Defining Postoperative Kyphosis Following Cervical Laminaplasty: Incidence and Risk Factor Analysis

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INTRODUCTION: Laminaplasty is an established surgical intervention to alleviate spinal cord compression in a variety of pathologies. One significant complication is the development of postoperative cervical kyphosis. This deformity not only compromises the surgical outcomes by potentially inducing instability and neurologic deficits but also predisposes patients to chronic pain and functional impairment. Given the debilitating effects of these complications, understanding the preoperative risk factors contributing to post-laminoplasty kyphosis is critical. This study aims to better understand preoperative risk factors leading to post-laminoplasty kyphosis.

METHODS: This is a retrospective review of a prospective database of posterior cervical laminaplasty patients. Patients who underwent a posterior cervical laminaplasty by one of six surgeons from 2017 – 2024 were included. All patients had minimum one year radiographic and clinical follow-up. Radiographical measurements were taken using Ambra Imaging software: preoperative, postoperative, and final C2-7 Cobb angle, T1 slope, Torg-Pavlov ratio, C2-7 SVA (sagittal vertical axis), C2-7 flexion ROM (range of motion), C2-7 extension ROM, and K-line. Postoperative kyphosis was defined as a 15-degree or more positive (kyphotic) change in the C2-7 Cobb angle compared with preoperative alignment. Demographics of patients with and without postoperative kyphosis were compared using independent t-tests and ANOVA. Multiivariate logistic regression was used to identify preoperative risk factors independently associated with development of postoperative kyphosis following cervical laminaplasty.

RESULTS: A total of 110 patients were included. Among these, a total of 48 patients had postoperative kyphosis at final follow-up. The mean age for this patient sample was 65.1 ± 10.2 years, and a mean BMI of 30.2 ± 7. No significant differences were observed in the two groups with age (p=0.406), smoking status (p=0.845), BMI (p=0.130), sex (0.740), or Charlson Comorbidity Index (CCI), 0.892) (Table 1). The mean change in C2-C7 cobb angle from pre-op image to final follow-up was 8.1 ± 11.3 (mean ± SD) degrees of kyphosis, while the mean total change was 11.4 ± 9.5 degrees of kyphosis from pre-op to immediately post-operatively. Patients regained a mean of 3.7 ± 9.3 degrees of lordosis from the immediate postoperative image to the final follow-up. Amongst all preoperative parameters, the only independent risk factor for post-laminoplasty kyphosis was the amount of preoperative neck flexion (OR 1.1 per degree, p=0.010).

DISCUSSION AND CONCLUSION: In a sample of 110 laminaplasty patients with mean 1-year follow-up, on average, patients developed 8 degrees of kyphotic change at final follow-up compared to their preoperative C2-7 alignment. In the immediate postoperative period, on average, patients developed 11 degrees of kyphosis from baseline, and patients regained 4 degrees of lordosis from the immediate postoperative visit to final-followup. The only risk factor identified for significant postoperative kyphosis following cervical laminaplasty was the amount of preoperative neck flexion. Patients with increased preoperative neck flexibility likely have the additional ability to compensate for residual stenosis by increasing cervical kyphosis/flexion. This information is important for preoperative planning and patient counseling.

Table I Group Demographics

	Kyphosis <15 Degrees	Kyphosis >15 Degrees	All patients	p-value
Overall	62	48	110	
Age	64.5 + 10.0	66.1 + 10.5	65.1 + 10.2	0.406
BMI	31.1 + 6.4	28.9 + 7.9	30.2 + 7.1	0.130
Female sex	35.48%	38.64%	36.79%	0.740
Smoking	12.90%	11.63%	12.38%	0.845
Diabetes	35.50%	25.00%	30.91%	0.238
CCI				
0-2	17.74%	18.75%	18.18%	0.892
3-4	46.77%	41.67%	44.55%	
5+	33.90%	35.40%	34.60%	

Groups of kyphosis greater than 15 degrees and less than 15 are both defined as the difference between preoperative to final C2-C7 cobb angle.

Table IIA Cobb Angles Measurements	**Mean Degrees**	**Degrees Range**
Change in C2-7 angle Pre-Final	8.1 ± 11.3	-23 to 48
Change in C2-7 angle Pre-Post	11.4 ± 9.5	-5 to 39
Change in C2-7 angle Post-Final	-3.7 ± 9.3	-31 to 16.3
C2-7 preoperative extension	-21.8 ± 9.1	-54 to -4
C2-7 preoperative flexion	12.3 ± 11.0	-21 to 38
Table IIB Risk Factors for New Postoperative Kyphosis		
Preoperative C2-7 flexion	OR 1.1	(p=0.010)