

ROLE OF ANTERIOR DECOMPRESSION IN CERVICAL SPONDYLOSIS MYELOPATHY: A REPORT OF 64 CASES

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ABSTRACT

The management of cervical spondylosis has evolved over the past decades. Surgical decompressive and stabilization techniques have become more widely accepted for use in patients with intractable pain or neurological deficits. Advances in neuroimaging, surgical technique, and surgery-related technology including the operating microscope and anterior fixation devices have all contributed to the expanding role of surgery for the treatment of this condition. This study was conducted to evaluate the efficacy of corpectomy to achieve anterior decompression of neural elements or to remove anterior lesions. Between 2000 and 2004, 143 patients underwent anterior cervical decompression for the treatment of cervical spondylotic myelopathy (CSM). The author evaluates 64 of 143 cases as mentioned above comprise 1-level lesion (11 cases), 2-level lesions (37 cases), and 3-level lesions (11 cases). Ten patients presented with neck pain, 11 with arm pain, 22 with difficulty to walk, 6 with upper limb weakness, and 15 with sensory symptoms. Myelopathy severity was graded using the Harsh functional myelopathy grading system. Autograft (iliac crest) was used in all cases. The average follow-up duration was 25 months (range 8 – 48 months), symptomatic improvement was achieved. Harsh scores reflected improvement for 95.31 % of patients, 3.25 % with persistent of symptom and only one patient showing worsening. Preoperative myelopathy severity was not correlated with age or gender but was correlated with number of levels of spinal cord compression. The outcome, postoperative myelopathy severity, hospital stay and operating time also were not correlated with age or gender but significantly correlated with duration of symptoms, number of levels of spinal cord compression, preoperative myelopathy severity, and number of levels decompressed. Anterior cervical decompression has an important role in the management of CSM. Following treatment in this series, radiculopathy always improved and myelopathy was reversed in most patients.

Keywords: anterior cervical decompression, cervical spondylosis myelopathy (CSM)

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INTRODUCTION

Cervical spondylosis is the most frequent pathological condition affecting the adult spine. It is the most common cause of cervical radiculopathy and myelopathy in patients older than 50 years of age. The spondylotic process represents a spectrum of degenerative changes involving hypertrophic changes in facet joints and vertebral bodies, herniation of the cervical intervertebral discs, swelling of the ligamentum flavum, or ossification of the posterior longitudinal ligament (OPLL). Osteophytes developing from degenerative process can lead to subsequent compression of adjacent nerve roots or the spinal cord, inducing a wide range of clinical signs and symptoms.

Patients may have various symptoms such as spasticity in the gait and hands, with muscular atrophy and sensory impairment, and sphincter disturbances. In milder cases, various conservative treatment options are

applied including rest, cervical traction, cervical braces, and medication. When the clinical picture is severe and progressive, or when conservative treatment is not effective, surgical intervention is indicated. Surgical treatment is generally reserved for those patients with intractable pain, progressive neurological deficits, and documented compression of the cervical nerve roots, the spinal cord, or both. Increasingly, anterior cervical decompression from C2 – T1 is being used to decompress and reconstruct the cervical spine for a wide variety of CSM. Followed by reconstruction, anterior cervical decompression permits the most direct and adequate decompression of the anterior spinal or resection of lesions that involve the cervical vertebral bodies. The technique minimally disrupts normal cervical muscles and is associated with a low risk of injuring surrounding structures.

MATERIAL AND METHODS

Patient Population

An observational descriptive study was carried out at several hospitals in Surabaya, between 2000 and 2004. The author evaluated 64 cases from 143 patients with cervical spondylotic myelopathy (CSM) and radiculopathy underwent anterior cervical corpectomy and iliac bone fusion. There were 51 men and 13 women (Figure 1).

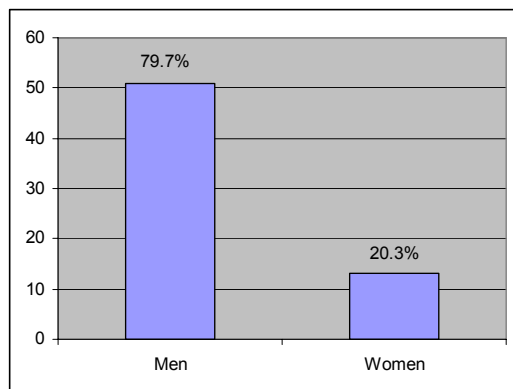


Figure 1. Bar graph showing the comparison of number (percent) between men and women patients.

The author divided the patients within three age groups (Table 1)

Table 1. Patients' age group

Age	Number of Patients (percent)
< 40 years	(7) 10.9 %
41 - 55 years	(29) 45.3 %
> 55 years	(28) 43.8 %

Criteria for inclusion were primary cervical spondylosis demonstrating radiculopathy, myelopathy and/or myeloradiculopathy that correlated with appropriate level and side of neural compression revealed on MR imaging (Figure 2). All patients underwent medication prior to operation.

Preoperative Assessment

The interview and the examination make the diagnosis. The imaging (diagnostic) studies confirm it.

-James Garber Galbraith, III, M.D.

All patients underwent standardized neurological and clinical assessment. The author based the decision to offer surgery to patients with CSM on several key factors. Patients must have appropriate clinical symptoms and signs and must have correlative imaging studies that confirm the presence of cervical spinal cord compression. They must be acceptable candidates for surgery from medical, surgical, and anesthetic comorbidity standpoints. It must be concluded that the patient's cervical cord compression is the cause of the neurological findings, as distinguished from cerebral ischemia, multiple sclerosis, amyotrophic lateral sclerosis, or other neurodegenerative disorders.



Figure 2. Sagittal (left) and axial (lower right) T2-weighted MR imaging reveals multi-level cord compression. T1-weighted MR images of a C5-C6 cord compression (upper right)

Typically, patients must have failed medical therapy and have demonstrated progression of their symptoms and signs over time. Appropriate candidates for single-level cervical corpectomy are those patients with signs and symptoms of myelopathy who have evidence on imaging studies of spinal cord compression by osteophytes or soft disc herniation at two adjacent motion segments. In patients with spinal cord compression at three or more adjacent motion segments decompression were achieved by two- or more- level corpectomy. This study limited by three level lesions.

Indications for multilevel decompression and fusion vary by disease process. For cervical radiculopathy, indications for surgery include progressive neurological deficit, static neurological deficit with radicular pain, and persistent, or recurrent arm pain that is not

responsive to conservative therapy. Neurological deficits and radicular symptoms should correspond to lesion identified on diagnostic studies. Multiple level discectomy and fusion should be considered for nerve root compression at multiple levels with significant axial neck pain or significant narrowing of the neural foramen by osteophyte formation.

For cervical myelopathy or myeloradiculopathy, indications for multilevel decompression and fusion are based on the progression of clinical symptoms of cervical myelopathy and on the radiological detection of multilevel spondylosis with ventral compression. The clinical diagnosis of cervical myelopathy requires clinical symptoms of myelopathy, radiographic evidence of mechanical compression, and exclusion of non mechanical causes of long tract alteration such as multiple sclerosis and amyotrophic lateral sclerosis. Indications for surgical treatment of cervical spondylosis myelopathy (CSM) include progressive impairment of function without sustained remission and failure to demonstrate improvement in myelopathy after cervical immobilization.

For cervical radiculopathy, cervical myelopathy, or cervical myeloradiculopathy, MRI of the cervical spine is the initial diagnostic imaging technique of choice for gathering information required for surgical intervention. If instability or segmental motion is suspected, then radiographs of the cervical spine with flexion and extension views are indicated. In cadaveric studies, the horizontal movements between vertebral bodies greater than 3.5 mm seen on lateral radiographs or forward angulation greater than 11 degrees of one vertebral body with respect to another indicate relative instability (White et al, 1975). Preoperative data were collected through standardized patients questionnaires, neurological and clinical assessment (table 2) and MR imaging studies data before surgery (Table 3).

TECHNIQUE FOR ANTERIOR CERVICAL DECOMPRESSION

Preoperative Preparation

There are several general principles to the treatment of all patients undergoing cervical anterior decompression for spondylotic myelopathy. The positioning of the patient's head and neck during the procedure is an important preoperative consideration. Excessive extension or flexion of the cervical spine may exacerbate the epidural compression and cause a focal cord injury. A neutral or slightly extended position of the patient's cervical spine is preferable. This is important, particularly in elderly patients with severe

cord compression, to avoid of a sustained period of hypotension. A brief period of transient hypotension, particularly during induction of anesthesia, increasing the potential for hypoperfusion of an already-compromised spinal cord.

Table 2. The type of symptoms

No.	Type of Symptoms	Number of Patients (percent)
1.	Neck Pain	10 (15.63%)
2.	Arm Pain	11 (17.19%)
3.	Difficulty to walk	22 (34.38%)
4.	Upper limb Weaken	6 (9.38%)
5.	Sensory Symptoms	15 (23.42%)

Table 3. MR imaging studies data showing number of patients with myelum compression in each level lesion and co-existence of spinal cord lesion.

MRI	Number of Level	Number of patients (percent)
Myelum Compression	1 Level	(17) 26.6 %
	2 Level	(39) 60.9 %
	3 Level	(8) 12.5 %
Cord Lesion	Yes	(43) 76.2 %
	No	(21) 32.8 %

Operative Technique

The primary goal of the surgical management of patients with CSM is decompression of the spinal cord and elimination of the anteroposterior flattening and distortion of the cervical cord. Secondary surgical considerations include realignment of the cervical spine, stabilization of cervical spinal instability, and/or correction of cervical spinal deformity.

The operations were all performed by the author. The operative procedure selected must make physiological and anatomic sense and must 1) decompress the entirety of the compromised spinal cord, 2) maintain physiological motion and biomechanical support as much as possible, 3) correct an existing spinal instability and/or cervical deformity, and 4) accomplish steps 1 through 3 with the least morbidity to the patient.

The operation was performed in the supine position under general anesthesia with the neck is moderately hyperextended. The head is slightly rotated, approximately 10 degrees off the midline, toward the

left, exposing the right neck. Folded towels were then placed under the neck, packed under as tightly as possible, to help provide dorsal sinus process and/or musculature pressure to improve on or restore cervical lordosis.

For one- or two-interspace procedure, a transverse incision 2 to 3 cm in length was made in a skin fold in the right neck begins at the midline and is carried laterally to the medial border of the sternocleidomastoid muscle. Three-level interspace procedures require a vertical incision along the anterior border of the sternocleidomastoid muscle. Dissection was performed down through the subcutaneous tissues and the platysma. Blunt dissection was used to dissect down to and expose the ventral aspects of the vertebral bodies. Intraoperative C-Arm was used to confirm the level. A handheld esophageal retractor assists with retracting the trachea and esophagus medially. The neurovascular bundles, the superior laryngeal nerve, and/or the recurrent laryngeal, with associated vasculature were preserved. Dissection was performed high up the ventral surface of the superior vertebral level and low down the ventral surface of the inferior vertebral level.

There were two key times during the operative procedure that we stop to orient ourselves to the anatomic midline of the vertebral bodies and the lateral margins of the dissection. The goal was to know where the midline was and to work laterally and bilaterally within the spinal canal to fully decompress the spinal cord and/or exiting nerve roots at each level during a Smith-Robinson procedure, or perform complete ventral cord decompression bilaterally during a corpectomy procedure. We avoid inappropriate, too-far lateral dissection to one side, typically to the patient's left from a right-sided operative approach, and, equally important, inadequate decompression to the opposite side.

Self-retaining retractors were then placed beneath the medial edges of the reflected longus coli muscles. The mediolateral extent of the bone to be resected was marked. Usually, 15 to 17 mm of bone in a mediolateral direction was resected to be certain that all osteophytes were removed. The disc and cartilaginous endplates are then removed with curettes and rongeurs. We use an extra-rough 6-mm diamond burr to resect bone because it will not cut or snag soft tissue. After half of the depth of the vertebral body was resected in the anteroposterior plane, the operating microscope was brought into the field. As bone resection proceeds, the endplates of the adjacent vertebrae were also resected.

When the posterior longitudinal ligament (PLL) was reached, the last bits of bone may be resected with fine curettes. The PLL was entered with a nerve hook, with care being taken to lift the ligament away from the dura.

A number 11 knife blade was used to cut down on the ligament over the nerve hook, thus, exposing the dura. Fine Kerrison rongeurs were used to resect the PLL to the edges of the bone exposure. Resection of the PLL ensures that extruded disc fragments will not be missed and that osteophytes that may be buried in the PLL will be resected.

Reconstruction of the corpectomy was performed using an iliac crest autograft. We prefer the iliac crest to the fibular autograft because fusion occurs more rapidly with the mostly cancellous iliac crest compared with the predominantly cortical bone of the fibula. The graft was cut 2-mm longer than the rostrocaudal length of the corpectomy. The anteroposterior depth of the graft was cut to 10 mm, which will ensure that it was well away from the anterior surface of the dura. The graft was then inserted into the area of corpectomy. The C-Arm unit was brought into the field, and anterior cervical plate was chosen. C-Arm guidance during screw insertion will ensure accurate screw placement and screws 14 to 16 mm in length will usually be of sufficient length to accomplish fixation while avoiding penetration of the spinal canal.

Drain sometimes was placed in the prevertebral space and brought out through a stab wound placed inferior to the incision. The superficial cervical fascia and platysma muscle were closed in separate layers then a subcuticular suture was placed. A rigid collar was used for multilevel corpectomies for 6 weeks after surgery.

RESULTS

Spondylosis in this study occurred in one- to three-level. All the patients underwent decompression through anterior cervical approach for the treatment of CSM. One-level lesion occurred in 16 cases (25%); two-level lesion in 37 cases (57.8%); and 3-level lesion in 11 cases (17.2%). The mean of operative time was found to be 5.16 hours (range 3 - 8 hours). The mean length of hospital stay was 7.67 days (range 6 to 15 days).

Before and after surgery, degree of myelopathy was assessed using Harsh myelopathy grading system (Table 4 and Table 5). Improvement of symptoms was found in 61 cases. Worsening of symptoms was found in only 1 case, and persistent of symptoms in 2 cases. Statistical analysis using Sign test shows that there is a significant difference between pre and post-operative myelopathy degree ($p = 0.000$). The shift of myelopathy degree after surgery existed from IIIA to I level of myelopathy. Six factors to predict the outcome were evaluated, i.e. neck pain, arm pain, difficulty to walk, upper limb weaken, sensibility symptoms, duration symptoms. Two

variables were significant as predictor of outcome: difficulty to walk ($p = 0.012$) and duration of symptoms ($p = 0.007$).

Table 4. Harsh myelopathy grading scale

Grade 0	no evidence of myelopathy
Grade I	able to run, but abnormal strength, tone or reflexes
Grade II	difficulty in running or climbing stairs
Grade III	difficulty in walking
A	independent but unsteady
B	cane or crutch dependent
C	walker or assistant dependent
Grade IV	difficulty in standing

Table 5. Summary of pre- and post-operation degrees of myelopathy using Harsh functional myelopathy grading system.

Myelopathic Grade			Post Operation			
Level			III B	III A	II	I
			2	7	20	35
Pre Operation	III C	9	2	3	1	3
	III B	19	-	3	9	7
	III A	22	-	-	9	13
	II	13	-	1	1	11
	I	1	-	-	-	1

Table 6. Result of statistical analysis of predictor of outcome.

Variables	<i>p</i> -values	
Neck Pain	0.495	NS
Arm pain	0.220	NS
Difficulty to walk	0.012	S
Upper limb weaken	0.395	NS
Sensory Symptoms	0.532	NS
Duration of symptoms	0.007	S

S : significant

NS : non-significant

Correlation between duration of symptoms and post operative degree of myelopathy was analyzed using Spearman correlation test. The results showed that the longer the duration of symptoms the less significant the improvement of symptoms and degree of myelopathy. Post-operative degree of myelopathy level I was found in 45.7% cases with 3 months duration of symptoms. Level II post operative degree of myelopathy was found in 50% of patients with 3 – 6 months duration of symptoms. Patients with 6 – 12 months duration of

symptoms were in Level IIIA degree of myelopathy in 42.9%.

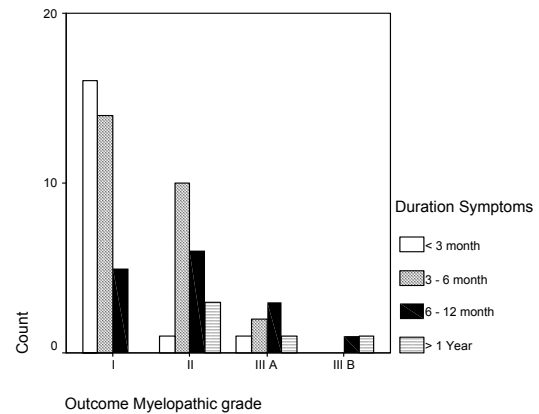


Figure 3. Outcome myelopathic grade

DISCUSSION

CSM is the most common spinal cord disorder to occur during and after middle age and the most serious consequence of cervical disc degeneration. Although it has been approached surgically using a variety of anterior and posterior procedures, the question of the most appropriate procedure remains controversial. In 1955 Robinson and Smith described an anterior cervical approach for decompression and stabilization of segmental cervical disease in which they placed tricortical horseshoe-shaped iliac crest grafts into the intervertebral space. In 1958 Cloward used dowel bone graft to perform anterior cervical decompression and arthrodesis. In 1960 Bailey and Badgley applied these techniques to tumor resections alone and reported that the use of the technique for trauma and kyphotic deformities led to unacceptable rate of progressive deformity, instability, and graft extrusion. In 1967 Bohler used plates for the anterior fixation of cervical fractures, and Orozco and Llovet-Tapias introduced the H plate in 1970. In 1980 Caspar, et al., developed a system that included bicortical screws. In 1986 Morscher introduced a unicortical locking plate screw system; other locking plate system and fixed or multi-angle screws (polyaxial) have since been designed.

This series of 64 patients were undergone cervical corpectomy. At the latest follow-up examination, 61 cases (95.31%) had improved neurologically. This finding is comparable to or better than those reported in other studies. In the series by Kojima, et al., 45 (87%) of 52 patients improved neurologically after corpectomy. The outcome was lower in the series reported by Bohlman and Anderson in which 66.6% of their patients

improved neurologically after corpectomy. In the literature, only 227 reported patients have undergone multilevel corpectomies, 60% of whom underwent two-level corpectomies. In 16% of the cases, the fusion was supplemented by placement of instrumentation. In our series, 73.4% of the patients (47 cases) underwent multilevel corpectomies: 12.5% underwent three- and 60.9% two-level corpectomies. In this study, myelopathy improved in 80% of cases. There are two variables that positively correlated with the post-operative degree of myelopathy, i.e duration of symptoms and difficulty to walk. Three months or less duration of symptoms correlated with the better outcome. These predictors have not been reported in other literatures.

CONCLUSION

In summary, cervical myelopathy tends to be a process resulting in progressive spinal cord compression and ischemia with resultant, often permanent, neurological injury. In appropriately selected patients, spinal cord decompression procedures can arrest the progressive process and optimize the patient's opportunity for neurological improvement and recovery. The choice of the operative procedure with the best chance to benefit an individual patient depends on multiple features of the pathology responsible for the myelopathy, including the primary direction of cord compression; the presence of focal disease or diffuse, multisegment, or concentric cord compression; and the presence or absence of associated cervical spinal instability and/or deformity. The author favors the anterior approach to cervical cord compression and resultant myelopathy, particularly if the cord compression is primarily ventral, is localized to an interspace or three (limited in four) interspaces and/or is associated with cervical spinal instability or a kyphotic deformity requiring anterior cervical spinal realignment, reconstruction, internal fixation, and fusion. Finally the author suggests that corpectomy and spinal fusion is a reasonable operative method for CSM because : 1) there is adequate anterior decompression, even if there is associated OPLL; 2) stabilization of the cervical spine is ensured in the early or late follow-up; 3) the large operative field permits removal of posterior or posterolateral osteophytes compressing the cervical cord; and 4) mortality and morbidity can be minimized by the use of an operative microscope and high speed drill.

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