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Original Article

Effect of surgical treatment on mild cervical spondylotic myelopathy with remarkable intramedullary magnetic resonance imaging signal changes

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Abstract: *Background:* The mild level of cervical spondylotic myelopathy (CSM) refers to CSM patients with JOA scores of ≥ 15. Surgical treatment may effectively prevent the progression of disease as the standard of care for moderate or severe CSM (JOA scores of < 15). However, the effect of surgical treatment on mild CSM remains controversial. A key point emerging from previous studies is the importance of identifying the specific mild CSM patients who will possibly benefit from surgical treatment. *Objectives:* To investigate the effect of surgical treatment on mild CSM with remarkable intramedullary magnetic resonance imaging (MRI) signal changes. *Methods:* Mild CSM patients with remarkable intramedullary MRI signal changes including intramedullary increased signal intensity (ISI) and severe cervical cord compression (> 50%) in T2-weighted MRI were retrospectively analyzed, and Japanese Orthopaedic Association (JOA) scores and visual analogue scale (VAS) scores were compared between patients receiving surgical treatment and patients receiving conservative treatment. *Results:* For patients receiving surgical treatment, both JOA and VAS scores after treatment were significantly improved compared with before treatment and remained stable during a follow-up period of 24 months. However, for patients receiving conservative treatment, both JOA and VAS scores after treatment were significantly improved from 7 days to 12 months compared with before treatment and were not significantly improved at 18 months and 24 months. Moreover, the recovery rates of JOA and VAS scores of conservative treatment were much lower than surgical treatment. Surgical treatment group had cervical cord compression of < 50% after treatment, and conservative treatment group had still cervical cord compression of > 50%. *Conclusions:* Surgical treatment had a better effect on mild CSM patients with remarkable intramedullary MRI signal changes compared with conservative treatment. Therefore, it might be applied in the treatment of mild CSM patients with remarkable intramedullary MRI signal changes.

Keywords: Cervical spondylotic myelopathy, surgical treatment, magnetic resonance imaging, Japanese Orthopaedic Association scores, visual analogue scale (VAS) scores

Introduction

Cervical spondylotic myelopathy (CSM) is the most common cause of spinal cord dysfunction and occurs mainly in people with an age greater than 40 years [1, 2]. It usually develops insidiously with clinical symptoms and signs including bladder dysfunction, gait instability, loss of fine motor control for the upper limbs, weakness, hyperreflexia, and alteration of joint position sense and so on [3, 4]. Along with widespread use of computers and air conditioners, the incidence of cervical spondylosis gradually increases, and meanwhile, the age of onset continually decreases [5, 6]. Magnetic resonance imaging (MRI) is the optimal imaging method in the diagnosis of CSM [7]. It may display the relationship between location of cervical cord compression and adjacent structures, and estimate preliminarily the degree of compression and the nature of myeleterosis [8, 9]. The mild level of CSM refers to CSM patients with Japanese Orthopaedic Association (JOA) scores of ≥ 15. Surgical treatment may effectively prevent the progression of disease as the standard of care for moderate or severe CSM (JOA scores of < 15) [4, 10-12]. However, there is no evidence that preventive decompression

Figure 1. 49-year male CSM patient with cervical spinal compression > 50%.

surgery is favorable for patients with asymptomatic cervical spondylotic spinal cord encroachment, and conservative treatment is therefore feasible in this patient population [12, 13]. Moreover, the effect of surgical treatment on mild CSM remains controversial [12-14], and a key point emerging from these studies is the importance of identifying the specific mild CSM patients who will possibly benefit from surgical treatment. In this paper, the effect of surgical treatment on mild CSM with remarkable intramedullary MRI signal changes was compared with conservative treatment, and the purpose was to investigate the effect of surgical treatment on mild CSM with remarkable intramedullary MRI signal changes.

Materials and methods

Patients

A total of 162 CSM patients with JOA scores of ≥ 15 (mild CSM) and remarkable intramedullary magnetic resonance imaging signal changes were included in this single-center observational study between January, 2012 and January, 2014. Among them, 63 patients were caused by herniated disk, 46 by calcification of posterior longitudinal ligament, 32 by vertebral degeneration, and 21 by degeneration of other adjacent soft tissues. A total of 133 patients selected conservative treatment and 29 patients selected surgical treatment. All patients had MRI and their JOA scores and visual analogue scale (VAS) scores were evaluated before treatment. This study received the approval of the ethic committee of Traditional Chinese Hospital Affiliated to Xinjiang Medical University (2012096006), and all patients provided informed consent.

Inclusion criterion

(1) CSM patients with JOA scores of ≥ 15 [10, 15]; (2) CSM patients with remarkable intramedullary magnetic resonance imaging signal changes including intramedullary increased signal intensity (ISI) and severe cervical cord compression (> 50%) in T2-weighted MRI [16-18] (**Figure 1**); (3) CSM patients with an age greater than 40 years.

Exclusion criterion

(1) CSM patients accompanied with neurological diseases; (2) CSM patients accompanied with severe cardiovascular, cerebrovascular, liver, kidney and hematopoietic system diseases; (3) CSM patients with < 15 JOA scores; (4) CSM patients with mild or moderate cervical cord compression (≤ 50%) in T2-weighted MRI (**Figure 2**).

Treatment methods

Patients receiving surgical treatment were treated with anterior, posterior, or combined anterior and posterior approaches, with the aim of decompressing the pressure from the spinal cord. Patients receiving conservative treatment were treated with cervical immobilization, analgesics, anti-inflammatory and phys-

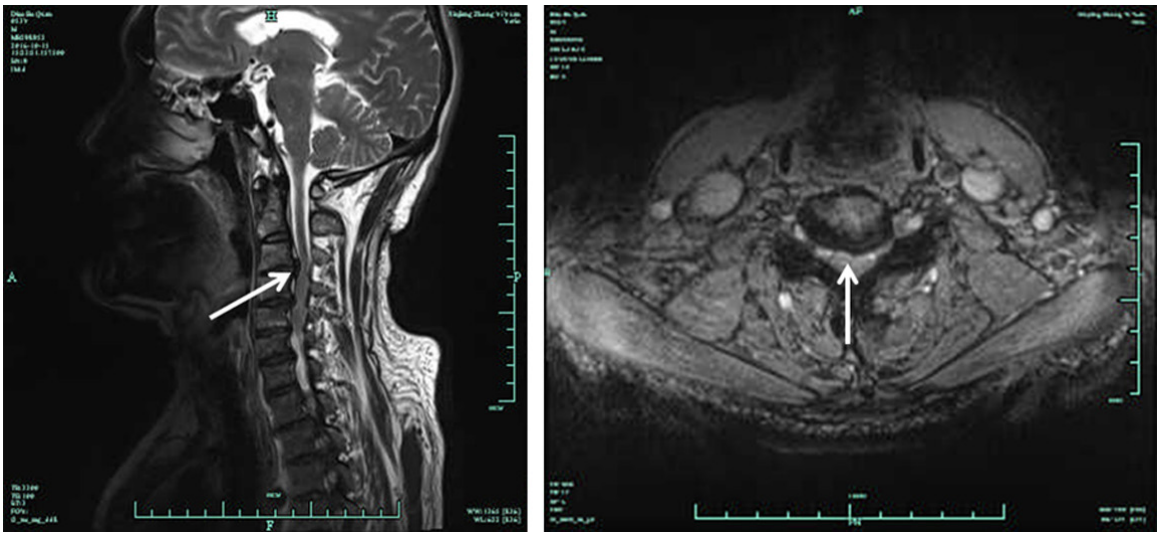

Figure 2. 44-year female CSM patient with cervical spinal compression ≤ 50%.

Table 1. General data of surgical treatment group and conservative treatment group

	Surgical treatment group (n=29)	Conservative treatment group (n=133)	χ^2/t	*P*
Age	53.76±7.51	51.42±8.26	1.490	0.146
BMI	24.20±3.91	23.43±4.69	0.917	0.357
Sex ratio (male/female)	1.64 (18/11)	1.51 (80/53)	0.037	0.848
JOA score	15.11±0.61	15.28±0.38	1.441	0.152
VAS score	4.55±0.49	4.74±0.91	1.583	0.125

iotherapy. All patients were followed up for MRI results, JOA scores and VAS scores at 7 days, 1 month, 3 months, 6 months, 12 months, 18 months and 24 months after treatment.

Recovery rates of JOA and VAS scores

The recovery rate of JOA score (%) was evaluated with a previously published formula [19]:

Recovery rate of JOA scores (%)=[postoperative score-preoperative score]/[full score (17)-preoperative score] × 100.

Recovery rate of VAS scores (%)=[postoperative score-preoperative score]/(preoperative score) × 100.

Statistical analysis

All data were analyzed using the SPSS version 19.0 for Windows (SPSS Inc., USA). Measurement data were expressed as mean ± SD, and enumeration data as percentages. Measurement data were compared with Student's *t* test, and enumeration data with chi-square test. Significance was set at $P < 0.05$.

Results

General data

These 162 patients, including 98 males and 64 females, had an average age of 51.84±8.13 years old ranging from 35 to 82 years old, average body mass index (BMI) of 23.27±4.56, average JOA score of 15.25±0.43, and VAS score of 4.76±0.85 before treatment. The age, BMI, JOA score, VAS score and sex ratio were not statistically different between surgical treatment group and conservative treatment group (**Table 1**). All patients received successful surgical decompression for CSM in surgical treatment group.

JOA scores and recovery rates

As shown in **Figure 3**, the JOA scores of surgical treatment group after treatment were significantly elevated compared with before treatment (all $P < 0.05$) and remained stable at different time-points (all $P > 0.05$). As also shown in **Figure 3**, the JOA scores of conservative treatment group after treatment were significantly elevated at 7 days, 1 month, 3 months, 6 months and 12 months compared with before treatment (all $P < 0.05$), but were only slightly

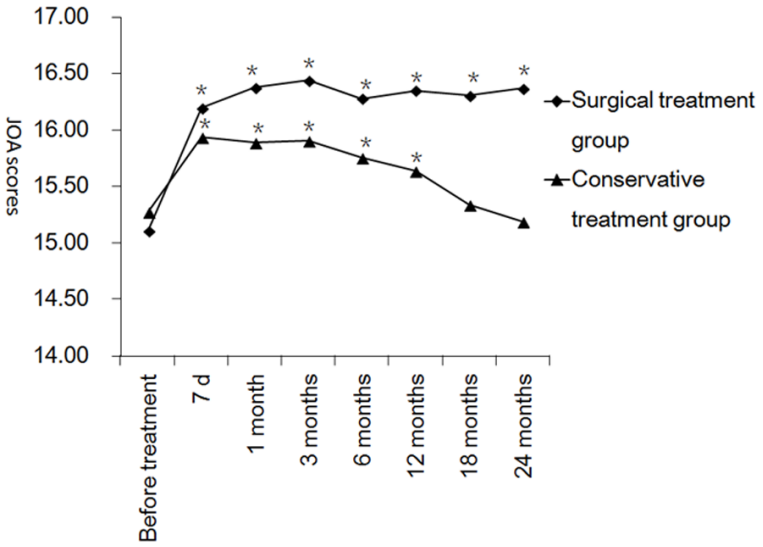

Figure 3. JOA scores in surgical treatment group and conservative treatment group. *: $P < 0.05$, vs before treatment.

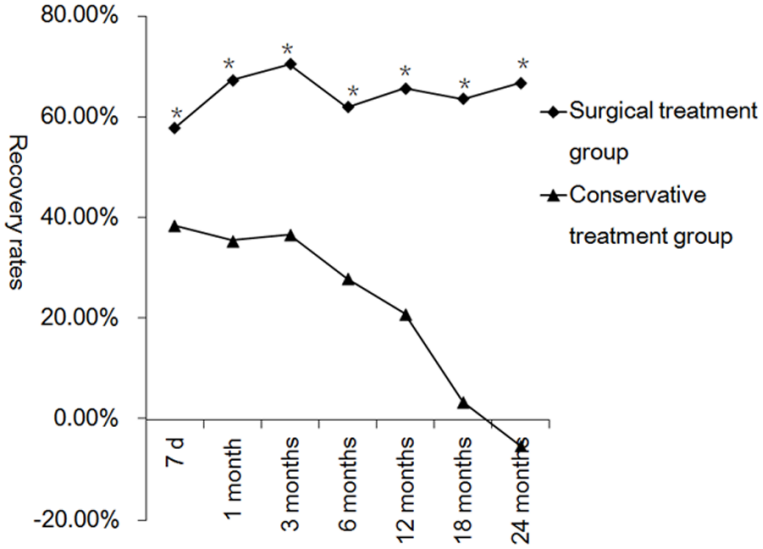

Figure 4. Recovery rates of JOA scores in surgical treatment group and conservative treatment group. *: $P < 0.05$, vs conservative treatment group.

elevated at 18 months ($P > 0.05$) and slightly declined at 24 months ($P > 0.05$). Moreover, the recovery rates of JOA scores of surgical treatment group were much higher than conservative treatment group at all time-points after treatment, especially at 18 months and 24 months (all $P < 0.05$, shown in **Figure 4**).

VAS scores and recovery rates

As shown in **Figure 5**, the VAS scores of surgical treatment group after treatment were significantly declined compared with before treatment (all $P < 0.05$) and remained stable at different time-points after treatment (all $P > 0.05$). As also shown in **Figure 5**, the VAS scores of conservative treatment group after treatment were significantly declined at 7 days, 1 month, 3 months, 6 months and 12 months compared with before treatment (all $P < 0.05$), but were only slightly declined at 18 months and 24 months after treatment ($P > 0.05$). Moreover, the recovery rates of VAS scores of surgical treatment group were much higher than conservative treatment group at all time-points after treatment, especially at 18 months and 24 months (all $P < 0.05$, shown in **Figure 6**).

MRI results

All patients had cervical cord compression of < 50% in surgical treatment group at all time-points (7 d, 1 month, 3 months, 6 months, 12 months, 18 months and 24 months) after treatment. However, all patients had still cervical cord compression of > 50% in conservative treatment group at all time-points after treatment.

Discussion

Surgical treatment may effectively prevent the progression of moderate or severe CSM [4, 10-12]. However, the effect of surgical treatment on mild CSM remains controversial. In 2000, two prospective studies were performed with the aim of comparing surgical treatment to conservative treatment for CSM. Kadanka *et al.* [20] found that the effect of surgical treatment for CSM was not different from conservative treatment within the follow-up period of 2 years using the modified Japanese Orthopedic Association (mJOA) score as the primary outcome measure. The improvement of the mJOA

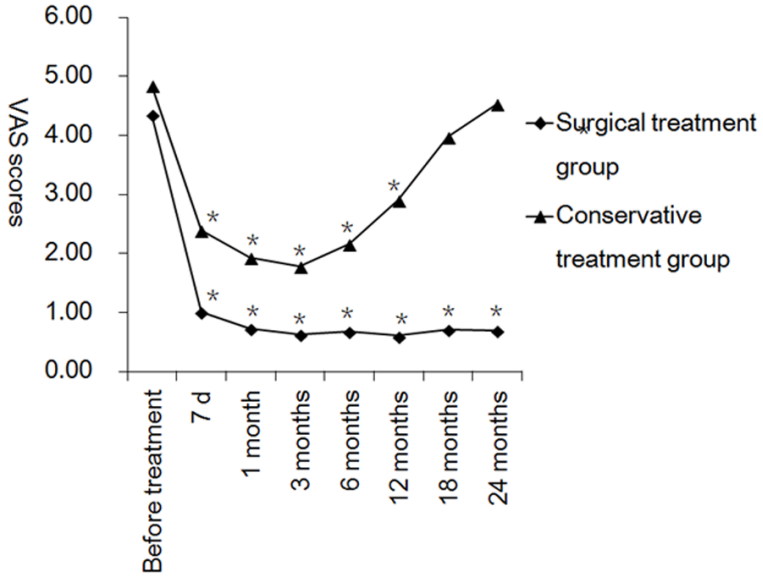

Figure 5. VAS scores in surgical treatment group and conservative treatment group. *: $P < 0.05$, vs before treatment.

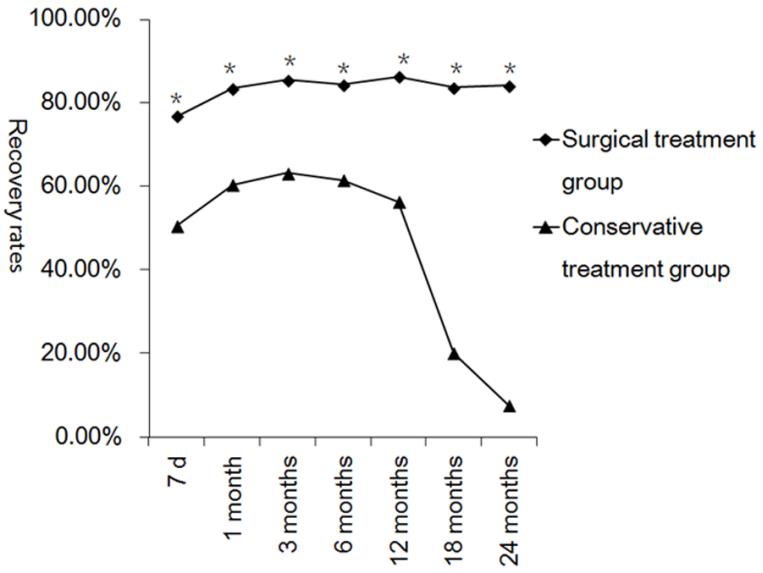

Figure 6. Recovery rates of VAS scores in surgical treatment group and conservative treatment group. *: $P < 0.05$, vs conservative treatment group.

scores was not observed for both surgical treatment and conservative treatment in this study. However, Sampath P *et al.* [21] found that the effect of surgical treatment was superior to conservative treatment at 11.2 months after treatment using the Cervical Spine Research Society (CSRS) questionnaire as the outcomes. Subsequently, in 2002, Kadanka *et al.* [22] performed again a similar study with a prolonged follow-up period and increased sample size. The results reconfirmed that the effect of surgical treatment for CSM was not different from conservative treatment within the follow-up period of 3 years. In 2011, a study with a follow-up period of 10 years also found a similar result [23]. The key points emerging from these studies include a stable condition of mild CSM and the importance of identifying the specific mild CSM patients who will possibly benefit from surgical treatment. Intramedullary MRI signal changes may be not necessarily correlated with postoperative recovery or neurological function, but it should be noted and documented as evidence of the extent of CSM pathology. Until recently, the potential of remarkable intramedullary magnetic resonance imaging (MRI) signal changes as an indication for surgical treatment of mild CSM has not been investigated.

In this paper, mild CSM patients with remarkable intramedullary MRI signal changes including intramedullary ISI and severe cervical cord compression (> 50%) in T2-weighted MRI were retrospectively analyzed. For patients receiving surgical treatment, both JOA and VAS scores after treatment were significantly improved compared with before treatment and remained stable during a follow-up period of 24 months. However, for patients receiving conservative treatment, both JOA and VAS scores after treatment were significantly improved from 7 days to 12 months compared with before treatment and were not significantly improved at 18 months and 24 months. These results indicated (1) surgical treatment could improve JOA and VAS scores for at least 24 months; and (2) conservative treatment could improve JOA and VAS scores

for at least 12 months, but JOA and VAS scores would reduce to the level before treatment from 18 months after treatment. In addition, the recovery rates of JOA and VAS scores of conservative treatment were much lower than surgical treatment. Therefore, surgical treatment had a better effect on mild CSM patients with remarkable intramedullary MRI signal changes compared with conservative treatment.

In conclusion, surgical treatment had a better effect on mild CSM patients with remarkable intramedullary MRI signal changes compared with conservative treatment. Therefore, it might be applied in the treatment of mild CSM patients with remarkable intramedullary MRI signal changes.

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Disclosure of conflict of interest

None.

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