Original Research Article

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Cervical Spondylotic Myelopathy Prognosis and Outcome Following Surgery

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Abstract

Introduction: Cervical spondylotic amyotrophy (CSA) is characterized by muscle atrophy in the upper extremities without gait disturbance.

Aims: To analyze the pathophysiology, clinical features and various treatment options in cervical spondylotic myelopathy and the pattern of neurological recovery, prognosis and outcome following surgery.

*Materials and methods:*The present study is a prospective study, observational study evaluate prognosis and outcome following surgery in cervical spondylotic myelopathy comprising of 47 cases studied over a period of 2 years.

Results: Cervical spondylotic myelopathy is commonly seen in elderly age group (mean age is 50 years) and it affects more commonly males. The neurological recovery was apparently best in the upper limb function, followed by lower limb function and least in the sphincter function. The neurological recovery was less in patients with age greater than 60 years, duration of symptoms more than 1 year, sphincter disturbances and hyperintense signal changes in the cord on T2W1 images.

Conclusions: There is no significant difference in the outcome between anterior vs. posterior surgery. Anterior surgery had more complications at the early stage after operation which gradually improved.

Keywords: Cervical spondylotic myelopathy; Neurological recovery; Surgical decompression.

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Introduction

Cervical spondylotic myelopathy results from degenerative changes in the cervical spine and associated soft tissue structures that lead to spinal canal stenosis, spinal cord compression and subsequent spinal cord dysfunction. It often develops progressively without apparent predisposing factors and progresses slowly. Long standing spinal cord compression can eventually result in irreversible, histological, and physiological changes, such as neurofibrosis, demyelination, and a loss of neurons.[1]

In most cases of cervical spondylotic myelopathy, the symptoms rarely improve with conservative management and progress steadily. Therefore, early surgical treatment before the occurrence of irreversible changes is strongly recommended. The most common surgical options include anterior cervical decompression and fusion, laminectomy and laminoplasty. The goal of operative intervention in the treatment of cervical spondylotic myelopathy includes the following: (a) decompression of

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the spinal cord and nerve roots; (b) deformity prevention by maintaining or supplementing spinal stability; and (c) alleviating pain. Surgical treatment can relieve the neurological symptoms and spinal cord compression, but the postoperative outcomes are affected by a range of factor.[2]

Although there are many options available for the surgical treatment of cervical spondylotic myelopathy, the choice of surgical approach for cervical spondylotic myelopathy is still a controversial issue. Anterior procedure is generally recommended for patients with compression of less than three levels or in patients with kyphotic alignment, while posterior decompression is suggested for three or more levels of compression. The existing information does not clearly favor any one single approach or operative option.

Studies have been done to evaluate the factors affecting the surgical outcomes. Only few studies have looked into the relative recovery of upper and lower limb function and bladder and bowel changes; this pattern of neurological recovery is important as it can inform both patients and surgeons about what to expect after the surgery.[3]

The objective of this study is to compare the clinical outcome of anterior approach versus posterior approach and investigate the prognostic factors and pattern of neurological recovery after surgical decompression for patients suffering from cervical spondylotic myelopathy.

Materials and Methods

The present study is a prospective study, observational study evaluate prognosis and outcome following surgery in cervical spondylotic myelopathy comprising of 47 cases studied over a period from August 2010 to December 2012 in the department of neurosurgery, Osmania general hospital, Hyderabad.

Inclusion criteria

Patients who undergo surgery for symptomatic CSM defined as a combination of one or more of the following symptoms: Numb hands, clumsy hands, impairment of gait, bilateral upper limb/lower limb parethesiae and sphincter disturbances and one or more of the following signs: corticospinal distribution motor deficits or wasting and weakness of intrinsic muscles of hand, hyperflexia, positive Hoffman sign, up going plantar responses, lower limb spasticity and unstable gait.

Exclusion criteria

Asymptomatic CSM, previous surgery for CSM, active infection, neoplastic disease, rheumatoid arthritis, ankylosing spondylitis, truma and OPLL.

Data were collected using proforma which includes demographic data, presenting complaints, comorbid conditions, diagnosis, preoperative status, operative findings and postoperative progress of the patient.

All the patients were evaluated as per age group, gender, presence of various symptoms and duration of symptoms, modified Japanese orthpedic association scale and MRI finding. Patients were treated with either decompressive cervical laminectomy or anterior decompression and fusion.

Patients with primarily anterior compression, <3 level of disease, kyphotic deformity, absence of congenital canal stenosis and associated radiculopathy were treated with anterior approach. Patients with primarily posterior compression, >3 levels of disease, normal or lordotic deformity, and presence of congenital canal stenosis were treated using posterior approach. Neurological status and clinical status was evaluated after one week, one month, three months and six months of surgery.

Outcome measures

Clinical conditions before ad after surgical treatment were assessed using the modified Japanese orthopaedic association (mJOA) score. The mJOA score was assessed before the operation, at one week, one month, three months and six months. The upper limb function score was defined as the upper limb motor mJOA score plus the upper limb sensory mJOA score.

The lower limb function score was defined as lower limb motor mJOA score plus the lower limb sensory mJOA score. The sphincter function was assessed by the sphincter function mJOA score.

The pattern of neurological recovery in the overall mJOA scores, upper limb function mJOA score, lower limb function mJOA score and sphincter fuction mJOA score after surgical decompression were documented and analysed. The surgical outcome was calculated by the method of "modified recovery rate" described by Hirabayashi.

Stastical analyses were done by students *t* test and *p*-values <0.05 were regarded as stastically significant.

Table 1: Japanese orthopaedic association score (JOA score modified by Keller 1993)

Criterion Points	Points
Motor function	
Paralysis	1
Upper extremity	
Fine motor function massively decreased	2
Fine motor function decelerated	3
Discreet weakness in hands or proximal arm	4
Normal function	5
Motor function	
Unable to walk	1
Lower extremity	
Need walking aid on flat floor	2
Need handrail on stairs	3
Able to walk without walking aid, but inadequate	4
Normal function	5
Sensory	
Upper extremity/lower extremity/trunk	
Apparent sensory loss	1
Minimal sensory loss	2
Normal function	3
Bladder function	
Urinary retention	1
Severe dysfunction	2
Mild dysfunction	3
Normal function	4
Total score	**0–17**

Results

The youngest patient in our body study was 27 years old, whereas the eldest patient was 76 years old. The mean age in our study was 50 years.The commonest clinical presentations in our study were motor symptoms. Most of the patients in our study had symptoms for more than 12 months. The mean duration of symptoms in our study was 14 months.

Thirty three patients (70%) had improvement of the mJOA scores after the operation. The mJOA scores improved gradually after surgical decompression. The mean preoperative mJOA score was 10.81, and it improved to 12.47 at six months follow up. The mean recovery rate was 28%.The *p*-value equals 0.0002 (Table 2).

Table 2: Demographic distribution

Age intervals (in years)	No. of cases	Percentage (%)
21–30	02	4
31–40	12	25
41–50	11	23
51–60	14	30
61–70	07	16
>71	01	2
Total	**47**	**100**
Clinical Symptoms		
Sensory Symptoms		
Radiculopathy	12	26
Paresthesia	4	9
Motor symptoms		
Clumsiness of hands	44	95

Age intervals (in years)	No. of cases	Percentage (%)
Paresis	36	76
Bladder disturbance	8	17
Clinical Symptoms		
Sensory Symptoms		
Radiculopathy	12	26
Paresthesia	4	9
Motor symptoms		
Clumsiness of hands	44	95
Paresis	36	76
Bladder disturbance	8	17
Duration		
<6 months	11	23
6–12 months	17	36
>12 months	19	41

Of the total of forty seven cases, twenty four patients underwent anterior cervical decompression and fusion. The mean pre-operative mJ0A score is 11.3 which increased to 12.9 at the end of six months, with recovery rate of 27%. The *p*-value is 0.0073 which is statistically significant. Twenty three patients underwent cervical laminectomy. The mean preoperative mJOA score is 10.3 which increased to 12.1 at the end of six months, with recovery rate of 26%. The *p*-value is 0.0085 which is statistically significant (Table 3).

Table 3: Outcome based upon the approach

Approach	Total	Preoperative score	Final score	Recovery rate %	*p*-value
Anterior cervical decompression and fusion	24	11.3	12.9	27%	0.0073
Cervical laminectomy	23	10.3	12.1	26%	0.0085

Of twenty four patients who underwent anterior approach, discectomy and fusion with iliac bone graft and instrumentation was performed in sixteen patients. Of these sixteen patients, ten patients underwent single level and six patients underwent two level discectomy. Of eight patients who underwent corpectomy and fusion, single level corpectomy was performed in seven patients and one patient underwent two level corpectomy. The rest twenty three patients who had multi segmental compression underwent decompressive laminectomy (Table 4).

Table 4: Extent of compression and surgery performed

Compression	Total	Surgery Performed
Disc Prolapse		
Single level	10	Discectomy and fusion with iliac bone graft + plates and screws
Two levels	6	
Mid body compression		
Single level	7	Median corpectomy and fusion with iliac bone graft + plates and screws
Two levels	1	
Multi segmental	23	Decompressive laminectomy

The upper limb function had a similar trend as the overall mJOA score. The mean upper limb function score improved from 3.4 preoperatively to 4.3 at six months follow up with an average recovery rate of 35%. The *p*-value is less than 0.0001.

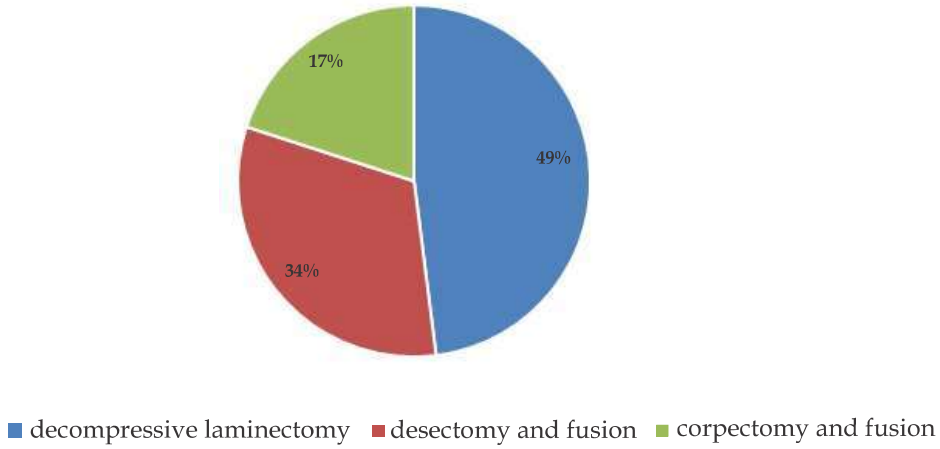

Fig. 1: Surgery Performed

Table 5: Upper limb, lower limb and sphincter function recovery after surgical decompression

	Preoperative score	Final score	Recovery rate%	*p*-value
Upper limb	3.4	4.3	35%	<0.0001
Lower limb	3.8	4.4	27%	0.0071
Sphincter	2.77	2.79	9%	0.8

The mean lower limb function score improved from 3.8 preoperatively to 4.4 at six months follow up with mean recovery rate of 27%.The *p*-value is 0.0071. Nine patients (17%) had an improvement in sphincter function after the operation with the mean preoperative sphincter function mJOA score improved from 2.77% to 2.79% with an average recovery rate of 9%. The *p*-value is 0.8. The pattern of lower limb and sphincter function improvement also followed that of the upper limbs and overall mJOA scores (Table 5).

Table 6: mJOA scores and recovery rates in different age groups, genders and pre-operative duration of symptoms

	Preoperative JOA Score	Final JOA score	Recovery rate %	*p*-value
Age <60	11.2	12.8	28%	0.003
Age>60	10.1	11.9	26%	0.06
Male	10.8	12.4	26%	0.0006
Female	11.1	12.9	31%	0.15
Symptoms duration <6 months	10.7	12.7	32%	0.03
Symptoms duration 6–12 months	11.6	13.1	28%	0.05
Symptoms duration >12 months	10.2	11.8	24%	0.02

Patients aged above 60 years had significantly lower preoperative and final mJOA scores compared with patients aged below 60 years. The mean preoperative mJOA score for patients above 60 years of age was 10.1 and for patients above 60 years of age were 11.9. There was improvement in the mJOA score after surgical decompression in both groups of patients. The mean mJOA score for patients aged above 60 years improved from 10.1 to 11.9 with a recovery rate of 26%. The mean mJOA score for patients aged below 60 years improved from 11.2 to 12.8 with a recovery rate of 28% Both male and female patients had improvement in mJOA scores after surgical decompression. The mean mJOA scores in male patients improved from 10.8 to 12.4 after surgery with a recovery rate of 26%. The mean mJOA scores in female patients improved from 11.1 to 12.9 after surgery with a recovery rate of 31%. The mean mJOA scores for patients with preoperative duration of symptoms less than 6 months improved from 10.7 to 12.7 with a recovery rate of 32%. The mean mJOA scores or patients with a preoperative duration of symptoms from 6–12 months improved from 11.6 to 13.1 with a 28% recovery rate. The mean mJOA scores for patients with a preoperative duration of symptoms of more than 12 months improved from 10.2 to 11.8 postoperatively with a recovery rate of 24% (Table 6).

Table 7: Clinical outcome as per MRI findings

Hyperintense signal on T2W1 images	No. of cases	Improvement	%
Present	17	9	53
Absent	21	18	86

In our study 86% of patients without hyperintense signal on T2W1 images in MRI improved with surgery, compared to only 53% improvement in those with hyperintense signal on T2W1 images. The *p*-value was 0.026763, which is statistically significant (Table 7).

Table 8: Complications of surgery

Complication	Type of Surgery		
	Discectomy with Fusion	Corpectomy with Fusion	Posterior Decompression
Temporary Recurrent laryngeal nerve paresis	1	1	–
Graft slippage	–	1	–
Superficial infection	–	1	1
CSF leak	–	1	–
Dysphagia	1	-	–
Paresthesiae	1	1	–
Neurological deterioration	–	1	1
Persistent donor site pain	1	1	–

Discussion

The present study is a prospective study, comprising of 47 cases studied over a period from August 2010 to December 2012, in the Department of Neurosurgery, Osmania General Hospital, Hyderabad.

Cervical spondylotic myelopathy is a problem of elderly population. However, similar to other degenerative diseases like coronary artery disease, Indians appear to be affected at a much younger age, almost 10–15 years earlier. The mean age in our study was 50 years, which is comparable to 53.7 years by Jain *et al*.[4] in SGPGI, Lucknow and lower when compared to Herkowitz *et al*.[5] (59 years).

Sex incidence in our study was showing a high preponderance among males and is evident in our study too, where 85% were male patients and 15% were female patients with an M:F ratio 6:1.

Most of the patients (41%) in our study had symptoms for more than a year. The mean duration of symptoms in our study was 14 months, which is less when compared with 18.2 months by Jain *et al*. The overall improvement in our study was 70%, which was better than the study by Jain *et al*.[4] (61%) and Herkowitz *et al*.[5] (56%). Motor symptoms were the most common presentation in our study (Table 9).

Patients with cervical spondylotic disease with neurological manifestations, form a heterogeneous group. The surgical options for different subgroups of patients are many. Although many reports of surgical results for various procedures comprising of anterior and posterior decompression have been published, few authors have presented statistical evidence that one procedure is superior to any other. As in other areas of clinical medicine, clear distinction of natural history is the basis against

Table 9: Comparison of various parameters

Parameters	Jain *et al*.[4]	Herkowitz *et al*.[5]	Present study
Age group	30–70	40–80	27–76
Mean age	53.7	59	50
Mean duration	18.2 months	24 months	14 months
Hand grip	96%	92%	95%
Paresis	70%	64%	76%
Sphincter disturbances	37%	46%	34%

which all forms of intervention must be judged. Braakman[6] in his editorial on management of cervical spondylotic myelopathy and radiculopathy discusses as to whether surgery is necessary at all for patients with cervical radiculopathy where in, the results of conservative management are so rewarding. There is need for controlled trails together data on neurological state, age of the patient, levels of spondylotic involvement and duration of symptoms in relation to the natural course of the disease.

In the midst of such wide ranging controversies, we have tried, through a prospective non-randomized study, to compare anterior versus posterior surgery, to analyze the pattern of neurological recovery and the role of various factors in determining the outcome of surgery in these patients.

It is now clearly evident from very many studies, that surgery does benefit patients of cervical spondylosis, by giving lasting relief from troublesome symptoms. The overall improvement of 70% noted in our study is comparable to similar results published in the literature.[7,8,9,10] The recovery rate of patients who underwent anterior decompression is 27%, which is statistically significant. The recovery rate in patients who underwent posterior decompression was almost similar 26%, which is statistically significant. We found no significant difference between the outcomes of the two sub groups.

The mJOA score is commonly used to assess the severity of symptoms in patients with cervical spondylotic myelopathy.[9,10] It assesses the upper limb, lower limb and sphincter functions in terms of the mJOA score after surgical decompression. They gradually improved, reached statistical significance at 3 months then reached a plateau at 6 months.

Chiles *et al*.[11] followed up 75 patients with anterior decompression and anterior spinal fusion done for cervical spondylotic myelopathy for 1 year. He found that 46.7% of patients had improvement of lower limb function and 75.4% patients had improvement in upper limb function. It appeared that the upper limbs recovered better compared with lower limbs. Our study shared similar findings. Thirty patients (64%) had improvement of overall upper limb function compared with twenty four patients (51%) who had improvement of overall lower limb functions. The recovery rate of overall upper limb was the best (35%), followed by lower limb function (27%) then sphincter function (9%). The recovery rate of upper limb and lower limb were statistically significant in our study.

Prognostic factors for surgical treatment of cervical spondylotic myelopathy are still controversial. Tomosato[12] and Fessler[13] reported no difference in neurological recovery in young and older age group patients after surgical decompression. However, Yonenobu[14] showed postoperative recovery of spinal cord function in the older age group is inferior to that of young patients. Our study showed that the recovery rate for patients aged below and above 60 years were 28% and 26%, respectively. The recovery rate of the two age groups was statistically significant in our study.

Tomosato[12] demonstrated patients with a longer duration of symptoms had inferior neurological recovery. Our study shared similar findings. The recovery rate for patients with symptoms duration <6, 6–12, >12 months were 32%, 28%, 24% respectively. The recovery rate in patients with symptoms duration of <6 months and >12 months was statistically significant.

Patients with hyperintense signals from the cord in T2W1 images were reported to be in a worse clinical condition compared to the patients with normal signals in the cord (Wada E *et al*.).[15] This finding was confirmed in our study. 86% of patients without hyperintense signals on T2W 1 images improved clinically after 6 months compared to only 53% of patients with hyperintense signals on T2W1 images. The hyperintense signal, by its presence in the preoperative MRI, could mean either inflammation or edema which is reversible or gliosis, microcavitation, or myelomalacia which are irreversible.

Complications of surgery for cervical spondylotic myelopathy as reported in literature, differs widely not only between authors but also with regard to the techniques employed.[14,15] Overall complication rate of 27.6% seen in our study is similar to the reported literature.[15] We had no mortality. Hoarseness of voice following anterior cervical decompression could be due either to mechanical damage to vocal cords (which needs to be confirmed with direct laryngoscopy following extubation), or to recurrent laryngeal nerve paresis. We have not evaluated the vocal cords for mechanical damage. Presuming the cause of hoarseness of voice in such patients to be due to nerve paresis, our incidence of 2 among 47 patients who underwent anterior decompression is similar to other reported series. Similar to other studies, hoarseness of voice improved completely between 4–12 weeks in our patients. CSF leak is a

known complication and is reported in literature.[16]

We had one such problem following anterior cervical discectomy and it subsided conservatively by medical management. Kotoh K[17] reported 4 graft slippages following surgery among 45 of his patients. We had one such problem. Reported rates of dysphagia following anterior cervical discectomy and fusion ranges from 0% to 24%. In the present study one patient had dysphagia. We had two patients who suffered severe paresthesiae following anterior cervical decompression and fusion. Infection at the operative site is either superficial or deep. We had 2 superficial wound infections. Donor site complications are common. Two patients had persistent donor site pain, which are reported in the literature. We did not find any post laminectomy kyphosis at follow up. Probably prolonged follow up periods are necessary.

Conclusion

There is an increase in the incidence of cervical spondylotic myelopathy due to increase in geriatric population, as the life expectancy has gone high worldwide. Cervical spondylotic myelopathy is commonly seen in elderly age group (mean age is 50 years) and it affects more commonly males. The neurological recovery was apparently best in the upper limb function, followed by lower limb function and least in the sphincter function. The neurological recovery was less in patients with age greater than 60 years, duration of symptoms more than 1 year, sphincter disturbances and hyperintense signal changes in the cord on T2W1 images.

The hypothesis that initiated this study could not be confirmed. There is no significant difference in the outcome between anterior vs. posterior surgery. Anterior surgery had more complications at the early stage after operation which gradually improved. A prospective randomized study is required to address this issue.

The earliest symptoms like clumsiness of hands and mild weakness in limbs are usually overlooked by the patient. By the time moderate to severe weakness of limbs and sphincter disturbance appear it is already late, as the prognosis is related to the duration of symptoms. Proper health education and understanding of the disease at bottom level of health care is more important for better prognosis.

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