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JNMU

Journal of Nanjing Medical University, 2008, 22(4):260-264

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**Research Paper**

# Application of anterior decompression and reconstruction using titanium mesh with locking plates in the management of cervical spondylotic myelopathy

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Received 24 January, 2008

## Abstract

**Objective**: To observe the clinical effect of anterior decompression and reconstruction using titanium mesh with locking plates in the treatment of cervical spondylotic myelopathy. **Methods**: One hundred and twenty patients with cervical spondylotic myelopathy were treated by anterior decompression and reconstruction using titanium mesh with locking plates. There were 66 men and 54 women ranges in age from 37 to 72 Years(mean age, 58.3 years). The mean Japanese orthopedic surgery association(JOA) scale was 9.6 points before operation. Patients were followed up clinically and radiographically. **Results**: Having stood surgery well, the operation time ranged between 60~100 min and bleeding during operation ranged between 20~200 ml. There were no case of postoperative infection, recurrent laryngeal nerve palsy, or esophageal or tracheal laceration or rupture. The average follow-up period was 14.3 months(range, 12 to 24 months) in 96 who were followed up. At the last follow-up visit the mean JOA scale had improved to 14.4 points, reflecting an improvement of 4.8 points. The results were considered to be excellent in 87 patients, good in 25, fair in 6, and poor in 2. No hardware-related complications or adjacent segment degenerative changes were encountered during the follow-up periods. Stable bone union was observed in all cases and the average time required for fusion was 5.7 months. **Conclusion**: Titanium mesh filled with autologous bone graft can avoid the complications associated with harvesting bone from the iliac crest donor site. When combined with cervical anterior locking plate, it can obtain satisfatory clinical results for the treatment of cervical spondylotic myelopathy.

**Key words**: cervical spondylotic myelopathy; titanium mesh; cervical vertebrae; anterior cervical plate

## INTRODUCTION

Compression of the spinal cord by the degenerating cervical spine tends to lead to progressive clinical symptoms over a variable period of time. Surgical decompression can stop this process and lead to recovery of function. The selection of a ventral or dorsal approach or a combined approach depends on numerous factors, including cervical alignment and contour, the number of vertebral segments involved, the cause of the spinal cord compression(ventral, dorsal, or combined spinal canal pathology), patient metabolic factors, and the surgeon's experience with various surgical techniques[1]. Thus, anterior cervical corpectomy is an effective decompression technique for treating disorders that involve the anterior and middle parts of the cervical spine[2]. Anterior cervical reconstruction using titanium mesh cage with anterior plating has been introduced as an effective and safe technique that offers immediate, strong anterior column support while minimizing hardware complications. We have applied this method to treat 120 patients with cervical spondylotic myelopathy and the effects were satisfactory.

## MATERIALS AND METHODS

### Patient population

One hundred and twenty patients with cervical myelopathy were treated by anterior cervical reconstruction using titanium mesh cage with anterior plate. The series included 66 males and 54 females; their ages

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ranged from 37 to 72 years(mean age, 58.3 years). In all patients the diagnostic work-up included clinical examination, anterior-posterior and lateral x-rays of the cervical spine, and MRI. The mean duration of the clinical history was 17 months (ranging between 9 months to 34 months). The titanium mesh cages were used to replace 1 disc in 24 cases, 1 vertebral body in 54 cases and 2 vertebral bodies in 42 cases.

### Preoperative management

Preoperatively, we attempted to optimize factors that promote wound healing and spinal fusion. Patients were asked to cease using nonsteroidal antiinflammatory medications and to cease the use of nicotine as well. Nutritional status was assessed. If the patient was malnourished, nutritional supplementation was given before surgery.

### Operative procedure

After the induction of basal and local anesthesia, the patient was placed in a supine position with the head slightly extended. The head was also slightly rotated approximately 10 degrees off the midline toward the left thus exposing the right neck. A right-sided approach to the cervical spine was made with a vertical skin incision along the anterior border of the sternocleidomastoid muscle. After sharp dissection of the platysma, the interval between the carotid sheath and the esophagus was developed bluntly, thereby exposing the anterior cervical spine. Vertebral levels were verified by intraoperative fluoroscopy. The anterior longitudinal ligament was incised and the central three-fifths of the anterior vertebral body were then excised using a rongeur or osteotome. After the anterior cervical discectomy or corpectomy was performed all the way to the posterior longitudinal ligament, all cartilaginous endplates were removed down to the level of bleeding subchondral bone with curettes or a high-speed burr. Autologous bone obtained from the excised vertebral body was used as a bone graft material. In the case of discectomy, one-quarter of the vertebral endplates adjacent to the affected disc were removed with an osteotome and used for local autograft. After confirming anterior protrusion of the dural theca and good pulsation, an appropriate length of mesh with autologous bone fragment taken from the removed vertebra was inserted inlay fashion. Correct positioning of the mesh cage was confirmed by intraoperative fluoroscopy. A locking plate-and-screw system of the appropriate length was used to achieve anterior cervical fixation. Proper positioning of the fixation materials was confirmed by intraoperative radiography(Fig. 1~4).

The patients were placed in a soft cervical collar for comfort for a few postoperative days. Isometric muscle exercises were then encouraged, and no daily activities were restricted.

### Radiographic assessment

Postoperative radiographs were obtained at 0, 3, 6, 9, and 12 months postoperatively and annually thereafter. Radiographic assessment included postoperative sagittal alignment, fusion status, and implant-related

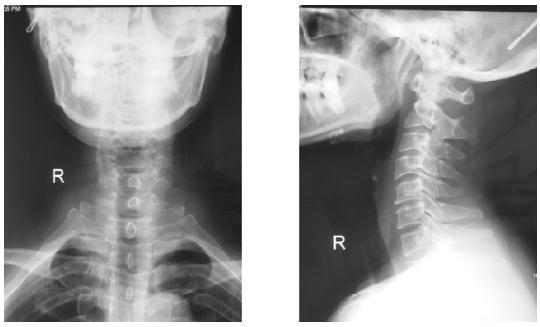


Fig. 1 Preoperative anterioposterior x-ray showed narrowing of C3/4 intervertebral space

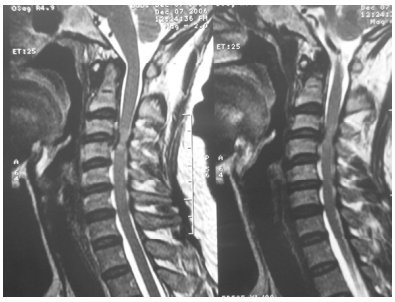

Fig. 2 MRI of the cervical region showed remarkable anterior compression of the spinal cord at the levels of C3/4

Fig. 3 MRI showed the disc herniation and the cord compression in C3/4

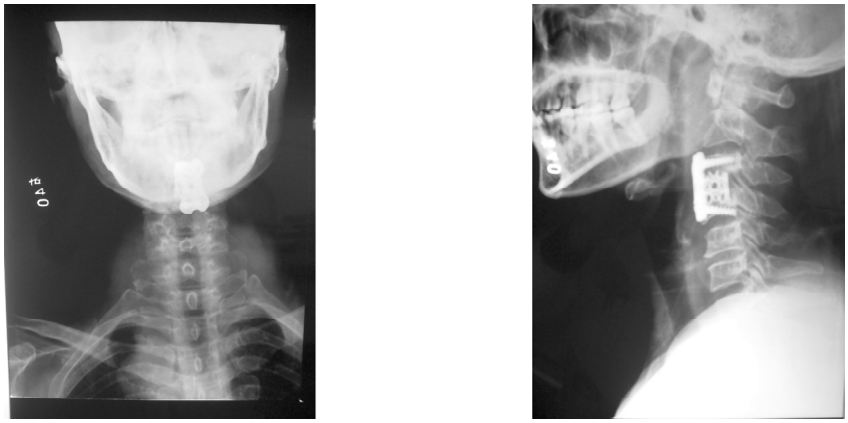

Fig. 4 Postoperative X-ray photograph showed adequate internal fixation

complications. Sagittal alignment(lordosis or kyphosis) of the operative segments was assessed by measuring the Cobb's angle between each endplate at the cranial and caudal ends. A solid fusion was diagnosed as the presence of all the following radiographic evidence: the absence of lucencies or halo formation around the screws or cage-bone interface; the absence of screw back-out or plate breakage or migration; < 3° of motion in flexion-extension radiographs; and osseous continuity through and/or around the cage in computed tomography (CT) sagittal reconstruction. Implant-related complications were also radiographically examined for, including breakage of screw-plate construct, cage subsidence, and/or dislodgment.

### Clinical evaluation

Clinical conditions were evaluated before operation and annually after operation according to the Japanese Orthopaedic Association(JOA) scoring system and Patient's Satisfaction grade. The JOA scoring system consists of seven categories: 0 to 4 points is awarded for the function of upper limbs and lower limbs(0 points for severe disorder, 4 points indicats normal status). 0 to 2 points is awarded for the feeling of upper limbs, lower limbs and trunk(0 points for severe disorder, 2 points indicats normal status). 0 to 3 points is awarded for the function of bladder(0 points for severe disorder, 3 points indicats normal status). The total score for the normal population is 17. Patient's satisfaction was graded according to the following criteria:"excellent" meant the patients did not experience any disturbance and had no limitation of activities; "good" designated patients who had mild, occasional disturbance and without limitation of activities;"fair" included patients who experienced a moderate level of disturbance, and who had moderate limitation of activities;"poor" cases showing the same preoperative symptoms; these patients were continually given high doses of analgesics, and it was believed that the surgery was a failure.

## RESULTS

All the patients withstood surgery well. The operation time was between 60~100 min and bleeding during operation was between 20~200 ml. Postoperative complications included transient dysphagia(4 patients) and dysphonia(3 patients). There were no incidences of infections, recurrent laryngeal nerve palsies, or esophageal or tracheal lacerations or ruptures. The average follow-up period was 14.3 months(range, 12 to 24 months) in 96 who were followed up. Cage subsidence ( >3 mm) occurred in 3 case. However, the mild subsidence did not influence the sagittal alignment in our series. The average time required for fusion was 5.7 months(range, 4 to 8 months). Before operation the mean preoperative JOA score was 9.6 points. At last follow-up the mean JOA score was 14.4, indicating a mean improvement of 4.8 in comparison with the preoperative values. Patient's Satisfaction was excellent in 67 patients, good in 21, fair in 6, and poor in 2 cases. No significant clinical sequelae, hardware complications, or adjacent segment degenerative changes were observed during the follow-up periods.

## DISCUSSION

Cervical spondylotic myelopathy is caused by changes in the tissue structure of the spinal canal resulting in a decrease in spinal canal volume and spinal cord compression. The main pathologic changes include: regression of intervertebral disc, hypertrophy of articular process, vertebral lamina or yellow ligament thickening and ossification of cervical posterior longitudinal ligament(OPLL)[3,4]. The surgical management of myelopathy involves enlarging the spinal canal by an anterior or posterior approach. The posterior approach is inadequate in cases in which the pathology lies at the anterior aspect of the spinal canal and in the presence of kyphotic deformity. In particular, increasing kyphotic deformity and instability that follows laminectomy is well documented and requires repeated anterior cord

decompression[5]. Therefore, anterior decompression along with stabilization often offers the best management for various pathologic entities(cervical spondylosis, OPLL, trauma, infection, tumor, etc.) causing myelopathy[6-8].

The goals of cervical internal fixation are to enhance stability to control an unstable segment, to improve the fusion rate, to correct spinal deformity, and to decrease the need for cumbersome bracing[9,10]. Anterior plate fixation of the cervical spine has become standardized and accepted with respect to cervical anterior fusion[11]. Regarding bone graft materials, tricortical iliac crest autograft has been the gold standard in the cervical anterior fusion. However, harvesting autogenous bone from the iliac crest can be associated with increased blood loss, hematoma, fracture and postoperative pain at the graft site and meralgia paresthetica[1,12,13]. Thus, the significant complication rate associated with harvesting bone graft from the iliac crest has encouraged an ongoing interest in finding alternative implants for anterior cervical fusion. Concurrently, cervical cages have been more recently introduced to provide an anterior structural support without harvesting tricortical bone block from the iliac crest. They offer advantages including immediate restoration and maintenance of intervertebral disc height, enlargement of a stenotic neural foramen, and stabilization of the degenerative disc[14].

Recently, anterior cervical reconstruction using titanium mesh cage with anterior plating has been introduced as an effective and safe technique that offers immediate and strong anterior column support while minimizing hardware complications[15,16]. The advantages of this procedure are as follows:① avoidance of bone grafting procedures; ② reduced hospital stay; ③ good biocompatibility; ④ immediate, strong anterior column support; ⑤minimal morbidity due to instrumentation[16,17].

Risk factors associated with this technique are as follows:① more than 3-level corpectomies; ② severe osteoporosis associated with systemic disease such as rheumatoid arthritis; ③OPLL; ④high level corpectomy (upper to C3). Considering these risk factors, anterior cervical reconstruction using titanium mesh cage with anterior plating can offer good clinical results and helps to avoid complications associated with harvesting bone from the iliac crest donor site.

In the present study, 120 cases of cervical spondylotic myelopathy were treated by anterior decompression and reconstruction using titanium mesh with locking plates. The cages were filled with autologous bone obtained from the excised vertebral body. This technique ensured immediate stability of the spinal column. Patients were mobilized within the first few postoperative days, which is of considerable importance in the usually old and multimorbid patient population undergoing this surgery. The most recent follow-up studies demonstrated solid bony fusion in all patients. There was no deterioration of the sagittal profile. The clinical outcome of our series, as evaluated according to the score proposed by both JOA and Patient's Satisfactory, was satisfactory.

However, the use of titanium cages still has some problems. Firstly their high modulus of elasticity contributes to subsidence through the endplates of the vertebral bodies[18]. This problem can be limited by endcapping the titanium cages. The endcaps(small titanium circular caps that snap onto the protruding spikes at the ends of the cage) increase the bone-metal surface area and help the cage to resist subsiding through the softer vertebral body endplate[19,20]. The second problem of using the cages is that they are extremely difficult to revise. If a cage requires extraction from a corpectomy site, a significant amount of drilling and destruction of the vertebral bodies above and below are required. A third disadvantage of using titanium cages is the difficulty of assessing fusion. In addition, magnetic resonance imaging artifact from the titanium cage degrades the image and makes it difficult to assess the spinal canal and the neural foramen. A fourth disadvantage is the cost of the cage.

A follow-up period of 14.3 months in 96 patients in this study is still considered to be a short duration. It is important for us to follow-up the patients in this series and other literature to examine any significant long-term changes in the cervical alignment and adjacent segment degeneration.

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