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Original Research

A study of prognostic factors and outcome of surgically managed patients with Cervical spondylotic Myelopathy

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Abstract

Background: Cervical spondylotic myelopathy (CSM) is a common degenerative disorder of the cervical spine and an important cause of spastic quadriparesis in middle aged and elderly patients. Multiple clinical and radiological variables have been proposed as prognostic factors, but their relative contribution to postoperative outcome remains unclear. **Methods:** This retrospective study included 85 surgically treated patients with CSM managed between March 2024 to September 2025 at Department of Neurosurgery, GSVM Medical College, Kanpur. Patients with definite clinical and MRI evidence of CSM and adequate follow up (≥ 2 months) were enrolled. Preoperative assessment included age, duration of symptoms, Nurick's grade, effective canal diameter, number of levels of compression, and intramedullary T₂ weighted hyperintense signal changes. Surgical approach (anterior or posterior) was chosen according to levels and site of compression and sagittal alignment. Outcome was graded using change in Nurick's grade at last follow up as improved (+1), stationary (0), or deteriorated (-1). Based on major prognostic variables, a composite MIN prognostic scale for CSM was devised and correlated with outcome using parametric statistics (ANOVA, $p < 0.05$). **Results:** The mean age was 49 ± 12 years with male predominance (81%). Improvement was observed in 34 patients (40%), 28 (33%) remained stationary, and 23 (27%) deteriorated. Shorter symptom duration (< 1 year), lower preoperative Nurick's grade (0-2), larger effective canal diameter (> 11 mm), one or two levels of compression, and absence of intramedullary T₂ hyperintense signal were each significantly associated with better postoperative outcome ($p < 0.05$). Patients with well defined T₂ hyperintense cord signal and canal diameter < 9 mm showed the worst prognosis. The MIN prognostic scale demonstrated strong correlation with outcome: most patients with scores ≤ 9 deteriorated, scores 10-13 were commonly static, and scores ≥ 14 were predominantly improved. **Conclusion:** Age, duration of symptoms, preoperative Nurick's grade, effective canal diameter, number of compressed levels, and intramedullary T₂ signal change are major prognostic determinants in CSM. The MIN prognostic scale, incorporating these factors, provides a simple and comprehensive tool for preoperative prognostication and counselling in patients undergoing surgery for CSM. Further prospective validation is warranted.

Keywords: Cervical Spondylotic Myelopathy; Nurick's Grade; MIN Prognostic Scale; Surgical Outcome

Introduction

Cervical spondylosis is a common degenerative disorder of the cervical spine which affects almost every person over 40 years, earlier or later. Pre-existing cervical canal narrowing either congenital or acquired makes the patient vulnerable to neurological deficit with onset of cervical spondylosis [1]. Cervical spondylotic myelopathy (CSM) is thought to be caused by cervical canal narrowing due to disc protrusion, ossification of posterior longitudinal ligaments (OPLL) or degenerative spondylosis [2]. Typically, patients with myelopathy have symptoms and signs for several years before seeking medical attention. Although the progression is usually slow, the course often involves a progressive decline if the disease is left untreated. A small percentage of patients exhibits a more rapid onset of progression of symptoms and signs [3].

Once patients have presented with the signs and symptoms of cervical spondylotic myelopathy, most have some degree of permanent disability, little changes of symptoms resolution is possible with conservative treatment, therefore many different surgical methods have been developed to expand the cervical spinal canal anteriorly or posteriorly [4]. Although the surgical outcome is directly associated with preoperative severity, there is little information about the role of factors which determine the outcome. Several studies have been done to determine the prognostic factors in outcome [5]. Many factors have been studied like, patients age, duration of symptoms, pathological changes to the spinal cord, cervical axial canal area, anteroposterior diameter, intramedullary high signal intensity on T₂ weighted Magnetic Resonance images (T₂ MRI) and their effect in prognosis [6]. The various factors affecting the prognosis in CSM have been studied by various authors [7-9]. But there is no comprehensive study comparing the impact of various factors on the outcome. In this study, an attempt has been made to study the impact of various individual factors affecting the diagnosis in CSM. A comprehensive prognostic scale incorporating the prognostic factors has been evolved and this scale also has been evaluated.

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Materials and Methods

The study was conducted from March 2024 to September 2025 at Department of Neurosurgery, GSVM Medical College, Kanpur. A total number of 85 patients were included in this study.

Patients with CSM, having definitive clinical and MRI features were included in the study. Other causes of spastic quadriplegia were carefully excluded. The patients who were not fit for surgery due to anaesthetic problems were excluded from the study. The follow up duration is from minimum of 2 months to maximum of 2½ years. Patients who lack regular follow up are excluded from the study.

Methods

1. The detailed history, duration of symptoms, mode of progression of weakness, highest level of cord compression, severity of involvement were studied and charted out.
2. Nurick's Grading was used to evaluate the severity of cervical myelopathy preoperatively and post operatively.
3. Patients age, duration of symptoms, preoperative neurological disability (Nurick's grade), effective canal diameter, number of levels of compression, intramedullary hyperintense signal changes in T2 MRI, were evaluated.
4. A new prognostic scoring system has been devised in the Institute (The MIN prognostic scale for CSM), incorporating the major prognostic factors and has been evaluated.

Table 1: MIN prognostic scale for cervical spondylotic myelopathy [10]

Prognostic Factors	Subdivisions	Score
Age	< 40 years	3
	40-60 years	2
	> 60 years	1
Duration of symptoms	< 1 year	3
	1-2 years	2
	> 2 years	1
Neurological Disability (Nurick's Grade)	0-2	3
	3	2
	4-5	1
Effective canal diameter	> 11 cm	3
	9-11 cm	2
	< 9 cm	1
Number of levels of compression	1 level	3
	2 levels	2
	3 or more levels	1
Intramedullary signal changes in MRI	No change	3
	T ₂ signal ill-defined	2
	T ₂ signal well-defined	1

Surgical methods: The anterior approach is selected for patients whose pathologic compression occurs anterior to the spinal cord at three or fewer vertebral segments. Also, for patients whose preoperative lateral cervical spine reveals a kyphotic deformity, the anterior approach is selected for cervical decompression because the posterior approach could exacerbate the kyphosis and worsening the myelopathy. Titanium box cage/bone graft was used for interbody fusion and to maintain the restored foraminal and disc space height and lordosis achieved at surgery. Anterior cervical disectomy with cage /bone graft interbody fusion was preferred for one or two level vertebral segment involvement and anterior medial corpectomy with cage fixation for three levels vertebral segment compression. Posterior approach was used in patients with pathological compression encompassed more than three vertebral body segments and for those patients in whom the posterior canal compromised by thickened ligamentum flavum, overgrowth of facet joints. The technique used for posterior decompression was cervical laminectomy from C3 to C7 with or without lateral mass plating.

Radiological assessment: X ray cervical spine lateral view was taken in all patients. Standard lateral radiograph were taken in neutral position of the cervical spine with a tube distance of 140cm. The current in X- ray machine is kept constantly at 55 Kilovolts and 100mA. The distance between the posterior prominence of the posterior osteophytes to nearest point on spino laminar line is measured at each level of cervical vertebra and maximum level of compression is noted. The above effective canal diameter is again confirmed with sagittal MRI cervical spine. MRI cervical spine, T1 weighted, T2 weighted, axial, sagittal cuts were done in all patients under study, the diagnosis is confirmed, the effective canal diameter at various cervical level, number of level of compression are studied. The exact details of the spinal cord, nerve roots, subarachnoid space and the soft tissue abnormalities (soft disc herniation, OPLL, thickened ligamentum flavum were assessed). Increased signal intensity within the spinal cord on T2 weighted images were studied. T2 signal change, either ill-defined or well defined were noted.

The patients were followed at a period of 1 months, 6 months and 1 year duration and the outcome scale in compared with Nurick's grade [11]. The outcome were recorded as per the latest postoperative follow up. Outcome was categorized into three groups depending on the preoperative and postoperative Nurick's grading as:

- 1) Improvement (+1),
- 2) Stationary (0),
- 3) Deterioration (-1)

Statistical analysis: Parametric statistical analysis was performed using ANOVA test. All analysis were performed using 17.5 Version. Significance level was set at $p < 0.05$.

Results

The average age of the 85 patients was 49 ± 12 years. There was male (69, 81%) dominance in the present study. Pre-operative characteristics among the study subjects were shown in table 1.

Table 1: Pre-operative characteristics among the study subjects

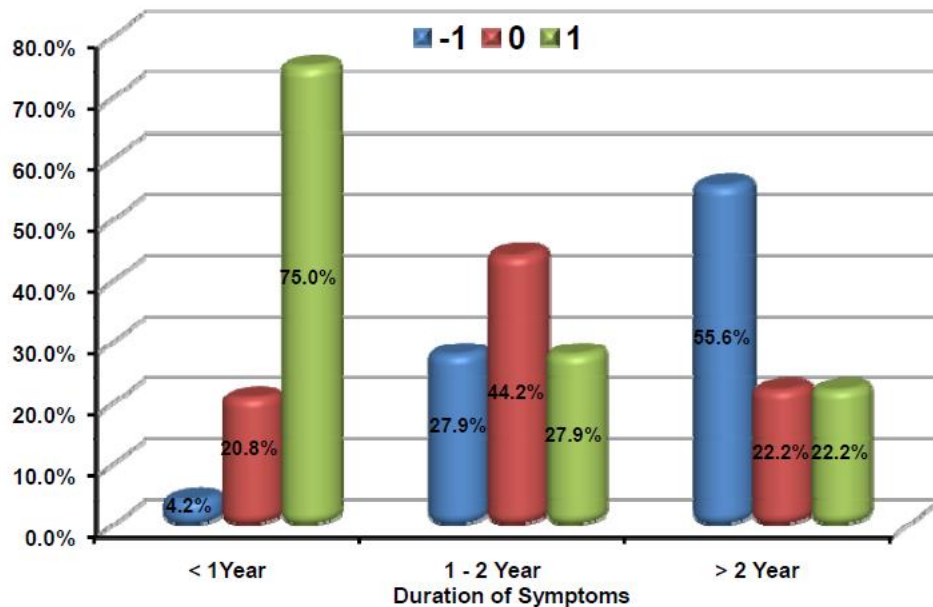
Prognostic Factor	Category / Subdivision	Number of Patients
Preoperative Nurick's Grade	0-2	34
	3	38
	4-5	13
Effective Canal Diameter	> 11 cm	19
	9-11 cm	49
	< 9 cm	17
Number of Levels of Compression	1 level	20
	2 levels	24
	3 or more levels	41
Intramedullary Hyperintense Signal Change (MRI)	No change	45
	T ₂ signal ill-defined	16
	T ₂ signal well-defined	24
Minimum Prognostic Score	6	2
	7	6
	8	5
	9	7
	10	6
	11	8
	12	4
	13	6
	14	8
	15	6
	16	4
	17	10
	18	3

Improved outcome was reported among 34 subjects while stationary and deteriorated among 28 and 23 subjects respectively (table 2).

Table 2: Outcome and surgical approaches among the study subjects

Parameter	Category / Subdivision	Number of Patients
Surgical Approach	Anterior	47
	Posterior	38
Postoperative Outcome	Improved (+1)	34
	Stationary (0)	28
	Deteriorated (-1)	23

The range of duration of symptoms varies from 16.8±7.2 months. There was statistically significant difference in outcome between duration of symptoms (P-value - 0.000 < 0.05) as shown in graph 1.



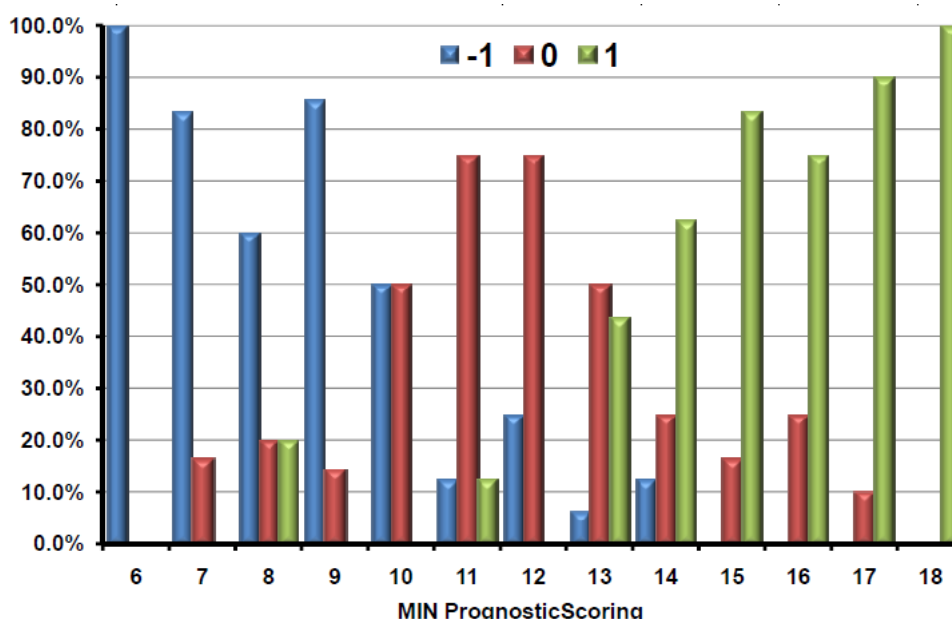
Graph 1: Duration vs. outcome

The average Nurick's grade was 2.2 ± 0.7 . There was statistically significant difference between Nurick's grade and outcome (P-value < 0.05). There was statistically significant difference in outcome between group of patient with and without intramedullary Signal Changes in MRI and also the type of T2 signal change (table 3).

Table 3: Association between prognostic factor and outcome

Factors	Outcome			Total
	-1	0	1	
Canal diameter				
Canal Diameter > 11 cm	1	1	17	19
Canal Diameter 9-11 cm	9	24	16	49
Canal Diameter < 9 cm	13	3	1	17
Nurick's Grade				
Grade 0-2	3	12	19	34
Grade 3	12	12	14	38
Grade 4-5	8	4	1	13
MRI				
MRI No Change	1	17	27	45
MRI T ₂ hyperintense ill defined	5	6	5	16
MRI T ₂ hyperintense well defined	17	5	2	24
No. of levels				
1 level	0	4	16	20
2 levels	1	8	15	24
3 or more levels	22	16	3	41

There was statistically significant difference between MIN prognostic scores and outcome (graph 2).

**Graph 2: MIN prognostic scoring for cervical spondylotic myelopathy and outcome**

Discussion

In this study, a series of 85 cases of CSM treated surgically have been evaluated and the contribution of the individual factors to the outcome have been analysed. An attempt have been made to formulate a comprehensive prognostic scale incorporating all these factors and evaluate the same.

CSM is a disease of middle age and elderly patients. It's rarely seen before the age of forty years [12]. In Naderi (1988) [13] study of 27 patients with CSM showed better neurological improvement in patients younger than 60 years. Langston (2009) [14] in his study confirm age of the patient as one of the important prognostic factors. Jae sung (2010) [15] in his prospective study also concluded, patients less than 40 years have better outcome. Fujiwara (1989) [16] and Kun (2005) [17] also confirms age as one of the prognostic factor in outcome. This is accordance with other major studies, which conclude that age group below 40 years have better outcome than those above 60 years.

The present study has shown good correlation between duration of symptoms and outcome, with duration of symptoms less than one year indicating good prognosis and duration of symptoms more than two years indicating poor outcome.

In this study of 85 patients, 34 patients presented with Nurick's grade 0-2, 38 patients with Nurick's grade 3 and 13 patients with Nurick's grade 4-5. 19 of 34 (56%) patients presenting with Nurick's grade 0-2 showed improvement. 8 out of 13 (62%) patients with Nurick's grade 4-5 worsened. Langston (2009) [14] in his study showed preoperative Nurick's grade along with age, duration and preoperative sensory evoked potential is important prognostic factor, patients with Nurick's grade of two or less showed better outcome.

In this study of 85 patients, 17 out of 19 patients (89.5%) with effective canal diameter more than 11mm showed improvement; 24 out of 49 patients with canal diameter 9 to 11 mm were stationary and 16 showed improvement. 13 out of 17 patients (76%) with effective canal diameter less than 9mm worsened. This is in agreement with other studies, confirming the role of effective canal diameter on the outcome in the CSM. Handa (2002) [19] in his study showed that canal stenosis is a main prognostic factor in CSM. Kun (2005) [17] in an analysis of 13 factors in prognosis of the CSM preoperatively concluded effective canal diameter is an important prognostic factor. Kohno (1977) [20] showed better recovery in post laminoplasty patients when postoperative canal diameter is above 12mm. White and Panjabi (1988) [21], Fergusson (1985) [22], Asgari (1996) [23], Fager (1973) [24], Jae-sung (2010) [15] also noted effective canal diameter is one of the important prognostic factor and better prognosis is seen when the effective canal diameter is above 11mm.

The present study have confirmed the finding that patients with single or two levels of compression have better outcome. Crandall and Batzdorf (1966) [12] showed that commonly in CSM two levels of involvement is seen. Fujiwara (1989) [16], Jae Sung (2010) [15] in their study showed one or two levels of cervical cord compression showed better outcome than three or more levels of compression. But Fessler (1998) [25] in

his study showed that extent of disease was not a negative predictor of clinical outcome.

In the present study of 85 patients, 27 of 45 (60%) patients with no intramedullary signal change in T2 MRI improved and 17 remained stationary; whereas 17 of 24 (70%) with well-defined hyperintense signal in T2 MRI worsened. This again, emphasizes the role of intramedullary hyperintense signal change in T2 MRI in the outcome. Magnetic resonance imaging with low signal abnormalities on T1 weighted images and high signal abnormalities on T2 weighted images have been associated with greater clinical disability. Chi-Jen Chen (2001) [26] in a study of 64 patients, divided intramedullary high signal intensity on T2 images into type 1 having a faint, fuzzy border and type 2 having a well-defined border. In the analysis, type 2 lesion had a poor prognosis.

MIN prognostic scale for CSM has been devised incorporating all these prognostic factors. In this study 16 out of 20 patients (80%) with MIN prognostic score of 9 and less worsened; 20 out of 34 patients (59%) with the score between 10 and 13 were static; 25 of 31 patients (81%) with the score 14 and above improved. The MIN prognostic score has good correlation with outcome. This is a retrospective study; a prospective study using the MIN prognostic scale for CSM is being undertaken to validate this scale further. This is a first instance, in the available literature, of a comprehensive prognostic scoring system in CSM.

Conclusion

Major factors affecting outcome in CSM are age, duration of symptoms, neurological disability (Preoperative Nurick's grade), effective canal diameter, number of levels of compression, intramedullary hyperintense signal change in T2 MRI. The new prognostic scale (MIN prognostic scale for CSM) is a simple, comprehensive prognostic scoring system suitable for routine application and has shown good correlation with outcome. Majority of patients who have score of 9 and less worsen, majority of patients with score between 10 and 13 remain static and patients who have score 14 and above improve.

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