Relationships Between Outcomes of Conservative Treatment and Magnetic Resonance Imaging Findings in Patients With Mild Cervical Myelopathy Caused by Soft Disc Herniations

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Study Design. A retrospective follow-up study of conservatively treated patients with mild cervical myelopathy caused by cervical soft disc herniation.

Objective. To investigate the outcome of conservative treatment for patients with mild myelopathy caused by cervical soft disc herniation and to evaluate usefulness of magnetic resonance findings in the prediction of the outcomes.

Summary of Background Data. Recent studies on conservative treatment for cervical soft disc herniation have focused mainly on radiculopathy, and not on myelopathy.

Methods. Twenty-seven patients with mild cervical myelopathy secondary to cervical soft disc herniation were treated conservatively for more than 6 months by cervical bracing and restriction of daily activities. Of the 27 patients, 17 patients (Group A) underwent conservative treatment only and it was associated with improvement in their neurologic deficits, while the other 10 patients (Group B) ultimately underwent decompression surgery because of neurologic deterioration. Comparisons between the two groups were made in regard to JOA scores, patient satisfaction, and magnetic resonance findings, including location of the disc herniation (focal or diffuse in the sagittal plane, median or paramedian in the axial plane).

Results. The JOA scores were 13.6 ± 1.6 in Group A and 14.1 ± 1.6 in Group B before treatment, 14.9 ± 1.0 and 12.9 ± 2.1, respectively, at 3 months, and 16.2 ± 0.8 and 16.0 ± 1.2, respectively, at the final follow-up. The JOA scores at 3 months were significantly lower in Group B than in Group A. Satisfaction with the results of treatment at the final follow-up was reported by 77% of the patients in Group A and 30% in Group B. Focal-type herniation was present in 47% of the patients in Group A and 70% in Group B, while median-type herniation was diagnosed in 77% in Group A and 30% in Group B. Follow-up magnetic resonance imaging of the patients in Group A showed spontaneous regression of a herniated mass in 10 patients (59%). Diffuse-type herniations were more likely to regress spontaneously than focal-type herniations (78% vs. 37%).

Conclusions. Conservative treatment is an effective treatment option for mild cervical myelopathy caused by cervical soft disc herniation. A good outcome can be expected in patients with a median-type and/or diffuse-type herniation on magnetic resonance imaging. [Key words: cervical disc herniation, myelopathy, conservative treatment] Spine 2001;26:1592–1598

Although surgical decompression has been the treatment of choice for cervical compressive myelopathy, conservative treatment is an alternative therapeutic option for mild cervical myelopathy.1,10 Nakamura et al12 recently reviewed 64 patients with cervical spondylotic myelopathy who underwent conservative treatment, including bracing, head halter traction, and skull traction and reported that 34% and 28% of the patients had no disability in the upper and lower extremities, respectively, at the final follow-up (3–10 years). They concluded that conservative treatment should be indicated in patients with mild myelopathy. Cervical soft disc herniation (CDH) is one of the compressive lesions that cause cervical myelopathy. Recent magnetic resonance imaging (MRI) studies on CDH have revealed that herniated masses frequently regress spontaneously with concomitant resolution of neurologic deficits, thereby warranting indications for conservative treatment of CDH.1,10

However, these studies included only patients with radiculopathy, and to the author’s knowledge, few studies have been conducted on conservatively treated patients with myelopathy caused by CDH. This is partly because early surgical intervention is usually undertaken for myelopathic patients because of concern about irreversible deterioration of the neurologic deficits. If conservative treatment could be safely performed for appropriate indications with a satisfactory outcome, patients would benefit by avoidance of various surgical morbidities.

The purpose of this study was to investigate the outcome of conservative treatment of patients with mild myelopathy caused by CDH and to evaluate the usefulness of MRI findings in the prediction of the outcome.

Materials and Methods

Between 1990 and 1999, 27 patients with cervical myelopathy caused by CDH were treated conservatively for at least 6 months at Keio University Hospital or one of its affiliated hospitals, and their clinical records, radiographs, and MRIs were reviewed. There were 20 male and seven female patients, and their mean age was 44.4 years (range, 27–69 years). The mean follow-up period was 3.9 years (range, 1–7.3 years). All patients had mild to moderate myelopathy with Japanese Ortho-
reminded to wear the cervical brace. Although other forms of conservative treatment were not routinely performed at our clinic, four patients underwent physical therapies, including intermittent cervical traction and heat therapy at their primary physician's clinic, and seven patients took nonsteroidal anti-inflammatory drugs for neck pain or paresthesia in the hands. Nineteen patients had occupations at the time of initial visit to our clinic. During the period of conservative treatment 5 patients continued to work as before, 11 reduced working time, 2 changed jobs, and 1 became retired. No episode was recorded that any physical activity or trauma exacerbated the patients’ symptoms.

Of the 27 patients, the 17 patients (Group A) underwent conservative treatment alone, either because their myelopathy improved or because their condition remained stable with minimal disability (final JOA score $\geq 15$), whereas the other 10 patients (Group B) underwent decompression surgery (8 by anterior discectomy and fusion and 2 by laminoplasty), either because they deteriorated neurologically or because their disability remained unchanged (preoperative JOA score $\leq 14$) despite conservative treatment for more than 6 months. Surgery was performed in the patients in Group B an average of 9 months after the start of conservative treatment.

All patients underwent MRI (Signa, 1.5 Tesla, General Electric, Milwaukee, WI) and had radiographs taken at the time of the initial examination, and follow-up MRI scans were taken every 3–6 months. The MRI films were independently evaluated in blind fashion by two spine surgeons who had considerable experience in reading MRIs of the cervical spine. Whenever there were inconsistencies between the opinions of the two examiners, they discussed them with each other and arrived at an agreement. The location of the disc herniations in the sagittal and axial plane was classified as follows. In the sagittal plane disc herniations confined to the disc level with a narrow base were defined as “local type” and those extending beyond the disc space and having a wide base as “diffuse type.” The levels of disc herniations were also recorded. In the axial plane herniations were classified into “median type” or “paramedian type” (Figure 1). To evaluate the magnitude of herniations, the transverse area of the spinal cord was measured at the level of herniation using Scion Image (Frederick, MD). On lateral view radiographs in the neutral position, the static sagittal diameter of the spinal canal was measured at C4, and in the extension

### Table 1. The Japanese Orthopaedic Association (JOA) Score for Evaluation of Cervical Myelopathy

<table>
<thead>
<tr>
<th>I. Upper extremity function</th>
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<tbody>
<tr>
<td>0. Impossible to eat with either chopsticks or spoon</td>
<td></td>
</tr>
<tr>
<td>1. Possible to eat with spoon, but not with chopsticks</td>
<td></td>
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<tr>
<td>2. Possible to eat with chopsticks, but inadequate</td>
<td></td>
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<tr>
<td>3. Possible to eat with chopsticks, but awkward</td>
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<tr>
<td>4. Normal</td>
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<tr>
<td>II. Lower extremity function</td>
<td></td>
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<tr>
<td>0. Impossible to walk</td>
<td></td>
</tr>
<tr>
<td>1. Need cane or aid on flat ground</td>
<td></td>
</tr>
<tr>
<td>2. Need cane or aid only on stairs</td>
<td></td>
</tr>
<tr>
<td>3. Possible to walk without cane or aid, but slow</td>
<td></td>
</tr>
<tr>
<td>4. Normal</td>
<td></td>
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<tr>
<td>III. Sensory</td>
<td></td>
</tr>
<tr>
<td>A. Upper extremity</td>
<td></td>
</tr>
<tr>
<td>0. Apparent sensory loss</td>
<td></td>
</tr>
<tr>
<td>1. Minimal sensory loss</td>
<td></td>
</tr>
<tr>
<td>2. Normal</td>
<td></td>
</tr>
<tr>
<td>B. Lower extremity</td>
<td></td>
</tr>
<tr>
<td>0. Apparent sensory loss</td>
<td></td>
</tr>
<tr>
<td>1. Minimal sensory loss</td>
<td></td>
</tr>
<tr>
<td>2. Normal</td>
<td></td>
</tr>
<tr>
<td>C. Trunk</td>
<td></td>
</tr>
<tr>
<td>0. Apparent sensory loss</td>
<td></td>
</tr>
<tr>
<td>1. Minimal sensory loss</td>
<td></td>
</tr>
<tr>
<td>2. Normal</td>
<td></td>
</tr>
<tr>
<td>IV. Bladder function</td>
<td></td>
</tr>
<tr>
<td>0. Complete retention</td>
<td></td>
</tr>
<tr>
<td>1. Severe disturbance</td>
<td></td>
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<tr>
<td>(1) Inadequate evacuation of the bladder</td>
<td></td>
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<tr>
<td>(2) Staining</td>
<td></td>
</tr>
<tr>
<td>(3) Dribbling urine</td>
<td></td>
</tr>
<tr>
<td>2. Mild disturbance</td>
<td></td>
</tr>
<tr>
<td>(1) Urinary frequency</td>
<td></td>
</tr>
<tr>
<td>(2) Urinary hesitancy</td>
<td></td>
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<tr>
<td>3. Normal</td>
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</tbody>
</table>

The diagnosis was based on the results of neurologic examination and the radiographic and MRI findings. All patients had numbness and sensory disturbance in both upper extremities and/or hyperreflexia in the lower extremities, in addition to marked indentation of the cervical spinal cord by a herniation on MRIs. Patients with neurologic deficits in only one upper limb and those with a positive Spurling sign were excluded because differential diagnosis from radiculopathy was difficult. Those with large spurs in the disc spaces on radiographs were diagnosed as having cervical spondylotic myelopathy and were also excluded from this study.

Conservative treatment consisted of cervical bracing with a collar and mandibular support, and restriction of daily activities. The patients were instructed to wear the brace for at least 8 hours a day during the first 3 months and to subsequently decrease the wearing time depending on their residual symptoms. For the first 3 months the patients were checked every month in our outpatient clinic, and at every visit they were reminded to wear the cervical brace. Although other forms of
position the dynamic diameter was measured at the level of the CDH.

Evaluations were made regarding period of morbidity before treatment, JOA scores, patient satisfaction, and the radiographic and MRI findings. Sensory disturbance was assessed by pinprick quasi-quantitatively using a 10-point scoring system where the intact pinprick sensation and complete loss of it were scored as 10 and 0, respectively. Patient satisfaction was assessed by using a 5-grade questionnaire that was mailed to the patients. Patients were asked whether they were “very satisfied,” “satisfied,” “intermediate,” “unsatisfied,” or “very unsatisfied,” and those who responded that they were “very satisfied” or “satisfied” were considered to be satisfied. The results were compared between the two groups to identify the factors related to prognosis after conservative treatment.

The unpaired t test, ANOVA, and χ² test were used for the statistical analyses, and a P value of less than 0.05 was considered statistically significant. Interobserver agreement was evaluated by using kappa scores.

Results

The mean age and period of morbidity before treatment in the two groups were comparable (Table 2). The JOA scores were 13.6 ± 1.6 in Group A and 14.1 ± 1.6 in Group B before treatment (P = 0.49), 14.9 ± 1.0 and 12.9 ± 2.1, respectively, at 3 months (P = 0.005), and 16.2 ± 0.8 and 16.0 ± 1.2, respectively, at the final follow-up (P = 0.64). In Group B the JOA score immediately before surgery was 12.0 ± 2.1. Thus, the JOA scores at 3 months were significantly lower in Group B than in Group A. The number of patients with the lower JOA scores of 11 and 12 points who are generally considered to be better treated by immediate decompression surgery was four (24%) in Group A and two (25%) in Group B (difference, not significant).

The 11 patients who underwent immediate surgery even though their initial JOA scores were more than 10 points had the mean JOA scores of 12.2 ± 1.2 before treatment and 16.1 ± 1.2 at the final follow-up. Thus, the JOA scores before treatment were significantly lower in this group of patients than in Group A and B (P = 0.013, ANOVA), whereas they were not significantly different among the three groups at the final follow-up. Satisfaction with the results of treatment at the final follow-up was reported by 77% of the patients in Group A and 90% in Group B (P = 0.62).

The static and dynamic diameters of the spinal canal on the radiographs were 13.2 ± 0.7 and 12.5 ± 1.1 mm, respectively, in Group A, and 13.7 ± 0.7 and 12.6 ± 1.5 mm in Group B. The differences were not statistically significant (P = 0.14 for the static canal diameter and 0.84 for the dynamic diameter).

In Group A 47% of the patients had a focal-type herniation and the remaining 53% had a diffuse-type, whereas in Group B 70% had a focal-type and 30% had a diffuse-type (P = 0.42). In Group A a disc hernia was located at C3–C4 in eight patients (47%), at C4–C5 in five (29%), at C5–C6 in three (18%), and at C6–C7 in one (6%), whereas in Group B it was located at C4–C5 in three patients (30%) and at C5–C6 in seven (70%). Thus, in Group A a disc hernia was located more rostrally than in Group B (P = 0.02). The axial location of the herniation was median in 77% of the patients in Group A and 30% in Group B; thus, median-type herniation was significantly more frequent in Group A, whereas the paramedian-type was more frequent in Group B (P = 0.04) (Table 3, Figures 2 and 3). The kappa scores were 0.78 for the types in the sagittal plane and 0.7 for the types in the axial plane, both of which were considered to be in moderate agreement. An increased signal intensity area in the spinal cord was observed in 71% of the patients in Group A and 60% in Group B (not significant, P = 0.5). The mean transverse spinal

Table 3. MRI Findings

<table>
<thead>
<tr>
<th>Type of Herniation</th>
<th>Sagittal Area (mm²)</th>
<th>Increased Signal Intensity Lesions of the Spinal Cord</th>
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<tr>
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<tr>
<td>Group A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Focal</td>
<td>9 (53)</td>
<td></td>
</tr>
<tr>
<td>Diffuse</td>
<td>13 (77)</td>
<td></td>
</tr>
<tr>
<td>C3–4</td>
<td>4 (24)</td>
<td></td>
</tr>
<tr>
<td>C4–5</td>
<td>8 (47)</td>
<td>12 (71)</td>
</tr>
<tr>
<td>C5–6</td>
<td>5 (29)</td>
<td></td>
</tr>
<tr>
<td>C6–7</td>
<td>3 (18)</td>
<td></td>
</tr>
<tr>
<td>Group B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Focal</td>
<td>7 (70)</td>
<td></td>
</tr>
<tr>
<td>Diffuse</td>
<td>3 (30)</td>
<td></td>
</tr>
<tr>
<td>Axial</td>
<td>7 (70)</td>
<td></td>
</tr>
<tr>
<td>Paramedian</td>
<td>0 (0)</td>
<td></td>
</tr>
<tr>
<td>C3–4</td>
<td>3 (30)</td>
<td></td>
</tr>
<tr>
<td>C4–5</td>
<td>7 (70)</td>
<td></td>
</tr>
<tr>
<td>C5–6</td>
<td>0 (0)</td>
<td></td>
</tr>
<tr>
<td>C6–7</td>
<td>1 (6)</td>
<td></td>
</tr>
</tbody>
</table>

* Median-type herniations were significantly more frequent in Group A (P < 0.05, χ²-test).
† Level of herniations was more rostral in Group A than in Group B (P < 0.05, χ²-test).
The numbers in parentheses are percentages.
Cord area at the level of disc herniation was 60.0 ± 13.7 mm² in Group A and 58.5 ± 9.2 mm² in Group B (not significant, P = 0.78).

Follow-up MRI indicated that of the 17 patients in Group A, 10 (59%) showed spontaneous regression of the herniated mass (Table 4, Figure 4). The regression was first noted at an average of 9 months (range, 6 months to 1 year 10 months) after the initial MRI examination. Spontaneous regression of the herniated mass was noted in 37% of the patients with focal-type herniation and 78% with diffuse-type herniation. Thus, although statistically not significant, diffuse-type herniation spontaneously regressed more frequently than focal-type herniation (P = 0.15). The kappa score for interobserver agreement on spontaneous regression was 0.76, which was considered to be moderate agreement.

Discussion

Conservative treatment is commonly used to treat patients with a lumbar disc herniation (LDH), and the success rate is very high. By contrast, there have been relatively few reports regarding conservative treatment of CDH. Saal et al treated 26 patients with a herniated cervical intervertebral disc nonoperatively and achieved a successful outcome in 24 of the 26 patients. Bush et al noted spontaneous regression of disc...
herniations with satisfactory clinical recovery in 12 of 13 patients treated conservatively. Mochida et al10 conducted an MRI study on patients with cervical radiculopathy secondary to CDH, observed spontaneous regression of the herniated mass in 40% of the patients, and found that migrated herniations regressed more frequently than focal herniations. Although these authors focused on conservative treatment for cervical disc herniation, they excluded patients with myelopathy from the indications for conservative treatment, and there have been few reports on conservative treatment for cervical myelopathy caused by CDH.

The current study demonstrated that conservative treatment was effective in 63% of the patients (Group A), and 59% of the patients who were treated conservatively experienced spontaneous regression of the disc herniation with concomitant resolution of their neurologic symptoms. Moreover, there were no significant differences in the final results between the patients who were initially treated conservatively and those who underwent immediate surgery.

Conservative treatment in our clinic was not aggressive and easily tolerated by patients, including only cervical bracing and restriction of physical activities. Exceptionally, other forms of treatment such as medications of nonsteroidal anti-inflammatory drugs and intermittent cervical traction were taken in only a small portion of the patients. The current authors cannot conclude from this retrospective study whether the patients obtained better results by these conservative treatments than by a natural course of mild myelopathy because of CDH. A further prospective randomized trial should be performed to clarify this issue.

Of the factors investigated in this study, only type and level of herniation on MRI were of significant prognostic value, i.e., patients with median-type herniations on ax-
ial images and those with herniations at more rostral intervertebral levels obtained better outcomes after conservative treatment, and although not statistically significant, diffuse-type herniations were observed more frequently in Group A and spontaneously regressed more frequently than focal-type herniations. Therefore, conservative treatment can be recommended as more favorable for patients with these types of herniations. The reasons for the close relationships between type of herniation and the outcome are speculated to be as follows. Median-type herniations are located in the center of the spinal canal, where it is large enough for the cord to escape compression by the disc herniation, whereas para-median-type herniations are located laterally, where the spinal canal is narrower and the spinal cord is tethered by the nerve roots and denticulate ligaments, making it susceptible to compression by disc herniation. Diffuse-type herniation is more likely to spontaneously regress, with a concomitant improvement of myelopathy, because herniated masses that migrate diffusely into the epidural space may be more subject to inflammatory responses, as reported in migrated-type LDH. However, although a large number of basic and clinical studies regarding regression of herniation have been conducted on LDH, little is known about CDH. CDH is different from LDH in that it is often located in the space between the superficial and deep layers of the posterior longitudinal ligament, and CDHs tend to contain more cartilaginous endplates than LDH. These characteristics of CDH may make the regression process somewhat different from that of LDH, and this matter needs to be clarified by further studies.

Conservative treatment for cervical myelopathy caused by CDH has several shortcomings. First, the optimal timing for decompression surgery, which should be performed before irreversible changes occur in the spinal cord, may be missed. Second, some of the patients may remain disabled by myelopathy longer than those treated surgically. Therefore, we should be more careful in choosing conservative treatment for patients with myelopathy than for patients with radiculopathy. Our current impression is that conservative treatment should be indicated for patients with mild myelopathy who can walk on flat ground without a cane (JOA scores of lower extremity function ≥2 and/or Nutrick grades ≤3). Patients with severe myelopathy may require immediate surgical decompression. The chronologic changes in the JOA scores showed a striking difference between the two groups at 3 months after the initial examination. The patients in Group A had recovered neurologically or their neurologic status at least remained unchanged, whereas the majority of the patients experienced significant neurologic deterioration in whom conservative treatment had failed. We therefore believe that conservatively treated patients should be followed carefully and that their neurologic status should be re-evaluated at 3 months after the start of conservative treatment. For those who experience neurologic deterioration during this period, decompression surgery should be considered as a mean of obtaining a satisfactory final outcome.

Figure 4. A 41-year-old man with multiple disc herniations, at C2–C3, C4–C5, and C5–C6. Spinal cord compression was most severe at C4–C5. He was treated conservatively. The initial JOA score was 13 points and improved to 15 at 6 months and 17 (perfect score) by the final follow-up at 5.8 years. A, T2-weighted sagittal image before treatment. B, After 1 year. C, After 3 years.
In conclusion, a good outcome of conservative treatment for mild cervical myelopathy caused by soft disc herniation can be expected, especially in patients with central-type and diffuse-type herniations on MRI.

**Key Points**
- A retrospective follow-up study of conservatively treated patients with mild cervical myelopathy due to cervical soft disc herniation.
- Conservative treatment was effective in 63% of the patients and, thus, can be a therapeutic option for mild cervical myelopathy due to cervical soft disc herniation.
- Patients with a median type and/or diffuse type CDH on MRI obtained more favorable outcomes.

**References**