Outcome of conservative treatment of spondylotic cervical myelopathy and the predictive value of the magnetic resonance imaging findings

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Background
Cervical spondylotic myelopathy (CSM) is a common neurological problem both in the young and old. Although surgical decompression has been the treatment of choice for cervical compressive myelopathy, conservative treatment is an alternative therapeutic option for mild cervical myelopathy.

Patients and methods
Forty-six patients with mild-to-moderate CSM were conservatively treated for 6 months and evaluated using the Japanese Orthopedic Association (JOA) scores to see the outcome. On the basis of outcome they were divided into two groups: group A included those with good outcome and group B included those with poor outcome. Both groups were compared as regards the JOA scores and MRI findings.

Results
The JOA scores were as follows: 12.5 ± 1.8 in group A and 11.7 ± 1.43 in group B before treatment, and 16.3 ± 1.02 for group A and 12.53 ± 1.28 for group B at the final follow-up. Good outcome was obtained in 63% of the patients after conservative treatment. On MRI, paramedian type is associated with good outcome and focal increased signal intensity is associated with good outcome. However, median-type and multisegmental increased signal intensity are associated with poor outcome.

Conclusion
We conclude that there is a significant association between the MRI findings and the outcome following conservative treatment of CSM, and the conservative line of treatment is effective.

Keywords:
cervical spondylosis, magnetic resonance imaging, outcome

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Introduction

The cervical spine is the most complicated articular system in the body, with 37 separate joints (including six intervertebral discs). The normal cervical spine moves 600 times/h, regardless of whether the individual is awake or sleeping [1]. Diseases of the spinal column are among the most frequent syndromes in modern society and are thought to be caused by ubiquitous degeneration processes, particularly of the intervertebral discs (discopathy) or of the adjoining vertebral bodies (spondylosis). With increasing age, a large proportion of the population exhibits radiological signs of discopathy or spondylosis, leading to constriction of the spinal canal [2]. Fifty-one percent of the adult population will experience neck and arm pain at some point in their lifetime. The predisposing factors to cervical intervertebral disc problems are heavy lifting, smoking, diving, operating heavy equipment that has a great deal of vibration, and driving [3]. Cervical myelopathy is a disorder most commonly seen in the elderly population due to spondylosis with resultant cord compression [4–6]. Compression may occur from osteophytes secondary to degeneration of the intervertebral joints [7], stiffening of connective tissues such as the ligamentum flavum at the dorsal aspect of the spinal canal, which can impinge on the cord by 'buckling' when the spine is extended [8], degeneration of intervertebral discs together with subsequent bone changes, and other connective tissue changes. At present, there are no definitive objective findings on MRI consistently described by radiologists that are reflective of myelopathy, with the exception of myelomalacia (identified through signal intensity changes to the cord). Signal intensity changes have been described as the most appropriate 'gold standard' for confirmation of a spinal cord compression myelopathy [9–11].

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Myelopathy can also be seen in younger patients when central disc herniations compress the spinal cord. Most typically, however, there are osteophytic changes and ligament thickening that make the canal stenotic. The close association between the presence of spinal stenosis and the occurrence of cervical myelopathy has led to the assumption that stenosis is the most important pathophysiological factor in the disease. Nevertheless, this concept is incapable of explaining the spectrum of the disease, particularly myelopathy without stenosis. Spinal stenosis is often accompanied by instability. The spondylotic restriction of the spinal canal results in release and shear forces on the spinal cord. These pathological factors lead to diffuse and focal axonal damage [12]. Although surgical decompression has been the treatment of choice for cervical compressive myelopathy, conservative treatment is an alternative therapeutic option for mild cervical myelopathy [13].

In 64 patients with cervical spondylotic myelopathy (CSM) who underwent conservative treatment, including bracing, head halter traction, and skull traction, 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 is one of the compressive lesions that cause cervical myelopathy.

Nakamura *et al*. [14] and Nagata [15] found MRI to be useful in the accurate diagnosis of myelopathy. Increased signal intensity (ISI) of the spinal cord on T2-weighted MR images is considered to reflect various intramedullary lesions [16,17]. Preliminary studies showed that ISI might reflect pathological changes of the spinal cord and thus indicated a poor outcome for CSM, even in patients who underwent surgery [18,19]. However, this opinion remained controversial; some authors [20,21] have suggested no clear correlation between the surgical outcome and ISI. Whether or not the pathological changes of spinal cord in ISI expression site are reversible is still not clear.

Patients and methods

The study was conducted on 46 patients (56.5% were male and 43.5% were female) with mild-to-moderate spondylotic myelopathy (CSM) for 6 months who were treated conservatively. The conservative treatment consisted of cervical bracing with a collar and/or mandibular support and restriction of daily activity. All patients were instructed to wear the bracing when driving, using computer, or sitting for long time and to avoid lifting of heavy objects and to decrease the wearing time gradually depending on their symptoms. Physiotherapy and NSAID and neuropathic pain killer were also given according to the patients' symptoms. They were checked every month in the outpatient clinic and the outcome was measured using the Japanese Orthopedic Association (JOA) [22] scores at the time of first examination and compared with the JOA scores at the final examination. Patients who showed either an improvement in the JOA score or a score of 15 or greater were considered to have good outcomes and classified as group A, whereas patients who underwent decompression surgery because of neurological deterioration, remained unchanged, or had a JOA score of 14 or less despite conservative treatment for 6 months were considered to have poor outcome and classified as group B. All patients underwent MRI scan of the cervical spines at the time of initial examination and follow-up scans were taken after 3–6 months. In the sagittal plane, disc herniation was defined as local if it was confined to the disc level with narrow base and as diffuse type for those extending beyond the disc space and having a wide base. In the axial plane, disc herniations were classified into median or paramedian type [23]. ISI was also evaluated in the initial and follow-up MRI on T2-weighted axial and sagittal images as the ISI were classified as focal or multisegmental. Comparison was made between the two groups (A and B) with respect to the JOA scores and MRI findings.

Results

In the studied group, 26 (56.5%) patients were male and 20 (43.5%) were female. In group A, 58.6% of them were male and 41.4% were female, whereas in group B 52.9% were male and 47.1% were female. No significant difference was found between the two sexes as regards the outcome. The mean age of group A was 53.4 ± 12.9 and that of group B was 52.8 ± 14.2, with no significant differences. The JOA scores (mean ± SD) before treatment at the initial visits of the study were 12.5 ± 1.48 (range: 10–14) in group A and 11.76 ± 1.43 (range: 10–14) in group B, with significant difference between the two groups. The JOA scores after 6 months of conservative treatment at the final follow-up were 16.3 ± 1.02 (range: 15–18) in group A and 12.53 ± 1.28 (range: 10–14) in group B with very high significant difference (P = 0.0001; Table 1).

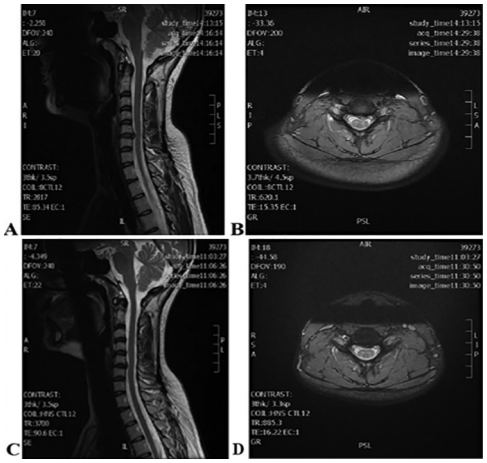
As regards the type of disc hernias (Figs. 1 and 2) on MRI findings on sagittal images, there were no

Table 1 Sex, age, and Japanese Orthopedic Association scores of groups A and B

Patients	Sex [*n* (%)]		Age (mean ± SD)	JOA1 score (mean ± SD)	JOA2 score (mean ± SD)
	Male	Female			
Group A (*n* = 29)	17 (58.6)	12 (41.4)	53.4 ± 12.9	12.5 ± 1.48	16.3 ± 1.02
Group B (*n* = 17)	9 (52.9)	8 (47.1)	52.8 ± 14.2	11.76 ± 1.43	12.53 ± 1.28
P value		NS		>0.05	0.0001

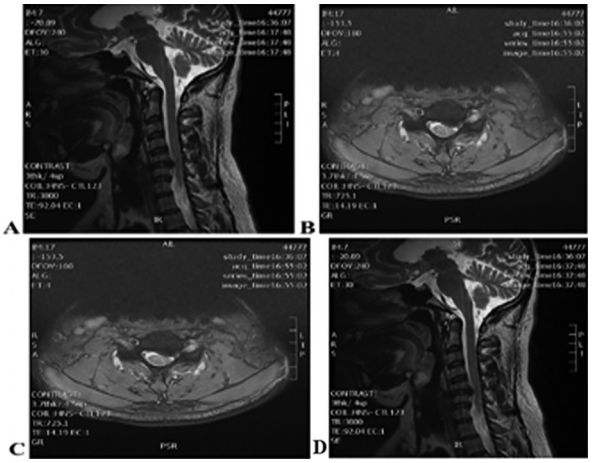
Highly significant difference between the two groups in the JOA scores at final valuation; JOA, Japanese Orthopedic Association.

Figure 1



A 35-year-old woman with a diffuse and median type disc herniation at C5–C6. The initial Japanese Orthopedic Association score was 13 points, and it improved to 17 points at the final follow-up: (a) T2-weighted sagittal image; (b) T2-weighted axial image; (c) T2-weighted sagittal image at the final follow-up; (d) T2-weighted axial image at the final follow-up.

Figure 2



A 39-year-old man with a focal and paramedian type disc herniation at C5–C6. The initial Japanese Orthopedic Association score was 11 points, and it became 13 points at the final follow-up: (a) T2-weighted sagittal image; (b) T2-weighted axial image; (c) T2-weighted sagittal image at the final follow-up; (d) T2-weighted axial image at the final follow-up.

significant differences in the outcome (as expressed by JOA scores) between focal and diffuse type; focal types were observed in 16 (55%) patients in group A and in 10 (58.8%) patients in group B, whereas diffuse types were observed in 13 (45%) patients of group A and in seven (41.2%) patients of group B ($P > 0.05$). In contrast, the paramedian type, on axial images, was positively correlated with good outcome as expressed by JOA scores and the median type was associated with poor outcome. Paramedian types were observed in 21 (72.4%) patients of group A, whereas the median type was seen in eight (27.6%) patients. In group B, five (29.4%) were of paramedian type and 12 (70.6%) were of median type, with high significant difference ($P < 0.05$; Tables 2 and 3).

ISI on T2-weighted images was seen in 33 (71.7%) patients (ISI-positive cases); 13 (39.4%) of them were focal and 20 (60.6%) were multisegmental. The JOA scores (mean ± SD) of the ISI-positive cases at the initial evaluation were 11.82 ± 1.42, whereas the JOA scores of the ISI-negative cases were 13.2 ± 1.09, which represents a highly significant difference ($P = 0.0024$). The JOA scores (mean ± SD) of the ISI-positive cases at the final evaluation were 14.79 ± 2.08 and that for the ISI-negative cases was 14.62 ± 1.98, with no significant difference ($P = 0.7$; Table 3).

On comparison of ISI-positive cases in group A and group B, the JOA scores (mean ± SD) at the initial evaluation were 11.95 ± 1.43 in group A and 11.62 ± 1.45 in group B, with no significant difference between the two groups, whereas the JOA scores at the final evaluation were 16.15 ± 1.13 in group A, which was significantly high compared with 12.69 ± 1.14 in group B. In group A, 20 (60.6%) cases were ISI positive, 14 (70%) of them were focal and the remaining six (30%) were multisegmental. However, in group B there were 13 (76.5%) ISI-positive cases, six (46.2%) of them were focal and the remaining seven (53.8%) were multisegmental. Focal ISI is associated with good outcome and multisegmental ISI is associated with poor outcome ($P < 0.05$; Table 4).

Discussion

Conservative treatment of CSM is considered to be effective, as good outcome is obtained in 63%

of patients treated conservatively. This is consistent with the study by Hiroki *et al*. [24] and the study by Saal *et al*. [25], who treated 26 patients and achieved a successful outcome in 24 patients, and Bush *et al*. [26], who reported clinical recovery in 12 of 13 patients treated conservatively. Matsumoto *et al*. [23] reported that conservative treatment of CSM is effective in 63% of patients, and good outcome was achieved in 69% of patients in the study by Mastumoto *et al*. [27]. Male sex is predominant in both groups, with good outcome and with poor outcome, which is consistent with the study by Clarke and Robinson [28]. The JOA scores (mean ± SD) before treatment were 12.5 ± 1.48 in group A and 11.76 ± 1 in group B, and 16.3 ± 1.02 at the final follow-up after 6 months of conservative treatment. In contrast, in the study by Matsumoto *et al*. [23], the JOA scores were 13.6 ± 1.6 in group A and 14.1 ± 1.6 in group B before treatment and 16.2 ± 0.8 for group A and 16 ± 1.2 for group B at the final follow-up. In the study by Mastumoto *et al*. [27] on 52 patients, the mean JOA score was 14 ± 1.4 before treatment and 14.4 ± 1.9 at the final follow-up. The MRI findings are of high prognostic value, where median-type disc herniations were associated with good outcome and the paramedian type was associated with poor outcome. However, on MRI findings, on sagittal images, there were no significant differences in the outcome (as expressed by JOA scores) between focal and diffuse type; the focal types were observed in 16 (55%) patients in group A and in 10 (58.8%) patients of group B, whereas diffuse types were observed in 13 (45%) patients of group A and in seven (41.2%) patients of group B. This is partially consistent with the study by Matsumoto *et al*. [29], who reported that median-type herniations were found in 77% of patients with good outcome and 30% of patients with poor outcome, and the focal type was found in 70% of patients with poor outcome and in 47% of patients with good outcome. ISI on T2-weighted images can predict outcome, as focal-type ISI was associated with good outcome and the multisegmental type was associated with poor outcome. However, Matsumoto *et al*. [29] reported that ISI is not related to poor outcome and satisfactory outcome is obtained in 78% of patients without ISI, in 63% of those with focal ISI and in 70% of those with multisegmental ISI.

Table 2 Type of disc hernias on magnetic resonance imaging axial and sagittal images and relation to the outcome

Cases	Axial [*n* (%)]		Sagittal [*n* (%)]	
	Median	Paramedian	Focal	Diffuse
Group A (*n* = 29)	8 (27.6)	21 (72.4)	16 (55)	13 (45)
Group B (*n* = 17)	12 (70.6)	5 (29.4)	10 (58.8)	7 (41.2)
P value	<0.005	<0.005	>0.05	>0.05

Paramedian type and diffuse type are significantly associated with good outcome whereas the median type and focal type are associated with poor outcome.

Conclusion

We conclude that there is a significant association between the MRI findings and the outcome following conservative treatment of CSM, and the conservative line of treatment is effective.

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Nil.

Conflicts of interest

There are no conflicts of interest.

Table 3 Japanese Orthopedic Association Scores in relation to increased signal intensity-positive and increased signal intensity-negative cases on magnetic resonance imaging findings

MRI	*N* = 46 [*n* (%)]	Type [*n* (%)]		JOA1 scores (mean ± SD)	JOA2 scores (mean ± SD)
		Focal	Multisegmental		
ISI positive	33 (71.7)	13 (39.4)	20 (60.6)	11.8 ± 1.42	14.79 ± 2.08
ISI negative	13 (28.3)	—	—	13.2 ± 1.09	14.6 ± 1.98
P value				0.002	>0.05

Japanese Orthopedic Association Scores is significantly lower in ISI-negative cases at the initial evaluation but can't predict outcome; ISI, increased signal intensity; JOA, Japanese Orthopedic Association.

Table 4 Comparison of increased signal intensity-positive cases in group A and group B

Cases	ISI positive [*n* (%)]			JOA1 scores (mean ± SD)	JOA2 scores (mean ± SD)
	Total	Focal	Multisegmental		
Group A (*n* = 29)	20 (60.6)	14 (70)	6 (30)	11.95 ± 1.43	16.15 ± 1.13
Group B (*n* = 17)	13 (76.5)	6 (46.2)	7 (53.8)	11.62 ± 1.45	12.69 ± 1.14
P value		<0.05		>0.05	<0.05

Focal ISI is associated with good outcome and multisegmental ISI is associated with poor outcome; ISI, increased signal intensity; JOA, Japanese Orthopedic Association.

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