



Review Article

Which factors predict the loss of cervical lordosis following cervical laminoplasty? A review of various indices and their clinical implications

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ABSTRACT

Background: Many patients undergoing laminoplasty develop postoperative loss of cervical lordosis or kyphotic alignment of cervical spine despite sufficient preoperative lordosis. This results in poor surgical outcomes.

Methods: Here, we reviewed the relationship between multiple radiological parameters of cervical alignment that correlated with postoperative loss of cervical lordosis in patients undergoing laminoplasty.

Results: Patient with a high T1 slope (T1S) has more lordotic alignment of the cervical spine preoperatively and is at increased risk for the loss of cervical lordosis postlaminoplasty. Those with lower values of difference between T1S and Cobb's angle (T1S-CL) and CL-T1S ratio have higher risks of developing a loss of the cervical lordosis postoperatively. Alternatively, C2-C7 lordosis, neck tilt, cervical range of motion, and thoracic kyphosis had no role in predicting the postlaminoplasty kyphosis.

Conclusion: Among various radiological parameters, the preoperative T1S is the most important factor in predicting the postoperative loss of the cervical lordosis/alignment following laminoplasty.

Keywords: Cervical laminoplasty, Loss of cervical lordosis, T1 slope, C2-C7 lordosis, C2-C7 Cobb's angle, C2-C7 sagittal vertical axis, C2-C3 disc angle

INTRODUCTION

Although laminectomy has better long-term clinical and radiological outcomes, laminoplasty is still favored for the management of cervical spondylotic myelopathy as it preserves the cervical range of motion (ROM) with a lower risk of postoperative kyphosis.^[3,14-17] Despite an adequate preoperative cervical lordosis, increases in the T1 slope (T1S) may result in postlaminoplasty kyphosis.^[1,2,4-6] Here, we highlight the relationship between T1S and other radiological indicators of cervical alignment and correlate these with postlaminoplasty kyphosis/loss of lordosis.

METHODS

Measures of cervical alignment

Multiple studies have described various indices that help predict the risk of loss of cervical lordosis in postlaminoplasty patients [Table 1, Figure 1].^[9,11-13]

RESULTS

T1S

The T1S is one of the most important indices that can help predict the postlaminoplasty loss of cervical lordosis. Notably, the preoperative cervical lordosis (C2-C7 Cobb's angle) was greater in patients with higher T1S versus those with lower T1S; these patients have a higher risk of kyphosis postlaminoplasty.^[2,5-7,18] Lee *et al.*^[10] concluded that patients

with a T1S of $>29^\circ$ are more likely to exhibit postlaminoplasty kyphosis/loss of lordosis of more than 5° versus those with T1S of $<29^\circ$.

C2-C7 sagittal vertical axis (SVA)

Several studies have shown that the preoperative C2-C7 SVA had no significant correlation with the postlaminoplasty loss of cervical lordosis.^[2,5,6,18] Alternatively, Zhang *et al.*^[18] concluded that C2-C7 SVA was positively correlated with loss of cervical lordosis following laminoplasty.^[2,5,6,18] Lin *et al.*^[13] showed the combined effect of T1S and C2-C7 SVA on predicting loss of cervical lordosis. Patient with low T1S ($\leq 20^\circ$) and large C2-C7 SVA (>22 mm) surprisingly had an increased cervical lordosis postlaminoplasty.

Other factors are predictive of postlaminoplasty kyphosis

There are multiple other factors that predict postlaminoplasty kyphosis. Li *et al.*^[11] concluded that patients with high Cobb's angle-T1S ratio (CL/T1S) have a higher risk of kyphosis versus those with low CL/T1S. Kim *et al.*^[5] and Zhang *et al.*^[18] showed no relationship between cervical ROM and the risk for postoperative kyphosis. Similar to cervical ROM, neck tilt (NT) a measure of cervical spine tilt with respect to sternum, also does not predict the loss of cervical lordosis following laminoplasty.^[6] Thoracic kyphosis (TK) is, however, directly related to cervical lordosis.^[8] Cephalad vertebral level undergoing laminoplasty has also emerged as a new risk factor for loss of cervical lordosis following laminoplasty.

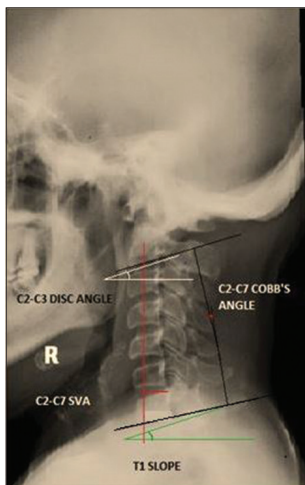


Figure 1: The lateral X-ray of cervical spine showing various radiological measurements.

CONCLUSION

A high T1S and C2-C7 SVA are the most predictive factors for postlaminoplasty kyphosis. Those risk factors that do

Table 1: Description of indices affecting cervical alignment.

C2-C7 SVA	The distance from the posterosuperior corner of C7 body and the vertical line from the center of the C2 body
T1 slope	The angle between the upper endplate of T1 vertebral body and the horizontal line parallel to floor on standing lateral radiographs
C2-C7 lordosis (CL)	The Cobb's angle measured between lower endplates of C2 and C7
T1S-CL	T1 slope minus C2-C7 cervical lordosis
CL/T1 S	Ratio of C2-C7 Cobb's angle to T1 slope
Cervical ROM (range of motion)	The cervical range of motion (ROM) is defined as the sum of the C2-C7 Cobb angle during flexion and extension lateral radiographs
Neck tilt (NT)	The angle formed by a line drawn in the upper end of the sternum and a line connecting the center of the T1 upper end plate and the upper end of sternum
Thoracic kyphosis (TK)	Thoracic kyphosis (TK) is defined as the Cobb angle between the upper endplate of T3 and the lower endplate of T12 on whole standing lateral radiograph
CVLL	Cephalad vertebral level of laminoplasty
C2-D3 disc angle	It is defined on a standing or upright radiograph by assessing the angle created by the line drawn parallel to the C2-3 disc space and the line parallel to the floor

CVLL: Cephalad vertebral level undergoing laminoplasty, TK: Thoracic kyphosis, NT: Neck tilt, ROM: Range of motion, SVA: Sagittal vertical axis

not contribute to this include; (1) the preoperative C2-C7 lordosis, NT, cervical ROM, and TK.

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Conflicts of interest

There are no conflicts of interest.

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