Surgical Result of the Combined Anterior and Posterior Approach in Treatment of Cervical Spondylotic Myelopathy

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Objective: The purpose of this study is to evaluate the efficacy and necessity of combined anterior approach [discectomy and fusion] and posterior approach [open-door laminoplasty] in the treatment of cervical spondylotic myelopathy.

Methods: The authors reviewed 14 cases in whom combined anterior and posterior approach performed for cervical myelopathy due to simultaneous anterior and posterior pathology such as huge central disc herniation with narrow spinal canal between January 2000 and December 2002. Clinical symptoms were evaluated by Japanese Orthopaedic Association (JOA) score and then the cervical curvature, change of spinal canal to vertebral body (SC/VB) ratio and canal widening were measured and compared to the clinical symptoms.

Results: The mean JOA score increased from 10.4 ± 3.1 preoperatively to 14.8 ± 1.2 at the final follow up with a mean recovery rate 66.4%. In all cases, there were not neurologic deterioration. Mild postoperative complications developed in two cases. One patient had a limitation of range of neck motion and the other one showed kyphotic change. Postoperative radiography showed an improvement of body to canal ratios (average 0.70 ± 0.08 before surgery to 1.05 ± 0.12 after surgery) and maintainance or recovery of cervical lordosis. Canal widening of antero-posterior diameter and dimension after operation is 6.8mm, 116.61mm².

Conclusion: Combined anterior and posterior procedure could be helpful in decompression of the spinal cord and good functional recovery in spondylotic myelopathy patients with combined anterior and posterior pathology such as huge disc herniation accompanying narrow spinal canal.

KEY WORDS: Combined anterior and posterior approach · Myelopathy · Narrow spinal canal.

Introduction

Surgical treatments of cervical spondylotic myelopathy can be performed by either anterior approach or posterior approach depending on pathology, involved vertebral segments, the experience and choice of surgeon. The result of the removal of intervertebral discs or bony spur by anterior approach is superior for one or two vertebral segments, however, for the cases with more than three segments or accompanied congenital spinal stenosis, a posterior approach is recommended [1,3,7,9,14,13]. However, together with severe anterior compression such as a huge disc, if posterior pathology such as the hypertrophy of yellow ligament, collapse, etc. were accompanied or the original spinal canal were narrow, complete decompression of the spinal cord by only one side operation is difficult to achieve. Hence, this study was performed to assess the indication and effectiveness of the combination of anterior and posterior approach as a surgical treatment of cervical spondylotic myelopathy.

Materials and Methods

Among those cervical spondylotic myelopathy patients due to anterior and posterior pathology or huge disc herniation who had been treated with combined anterior and posterior approach from January 2000 to December 2002 at our institute, we evaluated the records of 14 patients.

The average age of patients was 57.2 years (45–73), male
was 12 cases and female was 2 cases. The major symptoms of most patients were neck pain and radiating pain, followed by the weakness of upper and lower extremities and sensory change (Table 1). C-spine plain radiography, computed tomography (CT), and magnetic resonance images (MRI) were taken before and after the operation.

The Japanese Orthopedic Association (JOA) scale was used to evaluate the preoperative and postoperative clinical status in all patients. The evaluation was made before surgery and by postoperative 1 month, 3 months, and 1 year.

Statistical analysis was done using the factors that might have affected surgical outcomes including the gender, age at the time of surgery, duration of neurological symptoms, diameter of the spinal canal before surgery. It was done using SPSS by comparing the data using Pearson's chi square test, and significance was determined at P values less than 0.05. The rate of recovery was calculated to evaluate the surgical outcomes using the following formula by Hirabayashi.

The rate of recovery(%) = (postoperative score-preoperative score) / (total score-preoperative score) × 100.

Table 1. Preoperative symptoms and signs

<table>
<thead>
<tr>
<th>Symptoms &amp; Signs</th>
<th>Number of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neck pain</td>
<td>12</td>
</tr>
<tr>
<td>Radiating pain</td>
<td>12</td>
</tr>
<tr>
<td>Weakness of upper extremity</td>
<td>11</td>
</tr>
<tr>
<td>Weakness of lower extremity</td>
<td>9</td>
</tr>
<tr>
<td>Sensory change</td>
<td>8</td>
</tr>
<tr>
<td>Bladder &amp; bowel symptoms</td>
<td>4</td>
</tr>
</tbody>
</table>

Fig. 1. A: Preoperative radiogram shows narrow spinal canal (SC/VB ratio 0.7). B, C: Preoperative T2 weighted sagittal and axial magnetic resonance images show herniated disc with intramedullary high signal intensity of C4–5 and spinal stenosis from C3 to C5. D, E: Postoperative radiograms (anterior discectomy with fusion and laminoplasty) show widening of spinal canal (SC/VB ratio 1.2).

The diameter of spinal canal was measured at the most narrow portion of the spinal canal on CT.

By an anterior approach, intervertebral disc space where cord compression by disc herniation or bony spur was most severe due to the herniation of nucleus pulposus or the segment with kyphotic change was selected, the intervertebral disc was removed, and subsequently anterior decompression was performed, and in all cases, the solis device packing the iliac bone of patient was used. During anterior decompression, although the intervertebral disc compressing the cord was removed, the removal of bony spur was not attempted, and the primary purpose was to recover the cervical lordotic curve by increasing the space of intervertebral disc and correcting the kyphosis.

As the posterior, according to the Hirabayashi method, by using the spinous process removed from the patient or hydroxyapatite, laminoplasty was performed, and as the open site, the side with severe symptom was selected. 12 cases out of 14 cases, the anterior-posterior operation was performed on the same day, except 2 cases with kyphosis, and anterior decompression and interbody fusion were performed first. In the remaining 2 cases, 2 weeks and 1 month after the anterior approach, the posterior approach was performed (Fig. 1).

Results

11 cases out of 14 cases, SC/VB was shown to be lower than 0.8 that was a narrow spinal canal, and in all cases, severe cord compression due to disc herniation or stenosis was detected. The area underwent the anterior decompression and the fusion was all one segment, and in regard to cervical open door laminoplasty, C3–C7 was 8 cases, C4–C7 was 4 cases, and C3–C6 was 2 cases. On C-spine lateral radiography, the diameter of cervical canal was increased from the average 8.9 ± 1.8 mm prior to surgery to the average 15.7 ± 1.4 mm after surgery, the enlargement was 6.8 mm, and the dimension of cervical canal was found to be increased by 116.61 mm². The body to canal ratio was increased from the average 0.70 ± 0.09 prior to surgery to 1.05 ± 0.12 after operation (P < 0.01). On magnetic resonance imaging, the A-P compression rate was improved from the average 38.4 ± 7.6% (19.2–48.6) to 55.7
Table 2. Results of combined anterior and posterior approach cord

<table>
<thead>
<tr>
<th>Measurements</th>
<th>Preoperation</th>
<th>Postoperation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spinal canal diameter</td>
<td>8.9 ± 1.8mm</td>
<td>15.7 ± 1.4mm</td>
</tr>
<tr>
<td>Body to canal ratio</td>
<td>0.70 ± 0.09</td>
<td>1.05 ± 0.12</td>
</tr>
<tr>
<td>A-P compression ratio</td>
<td>38.4 ± 7.6%</td>
<td>55.7 ± 7.2%</td>
</tr>
<tr>
<td>Average of canal diameter widening</td>
<td>-</td>
<td>6.8mm</td>
</tr>
<tr>
<td>Average of canal dimension widening</td>
<td>-</td>
<td>116.61 mm²</td>
</tr>
</tbody>
</table>

Table 3. Preoperative and postoperative JOA* score and recovery rate

<table>
<thead>
<tr>
<th>JOA Core Factor</th>
<th>Preoperation</th>
<th>Postoperation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor</td>
<td>upper extremity</td>
<td>2.4</td>
</tr>
<tr>
<td>Sensory</td>
<td>lower extremity</td>
<td>2.2</td>
</tr>
<tr>
<td>Bladder</td>
<td>upper limbs</td>
<td>0.6</td>
</tr>
<tr>
<td>Sensory</td>
<td>lower limbs</td>
<td>1.2</td>
</tr>
<tr>
<td>Bladder</td>
<td>trunk</td>
<td>1.7</td>
</tr>
<tr>
<td>Total score</td>
<td>-</td>
<td>10.4</td>
</tr>
<tr>
<td>Recovery rate (%)</td>
<td>-</td>
<td>66.4%</td>
</tr>
</tbody>
</table>

*JOA: Japanese Orthopaedic Association Scale

± 7.2% (43.1–69.3)(P < 0.01) (Table 2). In most patients, by the enlargement of the spinal canal, the subarachnoid space was recovered and the ratio of the antero-posterior spinal compression was improved, and in 3 patients who had myelopathy for a long time, despite of the good recovery of the subarachnoid space, severe cord atrophy in the area of preoperative spinal compression was observed. Radiographs taken at regular intervals during the follow-up period have revealed solid fusion and maintained lordotic curve in all patients.

The average JOA score was 10.1 points before operation but improved to 14.8 points after surgery, showing a 66.4% improvement (Table 3). Lower extremity motor power was recovered better than that of upper extremity. No patient showed worsening after surgery. After operation, the limitation of range of motion was detected in 1 case, and the increase of the kyphotic angle was observed in 1 case, nonetheless, the exacerbation of symptom was not detected. More than a 40% improvement was seen even in 2 patients older than 70 years of age.

Despite the fact that we could not confirm statistical significance using the small number of patients, the rate of recovery was related with cervical curvature. It was better in those patients with lordotic curve compared with those with kyphosis.

Discussion

Surgical treatments of cervical spondylotic myelopathy accompanied cervical disc herniation is performed by an anterior or posterior approach dependent on the lesion of spinal compression, its symptom, the invaded spinal segment, or the choice of surgeon.

The anterior surgical method was initiated by Cloward[9], and it can be performed relatively safely and readily. The anterior approach has a direct decompressive effect by removing the nucleus pulposus herniated forward, bony spur, and other spinal compression directly and widening the intervertebral disc space as well as the intervertebral foramen. In addition, it has the advantage of inducing early bony fusion and thus enduring the spinal stability immediately after surgery, and the correction of kyphosis is easy. Nevertheless, it is not desirable for the multi-segmental cord compression, and it is desirable to perform only on the cases that cord compression is limited to one or two segments, particularly for the cases with the symptom of radiculopathy.

Among posterior approach techniques, as laminoplasty, the Kurokawa method[2] that expands the spinal canal by resecting the medial spinous process and expansive open door laminoplasty that opens the spinal canal by the resection of the lateral side of lamina have been used. Its advantage is that without causing the instability of the spine, they expand the spinal canal from the posterior, and thus the spinal cord is moved to the posterior and the anterior compression is reduced, and furthermore, spinal tension is reduced and the blood flow is improved[7,9,14]. Hence, the posterior approach is effective only on the cases that the cervical lordotic curve is maintained, and in the patients with the posterior deformity, it may exacerbate the deformity, and since the posterior move of the spinal cord can not be anticipated, in the cases with the severe anterior spinal compression, proper cord decompression can not be expected[10,12,15]. In such manners, the anterior or posterior surgical approach is superior respectively in some cases, nonetheless, in the cases with the severe anterior spinal compression due to a huge central disc accompanying posterior pathology such as the hypertrophy of the ligament flavum, collapse, etc. or the cases with the narrow spinal canal congenitally, the complete spinal decompression is difficult to achieve by the surgery engaging only one approach.

For example, in the cases with spinal compression due to the cervical kyphotic deformity and the spinal stenosis, the laminoplasty by a posterior approach does not induce the posterior move of the cord and thus the appropriate spinal decompression can not be expected, and in regard to an anterior approach, since the additional space in the vicinity of the spine is absent due to the narrow spinal canal, during decompression, the risk of cord injury is high, and in the cases of the fixation of multi-segments, the possibility of the non-fusion of bone grafts and the degeneration of the adjacent segments may present. Because of such reasons, we selected the area with the most severe herniation of the intervertebral disc or the apical segment of the kyphotic change, recovered the cervical lordosis by performing the anterior fusion, and simultaneously, by performing laminoplasty, the posterior move of the cord
was induced. In our cases, except 1 case, the cervical lordotic
curve was maintained after surgery, and together with the
improvement of symptoms was detected.

In addition, in the patients with myelopathy accompanying
radiculopathy as well as with the patients with a central huge disc
herniation accompanying the narrow spinal canal, if the multi-
level cord compression condition and compression were
detected by magnetic resonance imaging, radiculopathy could
not be achieved effectively by laminoplasty only, and during the
posterior foraminotomy, massive bleeding due to venous
congestion is anticipated. It is believed that in such
cases, if spinal decompression were achieved by laminoplasty,
and, simultaneously, by anterior approach, the height and
space of intervertebral disc were increased, with the resection
of compressing disc or the anterior bony spur, appropriate cord
decompression and the improvement of symptoms may be
achieved more safely. The authors believe that the risk can be
declined when operating posterior approach with 3-pin
fixation instead of the horseshoe, which includes some risk of
instability by operating anterior and posterior on the same
day. But much concern is needed. In addition, if it were removed
by anterior approach, cord decompression may be insufficient,
and furthermore, in the cases with narrow spinal canal, the risk
of cord injury is high. The compression rate and the symptoms
improved, except for the 3 patients who had severe cord atrophy
using anterior and posterior surgery. The anterior and posterior
surgery can be thought as an over treatment for cervical spond-
yloptic myelopathy in this case, but that spinal cord decom-
pression is essential for more safety, since we are treating the
cervical spine that controls the whole body.

Limitations inherent to this study include ① a few cases
② bigger procedure for patient (especially elderly) ③ position
change in unstable state ④ no control group. So much more
study must be made focusing these limitations.

Conclusion

We believe that effective cord decompression could be
achieved by performing the simultaneous anterior
interbody fusion and the posterior laminoplasty in selected
cervical spondylotic myelopathy patients with both anterior
and posterior pathology such as huge disc herniation with
narrow spinal canal.

Acknowledgement
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References
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Commentary

It is very difficult in some patients to decide which
procedures can relieve myelopathy.

We usually choose anterior approaches to the anterior and
anterolateral compressive lesions in less than 2–3 segments of
the cervical spinal canal, and posterior approaches to the stenosis
of the cervical spinal canal at the upper cervical spine and lesions
involving more than 3 segments.

An authors are reporting combined anterior and posterior
approaches in the treatment of cervical spondylotic myelopathies. I totally agree with authors in selected cases of cervical
spondylotic myelopathies. But in such an illustrated case in
the manuscript, I think anterior discectomy would be enough
to relieve the canal stenosis. And as authors commented, We
need larger number of cases and control studies to conclude
the better results of combined approaches to cervical spondylotic myelopathies.

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