints were evaluated. In a control group of 29 patients open laminotomy was performed.

The clinical outcome was evaluated in 44 patients. The mean follow-up duration was 22 months. The mean rate of improvement was 72% based on the Japanese Orthopaedic Association score, and good results were obtained in 38 patients. Although the rate of morbidity decreased in the MEPD group, the incidence of complication was slightly higher. Effective decompression was demonstrated in the majority of the patients by using magnetic resonance imaging. Radiographic instability appeared in one patient postoperatively, and based on computerized tomography scanning, a tendency toward invasion of the facet joint on the approach side was noted.

Conclusions. Microendoscopic posterior decompression is a minimally invasive procedure and is as useful as other conventional procedures in treating lumbar spinal stenosis; however, a few technical problems remain to be solved.

Key Words • lumbar spine • stenosis • endoscopic surgery • laminotomy

Lumbar spinal stenosis is one of the most common diseases of the spine in the elderly population. Wide laminectomy has been the traditional surgical treatment for lumbar spinal stenosis; however, this procedure as well as laminotomy, laminoplasty, and unilateral approaches to treat bilateral compression have resulted in a more limited decompression. At the same time, these limited decompressive procedures have been reported to yield good results.9-10,15,23 Minimally invasive procedures have led to remarkable changes in surgery. Their advantages are reduced tissue trauma and morbidity. Additionally, in spinal surgeries, the minimally invasive modalities, including percutaneous, endoscopic, and image-guided procedures, can be applied in the treatment of several conditions. Microendoscopic discectomy is one of the minimally invasive procedures reported by Foley and Smith1 in 1997. It is an endoscopic technique in which the tubular retractor is used to treat lumbar disc herniation, and it has numerous advantages over conventional procedures such as a small skin incision, gentle tissue dissection, and excellent visualization. The reported clinical results obtained with MED have been conclusive with those obtained using conventional discectomy. Therefore, since January 2001, MED has been replaced with those obtained using conventional discectomy. Since May 2001, we have applied MED techniques to posterior decompression procedures for the treatment of lumbar spinal stenosis. We describe the details of MEPD, the early clinical outcome, complications, and the radiographic/neuroimaging results.

Abbreviations used in this paper: CPK = creatine kinase; CRP = C-reactive protein; CSF = cerebrospinal fluid; CT = computed tomography; EBL = estimated blood loss; JOA = Japanese Orthopaedic Association; LOS = length of stay; MED = microendoscopic discectomy; MEPD = microendoscopic posterior decompression; MR = magnetic resonance; VAS = visual analog scale; WBC = white blood cell.
Clinical Material and Methods

Patient Population

Forty-seven patients with lumbar spinal stenosis underwent MEPD in our department between May 2001 and August 2003. All the MEPD procedures were performed by the same surgeon (K.I.). The patient population comprised 23 men and 24 women whose mean age at surgery was 66 years (range 31–88 years). All patients had presented with low-back pain and lower-extremity symptoms in all the patients neurogenic claudication was referable to the lumbar spine, and 27 were severely limited in the distance they could walk (<100 m). In objective evaluations, lower-extremity sensory disturbance was demonstrated in 25 patients and decrease of lower-extremity muscle strength was documented in 34 patients (mild in 26, marked in eight). Urinary dysfunction was observed in two patients. The mean duration of lumbar spinal stenosis symptoms was 30 months. In 32 patients cauda equina syndrome was present, and 15 patients suffered only radiculopathy. Degenerative spinal stenosis was observed in 26 patients (combined with disc herniation in four), degenerative spondylolisthesis was documented in 14, degenerative scoliosis was present in five, and a facet joint cyst was revealed in two patients. Diabetes was documented in four patients, and other internal diseases, such as hypertension, ischemic heart disease, and hepatic disorder, were present in 22. Four patients received preoperative anticoagulant or antiplatelet therapy. Preoperative MR imaging and CT myelography revealed moderate-to-severe spinal stenosis in all the patients. Thirty patients underwent MEPD at L4–5, one at L2–3, one at L3–4, three at L5–S1, six at L3–4 and L4–5, three at L4–5 and L5–S1, two at L2–3 and L3–4, and one at L2–3 to L4–5. The postoperative follow-up period ranged from 12 to 42 months (mean 22 months).

Clinical Evaluation

The clinical evaluation was conducted using the JOA classification (Table 1) and a VAS at 3 months and at the final follow-up examination. The improvement rate based on VAS score was calculated as follows: (preoperative score – postoperative score)/preoperative score × 100%. The clinical results were assessed based on the improvement rate according to the JOA score, and cases were classified according to one of the following four grades: poor (improvement rate < 24%), fair (between > 25% and < 49%), good (between > 50% and < 74%), and excellent (> 75%). In addition, operative time, operative blood loss, changes in the laboratory data including WBC, CRP, and CPK levels, the duration of fever after surgery, and postoperative VAS score for low-back pain were studied to evaluate tissue trauma and morbidity. The postoperative spinal instability was evaluated using dynamic lateral radiography; significant instability was defined as greater than a 5% increase in the horizontal displacement or greater than a 5˚ increase in the sagittal motion after surgery.

In 30 patients MR imaging was performed after MEPD to examine the effectiveness of decompression on the dural sac. Preoperative and postoperative CT scanning was performed to examine the extent of the spinal canal decompression and the degree of surgical invasion on the facet joints. The latter was measured using a modified Grobler method. The coronal dimension was measured between the medial edge and the posterolateral edge of the facet joint. Reduced dimension was defined as the width of the resected facet joint (Fig. 1). The reduction rate was calculated as follows: reduced dimension/coronal dimension × 100%. These values on the approach side and those on the contralateral side were compared to determine whether there were any differences.

Control Group

A control group consisted of 29 patients who underwent conventional microscopic laminotomy immediately preceding the initiation of the endoscopic series (1999–2001). These surgeries were performed at the same institution by the same surgeon (K.I.). The total number of vertebral levels was 44. There were 15 men and 14 women whose mean age at surgery was 69 years (range 46–84 years).
years). Cauda equina syndrome and radiculopathy alone were documented in 16 and 13 patients, respectively. Degenerative spinal stenosis was present in 15 patients, degenerative spondylolisthesis in nine, degenerative scoliosis in two, and facet joint cyst in three. The data, including JOA scores, operative time, operative blood loss, the duration of fever after surgery, hospital LOS, and complications were obtained by retrospective chart review. The mean follow-up period in this control group was 23 months.

**Statistical Analysis**

The Welch t-test was used to evaluate the statistical significance.

**Surgical Technique**

Microendoscopic posterior decompression is a unilateral endoscopic approach for bilateral decompression; the METRx Microendoscopic Discectomy System (Medtronic Sofamor Danek, Memphis, TN) is available in our department. The procedure was performed with the patient in the prone position after induction of general anesthesia. We ensured that the abdomen was not compressed and that the spine was flexed to expand the interlaminar space. The level of incision was marked under fluoroscopic guidance prior to surgery. A skin incision, approximately 2 cm in length, was made 1 in off the midline on the approach side. The approach side was chosen based on the severity of the symptoms. Serial dilators were passed to dilate gently the lumbar paraspinal muscles and retract the lumbo-dorsal fascia. A 16- or 18-mm tubular retractor was then passed over the dilators and secured to a flexible-arm retractor mounted on the side rail of the table. The dilators were removed, and the endoscope (25° angle) was attached to the tubular retractor.

A laminotomy was initially performed, and it was done so in a manner similar to that of MED. All the residual muscle tissues were removed to allow clear demonstration of the bone edges. The inferior edge of the lamina and the medial edge of the facet joint were identified. After the cranial edge of the ligamentum flavum was detached from the lamina, laminotomy and medial facetectomy were performed using an air drill, Kerrison rongeur, and an osteotome. At the same time, the anterior plate of the lamina on the contralateral side was removed in preparation of a later maneuver for the decompression. A sufficient bone resection was performed to reach the cranial attachment of the ligamentum flavum and the medial edge of the pedicle. The dura mater and the nerve root were exposed after the resection of the ligamentum flavum. Nerve root canal decompression or discectomy was performed if necessary. Thus, hemilaminotomy and medial facetectomy were completed on the approach side (Fig. 2A and C).

Decompression was performed on the contralateral side after the tubular retractor was swung laterally and downward to obtain a better view. The resection of the ligamentum flavum was performed at the lateral margin of the dural sac by using Kerrison rongeurs and curettes. The nerve root on this contralateral side was exposed after completely resecting the ligamentum flavum (Fig. 2B and D). A medial facetectomy was performed if necessary. Finally, complete decompression on both the sides was completed (Fig. 2E).

After inspecting the dural sac and nerve roots, the site was copiously irrigated with physiological saline. The tubular retractor and endoscope were withdrawn, and the fascia and skin were sutured closed.

**Results**

A summary of procedure-related data is provided in Table 2. Microendoscopic posterior decompression was performed in 47 patients (61 levels [one level in 35 cases, two levels in 11, and three levels in one]). The procedure was successfully performed at 60 levels (98%), but one procedure was converted to an open procedure after the intraoperative development of a dural tear. An additional herniotomy was performed at four levels where disc mat-
ter had herniated, and discectomy was performed at eight levels. Additional nerve root decompression was performed at four levels. The mean operative time was 124 minutes per level (range 70–185 minutes/level). This was slightly longer than the mean 101 minutes per level (55–190 minutes/level) in the control group and reflected the learning curve of the MEPD procedures. The mean intraoperative EBL was 68 ml per level (range uncountable–300 ml) in the MEPD group and 110 ml per level (range 15–340 ml) in the control group. Access-related complications occurred in seven patients in the MEPD group: four dural violations and CSF leaks and three fractures of the inferior articular process on the approach side. In the former four patients, intraoperative open conversion was necessary in one patient, and repeated operation was performed in one patient, 5 days after MEPD, to treat a cauda equina herniation. Delayed CSF leaks and pseudomeningoceles were not observed in any patient. In the three patients who suffered a fracture of the articular process, no postoperative spinal instability appeared during the follow-up period. A postoperative epidural hematoma was observed in one patient, and repeated operation was performed 12 days after MEPD. The presence of wound infections was not investigated. Neurological complications occurred in seven patients who complained of transient leg symptoms, including mild paresthesia and mild decrease of muscle strength, on the contralateral side. In one patient we observed a conjoined nerve root on the contralateral side. All of these symptoms were mild, and most spontaneously improved within 3 months. Overall, complications were observed in 12 patients (25%) in the MEPD group and in four patients (14%) in the control group. There were two dural violations, one fracture of the inferior articular processes, and one transient neurological complication.

The degree of morbidity was evaluated in 35 patients

<p>| TABLE 2 |
| Summary of the differences between the MEPD group and the control group* |</p>
<table>
<thead>
<tr>
<th>Clinical Results</th>
<th>MEPD</th>
<th>Control</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>improvement in JOA score (%)</td>
<td>72 ± 20</td>
<td>70 ± 16</td>
<td>NS</td>
</tr>
<tr>
<td>good &amp; excellent results†</td>
<td>38 (81%) of 47</td>
<td>23 (79%) of 29</td>
<td>NS</td>
</tr>
<tr>
<td>complication rate (%)</td>
<td>25</td>
<td>14</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>dural tear‡</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>IAF fracture‡</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>neurological deficit (transient)‡</td>
<td>7</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>wound infection‡</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>time (mins)</td>
<td>124 ± 29</td>
<td>101 ± 29</td>
<td>NS</td>
</tr>
<tr>
<td>EBL (ml)</td>
<td>68 ± 61</td>
<td>110 ± 79</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>days of fever</td>
<td>1.2 ± 1.5</td>
<td>3.5 ± 1.5</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>use of analgesics§</td>
<td>0.5 ± 1.0</td>
<td>3.4 ± 2.5</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>LOS (days)</td>
<td>18 ± 7.1</td>
<td>24 ± 3.0</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

* IAF = inferior articular facet; NS = not significant.
† Good and excellent results: improvement rate of JOA score greater than 50%.
‡ Value represents number of cases.
§ Value represents the average time per day of analgesic usage.
who underwent single-level MEPD. As controls, 15 patients who underwent the conventional single-level laminotomy were evaluated. The mean duration of fever was 1.2 days in the MEPD group and 3.5 days in the control group. Analgesic medication (diclofenac sodium suppository) was used a mean of 0.5 times per week after surgery in the MEPD group and 3.4 times per week in the control group. The severity of low-back pain was evaluated using the VAS at 2 days after surgery. The mean VAS score was 27, which was regarded as reflecting mild pain in the MEPD group. All the patients in both groups could walk 1 day after surgery. The laboratory data were evaluated in 15 patients in whom complete pre- and post-MEPD laboratory data were available. The laboratory data including WBC, CRP, and CPK levels reached the presurgery values 1 day after surgery. The laboratory data were evaluated in 44 patients based on the subjective symptoms, in the MEPD group the mean score of low-back pain improved slightly from 1.8 to 2.2, and the leg pain and ambulatory ability was particularly associated with a good recovery—an improvement from a mean 0.5 to 2.6. In the control group, the mean low-back pain score improved slightly from 1.5 to 1.6 and that of leg pain showed good improvement. Ambulatory ability was regarded as excellent in 24 patients, good in 14, fair in three, and poor in three, based on the JOA score; according to the VAS score results greater than 50% recovery was obtained in 37 patients. In the control group, the mean JOA score was 17.6 before surgery and that at final follow up was 25.6. The mean rate of JOA score improvement was 69.6% at the final follow up and status was regarded as excellent in 11 patients, good in 12, fair in three, and poor in three. In terms of clinical results, there were no significant intergroup differences. Clinical results, morbidity, and complications for both groups are summarized in Table 2.

Table 2: Summary of JOA scores indicating clinical results*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Preop</th>
<th>3-Mo Postop</th>
<th>Final FU</th>
<th>Rate of Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>low-back pain</td>
<td>1.5 ± 0.6</td>
<td>2.2 ± 0.6</td>
<td>2.1 ± 0.6</td>
<td>0.5 ± 0.6</td>
</tr>
<tr>
<td>leg pain</td>
<td>1.0 ± 0.4</td>
<td>2.1 ± 0.6</td>
<td>2.1 ± 0.6</td>
<td>0.6 ± 0.6</td>
</tr>
<tr>
<td>walking ability</td>
<td>0.5 ± 0.6</td>
<td>2.6 ± 0.7</td>
<td>2.6 ± 0.7</td>
<td>0.6 ± 0.7</td>
</tr>
<tr>
<td>straight leg raising</td>
<td>1.6 ± 0.5</td>
<td>2.0 ± 0.0</td>
<td>2.0 ± 0.0</td>
<td>0.6 ± 0.0</td>
</tr>
<tr>
<td>sensory disturbance</td>
<td>1.2 ± 0.7</td>
<td>1.6 ± 0.5</td>
<td>1.6 ± 0.5</td>
<td>0.5 ± 0.5</td>
</tr>
<tr>
<td>motor disturbance</td>
<td>1.0 ± 0.6</td>
<td>1.5 ± 0.6</td>
<td>1.7 ± 0.5</td>
<td>0.5 ± 0.5</td>
</tr>
<tr>
<td>total</td>
<td>14.3 ± 4.1</td>
<td>25.0 ± 2.8</td>
<td>24.9 ± 3.2</td>
<td>24.9 ± 3.2</td>
</tr>
<tr>
<td>w/ DS (14)</td>
<td>13.6 ± 4.1</td>
<td>25.4 ± 2.2</td>
<td>24.0 ± 3.0</td>
<td>24.0 ± 3.5</td>
</tr>
<tr>
<td>w/o DS (28)</td>
<td>15.0 ± 3.6</td>
<td>24.8 ± 3.0</td>
<td>25.3 ± 3.0</td>
<td>73.3 ± 21</td>
</tr>
</tbody>
</table>

* The pre- and postoperative dynamic sagittal angles were 9.4 ± 6.3° and 8.1 ± 6.1° (not statistically significant), respectively, and the pre- and postoperative rates of vertebral slippage in the 14 patients with degenerative spondylolisthesis were 13.6 ± 4.9% and 13.7 ± 3.7% (not statistically significant), respectively. Abbreviation: NS = not significant.

Table 4: Results of radiographic studies*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Approach Side</th>
<th>Contralat Side</th>
<th>p Value†</th>
</tr>
</thead>
<tbody>
<tr>
<td>coronal dimension (mm)</td>
<td>9.9 ± 3.2</td>
<td>9.9 ± 3.6</td>
<td>NS</td>
</tr>
<tr>
<td>reduced dimension (mm)</td>
<td>2.1 ± 2.0</td>
<td>1.4 ± 1.7</td>
<td>0.01</td>
</tr>
<tr>
<td>reduction rate (%)</td>
<td>22.6 ± 24</td>
<td>13.1 ± 15</td>
<td>0.01</td>
</tr>
<tr>
<td>before (37 cases)‡</td>
<td>25.8 ± 24</td>
<td>14.6 ± 16</td>
<td>0.01</td>
</tr>
<tr>
<td>after (21 cases)$§</td>
<td>17.0 ± 24</td>
<td>10.6 ± 14</td>
<td>0.01</td>
</tr>
</tbody>
</table>

* Statistical analysis was performed using the Welch t-test.
‡ Refers to the period before the use of curved instruments.
§ Refers to the period since the use of curved instruments.
translation were associated with good recoveries, as follows: the mean leg pain score improved from 1.0 to 2.2 and ambulation from 0.7 to 2.5. There was no intergroup difference in the improvement of the subjective symptoms. In the MEPD group, three patients complained of moderate low-back pain, which was accorded one point in the JOA classification at the final follow-up examination, and in none was the result regarded as good. Based on objective findings, the score of sensory disturbance was associated with a lower rate of improvement than that of motor disturbance. No clinical difference was observed between the patients with and those without spondylolisthesis (Table 3).

Overall, good and excellent results were observed in 81% of the patients in the MEPD group, and no patient required additional immobilization during the follow-up period. Three patients, by contrast, required necessary repeated operation in the control group for disc herniation during the follow-up period. At the final follow-up examination, no patient in either group had suffered deterioration due to complications such as dural tears, fractures of articular process, or neurological events.

On radiographic studies, the dynamic sagittal angles changed slightly from a mean 9.4 to 8.1°, but no significant difference was observed between them before and after surgery, respectively. Postoperative spondylolisthesis was never identified at levels at which it had not already been present prior to surgery. In the patients with spondylolisthesis, the mean slippage rate was 13.6% before surgery, whereas it was 13.7% after surgery (Table 4). An increase in the postoperative segmental instability was observed in only one patient with spondylolisthesis in whom segmental instability was documented before surgery; outcome in the case was regarded as poor at the final follow-up. The effectiveness of decompression was evaluated on a cross-sectional area of the dural sac at the disc level, which was demonstrated on axial T2-weighted MR images obtained before and after MEPD. Overall we examined 36 levels in 30 patients who underwent MR imaging after MEPD. The mean cross-sectional area of the dural sac was 68 ± 34 mm² before MEPD, and this increased to 145 ± 46 mm² at the follow up (Fig. 4). There was a significant difference in the cross-sectional area of the dural sac when comparing pre- and post-MEPD images. An insufficient decompression was observed at four levels in three patients (insufficient decompression was defined as a cross-sectional area of the dural sac < 100 mm²). In one of these three patients the clinical result was judged to be fair and in the other two it was considered to be good at the final follow-up examination. We conducted CT scanning to determine the degree of invasion of the facet in 44 patients (58 total levels). A significant difference was observed between the reduced coronal dimension of the facet joint on the approach side (mean 2.1 mm) compared with the contralateral side (mean 1.4 mm). The mean reduction rate was 22.6% on the approach side, which was significantly higher than that on the contralateral side (mean 13.1%). The overresection of the inferior articular process on the approach side was detected in some initially treated patients. The reduction rate was distinctly decreased when we made a comparison between the surgeries performed before and those conducted using the curved instruments (Table 4). These results clearly indicated that the invasion of the facet joint was greater on the approach side than on the contralateral side when using MEPD techniques; however, the applica-

**Fig. 4.** The cross-sectional area of the dural sac was 68 ± 34 mm² before MEPD and 145 ± 46 mm² at follow up. There was a significant pre- and post-MEPD difference in the cross-sectional area of the dural sac.
Discussion

Several surgical options have been reported for the treatment of lumbar spinal stenosis, and there is consensus that decompression is necessary. The indications of fusion for the treatment of lumbar spinal stenosis, however, have remained controversial. Some investigators have reported excellent outcomes after fusion.17 On the contrary, postoperative instability after decompression has been reported in other studies in which fusion was not also reported.4,11,16 Several authors have assumed that the presence of degenerative spondylolisthesis is an indication for fusion.7 In contrast, some investigators have shown that decompression alone, without violation of the integrity of the posterior structures, can effectively prevent postoperative instability.9,15 In some biomechanical studies the importance of the posterior column has been revealed in maintaining spinal stability.1,2,24 Although decompression, which requires a total facetectomy or pars interarticularis resection, is indicated with a fusion, reduced surgical invasion of the posterior structures would decrease the risk of postoperative instability. Although laminotomy is one of the less invasive procedures for the posterior structures, a microscopic unilateral approach for bilateral decompression is more minimally invasive.19,26 The microdecompression procedure is undertaken to preserve the posterior structures that consist of the spinous process and interspinous-supraspinous ligamentous complex. The clinical outcomes after a microscopic procedure, as described by McCulloch,18 were similar to those of standard laminectomy, and good outcomes were shown in 70 to 80% of the patients 3 to 5 years postoperatively.

Guinot, et al.,9 reported that microendoscopic laminotomy can be used to decompress the spinal canal as effectively as open laminotomy in a human cadaveric model. Microendoscopic posterior decompression involves an endoscopic technique that is a modification of the microscopic procedures described by McCulloch.19 It has a few advantages in terms of effects on the posterior soft tissues compared with microdecompression. The length of skin incision is approximately 2 cm per level in MEPD, whereas it is greater than 5 cm per level when microdecompression is performed. Additionally, MEPD is appreciably less invasive with respect to the paraspinal muscles because of the tubular retractor system, which allows for gentle tissue dissection and minimizes the elevation and the retraction of the paraspinal muscles. Postoperative denervation of the paraspinal muscles has been one of the important complications. Sihvonen, et al.,25 correlated this iatrogenic injury of the paraspinal muscles to an increased incidence of failed-back syndrome. Mayer, et al.,18 demonstrated a decrease in paraspinal muscle strength as well as the presence of atrophy after extensive muscle retraction during open decompression. In the present study, the postoperative recovery of CPK levels occurred within 1 week, and after surgery the degree of low-back pain was mild. It seemed reasonable to consider MEPD to be a relatively less invasive procedure with regard to the paraspinal muscles. Additionally, the duration of fever after surgery, the need for analgesic medication, and the LOS decreased in the MEPD-treated group. The fact that the morbidity rate after surgery decreased because of the MEPD procedure suggested that the procedure itself is minimally invasive for lumbar spinal stenosis.

We found that good results were present in 81% of the patients at a mean of 22 months after MEPD, based on JOA score, and these results were on par with those of the conventional microscopic laminotomy. There were no differences between the MEPD group and the microscopic laminotomy group in terms of the symptomatic improvement rate for low-back pain, leg pain, and ambulatory ability. Furthermore, the fact that good results were documented in 37 patients (79%) in this study, based on VAS scores, suggested that MEPD may lead to similar clinical results as those associated with conventional procedures for lumbar spinal stenosis. Khoo and Fessler14 reported that microendoscopic decompressive laminotomy in patients with lumbar spinal stenosis yielded symptomatic improvement in nearly 80% of the cases at a mean of 12 months postoperatively. Similarly, Yoshida, et al.,27 reported good outcomes after microendoscopic decompressive laminotomy. The follow-up periods in these studies, however, including the present study, were insufficient for evaluating the potential segmental instability and recurrent stenosis. In fact, in a report on a retrospective surgical series of 88 patients undergoing laminectomy for lumbar stenosis the authors noted the deterioration of surgical results over a period of time.12,13

The neuroimaging-related definition of lumbar central spinal stenosis requires that the cross-sectional area of the dural sac be less than 75 mm².19 In this study, the mean cross-sectional area of the dural sac after MEPD was 145 mm², and sufficient decompressive results were observed in most of our patients, based on evaluation of MR imaging studies. Insufficient decompression, however, was observed in three patients in whom the cross-sectional area of the dural sac was greater than 75 mm² but less than 100 mm². Postacchini and Cinotti22 reported on 40 patients who underwent surgery for lumbar spinal stenosis (mean follow-up period 8.6 years). They concluded that regrowth of the posterior arch in most patients during the years after decompressive surgery and that in a minority there is marked bone regrowth, which may occasionally reproduce neural compression. Because of this bone regrowth after decompressive surgery, an insufficient decompression may be a risk for recurrent stenosis during the long term after surgery. We believe that further clinical follow-up data are necessary to allow evaluation of the long-term results after MEPD.

Several complications of posterior lumbar surgery, such as wound infection, CSF leakage due to intraoperative dural injury, and postoperative epidural hematoma have been reported. The complication rate associated with standard laminectomy and laminotomy is considered to be low, whereas that of MEPD was relatively high in our study: four dural tears, three fractures of the inferior facet joint, one postoperative epidural hematoma, and seven transient leg symptoms on the contralateral side. Khoo and Fessler14 reported four dural violations and CSF leaks after 25 microendoscopic decompressive laminotomy procedures. Because the diameter of the tubular retractor is less than 18 mm, surgical maneuvering in the small cavity is diffi-
cult and troublesome. The maneuvers required for the decompression of the nerve root on the contralateral side are difficult because the direction of insertion of the instruments is not synchronized with the anatomical structures.

In the present series, three dural injuries occurred on the contralateral side. To prevent the dural injury and to protect the expanding dural sac, the ligamentum flavum must not be resected until completion of laminotomy, which
can be achieved using curved instruments. In our series, a fracture of the inferior facet was the result of overresection. In MEPD the approach is more lateral than that in the standard procedures because the shape of the tubular retractor is cylindrical and the spinous processes disturb the medialization of the retractor. On the approach side, the reduction rate of the facet joint was approximately 23%. Surgeons tend to resect the inferior facet excessively on the approach side in MEPD, particularly in cases involving wide spinous processes or a developmentally narrow spinal canal. Therefore, to prevent overresection of the inferior facet, we have used a curved osteotome and Kerrison rongeur since April 2003. The extent of facet removal has actually decreased since application of these curved instruments, and recently, we performed a “triangular” decompression (Fig. 5).

The postoperative neurological complications (namely, transient leg symptoms on the contralateral side) were observed in seven patients. In all cases the neurological complications were mild and all had subsided by the final follow-up; however, prevention of this complication is important. We considered that this complication might be the result of nerve root compression during surgery or postoperative epidural hematoma. This complication occurred in patients initially treated in this series. If an epidural hematoma developed after MEPD (Fig. 6), the posterior space of the nerve root on the contralateral side was slightly narrowed. In fact, the incidence of this complication decreased in relation to an increase in the surgeon’s experience as well as the application of postoperative drainage for 48 hours after surgery. Finally, the overall incidence of complications appreciably decreased as the surgeon’s experience increased and several policies in the latest series of MEPD were applied.

Recent trends and instrument modifications have resulted in a shift from endoscopic to microscopic surgery involving the same tubular retractor. Palmer, et al.,21 reported on bilateral decompression of lumbar spinal stenosis via a unilateral approach involving a microscope and a tubular retractor system. The microscopic technique is more popular and easier than the endoscopic technique because of the two-dimensional visualization and the difficulty in hand–eye coordination in the latter. Despite this, the endoscopic procedure offers a unique advantage—wide and excellent visualization beyond the tubular retractor—because the instrument is angled at 25°. The endoscopic procedure allows decreased invasion of the facet joints due to use of the curved instruments and provides visualization of anatomical detail, and these are far superior to those of the microscopic technique.

We found MEPD to be a minimally invasive procedure, and its short-term results in the treatment of lumbar spinal stenosis were in accordance with those of conventional procedures. Some problems remain, however. In our study, only short-term results were reported, and the follow-up duration was not sufficient to allow for evaluation of the effectiveness of MEPD for the treatment of lumbar spinal stenosis. Further follow-up studies should be performed to evaluate the long-term results. The other problem was that MEPD had a higher complication rate than other conventional procedures. To ensure overall safety, surgeons should be well trained and curved instruments should be used.

Conclusions

The endoscopic technique provides a wide and excellent visualization. Microendoscopic posterior decompression, which is an endoscopic procedure, is a useful minimally invasive procedure for treating lumbar spinal stenosis. We obtained relatively good results in this study; however, a longer follow-up duration is necessary, and technique and instruments must be improved.

References


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