

## Quantitative evaluation and grading of neurological recovery after Anterior Cervical Surgery for Single or Double Level cervical Spondylotic Myelopathy

Mahendra Singh<sup>1</sup>, Kuldeep Dhankhar<sup>2</sup>, Nandlal Bharwani<sup>3\*</sup>, Hemant Jain<sup>4</sup>, Kishore Raichandani<sup>5</sup>, Mahesh Bhati<sup>6</sup>

<sup>1</sup>Assistant Professor, M.S. Orthopaedics, Department of Orthopaedics, DR.S.N Medical College, Jodhpur, Rajasthan, India

<sup>2</sup>Senior Resident, M.S. Orthopaedics, Department of Orthopaedics, DR.S.N Medical College, Jodhpur, Rajasthan, India

<sup>3</sup>Senior Resident, M.S. Orthopaedics, Department of Orthopaedics, DR.S.N Medical College, Jodhpur, Rajasthan, India

<sup>4</sup>Associate Professor, M.S. Orthopaedics, Department of Orthopaedics, DR.S.N Medical College, Jodhpur, Rajasthan, India

<sup>5</sup>Senior Professor, M.S. Orthopaedics, Department of Orthopaedics, DR.S.N Medical College, Jodhpur, Rajasthan, India

<sup>6</sup>Senior Professor and HOD, M.S. Orthopaedics, Department of Orthopaedics, DR.S.N Medical College, Jodhpur, Rajasthan, India

Received: 18-11-2021 / Revised: 28-12-2021 / Accepted: 14-01-2022

### Abstract

**Background:** Cervical Spondylotic Myelopathy (CSM) is a common cause of spinal cord dysfunction it may lead to function disability as well as neurological deterioration. Surgical decompression is essential in progressive disease. Postsurgical neurological recovery assessment is essential. Most of these methods of assessment is either subjective or numerical values at a time. It is important to quantify these outcome and grade it into a scale for better understanding. **Materials and Methods:** 48 patients with single or double level CSM underwent anterior cervical discectomy and fusion (ACDF) or anterior cervical corpectomy and fusion at our institute from January 2017- 2019. Data analyzed for age, sex, duration of follow-up, operative time, blood loss and complication. Moderate and severe grade myelopathy considered surgical candidates. 31 patients had moderate (mJOA, 12-14) and 14 patients had severe (mJOA, 11 and less) myelopathy. Metallic spacer for ACDF and titanium mesh cage (TMC) for ACCF with Morcellised local auto graft and all cases supplemented with variable angle cervical plates. MJOA scores and Hirabayashi recovery rate calculated at 1<sup>st</sup> month, 3<sup>rd</sup> month, 6<sup>th</sup> month and 12<sup>th</sup> month post-operatively. **Results:** Out of 48 patients, we had final follow-up of 45 patients. Mean age of our study 58.53±6.61 years (range 35- 73 years) Mean duration of follow-up 19.71±5.29 months (13 – 34 Months). Mean operative time and mean blood loss was more in single level ACCF cases as compare to single ACDF cases. C5-C6 ACDF and C5 Corpectomy were most performed surgeries in our study. Our all patient has shown neurological recovery from some to complete extent at final follow-up of 12 months. All moderate grade patient improved to mild grade or normal neurology and all severe grade patients improved to either moderate or mild grade. We have observed 100 % improvement in mJOA grade after anterior cervical surgery. At 12 months follow-up, 12 patients had normal (18) mJOA Score, 30 mild (mJOA, 15-17) grade and 3 moderate grade. At final follow-up 93.3% patients had shown excellent to good recovery rate (29/ 45 excellent, 13/45 good whereas 3/45 (6.66%) have shown fair recovery rate. One patient had deep surgical site infection, three patients had transient dysphagia, one had dural injury and one patient had subsidence of TMC. **Conclusion:** Anterior cervical surgery is safe and effective surgery for single/ double level cervical spondylotic myelopathy (CSM) with less complication rates.

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

### Introduction

CSM is form of degenerative disease, which is progressive in nature and one of the most common cause of neural dysfunction in modern world[1-3]. Disc degeneration and new osteophytes formation in middle age exaggerate the symptoms[4]. Cord compression can be seen in the form of osteophyte formation, facet joint arthropathy, ligament flavum hypertrophy and disc herniation. CSM usually presents with progressive fine motor dysfunction, affected hand dexterity, and worsening gait balance. Clinically these patients have UMN signs like hypertonia, exaggerated DTRs, positive Hoffman's

sign and Positive Babinski sign.

This symptoms pattern can be asymmetrical depends on site of compression[5]. Upper and lower extremity sensorimotor dysfunction and sphincter disturbance most commonly occur in a slow pattern with disease progression, although rapid neurological decline can occur in a minority of cases[5].

Firstly, conservative treatment in the form of neuralgic pain relievers, physiotherapy and use of soft/ hard cervical collar for immobilization offered to them[6]. Most of cases do not respond to conservative treatment and they followed slow and gradual neurologic dysfunction which graded over time in form of mJOA scoring. It is very well-established surgical decompression of the cervical cord is most effective way of treatment in CSM. Adequate decompression at least halts the further progression, and it may provide functional recovery. CSM can be treated with anterior, posterior or combined procedures, each have specific advantages and disadvantage[7].

\*Correspondence

**Dr. Nandlal Bharwani**

Senior Resident, M.S. Orthopaedics, Department of Orthopaedics, DR.S.N Medical College, Jodhpur, Rajasthan, India.

E-mail: [nandlalbharwani21@gmail.com](mailto:nandlalbharwani21@gmail.com)

Most appropriate surgical plan depends on the location of compression, no of affected levels, stability and alignment of the cervical spinal, medical comorbidity and surgeon's expertise. Advantage of Anterior approach that it allows direct decompression of ventral pathology, better fusion rate, less infection rate and better restoration of lordosis[8,9]. They found that all the compressive surgeries were better approached and handled anteriorly than posterior approach to cervical spine[9].

Assessment of clinical outcome after surgical intervention has paramount importance. It can be qualitative in forms of functional well-being as well as quantitative in the form of neurological recovery grading. Many authors have used different methods to assess clinical outcome after anterior cervical surgery. Sampath et al[10] used telephonic interview to know about recovery and Liu[11], Uribe[12], Chagas[13] used Odom's criteria to assess postoperative clinical outcome after anterior cervical surgery (ACDF /ACCF). Odom's Criteria is a subjective criterion to assess patient recovery in terms of their ability to perform daily occupation tasks. With availability of well accepted m JOA score[14] it is important to quantify surgical outcome into scoring points. MJOA is highly reproducible criteria Every individual have a certain numerical score at different point of time and different stage of disease. It is difficult to make any inference by a numerical value regarding postsurgical clinical outcome. To better understand this aggregated numerical m JOA score we require it grading on a scale at every follow-up. It helps us to understand recovery trend at every follow-up. Hirabayashi Recovery rate[15] formula is utilized to grade them into excellent to poor outcome. Many authors utilized Nurick grade, Odoms criteria and Mjoa score to assess clinical outcome of anterior cervical surgery in CSM but Literature regarding quantitative assessment of clinical outcome after anterior cervical surgery in form of recovery rate is scanty. So we rare using MJOA and Hirabayashi recovery rate to evaluate these results.

Aim of this study to evaluate clinical Outcome of Anterior Cervical Surgery in Single Or Double Level Cervical Spondylotic Myelopathy (CSM).

#### Materials and methods

After getting ethical committee clearance, a prospective analysis of 48 patients with cervical spondylotic myelopathy who underwent ACDF or ACCF by a single surgeon at our institute in dept. of orthopedics from 2017 to 2020 with minimum 1 yr follow up analyzed. Patients with age group 40-80 years, single / double level CSM, signs and

symptoms of cord compression, failed conservative trial, and m JOA score in moderate / severe category were included in this study. Patients with cervical trauma, Previous Cervical surgery, tandem spinal stenosis, primary cord pathology, Myelopathy due to OPLL (ossification of posterior longitudinal ligaments), radiculopathy without myelopathy, congenital spinal deformity, and metastatic disease were excluded.

Detailed clinical evaluation with calculation of mJOA and grading as mild (15-17), moderate (12-14) and severe (11 or less) done. Radiological analysis in form of Antero-posterior and erect lateral radiograph of cervical spine to assess cervical spine alignment .CT Scan Cervical Spine for preoperative planning and to rule out OPLL. MRI (Magnetic Resonance Imaging) of cervical spine with whole spine screening for clinico- radiological correlation, to identify affected level and degree of compression. Patients with failed response to conservative treatment and worsened over period of time with moderate and severe grade (m JOA score), considered for surgical intervention. In our study, we performed ACDF (Anterior Cervical Discectomy with Fusion) for in disc space level compression and ACCF (Anterior Cervical Corpectomy and Fusion) in retro vertebral with disc space level compression.

Post-surgery clinical assessment on every visit with m JOA Score to see the change in neurological status. Hirabayashi recovery rate (RR)<sup>15</sup> Method utilized to see postoperative clinical improvement they quantified based on Recovery rate into four groups accordingly (RR)=(postoperative JOA score–pre-operativeJOA score) / (max score–preoperative JOA score)×100%.A score of 75 to 100% was designated as excellent, 50 to 74% as good, 25 to 49% as fair and 0 to 24% as poor<sup>15</sup>.

#### Surgical Technique[16]

Left Anterior approach with transverse incision used. Appropriate size titanium disc spacer for discectomy and titanium mesh cage (TMC) for corpectomy filled with local autologous graft used. All cases supplemented with appropriate size variable angle anterior cervical plates. Hard Cervical collar for 6 weeks followed by soft cervical collar for 6 weeks. All patient advised to follow strict rehabilitative training programme at our institute.

Review at 1st, 3rd, 6th and 12th month postop with X-ray Cervical spine, mJOA score charting done on every follow-up. Follow-up CT Scan at 6 months to see fusion status and MRI to see decompression status of cord.

#### Case 1: Showing ACCF procedure

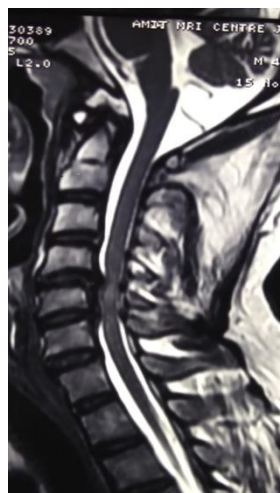


Fig-1: Sagittal section of cervical spine mri showing retrovertebral compression at C5 level



Fig-2: Corpectomy at C5 level shown in lateral view of cervical spine

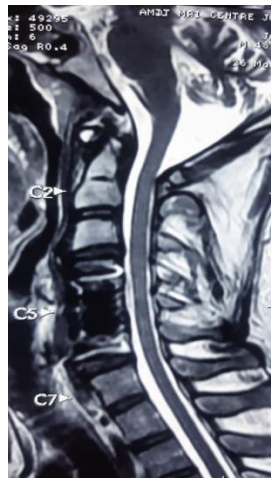


Fig-3: Showing post-operative Mri cervical spine at One year follow-up

Case 2: Showing ACDF procedure

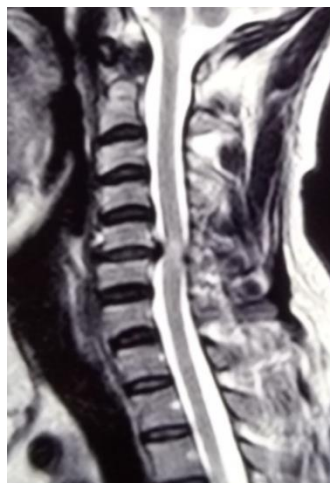


Fig-4: Sagittal section of MRI cervical spine showing disc level compression at C5-C6 level



Fig-5 ACDF at C5-C6 level shown in lateral view of cervical spine



Fig-6: Showing Post-operative MRI of cervical spine at one year follow-up

**Results**

Mean age of our study was 58.53±6.61 years (range 35- 73 years) with male to female ratio 30:18 . 28 patients had single level and 20 had double level involvement. 28 Patient underwent Single level ACDF, 8 patients underwent Double level ACDF and 12 patient underwent ACCF .We have mean duration of follow-up was 19.71±5.29 months (13 – 34 Months).

Mean operative time in Single level ACDF 65.43±9.55 minutes (range, 45-80) Double level ACDF group 115.25±9.0minutes (range, 135-150) and ACCF group was 149.50±10.01 minutes (range, 140 -

170). Mean blood loss in Single level ACDF 96.89±21.28 ml (range, 60-200) Double level ACDF group 120.50±13.72 ml (range, 100-320) and ACCF group was 195.33±15.91 ml(range, 180 -550) . Among ACDF group C5-C6 ACDF were most commonly Performed and ACCF group, C5 Corpectomy was most commonly performed.

At the last we had follow-up of 45 patients as 3 patients had follow-up of less than 6 months. Table- 1 and Graph-1 shows improvement in m JOA score when compared preoperatively and postoperatively whereas Table 2 and Graph-2 shows Recovery Rate score used postoperatively to see clinical improvement.

**Table 1: m JOA score of patients**

Score	Preoperative	1 <sup>st</sup> month postoperative	3 <sup>rd</sup> month postoperative	6 <sup>th</sup> month postoperative	12 <sup>th</sup> month postoperative
Normal (18)	0	0	0	4	12
Mild (15-17)	0	7	25	28	30
Moderate (12-14)	31	28	15	10	3
Severe (<11)	14	10	5	3	0

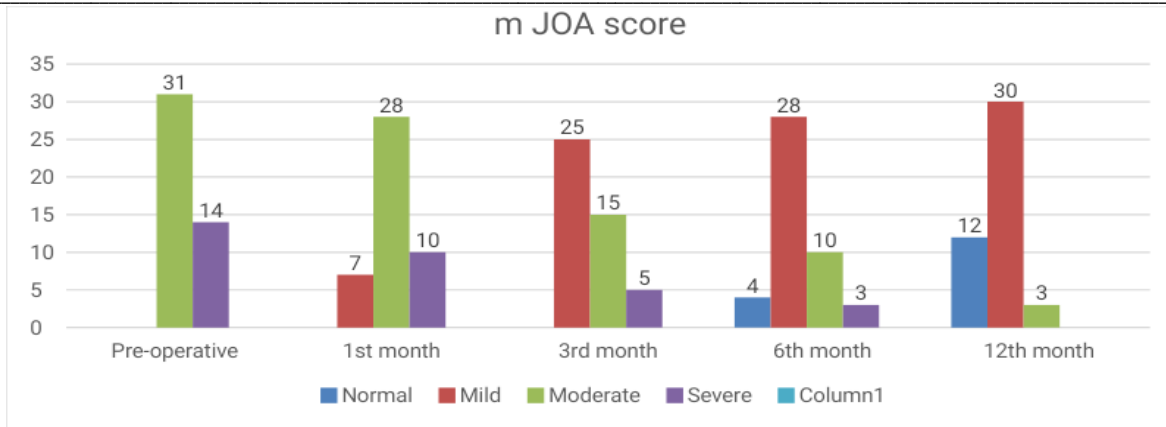


Fig.7: m JOA score

Table-2: Post surgery Recovery rate (RR)

Recovery Rate	1 <sup>st</sup> month	3 <sup>rd</sup> month	6 <sup>th</sup> month	12 <sup>th</sup> month
Excellent	0	1	9	29
Good	4	19	25	13
Fair	14	21	9	3
Poor	27	4	2	0

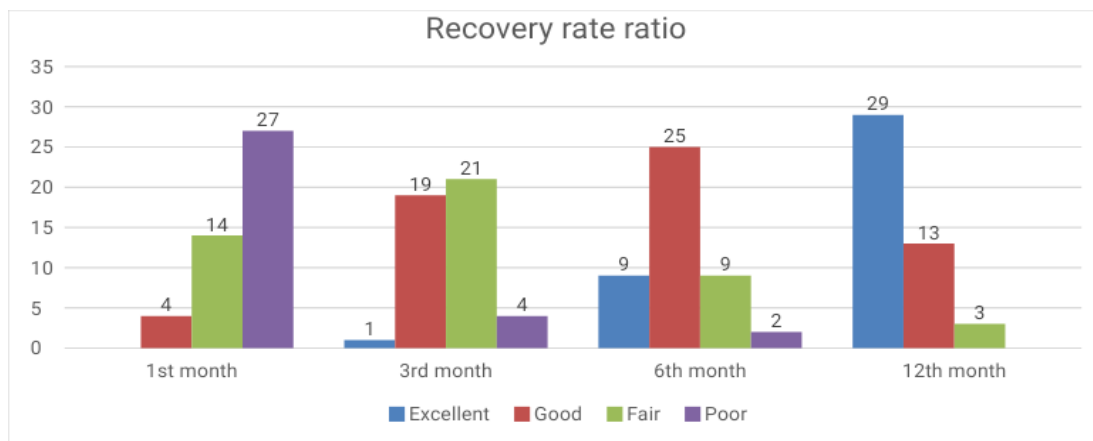


Fig. 8: Recovery rate ratio

In our study we have 31 patients in moderate and 14 patients in severe grade of CSM. After appropriate surgical intervention (ACDF/ACCF) patients has started showing signs of recovery from 1 month post op. At 1 month postop, 6 patients of moderate grade improved to mild grade, 1 patient of severe grade improved to mild grade and 3 patients of severe grade improved to moderate grade. At 3rd month 16 more patients from moderate to mild, 2 patients from severe to mild and 3 patients from severe to moderate grade. At 6-month, 5 more patients from moderate to mild, 2 patients from severe to mild and 4 patients recovered to normal. At final follow-up of 12 months 10 more patients improved from moderate to mild, 3 patients from severe to moderate group, no patient were in severe grade and 12 patients recovered to normal. At this stage we have 12/45 patients with Normal neurology, 30/45 patients in mild grade, 3/45 patients in moderate grade and none in severe grade. Our 31 patients of moderate grade and 11 patients of severe grade has improved to either mild grade or normalcy at 12 months follow-up. Out of 14 patients in severe grade 11 improved to mild and 3 improved to moderate grade at final follow-up. Our all patient has shown recovery from some to complete extent at final follow-up of 12 months. We have observed 100 % improvement in mJOA grade after anterior cervical surgery in CSM.

We have calculated recovery rate by using Hirabayashi Recovery rate formula at every follow-up and results are summed up in table 2. At final follow-up at 12 months 29/45=64% patient had shown excellent and 13/45 = 29% has shown good recovery. So, 42/45 = 93.3% patients had Excellent to good outcome at final follow-up. In Our study we observed dysphagia in three patient (2 ACCF & 1 ACDF, 3/45 =6.67 %) which managed conservatively, it resolved after 3 weeks in two patients and 4 weeks in one patient. One patient had deep SSI with copious purulent discharge from surgical site on 5th day post op, underwent emergency surgical exploration with wound wash and IV antibiotics for 2 weeks. Had Dural injury in one ACCF patient, managed with intraoperative microsurgical repair, fibrin glue application and Continuous Sub arachnoid lumbar drain placement for one week. No signs of CSF leakage observed in follow-up and wound healed routinely. TMC Subsidence in inferior end plate at third week post-operative with continuous axial neck pain, hard collar immobilization extended up to 3 months, Axial neck pain resolved and no further subsidence observed.

**Discussion**

CSM is a degenerative condition of cervical spine which is progressive with increasing age[17]. Extent of disease and improvement in neurological status after surgery are important[14].

The age group which was most commonly affected was 58.53±6.61 years which was comparable to study by Azimi et al age in range of 54±8.3 years[14]. In our study most common level at which pathology seen was C5-C6 level which was comparable to study conducted by Ali et al[18]. In our study ACCF cases were associated with more mean operative time and mean blood loss, which is similar to Chul et al. However, few studies have reported on the pattern of neurological recovery, while to our knowledge, none have reported on anterior surgery in an Indian population.

In our study patients undergone anterior cervical surgery showed improvement in activities of routine and improvement in neurological symptoms which was comparable to study by Fehling MG et al[17,18] showed improved quality of life in. Sampath et al[10] observed surgically treated patients improved functionally as well as neurologically and non-surgically had a significant worsening of their ability to perform activities of daily living, with worsening of neurologic symptoms. By unique satisfaction assessment they concluded that 87% of the patients would decide again for the surgical procedure if the results were previously known. Srinivasan[9] studied 40 cases and found neurological improvement in 50 to 80% of patients after anterior surgery. Liu et al[8] concluded According to the Odum criteria, the percentage of patients with excellent and good clinical outcomes was 84.1% in the ACDF group, 79.5% in the ACCF group. Sampath[10] concluded that 87% of the patients would decide again for the surgical procedure if the results were previously known. Chagas et al[13] observed that 97.4% of the patients had a better or equal postoperative Nurick score after anterior cervical surgery and fusion in cervical myelopathy. Fessler et al reported, 92% of patients experience symptom improvement after anterior decompression and fusion for CSM. In our study We have observed 100% improvement in mJOA grade after anterior cervical surgery in CSM. At final follow-up at 12 months 31/45=69% patient had shown excellent recovery. 43/45 = 95% patient had Excellent to good outcome at final follow-up Uribe et al[12] in comparative study of ACCF and ACDF observed that 41/42 ACDF patient (97.6%) and 36/38 ACCF patients (94.7%) had shown excellent to good recovery after surgery at minimum 12 months follow-up. Use of mJOA score for quantitative assessment of neurological dysfunction and grading of neurological outcome as per Hirabayashi recovery rate make it simple to understand. Simultaneous use of both of these improve authenticity of recovery grading.

#### Limitation

The only limitation of our study was that our follow-up period is short and to validate these results long- follow-up with larger study group is a future research scope.

#### Conclusion

Anterior cervical surgery for one or two level CSM is proved to be safe and effective with excellent recovery rate. All patient has improved their myelopathy grade after surgery.

#### References

- Singh A, Tetreault L, Casey A, Laing R, Statham P, Fehlings MG. A summary of assessment tools for patients suffering from cervical spondylolytic myelopathy: a systemic review on validity, reliability and responsiveness. *Eur Spine J.* 2015.
- Edwards CC 2nd, Riew KD, Anderson PA, Hilibrand AS, Vaccaro AF. Cervical myelopathy. Current diagnostic and treatment strategies. *Spine J.* 2003
- Young WF. Cervical spondylolytic myelopathy: a common cause of spinal cord dysfunction in older persons. *Am Fam Physician.* 2000
- D.C Baptiste, M.G. Fehlings, Pathophysiology of cervical myelopathy, *Spine J.* 2006;6 (6):1.
- Yoshimatsu H, Nagata K, Goto H, Sonoda K, Ando N, Imoto H, Mashima T, Takamiya Y. Conservative treatment for cervical spondylolytic myelopathy. prediction of treatment effects by multivariate analysis. *Spine J.* 2001 Jul-Aug;1(4):269-73.
- Lin Q, Zhou X, Wang X, et al. A comparison of anterior cervical discectomy and corpectomy in patients with multilevel cervical spondylolytic myelopathy. *Eur Spine J.* 2012; 21(3): 474-481.
- Clinical outcome of cervical spondylolytic myelopathy in preoperative and postoperative period R. Srinivas
- Outcome of Patients Treated for Cervical Myelopathy A Prospective, Multicenter Study With Independent Clinical Review Prakash Sampat
- Liu Y, Qi M, Chen H, et al. Comparative analysis of complications of different reconstructive techniques following anterior decompression for multilevel cervical spondylolytic myelopathy. *HSSJ. Eur Spine J.* 2012; 21(12): 2428-2435.
- Uribe JS, Sangala JR, Duckworth EA, Vale FL. Comparison between anterior cervical discectomy fusion and cervical corpectomy fusion using titanium cages for reconstruction: analysis of outcome and long-term follow-up. *Eur Spine J.* 2009;18(5):654-662.
- Azimi P, Shahzadi S, Benzel EC, Montazari A. Functional evaluation using the modified Japanese Orthopaedic Association score (mJOA) for cervical spondylolytic myelopathy disease by age, gender, and type of disease. *J Inj Violence Res.* 2012;4.
- Hirabayashi K, Miyakawa J, Satomi K, Maruyama T, Wakano K. Operative results and postoperative progression of ossification among patients with ossification of cervical posterior longitudinal ligament. *Spine (Phila Pa 1976).* 1981;6:354-64.
- Gardocki RJ. Spinal anatomy and surgical approach. *Campbell's Operative Orthopaedics.* 11th edition(2)
- Fehlings MG, Smith JS, Kopjar B, Arnold PM, Yoon ST, Vaccaro AR, et al. Perioperative and delayed complications associated with the surgical treatment of cervical spondylolytic myelopathy based on 302 patients from the AOSpine North America Cervical Spondylolytic Myelopathy Study. *J Neurosurg Spine.* 2012;1.
- Ali MI, Ahsan K, Awwal MA, Khan RH, Akhond S, Das KP, et al. Treatment of cervical disc prolapse by anterior cervical discectomy fusion and stabilization with plating. *Mymensingh Med j.* 2009; 18(2):1.
- Fehlings MG, Wilson JR, Kopjar B, Yoon ST, Arnold PM, Massicotte EM et al. Efficacy and safety of surgical decompression in patients with cervical spondylolytic myelopathy: results of the AO Spine North America prospective multi center study. *J Bone Joint Surg Am.* 2013.
- Fessler RG, Steck JC, Giovanini MA. Anterior cervical corpectomy for cervical spondylolytic myelopathy. *Neurosurgery.* Aug 1998;43(2):257-265.
- Chul Oh MC, Zhang HY, Park JY, Kim KS. Two-level anterior cervical discectomy versus one-level corpectomy in cervical spondylolytic myelopathy. *Spine (Phila Pa 1976).* 2009 Apr 1;34(7):692-6.

**Conflict of Interest: Nil Source of support: Nil**