

Cervical Spondylotic Myelopathy Release by Unilateral Open-Door Laminoplasty with Miniplate Alone: Three Years Follow-up

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ABSTRACT

Objective: Cervical spondylotic myelopathy (CSM) is a common degenerative spine disease that requires surgical intervention if conservative failed. Currently, there is interest in various technical of laminoplasty. To review outcome of patients who underwent single-door cervical laminoplasty using titanium miniplates alone.

Materials and methods: The author performed surgery in patients with CSM by unilateral open-door laminoplasty, which allows through decompression of the cervical spinal canal. Pain was measured with a visual analog scale (VAS). Surgical outcome was analyzed with the modified Japanese Orthopaedic Association (mJOA) score.

Results: Visual analog scale scores and mJOA were significantly improved at 1, 2 and 3 years follow-up compared to preoperative levels. Recovery rate mJOA score 27,7%, excellent pain relief (100% of initial VAS score).

Conclusion: Open-door laminoplasty is easily applied for young spine surgeon, allows good field visualization and decompression, single-door cervical laminoplasty using miniplates alone is a safe technique and achieves a high hinge union rate, good canal decompression and neurological recovery.

Keywords: Cervical spondylotic myelopathy, Laminoplasty, Modified Japanese Orthopaedic Association, Visual analog scale.

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INTRODUCTION

Cervical spondylosis is an age-related degenerative change. Herniated cervical disk or ossification of the posterior longitudinal ligament (OPLL) can result in chronic compression of the spinal cord. A common treatment for cervical spondylotic myelopathy particularly for multilevel disk disease and ossification of the posterior longitudinal ligament without instability is expansive open-door laminoplasty.^{1,2} Posterior decompression with laminectomy is an effective method in patients with OPLL or multisegmental cervical spondylotic myelopathy (CSM). With these methods, decompression is achieved and the biomechanical integrity is maintained.³⁻⁵ Since the design of classic open-door laminoplasty with the use of sutures, this procedure has modification to reduce complications, such as restenosis and axial symptoms. With the development of surgical implants, surgeons have begun to use various kinds of lamina spacers include the use of bone struts, miniplate and hydroxyapatite or ceramic spacers. Titanium miniplates with or without bone strut or spacer provide immediate rigid fixation to prevent the spring-back closure of laminae.^{1,2} This study reviewed the outcome of a patient who underwent single-door cervical laminoplasty for CSM using titanium miniplates alone.

CASE REPORT

A 57-year-old male complaint weakness of all extremity (4/5) visual analog scale (VAS) score preoperatively was 7 and modified Japanese Orthopaedic Association (mJOA) score was 12, pathologies of the patients showed on T2WI magnetic resonance imaging (MRI) included multiple cervical spondylotic myelopathy, OPLL (Figs 1A and B). The patient was put under general anesthesia and endotracheal intubation was used to avoid excessive neck extension. A posterior midline incision was made and paraspinal muscles were dissected to expose the cervical spine from the inferior portion of the C2 lamina to the superior portion of the C7 lamina. The poorer side of the lamina was opened for laminoplasty. The posterior and ventral cortices were burred to a thin rim at the junction of the lateral mass and lamina. The burr was directed

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at 45° and perpendicular to the lamina. The remaining ventral cortex and the ligamentum flavum were removed using a diamond burr and Kerrison rongeur.^{1,5}

The precontoured laminoplasty system was used and fixed into 3, 4, 5 laminae. Care was taken to avoid breaking the hinge. The interspinous ligament of the level both caudal and cephalic to the laminoplasty was divided, and the hinge side of the lamina was gently pushed away from the open side. The inferior C2 lamina can be undermined if the hinge cannot be opened after appropriate thinning of the ventral cortex on the hinge. Dural pulsations should be seen with adequate decompression. The hinge was maintained open with a titanium miniplate fixed to the lamina and the lateral mass, each with 2 mini-screws unicortical and no spacer or bone graft was used (Figs 2A and B). Postoperatively, a soft neck collar was worn for 2 weeks.

Neck mobilization exercises were allowed as pain improved. At 3 years follow-up, computed tomography was used to assess as follows:

- Hinge union (the bridging of both ventral and dorsal cortices by cortical or cancellous bone)
 - Patency of the laminoplasty and screw pull-out
 - Violation of neuroforamina or vertebral foraminae.
- The canal expansion and any spring-back closure were assessed (Figs 3A and B). Neurological outcome was assessed using the mJOA score.

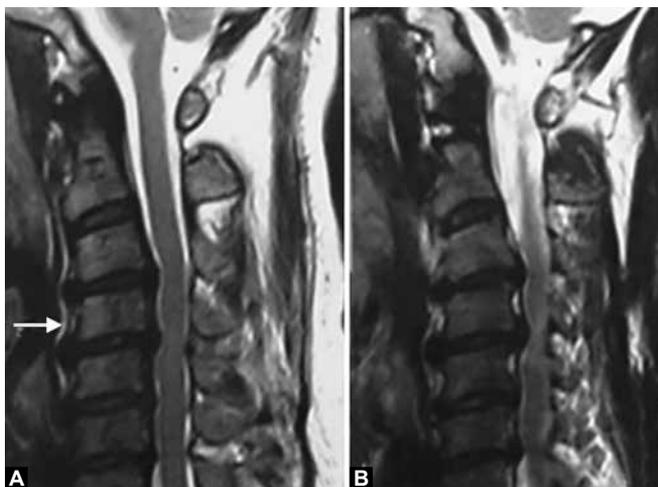
RESULTS

The follow-up period was 3 years. Visual analog scale score improved from 7 to 0 (100%) and the mJOA score improved from 12 to 17. The mean JOA recovery rate was 27.7%. Achieved mJOA score five, no patient had neurological deterioration. There were hinge fusion in the unplated laminae.

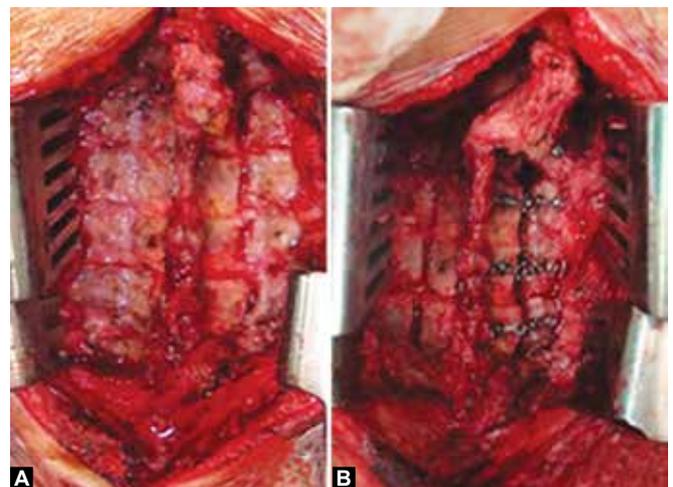
DISCUSSION

Cervical spondylotic myelopathy was proven to result from the narrowing of normal anteroposterior cervical spinal canal to a critical threshold. Degenerative cervical spondylosis, herniated cervical disk or OPLL can result in chronic compression of the spinal cord. The normal cervical aging process, congenital narrowing aggravated by acute trauma and bony malformations were identified as the primary causes of cervical stenosis that result in myelopathy.¹⁻⁵ Surgical treatment of multilevel CSM remains controversial and challenging. Laminoplasty are the most commonly performed posterior procedures for the treatment of multilevel CSM.^{1,7} Generally speaking, there are two types of laminoplasty methods. The first is the open-door method and the other is the double-door method. Unilateral open-door procedure, expansion of the spinal canal and preservation of the posterior structures for stability of the cervical spine are important.²

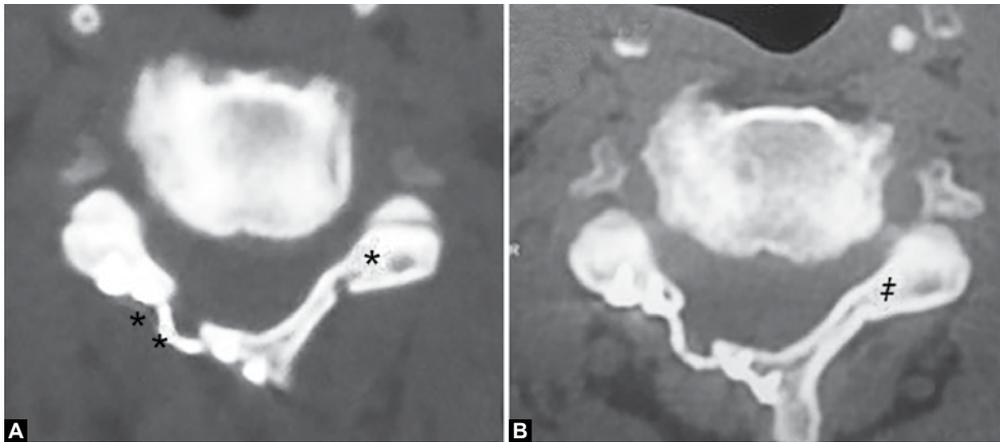
Titanium miniplates fixation can be used to instantly reconstruct the spinal canal to restore its integrity. A relatively stable mechanical environment is conducive to bone slot healing on the door axial side and is also conducive to left and right muscle strength balance in the neck. This balance means that during three-dimensional (3D) motion of the cervical spine the load distribution on both sides is coordinated to avoid excessive fatigue of muscles on one side. Studies have also found that when a simple titanium miniplate is used to fix laminae and lateral masses on the open-door side, stability can be provided at once and a patient can perform early postoperative activity. In addition, compared with bone union, the thin profile of a titanium miniplate provides more space for the spinal canal, assisting decompression. Finally, it is found that a titanium plate has good toughness and will not break.⁹



Figs 1A and B: (A) Cervical spine MRI T2WI showed multiple herniated disk and (B) OPLL



Figs 2A and B: (A) Unilateral open door laminoplasty intra-operatively and (B) following titanium plate placement



Figs 3A and B: (A) Care was taken to avoid breaking the hinge (single asterisk) the poorer side of the lamina was opened for laminoplasty and titanium plate (double asterisk) and (B) 3 years following surgery showed fused hinge (double dagger)

Unilateral open-door laminoplasty can be easily performed and the operation time is short, in addition, reports about serious complications are rare. The first advantage of the titanium miniplate over the commercial laminoplasty plate is the cost. The second advantage is that when cases have a bony anatomical variation or the open-door laminoplasty site does not match the commercial laminoplasty plate the titanium miniplate can be adjusted in length and bent in 3D to fit the contour of the abnormal anatomy on the open-door side.⁷

Anterior cervical decompression with spinal fusion is also practiced widely in patients with cervical spondylotic myeloradiculopathy which has been shown to lead to long-term changes at adjacent vertebral levels. Laminoplasty was developed to avoid these complications, with the first open door laminoplasty being described by Hirabayashi et al¹⁴ and which since then has been further modified by Hirabayashi et al.^{15,16} The elegance of this procedure lies in its simplicity with results comparable to laminectomy and anterior decompression. Itoh and Tsuji, besides others, have shown increased stability, with less sliding, tilting, and range of motion after compared with laminectomy. This may be protective against postoperative instability.⁵

Postoperative C5 palsy is thought to be caused by trauma induced by the surgical technique, displacement of the lamina on the hinge side, a tethering effect induced by an excessive posterior shift of the spinal cord after decompression, traction stress on the nerve root, or damage to the gray matter of the spinal cord. However, the precise mechanism responsible for C5 palsy remains unclear.^{8,9}

Muscles dysfunction in cervical problems must be overcome by exercise designed to improve dynamic stabilization in rehabilitation program.¹⁰ Early postoperative flexibility exercise and decreasing periods of cervical orthosis may improve neck pain and decreasing the loss of cervical range of motion.⁴ Isometric type of strengthening

exercise was performed several days after surgery, to prevent further muscle atrophy while wearing nonrigid cervical orthosis.⁴ Cervical stabilization exercise of the deep flexor muscles, longus colli and longus capitis is performed to promote dynamic stabilization of the spine through increasing flexibility, endurance and strength of those muscles.^{4,10} The recommendation of the exercise is performed 3 set per day, 3 days per week for 5 to 8 weeks will increase the distribution rate of muscle spindle of the deep cervical muscles to promote postural stability.¹⁰ Maintaining the neutral position of the spine by education of proper body mechanic to avoid overload at the joint and surrounding structures can be advocated as early as possible.⁴ Yeh et al gained improvement in cervical curvature and flexibility from 3 months to 1 year post open-door laminoplasty with aggressive rehabilitation after removal of cervical nonrigid orthosis (3–4 weeks).⁴

Mobilization training including transfer and ambulation is started postoperative day and encourage to return to daily activities as soon as possible.¹¹ The exercise testing must be done previously to measure the recent physical activity level after 1 year phase relative physical inactivity as an impact of weakness and other neurologic deficits due to CSM. Cardiovascular rehabilitation with upper and lower extremities endurance training were performed to increase maximum energy uptake (Vo₂max). Moderate to vigorous intensity is recommended with 3 to 5 times a week in frequency and 20 to 60 minute/session in 6 to 12 weeks duration.¹²

The overall functional status prognosis in this patient is good, considering the age is below 56 years old, improvement in motor function in upper and lower extremities postoperative becomes normal in strength (5/5), and also improvement in sensory function. The high rate increasing of mJOA scores (27.7%) and decreasing VAS (100%) in this study also reflecting higher functional outcomes and decreasing the disability level in this patient.¹³

CONCLUSION

Unilateral open-door laminoplasty using a titanium miniplate is a safe and simple fixation technique for the treatment of multiple levels of cervical myelopathy and OPLL. An advantage of this procedure is that it avoids potential complications associated with bone grafts or implants. Moreover, it is as easy to perform as the original procedure and can effectively maintain the vertebral arch in an expanded state.

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