



## Surgical Management of Cervical Spondylotic Myelopathy

Sah S,<sup>1</sup> Wang L,<sup>2</sup> Dahal M,<sup>1</sup> Acharya P,<sup>3</sup> Dwivedi R<sup>3</sup>

<sup>1</sup>Department of Orthopaedic, Koshi Zonal Hospital, Biratnagar, Koshi, Nepal, <sup>2</sup>Zhengzhou University, China, <sup>3</sup>Department of Orthopaedic, Nepalgunj Medical College, Nepalgunj, Nepal.

### ABSTRACT

**Introduction:** The surgical procedure by the anterior, posterior and combined antero-posterior approaches had applied for the treatment of cervical spondylotic myelopathy.

**Methods:** During the treatment process, all patients were pre-operatively as well post-operatively graded according to Japanese Orthopaedics Association. Several surgical methods such as anterior approach, posterior approach, and combined antero-posterior approach have been addressed for CSM patients, with the choice based on the pathogenesis of the myelopathy. The main indications for surgery were evidence of myelopathy on physical examinations, a JOA score below 13 points help with spinal cord compression observed on plain X-ray, CT scan, MRI studies.

**Results:** The pre-operative JOA scores were  $7.60 \pm 1.23$  in laminoplasty,  $8.30 \pm 1.03$  in discectomy and corpectomy and  $7.10 \pm 1.20$  in combined antero-posterior approach patients. At the follow-up after three months the JOA scores were laminoplasty  $13.30 \pm 1.30$ , discectomy and corpectomy  $13.55 \pm 1.15$  and combined antero-posterior  $13.50 \pm 1.08$ . The JOA recovery rate averaged,  $61.08 \pm 11.25\%$  in laminoplasty,  $60.67 \pm 10.60\%$  in discectomy and corpectomy and  $64.67 \pm 10.72\%$  in combined antero-posterior approach. The high- signal intensity changed to normal in 18 out of 28 and no any kyphotic change and instability were found in cervical spine at the follow up.

**Conclusions:** Patients with OPLL (continuous, segmental and mixed type), stenosis of cervical spinal canal, multilevel cervical spondylosis, large and high ossification of IVD with stenosis were improved with laminoplasty. Patients with PIVD, CSM with kyphosis, post laminectomy, OPLL herniated type, unstable vertebral alignment, stenosis by osteophytes, were improved with anterior approach. Ossified or deformed OPLL, unstable vertebral with stenosis, OPLL or OYL with cervical meandearing (swan-neck) were improved with Combined anterior and posterior approach.

**Keywords:** Cervical spondylotic myelopathy, anterior cervical discectomy and fusion, corpectomy

### INTRODUCTION

Cervical spondylotic myelopathy (CSM) is the secondary to degenerative changes in the cervical spine often include Prolapse intervertebral disc (PIVD), ossification of posterior longitudinal ligament (OPLL), ligamentum flavum hypertrophy, uncovertebral and facet joint osteophytosis which compress the spinal cord and subsequently lead to its injury and dysfunction. Patients

with CSM will generally have these symptoms: neck stiffness; unilateral or bilateral deep aching neck, arm and shoulder pain; motor or sensory changes upper limb and possibly stiffness or clumsiness while walking.<sup>1</sup>

**Correspondence:** Dr. Shambhu Sah, Department of Orthopaedic, Koshi Zonal Hospital, Biratnagar, Koshi, Nepal. Email: drssah@yahoo.com, Phone: 9852027513.

The operative treatment of CSM is recommended for patients who have either substantial or progressive impairment of neurological function or failed conservative management.<sup>2</sup> The goal of surgical treatment for CSM is the decompression of the spinal cord and maintenance of spinal stability.

## METHODS

A cross sectional study was conducted in Zhengzhou University, China from September 2004 to September 2005. Patients of cervical spondylotic myelopathy were studied after the consent. In this study Clinical, Radiological and Surgical selection are applied. During the treatment process, we had found the major Fifty patients included in this study. All patients were pre-operatively as well post-operatively graded according to Japanese Orthopaedics Association (JOA). Several surgical methods such as anterior approach, posterior approach, and combined antero-posterior approach have been addressed for CSM patients, with the choice based on the pathogenesis of the myelopathy. The optimal surgical management of the CSM remains controversial. The main indications for surgery were evidence of myelopathy on physical examinations, a JOA score below 13 points help with spinal cord compression observed on plain X-ray, CT scan ,MRI studies.(Table 1) Points in favour patients treated medically show continual progressive neurological deterioration, patients with CSM are at an increased risk of spinal cord injury from relatively mild traumatic events and early surgery can improve prognosis.<sup>3</sup>

X-ray was done to determine the disc height, size of the spinal canal, stability of spine with its curvature and range of motion (ROM). MRI was done to provides a soft tissue overview, demonstrates intrinsic signal changes in the spinal cord, visibility of CSF, MSCS (multisegmental cervical spondylosis).<sup>4</sup>

In this study 20 patients M/F: 13/7 age  $52 \pm 7$  were selected for laminoplasty, among them 11 were suffering from OPLL (7 continuous type, 3 mixed type and 1 segmental type), six patients were suffering from more than three segmental disc herniation out of which 3 had developed stenosis, 2 were suffering from OYL with developed stenosis and 1 pt. suffered from ossified disc herniation.

Laminoplasty falls into two categories: the unilateral hinge type and bilateral hinge type of laminoplasty. The decompression effect of laminoplasty consists of two distinct mechanisms. One is a direct posterior decompression effect and other is an indirect anterior decompression effect obtained by the posterior shift of the spinal cord from the anterior compressive lesions.<sup>5</sup> Kyphosis, isolated radiculopathy, loss of anterior

column support resulting from infection, trauma, and tumor in vertebral body were the contraindications. Currently, cervical plating systems incorporate a bone fixation screw secured by a locking mechanism. The locking mechanism has been evolved for two functions; one is to increase plate-screw rigidity while allowing unicortical fixation of the plate to the vertebra and the second is to prevent pushout failure of the screw from the plate.<sup>6</sup>

The statistical analysis were done using statistical package for social sciences (SPSS) version 15 for windows.

## RESULTS

Total 20 patients underwent laminoplasty through Hirabayashi's method, 20 underwent discectomy and corpectomy and 10 received combined antero-posterior surgery. Average follow up period was 3 months.

During laminoplasty, intraoperative CSF leakage in 2 was due to adhered yellow ligament which was repaired by suturing and facial patching. Post-operative C5 palsy was seen in 6 cases, which improved during follow up. During the follow up no kyphotic change, restenosis and instability were seen in patients treated with laminoplasty. To prevent postoperative hematoma we used drainage, which was removed after around 35 hours.

Twenty patients underwent discectomy and corpectomy. In 18 autogenous anterior iliac crest for bone graft with plating (Orion Sofamore plate) was done. Two patients used titanium mesh cage with cancellous bone from resected vertebral body with plating. There were no infections, neurological or graft-related complications (e.g. extraction, collapse, subsidence or kyphosis) and no hardware failure such as plate fracture, migration of cortical screw or malposition. No pseudarthrosis, hoarseness, adjacent disc degeneration and kyphotic change were found on follow up. Two complained of pain in iliac bone graft donor site during the follow up. Five experienced transient symptoms of mild dysphagia. This dysphagia resolved in all patients within 3 weeks after surgery. To avoid hematoma, we used rubber stick drainage, which was removed after around 24 hours (Table 1).

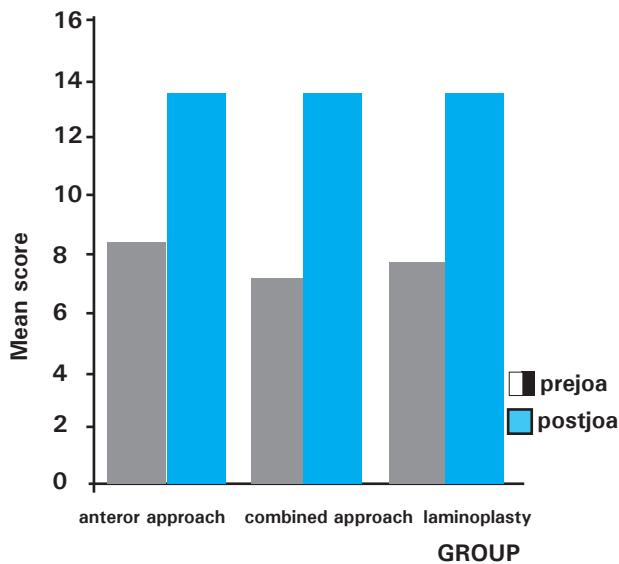
Ten patients underwent combined (laminoplasty with or without anterior approach, at the same sitting or at a different sitting) surgery. Among them single staged operation (first laminoplasty and then ACDF) was done on 3 patients. Two underwent anterior approach surgery, the outcome of which was not good so they underwent laminoplasty after about 9 months. The remaining 5 underwent laminoplasty followed by anterior approach

surgery after about six months. Transient dysphagia was seen in 3 patients and transient hoarseness was found in 4 patients. Those who underwent single staged operation used resected spinous process as bone graft in anterior discectomy.

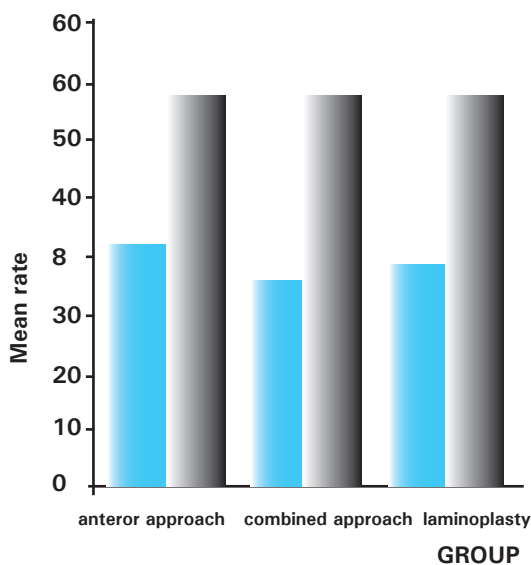
Out of 50 patients, 28 patients showed the presence of high signal intensities within spinal cord in T2 – weighted MRI image. Total 18 out of 28 patients showed improvement towards normal in the high-signal intensity T2- weighted MRI.

**Table 1.** Study population's particulars.

	Laminoplasty	Discectomy and Corpectomy	Combined
Age (year)	52 ± 8	56 ± 12	52 ± 14
Gender (male:female)	13:7	12:8	9:1
Preoperative sagittal alignment			
Lordotic	15	12	3
Straight	5	3	2
Kyphosis		4	4
Meandering		1	1
Pre-operative JOA score	7.60 ± 1.23	8.30 ± 1.03	7.10 ± 1.20
JOA score at the follow up	13.30 ± 1.30	13.55 ± 1.15	13.50 ± 1.08
Recovery rate	61.08 ± 11.25%	60.67 ± 10.60%	64.67 ± 10.72%
Mean operative time	1 ½ hour	1 ½ hour	3 ½ hours
Mean blood loss	150ml (100-300ml)	Discect - 65 ml (40-100ml) corpec-200ml	275ml (200-350ml)
Mean post-operative neck collar removed	5 weeks	2 ½ weeks	6 weeks
Mean post-operative drainage removed	35 hours	20hours	48 hours



**Figure 1.** Pre-operative and post-operative JOA score in patients for anterior approach, combined antero-posterior approach and laminoplasty.



**Figure 2.** JOA recovery rate in anterior approach, combined antero-posterior approach and laminoplasty.

JOA score improved to more than 13 points (Table 2). Regarding predictors of surgical outcomes, the following factors such as the preoperative transverse area of the spinal cord at the site of maximal compression, the age at the time of surgery, the chronicity of the myelopathic symptoms (preoperative JOA score), the multiplicity of involvement, the high-signal changes on T2-weighted images of the spinal cord before decompression and the sagittal cervical alignment have been considered the key predictors.<sup>7</sup>

**Table 2.** Japanese Orthopaedics Association Score.

VARIABLE	Grade
<b>1. MOTOR FUNCTION</b>	
<b>A)UPPER EXTREMITY</b>	
- Unable to feed oneself	0
-Unable to handle chopsticks; able to eat with a spoon	1
-Handles chopsticks with much difficulty	2
- Handles chopsticks with slight difficulty	3
-Normal	4
<b>B)LOWER EXTREMITY</b>	
-Unable to stand and walk by any means	0
-Unable to walk with/out a cane or other support on a level	1
-Walk independently on a level surface but needs support on stairs	2
-Capable of fast walking but clumsy	3
-Normal	4
<b>2.SENSORY FUNCTION</b>	
<b>A)UPPER EXTREMITY</b>	
-Apparent sensory loss	0
-Minimal sensory loss	1
-Normal	2
<b>B)LOWER EXTREMITY</b>	
-Apparent sensory loss	0
-Minimal sensory loss	1
-Normal	2
<b>C)TRUNK</b>	
-Apparent sensory loss	0

## DISCUSSION

This study shows that the major parameter i.e. the

-Minimal sensory loss	1
-Normal	2
<b>3)BLADDER FUNCTION</b>	
-Urinary retention and/or incontinence	0
-Sense of retention and/or dribbling and/or thin stream	1
-Urinary retardation and/or pollakiuria	2
-Normal	3
Total	17

**Recovery rate (by Hirabayashi method) =**

$$\frac{\text{Postoperative score-Poreoprative Score}}{17(\text{full score})-\text{preoperative score}} \times 100(\%)$$

Several modifications of laminoplasty were proposed to keep the cervical alignment. Hirabayashi et al described two mechanisms of neural recovery as the result of laminoplasty. The decompression effect of laminoplasty consists of two distinct mechanisms. One is a direct posterior decompression effect and other is an indirect anterior decompression effect obtained by the posterior shift of the spinal cord from the anterior compressive lesions. The dorsal shift of the spinal cord is achieved only in patients with a lordotic cervical spine. The spinal cord of a kyphotic cervical spine moves less posteriorly, and these patients still have some anterior compression after laminoplasty. Several authors described unfavorable results in patients with loss of lordosis that decreases the shift of the spinal cord. The curvature and the range of motion of the cervical spine have been reported to decrease after laminoplasty. The main cause of this change in curvature could be destruction of the facet joint by the lateral gutters formed as part of the laminoplasty, or the change could be the result of damage of the paravertebral muscles and their attachments to the spinous processes. Postoperative weakness of the posterior structure of the cervical spine may also be an etiological factor. Using spacer method of posterior element-preserving laminoplasty may initially seem complicated but can be performed more quickly as surgeons become more familiar with the procedure. Lateral mass spinal fixation is a safe and effective stabilization technique.<sup>8</sup>

The possible causes of axial pain after laminoplasty were disuse atrophy of the nuchal muscles and prolonged bracing and bone graft on the hinged side might increase the risk for axial pain. Postoperative laminoplasty C5 palsy is defined as paresis of the deltoid muscle and/or the biceps brachii muscle after cervical

decompression surgery without any deterioration of myelopathy symptoms. Half of affected patients complain of sensory deficits and/or intractable pain in the shoulder region (C5 dermatome area) as well as muscle weakness, whereas the other half manifest only motor weakness in the C5 area. Recurrent stenosis may occur after laminoplasty if laminae are elevated insufficiently to allow for adequate canal expansion or if the laminae are displaced anteriorly in the postoperative period. ROM: On radiological findings, some authors reported that range of motion of the cervical spine was reduced (22–70%) after laminoplasty.<sup>9</sup>

Transient dysphagia results from prolonged traction on the esophagus during surgery. Complications of the decompressive procedure involve vertebral artery injury, dural tear, and iatrogenic spinal cord injury. Injury to the vertebral artery can be avoided by strict orientation to the midline, and preoperative review of a computer tomography scan to rule out an anomalous vertebral artery. Furthermore, screws may fail to lock to the plate, leading to backing out and possible visceral injury. The injury of laryngeal nerve cause transient hoarseness. Adjacent-level disease is defined as the development of a new radiculopathy or myelopathy referable to a segment adjacent to a previously fused level in the cervical spine. Pseudarthrosis after an anterior cervical discectomy and fusion is a well-known complication. However, not all pseudoarthroses are symptomatic or require a subsequent surgical repair. Kyphotic change in patients who undergo Cervical corpectomy (CC) results from the axial loading on the graft before it is incorporated into the spine and its subsidence into the adjacent softer medullary bone of the vertebral bodies.<sup>10</sup>

The most common site for donor graft harvesting is the iliac crest. Minor complications include superficial infection, superficial seroma, minor hematoma, and pain. Major complications may include herniation of abdominal contents, vascular injuries, deep infections, neural injuries, deep hematomas, and iliac wing fractures. The theoretical advantages of disc arthroplasty include maintenance of range of motion, avoidance of adjacent segment degeneration, reconstitution of the disc height and spinal alignment, maintenance of mechanical characteristics, decreased surgical morbidity compared with fusion, avoidance of complications from instrumentation or postoperative immobilization, and to allow an early return to function. The introduction of interbody spacers, so-called cages, is the answer to donor site morbidity and optimization of the fusion construct. Two major types of titanium cages: threaded hollow cylinders and rectangular cages.<sup>11</sup>

Complications can generally be categorized as: approach-related, decompression-related, graft-related, long-term and

Patients health condition and habit. Careful patient selection remains the cornerstone of good surgical results. This, combined with high-quality imaging studies and meticulous surgical technique, will result in gratifying results with respect to neurologic recovery, function, and pain relief.<sup>12</sup>

## CONCLUSIONS

Anterior approach (discectomy and corpectomy with bone graft and plating), posterior approach (laminoplasty) and combined antero-posterior approach surgery could be addressed for

CSM patients, with the choice based on the pathogenesis of the myelopathy, signs and symptoms, radiological findings plain x-ray (cervical curvature, stability), MRI (types of OPLL, number of IVDP), CT (ossification and size of IVDP, single or double layer signs of ossification), age and preoperative JOA.

Hence indications for anterior approach, posterior approach and combined antero-posterior approach surgery could be addressed for CSM patients, with the choice based on the pathogenesis of the myelopathy, signs and symptoms, radiological findings i.e plain radiographs, MRI or CT pre-operative JOA score and patients health condition.

## REFERENCES

1. Martin-Benloch JA, Maruenda-Paulino JL, Barra-Pla A, Lagua-Garzarán M. Expansive laminoplasty as a method for managing cervical multilevel spondylotic myelopathy. *Spine (Phila Pa 1976)*. 2003 Apr 1;28(7):680-4.
2. Geck MJ, Eismont FJ. Surgical options for the treatment of cervical spondylotic myelopathy. *Orthop Clin North Am*. 2002 Apr;33(2):329-48.
3. Onari K, Toguchi A, Kondo S, Mihara H, Hachiya M, Yamada K. Cervical posterior fusion with wave-shaped rod under local anesthesia for cervical spondylotic myelopathy: review of 12 patients. *Spine (Phila Pa 1976)*. 2001 Nov 1;26(21):2334-9.
4. Kawaguchi Y, Kanamori M, Ishihara H, Nakamura H, Sugimori K, Tsuji H, Kimura T. Progression of ossification of the posterior longitudinal ligament following en bloc cervical laminoplasty. *J Bone Joint Surg Am*. 2001 Dec;83-A(12):1798-802.
5. Baba H, Imura S, Kawahara N, Nagata S, Tomita K. Osteoplastic laminoplasty for cervical myeloradiculopathy secondary to ossification of the posterior longitudinal ligament. *Int Orthop*. 1995;19(1):40-5.
6. Yan-Hong P, Chun-Yuan C, Shin-Yuan C, Jui-Feng L, Tsrong-Laang C, Wu-Fu C, Tomor H, Chain-Fa S, Ying-Sheng S, Shinn-Zong L. Complications of Multilevel Anterior Cervical Fusion. *Tzu Chi Med J*. 2004;16(2):79-82.
7. Morio Y, Teshima R, Nagashima H, Nawata K, Yamasaki D, Nanjo Y. Correlation between operative outcomes of cervical compression myelopathy and mri of the spinal cord. *Spine (Phila Pa 1976)*. 2001 Jun 1;26(11):1238-45.
8. Houten JK, Cooper PR. Laminectomy and posterior cervical plating for multilevel cervical spondylotic myelopathy and ossification of the posterior longitudinal ligament: effects on cervical alignment, spinal cord compression, and neurological outcome. *Neurosurgery*. 2003 May;52(5):1081-7; discussion 1087-8.
9. Iizuka H, Nakagawa Y, Shimegi A, Tsutsumi S, Toda N, Takagishi K, Shimizu T. Clinical results after cervical laminoplasty: differences due to the duration of wearing a cervical collar. *J Spinal Disord Tech*. 2005 Dec;18(6):489-91.
10. Rajshekhar V, Arunkumar MJ, Kumar SS. Changes in cervical spine curvature after uninstrumented one- and two-level corpectomy in patients with spondylotic myelopathy. *Neurosurgery*. 2003 Apr;52(4):799-804; discussion 804-5.
11. Zevgaridis D, Thomé C, Krauss JK. Prospective controlled study of rectangular titanium cage fusion compared with iliac crest autograft fusion in anterior cervical discectomy. *Neurosurg Focus*. 2002 Jan 15;12(1):E2.
12. Emery SE. Cervical spondylotic myelopathy: diagnosis and treatment. *J Am Acad Orthop Surg*. 2001 Nov-Dec;9(6):376-88.