

MOVEMENT STUDY FOLLOWING ANTERIOR CERVICAL DECOMPRESSION WITHOUT FUSION

ABDEL WAHAB M. IBRAHIM

*Department of Neurosurgery, College of Medicine & Medical Sciences,
King Faisal University, Dammam 31952, Saudi Arabia*

ABSTRACT

Movement studies of the neck have shown that certain patients with cervical spondylotic myelopathy (CSM) demonstrate instability in the vertebral joint immediately above the posterior osteophytic bar. While Cloward's anterior cervical decompression with fusion eliminates the cord or root compressive element, it adds to the hypermobility of the adjoining vertebral segment. In an attempt to reduce the hypermobility or subluxation, anterior cervical decompression without fusion was carried out on a selected group of twenty-three patients with spondylotic cervical myelopathy in whom the cord compression was mainly at a single level. Follow-up cineradiographic studies of these cases demonstrated the continued preservation of the range of movement of the adjoining vertebral segments and in 30%, a return of normal functional mobility to the affected cervical intervertebral joint. The findings and results of anterior cervical decompression surgery to a single level are reported.

Key Words: Cervical spondylosis, Cervical myelopathy, Cineradiography, Anterior Cervical decompression, Cloward's operation.

INTRODUCTION

Several etiological factors influence the development of cervical spondylotic myelopathy. The degenerative process of cervical spondylosis leads to acquired narrowing of the spinal canal or segmental hypermobility in ascending fashion as posterior osteophytes fuse the adjacent cervical vertebral segments.¹⁻³⁾ Acting singularly or in combination may increase the damage of the spinal cord or supportive vasculature.^{4,5)} On the other hand, subluxation of the cervical spine may occur secondary to ligamentous degeneration or excessive strain placed upon neighbouring vertebral joints by segmental auto-fusions.^{3,6,7)} When the combination of these changes, indicative of cervical spondylosis, become radiologically evident in a patient with progressive myelopathy, surgical consideration is primarily directed at decompression of the cervical cord and relevant roots either through anterior decompression of one or more levels, posterior laminoplasty or laminectomy.⁸⁻¹⁴⁾ Stabilization of the cervical spine was believed to be achieved by fusion and bone grafting after the anterior decompression. However, this led to transfer of the mobility component to the vertebral segment immediately above the fusion level.¹⁵⁻¹⁷⁾ It is generally observed that osteophyte growth, ligamentous and laminar thickening are more predominant in the lower cervical region, whereas, severe degrees of hypermobility or subluxation are more

Correspondence: Dr. A.W.M. Ibrahim, Department of Neurosurgery, CMMS, King Faisal University, P.O. Box 2208, Dammam 31952, Saudi Arabia

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common at the upper cervical levels, especially in patients with rheumatoid arthritis.¹⁸⁾ Cineradiographic studies have confirmed this trend in the cervical spine.¹⁵⁾ It therefore follows that grafting or cervical bone fusion after anterior decompression might not be necessary and indeed may aggravate the upper cervical instability. To verify this hypothesis, 23 cases of cervical spondylotic myelopathy secondary to a single level compression were studied pre- and postoperatively by movement studies.

MATERIALS AND METHODS

All patients referred to the Department of Neurosurgery at King Fahd Hospital of the University between 1986 and 1990 were reviewed. They were divided into groups as follows: Group 1 were those whose symptoms and signs were predominantly of a cervical radiculopathy; Group 2, those who predominantly presented with a cervical myelopathy due mainly to a single level compression; and Group 3, those who presented with cervical myelopathy secondary to multiple level compression or canal stenosis. Both Groups 1 and 3 were excluded from the study.

In Group 2, there were 20 patients with cervical myelopathy with or without minimal radiculopathy. Three other patients were included from Group 3 in whom multiple indentations or transverse bars were observed on cervical myelography or CT scan, and one of these indentations was most prominent. The age range of these patients was from 35 to 67 years (mean 47.3); the distribution was 21 men and two women. The length of history varied from three months to eight years. All patients had been tried with conservative treatment for a minimum of six months. Postoperative follow-up was on average 12 months and in some cases four years.

All the patients with cervical myelopathy had a plain cervical X-ray when first seen as outpatients. On admission to the hospital, they had either cervical myelography only or contrast-enhanced CT scan and in four cases a cervical MRI. At varying intervals, all had movement studies of their cervical spine (cineradiography) before surgery (Cloward's anterior cervical decompression). Movement studies were conducted while the patient was standing during flexion and extension. All patients were carefully rehearsed in the movement required so that true flexion and extension and not a "nodding" movement were viewed. Screening was performed by fluoroscopy with Videomed III attached to VCR.

RESULTS

The radiographic and movement study findings are tabulated and shown in Table 1.

The majority of the spondylotic osteophytes affected the lower cervical levels C5/6 and C6/7. Reduction or loss of movement was observed at the same levels and some gliding or rocking movement was observed immediately above the fused (diseased) intervertebral space. Table 2 shows the distribution of the Cloward's anterior cervical decompression. Forty-three percent were performed at C5/6 level. The surgical procedure performed is as detailed by Cloward (1958).¹¹⁾ Patients were selected for surgery if their myelopathy was progressive and refractory to conservative treatment. Over 35% improvement was observed in the follow-up cervical movement studies done six to eight weeks postoperatively on the group (Table 3). Collapse of the intervertebral foramina or anterior angulation was encountered in two patients who had a fair recovery of their CSM signs and had to be fitted with a hard collar for eight weeks. Follow-up movement studies at six months showed spontaneous autofusion in these two cases.

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Forty-seven percent of the patients achieved a dramatic recovery of neurological function rather than simply cessation of the progressive myelopathy. Functional and clinical recovery at six months was documented in 73% (Excellent and Good recovery category) of the cases, which also somewhat correlated to the age and length of the preoperative neurological signs (Table 4). All the patients were fitted with a cervical collar for three to four weeks postoperatively except for the two cases mentioned earlier. Plain X-ray, myelogram, and postoperative X-ray of a patient are illustrated as an example (Figures 1–4).

Table 1. Abnormal Spondylotic Changes on the Preoperative Radiological Investigations.

| Type of Investigation | No. of cases | X-ray Changes (pathological levels) | | | | | | Total of abnormal levels |
|--|--------------|-------------------------------------|------|------|------|------|-------|--------------------------|
| | | C2/3 | C3/4 | C4/5 | C5/6 | C6/7 | C7/D1 | |
| Plain Cervical X-ray | 23 | — | — | 2 | 10 | 11 | 3 | 26 |
| Cervical Cineradiography Immobility or “Gliding” | 23 | — | 1 | 4 | 12 | 9 | 3 | 29 |
| Cervical Myelogram only | 6 | — | — | 1 | 2 | 2 | 1 | 6 |
| Myelogram + CT Scan | 13 | — | — | 1 | 7 | 5 | — | 13 |
| Cervical MRI | 4 | — | — | — | 1 | 4 | 2 | 7 |

Table 2. Distribution of Anterior Decompressions Performed on Different Cervical Levels.

| Level | C3/4 | C4/5 | C5/6 | C6/7 | C7/D1 | Total | Single space | Double space |
|-------------------------------|------|------|------|------|-------|-------|--------------|--------------|
| Number of Cloward's procedure | 0 | 1 | 10 | 9 | 3 | 23 | 23 | 0 |

Table 3. Result of Follow-up Cineradiographic Examination.*

| No. of cases | No. of cases showing pathological immobility of subluxation at the level of | | | | | Total |
|--------------|---|------|------|------|-------|-------|
| | C3/4 | C4/5 | C5/6 | C6/7 | C7/D1 | |
| 23 | — | 3 | 8 | 6 | 2 | 19 |

* The follow-up cervical movement studies were done 6 to 8 weeks postoperatively.

Table 4. Result of Cloward's Anterior Cervical Decompression on Single Level (6 months post-operatively).

| Postoperative status | No. of patients | % | Average duration of the pre-op. disability |
|-----------------------|-----------------|------|--|
| a. Excellent Recovery | 11 | 47.8 | 6 months |
| b. Good Recovery | 6 | 26 | 9 months |
| c. Fair Recovery | 4 | 17 | 14 months |
| d. Unchanged | 2 | 8.7 | 2 years. |

- a. Return to normal activity.
- b. Reduction in spasticity and long tract signs but residual disability existed on discharge.
- c. Same as (b.) but residual signs were present at 6 months post-operatively.
- d. Persistence of the pre-operative neurological status.



Fig. 1. Cervical X-ray demonstrating the posterior C5/6 spondylotic bar.

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Fig. 2. CT scan of same patient showing 50% compromise of the spinal canal by the same C5/6 posterior osteophyte.



Fig. 3. Myelogram showing the indentation of the myodil column by the C5/6 osteophyte.



Fig. 4. The post-op (Cloward's anterior approach) demonstrating a complete resection of the posterior osteophyte.

DISCUSSION

Cervical spondylotic myelopathy is a potentially disabling neurological condition whose natural history may have variable manifestations, including intermittent, rapid or gradually progressive clinical course.^{2,3,6)} Several mechanisms have been implicated in the delayed or sudden onset of neurological deterioration which includes vascular ischaemia, direct compression by osteophytes, hypertrophy or degeneration of the ligamentum flavum and ossification of the posterior longitudinal ligament.^{1,4,5)} Another major causative factor is frequently an abnormal increase in segmental cervical vertebral motion.¹⁵⁻¹⁷⁾ This excessive motion superimposed upon a spinal cord compromised by osteophytic encroachments into the vertebral canal can result in injurious pressures and tensile stresses upon the spinal cord white tracts.^{1,2,16)} The capacity of the

spinal cord to adapt to gradually increasing pressure and deformation until a critical level of mechanical stress has been exceeded is well known.^{17,19)} Small increases in segmental motion of the cervical vertebra at levels of pre-existing spinal cord compromise could exceed local spinal cord tolerance, and neurological deterioration follows.

Although the value of any specific surgical procedure for CSM (cervical spondylotic myelopathy) remains controversial, nevertheless, there is a general agreement that the anterior approach for decompression as advocated by Cloward in 1958 seems a more logical and anatomically appropriate method of dealing with cervical disc prolapse or degenerative posterior osteophytes. This approach has been successfully employed on up to three diseased cervical levels,¹⁴⁾ however, it is occasionally complicated by recurrent laryngeal nerve paresis, dysphagia and infection. The wide posterior decompressive laminectomy or laminoplasty is reserved for CSM resulting from multiple stenotic levels⁸⁻¹⁰⁾ and is again massed by the greater muscle retraction and the removal of the posterior stabilizing structures predisposing to even further instability.

The original Cloward's technique necessitates the insertion of an autologous bone graft to fuse the adjacent cervical vertebrae after discectomy and or osteophylectomy; however, the necessity of cervical fusion in every patient has been questioned.^{20,21)} A consensus has emerged whereby in younger patients with "soft disc" protrusion and with only minimal degree of spondylosis, fusion is thought to be unnecessary. Furthermore, in older patients, it has been demonstrated that the normal cervical movement is taken up by the cervical vertebral segment above the fused vertebral level.^{15,17)} This in turn predisposes to subluxation at levels of pre-existing vertebral canal compromise which has the greatest potential to cause spinal cord damage by the adverse local stress. Cervical fusion where the vertebral canal is narrowed, therefore, does not prevent cord damage that is due to excessive spinal motion at a distant level. In this selected group of CSM patients where the cord compression occurred mainly at a single cervical level, Cloward's anterior approach without fusion was followed by an excellent to good recovery in 73%. The procedure seems to preserve the normal cervical mechanical mobility and restore it in 30% of previously immobile vertebral spondylotic segments (Table 3).

The cervical movement study, being of a dynamic nature, exhibited the true events preoperatively in contrast to the other radiological investigative methods. In this group of 23 patients with CSM, a total of 29 abnormal levels were detected by cineradiography as compared with 26 abnormal levels by other modalities (Table 1). Furthermore, it demonstrated postoperatively the functional improvement mainly in the mid-cervical segment.

This clinical improvement indicates that minimizing the stress produced by excessive mobility on a compromised cervical cord following cervical fusion plays a crucial role. Although this series is small, the marked functional improvement based on the results of the movement studies in addition to the other radiological investigation compares favourably with other studies.^{20,21)}

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