

Fusion rate of anterior cervical plating after corpectomy

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ABSTRACT

Purpose. To evaluate the neurological recovery and fusion rate of patients with myelopathy who were treated with anterior corpectomy and anterior cervical plating.

Methods. The results of 17 cervical myelopathy patients who underwent decompression and anterior cervical plating were retrospectively reviewed at a mean follow-up of 2 years.

Results. By Kurokawa score, 82.4% of patients showed excellent-to-good results. The fusion rates of 2-level and 3-level anterior cervical corpectomy, and of anterior plate fixation were 100%. There were no implant- or graft-related complications. Transient dysphagia in 9 (52.9%) patients resolved after a mean of 3 months (range, 1–9 months).

Conclusion. The use of anterior cervical plating

after anterior corpectomy and fusion with autologous bone graft greatly enhances arthrodesis. The improved fusion rate and low complication rate associated with anterior cervical plating may justify its use in the treatment of cervical spondylotic myelopathy.

Key words: bone plates; spinal cord diseases; spinal osteophytosis

INTRODUCTION

There have long been controversies regarding the optimal approach to decompression of multilevel cervical myelopathy. Some have suggested a posterior approach because it is a relatively simple procedure without significant morbidity,^{1,2} while others have

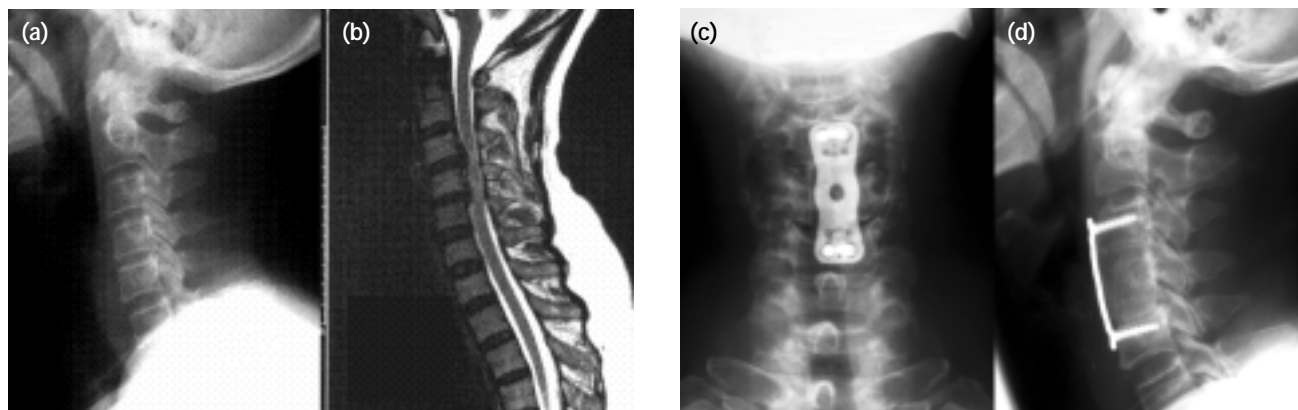


Figure (a) Radiograph and (b) magnetic resonance image of a 67-year-old woman showing C3 to C5 prolapsed intervertebral discs and a Pavlov's ratio of 0.72. (c) and (d) Postoperative radiographs showing C4 corpectomy, tricortico cancellous (Smith-Robinson) bone graft, and anterior cervical plating.

advocated an anterior approach, especially for patients who have lost normal cervical lordosis.³⁻⁵

Investigators have reported an inverse relationship between the number of levels of cervical spine fusion and the fusion rate.^{3,6-8} The development of pseudoarthrosis is regarded as a suboptimal surgical outcome because it is associated with segmental instability, recurrence of neck pain, and neurological deficit.⁹

With the development of internal fixation of the cervical spine, anterior cervical plating has become an important part of the spine surgeon's armamentarium and has been used increasingly in degenerative spinal conditions. Initially used to treat fractures in the 1980s, gradual design improvements have made wider application possible. A current system is the Zephir anterior cervical plate system (Medtronic Sofamor Danek, Memphis [TN], US). The design of the plate is low-profile, which allows placement and fixation of the plate with a minimum of soft-tissue retraction. A spring-loaded, plate-holding device delivers the plate to the surgical field, and a provisional fixation pin system ensures that it is held in the proper location during drilling. The single-hole or double-hole drill guide allows the pilot holes for screws to be drilled successively without moving the guide. It also allows variable angle screw placement.

The present study evaluates the role of anterior cervical plating in patients with cervical spondylotic myelopathy.

METHODS

We retrospectively reviewed 17 cervical myelopathy

patients (10 males and 7 females; ratio, 1.4:1) who underwent decompression and anterior cervical plating between August 2000 and August 2002 in the United Christian Hospital, Hong Kong.

Patients were assessed according to Japanese Orthopaedic Association (JOA) score, Nurick grading, and 10-second tests. Kurokawa scores were extrapolated from JOA scores. Clinical symptoms documented included neck pain and radiological cervical instabilities defined by the White-Panjabi method (i.e. lateral radiograph demonstrating $>11^\circ$ angulation or >3.5 mm translation during flexion and extension). Solid fusion was defined by radiological cross trabeculation and lack of segmental movement in flexion-extension views. Preoperative magnetic resonance imaging (MRI) was used to document T2-signal changes of the spinal cord. Patients were allowed to sit-out on days 2 to 3 and were allowed to mobilise within one week. It is our practice to use a Philadelphia neck collar for 2-level fusion and a halo vest for 3-level fusion at postoperative 8 to 12 weeks.

RESULTS

The patients' mean age was 67.9 years (range, 43-86 years). Patients were treated conservatively for a mean duration of 12 months. The predominant pathology was prolapsed intervertebral discs ($n=13$, Fig), followed by ossification of the posterior longitudinal ligament ($n=2$), and cervical spondylosis with kyphotic deformity ($n=2$). 13 cases involved 2-level stenosis, and 4 cases 3-level stenosis.

The operative procedure used was the left-sided Southwick-Robinson anterior cervical spinal approach

Table 1
Surgical outcomes according to Kurokawa score

Kurokawa score	No. of patients*
Excellent	11 (64.7%)
Good	3 (17.6%)
Fair	3 (17.6%)
Unchanged	0
Poor	0

* Because of rounding, percentages do not total 100

and decompression with corpectomy. Iliac crest tricortico cancellous (Smith-Robinson) bone graft was used in 16 cases. A titanium mesh cage with cancellous bone graft was used in one patient due to the inadequate length and shape of an iliac crest graft. All cases had some degree of degenerative stenosis, with Pavlov's ratio of 0.79 to 0.70 in 8 cases, 0.69 to 0.60 in 6 cases, and 0.59 to 0.50 in 3 cases.

According to the Kurokawa score, 82.4% of patients showed excellent-to-good results (Table 1). The fusion rates for 2-level and 3-level anterior cervical corpectomy, and for anterior plate fixation were 100%. The mean fusion period was 10.4 weeks (range, 7–14 weeks). Ten patients showed improvement of JOA score by an increment of less than 3, while 7 patients showed an incremental improvement of 4 or more (Table 2). Preoperative and postoperative Nurick grading of the patients showed no improvement in 6, one-grade improvement in 8, and 2-grade improvement in 3 (Table 3).

No patient developed postoperative neurological deterioration; therefore, no postoperative MRI was performed. 14 patients who showed hyperintense signal changes on preoperative T2-weighted MRI demonstrated the least postoperative neurological improvement (i.e. JOA score \leq 2 points). Preoperative MRI findings corresponded with neurological recovery.

There were no infections, neurological complications, or graft-related complications (e.g. extrusion, collapse, subsidence, or kyphosis), or hardware failures such as hardware fracture, migration, or malpositioning. Transient dysphagia in 9 (52.9%) patients resolved after a mean of 3 months (range, 1–9 months).

DISCUSSION

Plating of the anterior cervical spine was first described in 1980s, mainly for the treatment of acute cervical spinal fracture. Improvements in implant design have facilitated insertion procedures and

Table 2
Change in JOA scores

Change in JOA scores (postoperative – preoperative)	No. of patients, n=17
No change	3
+1	2
+2	5
+3	0
+4	4
+5	0
+6	1
+7	0
+8	0
+9	1
+10	0
+11	1

Table 3
Change in Nurick grades

Change in Nurick grades (postoperative – preoperative)	No. of patients, n=17
No change	6
1-grade improvement	8
2-grade improvement	3

enhanced biomechanical properties, leading to its increased use for degenerative cervical spine disease. Despite the widespread use of anterior cervical plates for degenerative conditions, controversy about whether plating improves outcome remains.

Many clinical studies have reported higher fusion rates with anterior cervical plates^{3,6,7,10-12}: fusion rates for single-level procedures range from 92% to 100%, and from 70% to 100% for 2-level or multilevel procedures. Many reports have shown that anterior cervical plating across 2 or more segments increases stability and fusion rates^{3,6,10,11}; however, the benefits for single-level anterior cervical discectomy and fusion are disputed.

The use of an anterior cervical plate in the treatment of degenerative spine disease has several biomechanical advantages. The increased stability across the operative segment decreases motion between the graft and vertebral endplate and increases the chance of solid fusion. Although definitive clinical evidence is lacking, development of a pseudoarthrosis has been reported to decrease with the use of cervical plates.^{9,13} A reduced incidence

of graft-related complications has also been observed with the use of anterior cervical plates.^{3,7,11,12} The plate not only acts as a buttress preventing graft extrusion, but decreases the extent of graft collapse and subsidence, preventing the formation of postoperative cervical kyphosis. It can also maintain sagittal balance and preserve the normal biomechanics of the unfused cervical segments, contributing to a decreased incidence of postoperative axial neck pain and reduced potential for adjacent-level disease.³

Although multiple discectomies are an alternative means of decompression in cases with predominately prolapsed intervertebral discs, we preferred corpectomy in the present series for the following reasons: first, most cases were spinal stenosis caused by the spondylotic changes (osteophytes) and prolapsed intervertebral discs; we aimed to address this compressive pathology. Second, we preferred using a single strut graft to multiple horse-shoe grafts to limit the number of fusion interfaces to 2 and to improve the fusion rate. Third, in cases of ossification of the posterior longitudinal ligament (the removal of which from the adhered dural sac may be difficult), corpectomy with the floating technique can achieve better decompression.

Decreased rates of fusion have been observed for multilevel discectomies, as a result of the increased number of graft-endplate interfaces.^{4,8} The rates of graft migration and related complications are also known to increase with multilevel procedures.¹ The increased stability provided by an anterior cervical plate effectively reduces the motion across 2 segments, thus enhancing the rate of fusion.

The overall fusion rate in this study was 100%, and many other recent studies have also reported a 100% fusion rate.^{5,14,15} The reason for our good results is multifactorial: first, we emphasised good endplate preparation after corpectomy. The endplates were prepared until there was a healthy bleeding cancellous bone surface, which has been shown to significantly improve graft healing.¹⁶ Second, following

the tricortico cancellous (Smith Robinson) bone graft application, skull traction was decreased before the application of the anterior cervical plate. This step was important to allow some degree of graft compression, which enhanced the fusion rate. Third, postoperative external immobilisation enabled prevention of excessive movement of the graft and construct. Further studies comparing the use of external immobilisation would provide valuable information on their relative contribution to the fusion rate.

Although hardware- or graft-related complications were not observed in our series, graft migration is one of the most serious complications of cervical spine corpectomy and strut graft fusion. The main determinant of graft migration is the number of levels of corpectomy and fusion, as demonstrated in another study²: one level (4.2%), 2 levels (5.3%), 3 levels (9.9%), 4 levels (16.7%). None of our 17 cases required additional anterior cervical plating or had graft migration or displacement because the use of an anterior cervical plate acts as a buttress to prevent displacement of the graft.

An unexpected observation from the present series showed a number of patients developing dysphagia postoperatively. This may relate to the anterior surgical approach. The presence of hardware did not increase the rate of development of dysphagia.^{12,17}

The true efficacy of anterior cervical plating can be defined only after a further large-scale study.

CONCLUSION

The use of anterior cervical plating after anterior corpectomy and fusion with autologous bone graft greatly enhances arthrodesis. The improved fusion rate and low complication rate associated with anterior cervical plating may justify its use in the treatment of cervical spondylotic myelopathies.

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