

Impact of Preoperative Spinal Cord Signal Intensity and Symptom Duration on Surgical Outcome of the Patients with Cervical Spondylotic Myelopathy

Farzad Omid-Kashani^{1, *}, Mohamed Hosein Ebrahimzadeh²,
Arezoo Naderimoghadam³, Hamid Amanzadeh⁴

¹Orthopedic Research Center, Orthopedic Department, Imam Reza Hospital, Mashhad University of Medical Sciences, Mashhad, Iran

²Orthopedic Research Center, Orthopedic Department, Qaem Hospital, Mashhad University of Medical Sciences, Mashhad, Iran

³Student Research Committee, Faculty of Medicine, Imam Reza Hospital, Mashhad University of Medical Sciences, Mashhad, Iran

⁴Orthopedic Department, Imam Reza Hospital, Mashhad University of Medical Sciences, Mashhad, Iran

Abstract

Background: Cervical spondylotic Myelopathy (CSM) is one of the most common causes of cervical spinal cord dysfunction in old patients and in those cases with refractory complaints, surgical decompression may become necessary. We aim to evaluate the impact of preoperative spinal cord signal change and symptom duration on surgical outcome of these patients. **Material & Method:** In this retrospective study, we reviewed 36 patients (25 male and 11 female) with CSM and mean age 55.7 ± 13.2 who were surgically treated in our orthopedic department. Preoperative duration of myelopathic symptoms, disability status (according to Neck Disability Index; NDI), signal change inside the cervical spinal cord (on T2-weighted magnetic resonance imaging; T2 MRI), and surgical outcome (based on Odom's criteria) were especially assessed. Statistical Package for the Social Sciences (SPSS) software version 16 was used for statistics and P value < 0.05 was interpreted as significance. **Results:** Mean duration of preoperative symptoms and follow-up periods were 17.5 ± 7.9 and 37.5 ± 8 months, respectively. Spinal cord signal intensity in T2 MRI was normal in 21 (58.3%), light in 9 (25%), and tense in 6 (16.7%). Surgery could improve NDI scores from 27 ± 9.3 preoperatively to 11.4 ± 12 at the last follow-up visit. Excellent or good surgical outcome could achieve in 28 patients (77.8%). Among the various patients' characteristics, only preoperative symptom duration and cord enhancement could show a significant correlation with patient's disability improvement and surgical outcome. **Conclusions:** Outcome of surgery in CSM is satisfactory in most of the patients although, preoperative duration of myelopathic symptoms and spinal cord signal enhancement were associated with lower disability improvement and poorer surgical outcome.

Keywords

Spondylosis, Cervical Cord, Outcome Assessment, Magnetic Resonance Imaging

Received: July 18, 2015 / Accepted: August 8, 2015 / Published online: August 13, 2015

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1. Introduction

As the cervical intervertebral disc degenerates, normal biomechanics of the cervical spine gradually changes and greater stress is applied on the surrounding structures and

progressively a full blown cervical spondylosis may occur.¹ Cervical spondylotic changes can lead to spinal stenosis including radiculopathy or myelopathy. Reduction in space available for the cord gradually induce white matter demyelination, gray matter neuronal loss, necrosis, cavitation and ultimately, white matter gliosis and diffuse gray matter

* Corresponding author

E-mail address: omidif@mums.ac.ir (F. Omid-Kashani)

necrosis may follow.^{2, 3} On the other hand, as motion and weight are greater in lower cervical spine, more degenerative changes are usually seen at C5-6 and C6-7 levels.⁴ This area of the cervical spine is also a watershed region in the cervical cord, with limited blood supply and consequently greater potential for spinal cord ischemia.⁵

Cervical spondylotic myelopathy (CSM) is one of the most common causes of cervical spinal cord dysfunction in old patents and in those cases with refractory complains or progressive neurologic deficit, surgical decompression may become necessary.⁶ There are many poor prognostic factors proposed for surgical outcome of the patients with CSM, but still debate exists about their definite roles. Old age at the time of surgery, loss of normal cervical lordotic curve, multi-segmental cord compression, and numerous underlying diseases are relatively known factors.⁷⁻¹⁰ In this study we aim to evaluate the impact of preoperative spinal cord signal change and symptom duration on surgical outcome of these particular patients.

2. Methods

Local institutional review board approval (registration number 920349) was first obtained and then we retrospectively began to gather the demographic, clinical, and paraclinical data from the medical records related to our surgically treated patients with CSM who had been treated from April 2010 to April 2013 in Orthopedic Department,

Imam Reza Hospital, Mashhad, Iran.

2.1. Inclusion and Exclusion Criteria

Our inclusion criteria included all the patients with documented CSM based on both imaging and clinical characteristics, presence of significant neurologic deficit (like deep tendon reflex or motor disturbances), intractable complains longer than 6 months, and those patients signed the informed consents. Those myelopathic patients who were not followed-up for more than two years, could not stop smoking during the perioperative time, had a previous history of cervical spine surgery, those with significant associated diseases (like uncontrolled diabetes mellitus or hemorrhagic diathesis), or those with underlying etiologies other than degenerative disease (e.g. cancer, infection, or trauma) were excluded from the study. In this study, we did not care about the exact surgical technique or approach and our primary aim was efficacious neural decompression and spinal stabilization, if necessary.¹¹

2.2. Patients Assessment

Preoperative symptom duration was assumed as the time between the beginning of clinical manifestation and surgical procedure. We evaluated patients' disability with neck disability index (NDI) questionnaire.^{12, 13} In this study, NDI was expressed as its raw score (zero to fifty). This questionnaire was completed preoperatively and at the last follow-up visit.

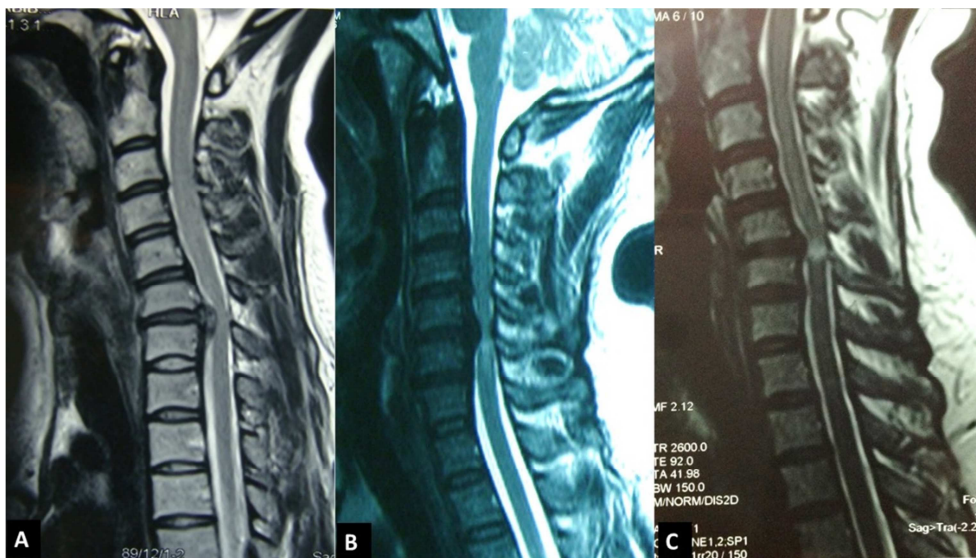


Fig. 1. Grading of cord enhancement based on increased signal intensity on T2 weighted MRI. A- Cord enhancement Grade 0, B- Cord enhancement Grade I, C- Cord enhancement Grade II. Note that signal intensity at the narrowest part of the cervical cord is identical with cerebrospinal fluid in this grade.

Signal change inside the cervical spinal cord (Fig. 1) was graded preoperatively based on amount of signal enhancement at the narrowest part of the cord on the sagittal T2 weighted magnetic resonance imaging (MRI) scans as grade 0 or none (without any signal enhancement in spinal

cord), grade 1 or light (with mild increased signal intensity inside the spinal cord), and grade II or tense (with severe increased signal intensity or bright signal identical with cerebrospinal fluid).¹⁴ At the last follow-up visit, surgical outcome was assessed according to Odom's criteria and

expressed as excellent, good, fair, or poor based on amount of improvement in preoperative symptoms and complains.¹⁵

3. Statistical Analysis

Statistical Package for the Social Sciences (SPSS) software version 16 was used for statistical analysis, data management and documentation. P value<0.05 was interpreted as significance. We used Kolmogorov– Smirnov Test, Pearson correlation coefficient, Spearman rank correlation, independent T test, and Mann-Whitney test in this analysis.

4. Results

Due to lack of proper follow-up assessment, four patients were excluded from the study. After all inclusion and exclusion criteria were assumed into account, we ultimately studied 36 patients comprising 25 male (69.4%) and 11 female (30.6%). Mean age of the patients was 55.7±13.2 (range; 31-80 years). Mean duration of preoperative symptoms and follow-up periods were 17.5±7.9 (range; 5-31 months) and 37.5±8 (range; 25-60 months), respectively. More than half of the patients (52.7%) were followed-up for greater than three years. Preoperative imaging characteristics of our patients were depicted in Table 1. NDI in preoperative and postoperative era at the last follow-up visit and surgical outcome at this latest time were also shown in Table 2. Mean improvement in NDI during this follow-up period was 15.6±11.

Table 1. Preoperative imaging characteristics of our treated patients.

Index	Number	Percentage (%)
Spinal cord signal change (T2 MRI):		
Grade 0	21	58.3
Grade I	9	25
Grade II	6	16.7
Cervical stenotic levels:		
1 level	11	30.6
2 levels	10	27.8
3 levels	8	22.2
4 levels	3	8.3
5 levels	4	11.1

Table 2. Disability improvement and surgical outcome in the operated patients.

Index	Preoperative	Postoperative at the most recent time
NDI*	27±9.3	11.4±12
Surgical outcome		
Excellent	-	24 (66.7%)
Good	-	4 (11.1%)
Fair	-	2 (5.6%)
Poor	-	6 (16.7%)

* NDI: Neck Disability Index

Relationships between variety of patients' characteristics with disability improvement and surgical outcome were depicted in Table 3. As this table shows, the only parameters that significantly and reversely correlated with patient's disability improvement and surgical outcome were preoperative symptom duration and the amount of cord enhancement.

Table 3. Relationship between patients' characteristics and clinical results.

Index	Disability improvement (P value)	Surgical outcome (P value)
Sex	0.531	0.924
Age	0.395	0.676
Preoperative symptom duration	0.013* (r: -0.41)	0.025* (r: -0.21)
Number of stenotic levels	0.921	0.964
Follow-up duration	0.298	0.179
Cord enhancement (T2 MRI)	0.012* (r: -0.25)	0.006* (r: -0.18)

* Significant statistically

5. Discussion

In this study, we tried to elucidate the impact of some preoperative characteristics on surgical outcome and disability improvement of the patients with CSM. Although the patient's age, sex, number of stenotic levels, and amount of follow-up duration have no prognostic role, we could find that preoperative symptom duration and cord enhancement have a reverse relationship with disability improvement and outcome of the surgery.

A review on the literature reveals that numerous studies have been carried out on prognostic effect of spinal cord

enhancement in the surgical outcome of CSM. Most of these studies like us, agreed with the poor prognostic effect of spinal cord signal change.^{9, 10, 16-20} Haddadian et al. in a prospective study evaluated clinical symptoms, signs, and imaging characteristics of 43 patients with CSM to find out their significance in surgical procedures. They found that atrophy of the hand muscles, preoperative spastic gait and cord atrophy as evident on MRI comprised poor prognostic factors in this decompressive surgery.¹⁶ Similarly, Chatley and co-authors in 2009, published the results of their study on 64 cases with CSM who underwent surgery.¹⁷ They concluded that multisegmental cord enhancement on T2-weighted MRI was associated with lower functional

recovery. There are fewer studies that suggest spinal cord signal change has no effect on the prognosis of the patients with CSM. Karpova et al. in a prospective study evaluated 65 patients with CSM.⁸ In contrary to our study, they quantified disability with modified Japanese Orthopaedic Association scale. Their results showed that younger age and higher preoperative disability scores were strongly associated with better recovery ratio. They could not find any relationship between spinal cord signal change or preoperative symptom duration and surgical outcome at the end of 12 months follow-up. This recent finding is completely contradicted with the results of the study we had carried out.

About the effectiveness of preoperative duration of myelopathic symptoms on the results of surgery, our findings are in line with the results of most other studies.^{8, 21, 22} Tetreault et al. in a systematic review of the literature found that preoperative severity and duration of myelopathic symptoms are the most predictive of surgical outcome.²² Similarly, Pumberger et al. reviewed and analyzed 284 patients with CSM and concluded that preoperative duration of myelopathic symptoms is a poor prognostic factor for surgical outcome but does not necessarily indicate higher severity of the disease.²¹ Although the study conducted by Karpova failed to show any relationship between the two.⁸

Our study had several significant flaws. We did not use any image analysis software to quantify the signal change of the spinal cord and just trusted our vision. Obviously, if we could carried out a prospective study on a larger number of patients using an appropriate computer software, the more reliable results would be achieved.

6. Conclusions

Outcome of surgery in CSM is satisfactory in most of the patients although, preoperative duration of myelopathic symptoms and spinal cord signal enhancement may be associated with lower disability improvement and poorer surgical outcome.

Acknowledgements

This study is funded by Student Research Committee, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran.

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