

## PROSPECTIVE STUDY

# Laminoplasty for Cervical Spondylotic Myelopathy

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## ABSTRACT

Cervical spondylotic myelopathy (CSM) is a commonly treated either by uninstrumented laminectomy, carrying the risk of postoperative instability, or by anterior or posterior decompression with fusion resulting in postoperative stiffness and possibly adjacent segment degeneration.

Cervical laminoplasty, initially developed for pediatric or OPLL patients could be an interesting surgical alternative to decompress and reconstruct cervical anatomy without fusion.

Sixteen patients, mean age 63, who presented with CSM were treated surgically using multilevel laminoplasty, and reviewed after 1 month, 6 months, 1 and 2 years. Clinical evaluation was performed based on the Benzel-JOA and Nurick scores. The preoperative mean Benzel-JOA score was 13.43; preoperative mean Nurick score was 1.81. Intramedullary hyperintensity in T2 MRI was observed in five patients. The operation was performed on 2 levels (19%) 3 levels (69%) and 4 levels (12%).

We used the open-door hinged laminoplasty technique, using metallic implants, without bone graft. At one month FU, mean JOA score was 15.44, and Nurick dropped to 1.05. At 6 months, mean JOA was 16.36 and Nurick was 0.72. At one year, the mean JOA score was 16.16, and Nurick was 0.83. At 2 years, mean JOA was 17.5 and Nurick was 0.25.

We reviewed the possible advantages and complications of spinal cord decompression by open-door laminoplasty for CSM. We conclude that this technique allows significant clinical improvement observed progressively in the two years following surgery without increased rigidity or instability.

**Keywords:** Cervical spine, Cervical spondylosis, Laminoplasty, Myelopathy.

**Abbreviations:** ASD: Adjacent segment degeneration; CSM: Cervical spondylotic myelopathy; FU: Follow-up; JOA: Japanese orthopedic association; ROM: Range of motion.

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## INTRODUCTION

Cervical spondylotic myelopathy (CSM) is a common condition. A recent multicentric analysis<sup>1</sup> confirmed that we should treat this condition aggressively as surgery significantly improves the quality of life scores, making surgical treatment of CSM a cost effective procedure.

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Several types of operations have been used, each with its own pros and cons. Multilevel uninstrumented laminectomy has been widely performed, is a fast procedure, but may be complicated by instability and pain.<sup>2</sup> Adding instrumented fusion to posterior decompression treats instability, but causes rigidity<sup>3</sup> and increases the risk of adjacent segment degeneration (ASD). Multilevel anterior median uninstrumented somatotomy has been used by some,<sup>4</sup> but is more time-consuming and may cause kyphosis. Anterior discectomy and fusion is commonly used for one or two levels spinal canal narrowing, but longer constructs create rigidity and increase the risk of reoperations for ASD.<sup>5</sup>

Cervical laminoplasty has been initially designed to treat patients suffering from myelopathy caused by ossification of the posterior longitudinal ligament,<sup>6</sup> and for cervical canal reconstruction in pediatric patients operated for spinal cord tumors.<sup>7</sup> Recently, cervical laminoplasty is gaining interest as an alternative to the previously enumerated techniques for the treatment of CSM.

It allows anatomical reconstruction without fusion and has the theoretical advantages of motion preservation, preservation of sagittal balance, noninduction of adjacent level degeneration. Although debated, it could also reduce postoperative pain.<sup>8,9</sup>

## MATERIALS AND METHODS

We studied prospectively 16 patients (10 men, 6 women-mean age: 63) suffering from cervical spondylotic myelopathy and surgically treated using the open-door laminoplasty technique with the Centerpiece system (Medtronic Inc., Memphis, USA). Patients with kyphosis, major instability, infections or fractures were considered contraindications for laminoplasty. They were assessed after 1 month, 6 months, 1 year and 2 years using the Benzel modified Japanese Orthopedic Association (JOA) scale<sup>10</sup> and the Nurick classification system for myelopathy,<sup>11</sup> on the basis of gait abnormalities (Table 1).

## RESULTS

The average preoperative Benzel-JOA score was 13.43, the average preoperative Nurick score was 1.81. Magnetic resonance imaging of the cervical spine was performed in 14/16 patients. A T2 hyperintense image inside the spinal cord was present in 31%. The patients were operated on 2 levels (19%), 3 levels (69%) or 4 levels (12%).

**Table 1:** The nurick classification system for myelopathy

Grade	Root signs	Cord involvement	Gait	Employment
0	Yes	No	Normal	Possible
I	Yes	Yes	Normal	Possible
II	Yes	Yes	Mild abnormality	Possible
III	Yes	Yes	Severe abnormality	Impossible
IV	Yes	Yes	With assistance	Impossible

After 1 month FU, the mean Benzel-JOA score was 15.06 and the mean Nurik score was 1.13. After 6 months FU, the mean Benzel-JOA score was 16.36 and the mean Nurik score was 0.72. After 1 year FU, the mean Benzel-JOA score was 16.16 and the mean Nurik score was 0.83. Finally, after 2 years FU, the mean Benzel-JOA score was 17.5 and the mean Nurik score was 0.25.

One patient presented a postoperative *S. aureus* infection. The implants had to be removed 2 months after the initial surgery, but no further surgery was performed as the uplifted posterior arch seemed stable. No collapse of this unsupported lamina was observed at any of the radiological controls done during FU. One patient had to be reoperated for a dural tear. One patient presented a transient C5 nerve palsy that recovered completely in a few months, without additional surgery.

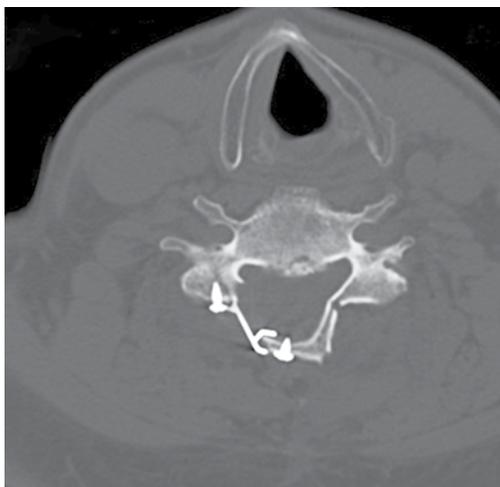
## DISCUSSION

Despite a small number of patients, and having to face the challenges and the learning curve of a new technique, spinal cord decompression by open door laminoplasty allowed significant clinical improvement, gradually over the years that followed surgery and radiological widening of the spinal canal (Fig. 1).

Still some questions remain unanswered.

### Does Laminoplasty Cause Kyphosis?

Machino et al<sup>12</sup> assessed the range of motion and the cervical alignment after cervical laminoplasty in 520 patients



**Fig. 1:** Axial computerized tomography of the cervical spine at the C5 level showing the localization of the implant and the widening of the spinal canal obtained by laminoplasty

suffering from CSM, with a mean FU of 33 months. They concluded that multilevel cervical laminoplasty did not affect significantly the sagittal balance of the cervical spine, causing only a slight 1, 8° increase in lordosis of the C2 to C7 segment, but no kyphosis. Our study was unfortunately too small to address this question.

### Does Laminoplasty Preserve Motion?

The effect of multilevel open door laminoplasty and laminectomy on the flexibility of the cervical spine has been studied in a cadaveric study by Kode et al.<sup>13</sup> They found that laminectomy caused a significant motion increase in the C2-T1 segment because of the loss of the posterior structures. Laminoplasty showed opposite results, with a 17 to 20% decrease in the postoperative motion of the same segment.

In their clinical study, Machino et al reported a similar postoperative decrease in the ROM after cervical laminoplasty, from 40, 1° before surgery to 33.5° at the final FU visit. The ROM of the cervical spine was preserved by 87.9%. This absence of postoperative instability also has the advantage of allowing the early removal of the cervical orthosis and the rapid start of postoperative neck exercises.<sup>12</sup>

In our series, we anecdotally identified two different groups of patients: when the spine was stiffened by osteophytes prior to surgery, laminoplasty did not induce any new motion, but in the younger patients or when motion was present before surgery, it could be preserved after laminoplasty (Figs 2A to C). No postoperative instability was observed.

### Does C5 Nerve Root Palsy Occur?

Postoperative C5 nerve root palsy is a complication often reported after posterior decompression of the cervical spinal cord. Its etiology is still unclear. It could be triggered by traction on the nervous plexus, with the C5 nerve root being more specifically exposed because it is the highest positioned nerve root.

Spitz et al<sup>15</sup> retrospectively reviewed 600 patients and found that the real incidence of C5 palsy after decompression for myelopathy was only 0, 8%. Perioperative neurophysiologic monitoring seemed of little value, electromyogram and somatosensory evoked potentials not being sensitive enough and having no predictive value.<sup>14</sup> Rowland et al<sup>15</sup> confirmed the relative rarity of this complication and added that it can



**Figs 2A to C:** Lateral cervical spine X-ray 6 months after open door laminoplasty of C4, C5 and C6 in flexion (A), in neutral position and in extension (B and C). Note the preservation of flexion/extension motion in this 40 years old patient

also be observed with the same incidence after multilevel anterior decompression.

### Do We Need a Bone Graft?

This question is difficult to answer as it is as difficult to know how long it takes for the hinge to heal, and as we do not know the importance of the anteroposterior forces pushing on the opened posterior arch. In the single patient in our series who needed to have his implants removed because of infection, the hinge had healed in 2 months, and did not collapse during the two following years. Therefore, the question of the bone graft is debatable and the answer is left to the surgeons's preference. Several models of implants exist, featuring titanium baskets to be filled with autologous bone, or featuring preattached hydroxyapatite spacers.

### Other Complications

CSF leaks have been described and are usually best treated by direct repair whenever possible, in association with the use of fibrin glue or sealant polyethylene glycol based gels, and temporary lumbar drainage in some cases.

Finally, the fracture of the 'hinge' when the posterior arch of the vertebra is lifted upwards has to be recognized and should also be stabilized immediately by the use of small titanium plates in order to avoid the migration of the lamina in the spinal canal.

### CONCLUSION

Compared to laminectomy or cervical multilevel fusion, laminoplasty for multilevel spondylotic myelopathy has the theoretical advantages of motion preservation, preservation of sagittal balance, noninduction of adjacent level degeneration and reduced postoperative pain.

In this series cervical multilevel laminoplasty has been used to treat either young patients with preservable motion or elderly patients with stiff non kyphotic cervical spines. Despite a small number of patients and having to face the learning curve of a new technique, spinal cord decompression by open door laminoplasty allowed significant clinical improvement, gradually over the years that followed surgery.

### REFERENCES

1. Woodard E, Kopjar B, Fehlings M, Yoon S, Arnold P, Massicotte E, Vaccaro A, Brodke D, Shaffrey C, Banco R, et al. Is surgery for cervical spondylotic myelopathy cost effective? Presented at the 2012 AANS meeting.
2. Guigui P, Benoist M, Deburge A. Spinal deformity and instability after multilevel cervical laminectomy for spondylotic myelopathy. *Spine (Phila Pa 1976)* 1998 Feb 15;23(4):440-447.
3. Kretzer RM, Hsu W, Hu N, Umekoji H, Jallo GI, McAfee PC, Tortolani PJ, Cunningham BW. Adjacent-level range of motion and intradiscal pressure after posterior cervical decompression and fixation: an in vitro human cadaveric model. *Spine (Phila Pa 1976)* 2012 Jun 1;37(13):E778-785.
4. Tourneux H, Nuti C, Fotso MJ, Dumas B, Duthel R, Brunon J. Evaluation of the clinical and radiological results of cervical longitudinal median somatotomy without graft. *Neurochirurgie* 2009 Feb;55(1):1-7.
5. Matsumoto M, Okada E, Ichihara D, Watanabe K, Chiba K, Toyama Y, Fujiwara H, Momoshima S, Nishiwaki Y, Iwanami A, et al. Anterior cervical decompression and fusion accelerates adjacent segment degeneration: comparison with asymptomatic volunteers in a 10-year magnetic resonance imaging follow-up study. *Spine (Phila Pa 1976)* 2010 Jan 1;35(1):36-43.
6. Mizuno J, Nakagawa H. Ossified posterior longitudinal ligament: management strategies and outcomes. *Spine J* 2006 Nov-Dec;6(6 Suppl):282S-288S.
7. Yeh JS, Sgouros S, Walsh AR, Hockley AD. Spinal sagittal malalignment following surgery for primary intramedullary tumours in children. *Pediatr Neurosurg* 2001 Dec;35(6):318-324.
8. Manzano GR, Casella G, Wang MY, Vanni S, Levi AD. A prospective, randomized trial comparing expansile cervical laminoplasty and cervical laminectomy and fusion for multilevel cervical myelopathy. *Neurosurgery* 2012 Feb;70(2):264-277.
9. Nurboja B, Kachramanoglou C, Choi D. Cervical laminectomy vs laminoplasty: is there a difference in outcome and postoperative pain? *Neurosurgery* 2012 Apr;70(4):965-970.

10. Benzel EC, Lancon J, Kesterson L, Hadden T. Cervical laminectomy and dentate ligament section for cervical spondylotic myelopathy. *J Spinal Disord* 1991 Sep;4(3):286-295.
11. Nurick S. The pathogenesis of spinal cord disorder associated with cervical spondylosis. *Brain* 1972;95:87-100.
12. Machino M, Yukawa Y, Hida T, Ito K, Nakashima H, Kanbara S, Morita D, Kato F. Cervical alignment and range of motion after laminoplasty: radiographic data from over 500 cases with cervical spondylotic myelopathy and a review of the literature. *Spine* 2012 Sep 15;37(20):E1243-E1250.
13. Kode S, Gandhi AA, Fredericks DC, Grosland NM, Smucker JD. Effect of multi-level open door laminoplasty and laminectomy on flexibility of the cervical spine: an experimental investigation. *Spine* 2012 Sep 1;37(19):E1165-E1170.
14. Spitz SM, Anaizi A, Sandhu F. Postoperative C5 root palsy and the use of neurophysiologic monitoring presented at the 2012 AANS meeting.
15. Rowland N, Wu JC, Gandhoke G, Mummaneni P. Anterior corpectomy versus posterior laminoplasty: is the risk of postoperative C5 palsy different? Presented at the 2012 AANS meeting.