Original Research Article

Surgical Outcome of Laminoplasty for Cervical Spondylotic Myelopathy a Multicentric Prospective Study

Dr. Md. Yousuf Ali[1*], Dr. Shahida Akter[2], Dr. Md. Ali Faisal[3], Dr. Chowdhury Iqbal Mahmud[4], Prof. Dr. Md. Golam Rahman[5], Dr. Shah Md Samsul Hoque[6], Dr. Md. Khorsherdul Alam[7]

[1]Associate Professor, Spinal Surgery, Dept. of Orthopaedics, Bangubandhu Sheikh Mujib Medical University, Dhaka, Bangladesh
[2]Medical Officer, Dept. of Conservative Dentistry, Bangubandhu Sheikh Mujib Medical University, Dhaka, Bangladesh
[3]Associate Professor, Orthopaedic Surgery, Dept. of Orthopaedics, Bangubandhu Sheikh Mujib Medical University, Dhaka, Bangladesh
[4]Associate Professor, Orthopaedic Surgery, Dept. of Orthopaedics, Bangubandhu Sheikh Mujib Medical University, Dhaka, Bangladesh
[5]Prof, And Head of Dept. of Orthopaedics, Shahabuddin Medical College Hospital, Dhaka, Bangladesh
[6]Associate Professor, Orthopaedic Surgery, Dept. of Orthopaedics, Bangubandhu Sheikh Mujib Medical University, Dhaka, Bangladesh
[7]Consultant, Orthopaedics, Kachua Upazila Health Complex, Chandpur, Bangladesh

Abstract

Background: Cervical spondylotic myelopathy (CSM) is the leading cause of spinal cord dysfunction in adults over 55, resulting from degenerative cervical changes that compress the spinal cord and lead to functional impairment. Laminoplasty, a posterior decompression technique, is widely used for multilevel cervical stenosis, preserving spinal stability while improving neurological outcomes. *Objective:* To evaluate the functional and neurological outcomes of en-bloc cervical laminoplasty in patients with CSM and to identify prognostic factors influencing recovery. *Methods:* This retrospective study included 85 patients who underwent en-bloc cervical laminoplasty at different private hospital and Bangabandhu Sheikh Mujib Medical University Bangladesh between January 2007 and June 2019. Preoperative symptom duration was categorized as <6 months, 6–18 months, and >18 months. Neurological and functional status were assessed using the modified Japanese Orthopaedic Association (mJOA) score and Nurick grading scale. Postoperative recovery rates were calculated using the Hirabayashi method. Data were analyzed using SPSS 22, with Fisher's exact test, ANOVA, and Spearman's correlation applied as appropriate. A p-value <0.05 was considered significant. *Results:* The mean age of patients was 65.8 ± 8.9 years, with 62.35% males. Multilevel stenosis was common, with four-level involvement in 37.65% of patients. Patients with shorter symptom duration (<6 months) achieved the best neurological recovery, with all reaching mJOA scores >15. Recovery rates varied according to preoperative mJOA and Nurick scores: complete recovery was observed in 75.0% of patients with mJOA ≥15 and 75–100% of patients with Nurick grades 0–2, whereas those with mJOA <12 or Nurick grades 3–4 experienced partial recovery, no change, or worsening. *Conclusion:* Early surgical intervention in CSM is associated with superior neurological outcomes. Higher preoperative mJOA scores, lower Nurick grades, and shorter symptom duration were strong predictors of complete recovery, while prolonged symptoms and severe baseline deficits limited postoperative improvement. These findings underscore the importance of timely diagnosis and surgical management in optimizing patient outcomes.
Keywords: Cervical spondylotic myelopathy, laminoplasty, mJOA score, Nurick grading, neurological recovery, multilevel cervical stenosis.

INTRODUCTION

Cervical spondylotic myelopathy (CSM) is the most common cause of spinal cord dysfunction in adults over the age of 55. It results from degenerative changes in the cervical spine, including disc herniation, osteophyte formation, and hypertrophy of the ligamentum flavum, which collectively compress the spinal cord. [1-3] The progressive nature of CSM often leads to functional impairment, gait disturbances, sensory deficits, and in severe cases, loss of independence. Given its high prevalence and disabling potential, timely and effective surgical intervention is crucial to halt disease progression and improve neurological outcomes.

Among the various surgical options, laminoplasty has emerged as a well-established posterior decompression technique for multilevel cervical stenosis. First introduced in Japan during the 1970s,

laminoplasty involves reconstruction and expansion of the lamina to widen the spinal canal while preserving spinal stability. [4-5] Compared to laminectomy with or without fusion, laminoplasty is considered advantageous due to reduced postoperative instability, preservation of motion segments, and avoidance of fusion-related complications. These benefits have made laminoplasty a preferred option in many centers worldwide for selected patients with CSM.

The surgical outcome of laminoplasty is influenced by multiple factors, including preoperative neurological status, age, duration of symptoms, radiological findings, and the presence of co-morbidities. While most patients experience significant neurological recovery and functional improvement, the degree of outcome varies, and not all patients achieve complete symptom resolution. Common postoperative concerns include axial neck pain, limited range of motion, C5 palsy, and, in some cases, restenosis. [6] Understanding the determinants of surgical success is therefore essential for optimizing patient selection and counseling.

Several scoring systems, such as the Japanese Orthopaedic Association (JOA) score and Nurick's grading, are widely used to assess functional recovery after laminoplasty. Improvement in these scores postoperatively reflects neurological and quality-of-life gains, thereby serving as reliable measures of outcome. [7-8] Radiographic evaluations, including spinal canal diameter and cervical alignment, further contribute to understanding surgical effectiveness and predicting long-term stability.

Despite the extensive use of laminoplasty, debates remain regarding its long-term outcomes compared with anterior approaches or posterior laminectomy with fusion. Some studies highlight superior preservation of cervical motion and lower rates of adjacent segment disease, while others report limitations such as postoperative kyphosis and persistent axial pain. These contrasting findings necessitate continued evaluation of surgical results to refine operative techniques and establish evidence-based guidelines.

Given the clinical burden of CSM and the critical role of surgery in altering its natural history, evaluating the surgical outcome of laminoplasty is highly relevant. Analyzing functional recovery, complication rates, and prognostic factors can help clinicians tailor surgical strategies, improve patient care, and enhance long-term quality of life for individuals suffering from this debilitating condition.

OBJECTIVE

In this study our main goal is to evaluate the functional and neurological outcomes of en-bloc cervical laminoplasty in patients with CSM and to identify prognostic factors influencing recovery.

METHODOLOGY

This retrospective study was conducted in different private hospital and Bangabandhu Sheikh Mujib Medical University Bangladesh between January 2007 and June 2019. A total of 85 patients who underwent en-bloc cervical laminoplasty for cervical spondylotic myelopathy (CSM) were included in the analysis. The duration of preoperative symptoms was categorized into three groups: patients who underwent surgery within the first 6 months, between 6–18 months, and after 18 months of symptom onset. Functional and neurological evaluations were performed using the modified Japanese Orthopaedic Association (mJOA) score and the Nurick scale. The mJOA score assesses upper limb, lower limb, and trunk motor dysfunction, sensory deficits, and sphincter involvement, with a maximum score of 18. Based on mJOA scores, patients were stratified into three groups: ≥ 15, 12–14, and <12. Postoperative recovery rate was calculated according to the method described by Hirabayashi *et al.,* where Recovery rate (%) = (postoperative JOA – preoperative JOA) / (18 – preoperative JOA) × 100. The Nurick scale graded disability on a scale from 0–5, according to the degree of gait disturbance at admission.

All patients in this series underwent hardware-augmented en-bloc laminoplasty. One side of the lamina was cut completely using a high-speed drill, while on the contralateral side only the outer cortex was cut, leaving the inner cortex intact. The lamina was elevated using small angled currets, preserving the ligamentum flavum, interspinous, and supraspinous ligaments. The elevated lamina was then fixed with mini-plates to maintain stability.

Statistical Analysis

Data were collected and analyzed using SPSS version 22. Descriptive statistics included frequency, percentage, mean, standard deviation, and minimum–maximum values. For categorical data analysis, Fisher's exact test was applied due to the small sample size. The Shapiro-Wilk test was used to evaluate normality of data distribution. One-way analysis of variance (ANOVA) was performed to compare quantitative data among independent groups. Correlations between variables were assessed using Spearman's correlation coefficient. A p-value of <0.05 was considered statistically significant.

RESULTS

In this study, the mean age of patients was 65.8 ± 8.9 years (range: 50–87), with a male predominance (62.35%) compared to females (37.65%). The average follow-up period was 35.2 ± 9.1 months, ranging from 19 to 53 months. Radiological assessment revealed that 9 patients had single-level stenosis, 21 had two-level

involvement, 33 had three-level stenosis, and 22 patients presented with four-level cervical stenosis, indicating that multilevel disease was more common in this cohort.

Table 1: Demographic status of the study group

Characteristic	Value
Mean Age (years)	65.8 ± 8.9
Age Range (years)	50 – 87
Sex (Male)	53 (62.35%)
Sex (Female)	32 (37.65%)
Mean Follow-up (months)	35.2 ± 9.1
Follow-up Range (months)	19 – 53
Single-level Stenosis	9
Two-level Stenosis	21
Three-level Stenosis	33
Four-level Stenosis	22

Patients with shorter symptom duration (<6 months) demonstrated the best neurological status, with all 28 patients (97.65%) achieving an mJOA score >15. In contrast, among those with symptoms lasting 6–18 months, the majority (18 patients, 64.3%) had moderate scores (12–14), while only 1 patient (2.35%) achieved a score >15 and 2 patients (7.1%) fell below 12. For patients with symptoms persisting beyond 18 months, neurological deterioration was more pronounced, with 26 individuals (92.9%) recording mJOA scores <12.

Table 2: Symptom duration and mJOA scores (n=85)

mJOA scores	<6 months (n, %)	6–18 months (n, %)	>18 months (n, %)
>15	28 (97.65%)	1 (2.35%)	0 (0.0)
12–14	2 (7.1)	18 (64.3)	8 (28.6)
<12	0 (0.0)	2 (7.1)	26 (92.9)

The recovery outcomes varied according to the preoperative mJOA scores among 85 patients. Among those with a score of ≥15 (n=24), 75.0% achieved complete recovery and 25.0% had partial recovery, with no cases of no change or worsening. In the group with scores between 12 and 14 (n=30), 60.0% showed complete recovery and 40.0% experienced partial recovery, again with no patients showing no change or deterioration. For patients with scores below 12 (n=31), none achieved complete recovery; 64.5% demonstrated partial recovery, 29.0% showed no change, and 6.5% experienced worsening of their condition.

Table 3: Recovery rates according to preoperative mJOA score

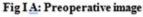| Preoperative mJOA score	Complete Recovery n (%)	Partial Recovery n (%)	No Change n (%)	Worsening n (%)
≥15 (n=24)	18 (75.0%)	6 (25.0%)	0 (0.0%)	0 (0.0%)
12–14 (n=30)	18(60.0%)	12 (40.0%)	0 (0.0%)	0 (0.0%)
<12 (n=31)	0 (0.0%)	20 (64.5%)	9 (29.0%)	2 (6.5%)

Among 85 patients stratified by preoperative Nurick Grade, recovery outcomes showed a clear correlation with initial neurological status. All 14 patients with Grade 0 achieved complete recovery (100%), while Grade 1 patients (n=20) had 85.0% complete and 15.0% partial recovery. For Grade 2 (n=23), 73.9% achieved complete recovery and 26.1% had partial improvement. In contrast, none of the 17 patients with Grade 3 recovered completely, with 64.7% showing partial recovery and 35.3% remaining unchanged. Grade 4 patients (n=11) had the poorest outcomes, with 54.5% partial recovery, 27.3% showing no change, and 18.2% experiencing postoperative worsening.

Table 4: Recovery rates according to preoperative Nurick Grade

Preoperative Nurick Grade	Complete Recovery n (%)	Partial Recovery n (%)	No Change n (%)	Worsening n (%)
0 (n=14)	14 (100%)	0 (0%)	0 (0%)	0 (0%)
1 (n=20)	17 (85.0%)	3 (15.0%)	0 (0%)	0 (0%)
2 (n=23)	17 (73.9%)	6 (26.1%)	0 (0%)	0 (0%)
3 (n=17)	0 (0%)	11 (64.7%)	6 (35.3%)	0 (0%)
4 (n=11)	0 (0%)	6 (54.5%)	3 (27.3%)	2 (18.2%)

Fig I A: Preoperative image

Fig 1 B: Per operative image

Fig 1 C: Immediate postoperative image

Fig 2 A: Post-operative image

Fig 2 B: Post-operative image

DISCUSSION

The present study evaluated the clinical and neurological outcomes of patients with cervical spondylotic myelopathy (CSM) undergoing surgical intervention. Our cohort had a mean age of 65.8 years, with a male predominance (62.35%), consistent with previous studies that reported higher prevalence of CSM in older adults and males due to occupational and degenerative predispositions. [7] The majority of patients presented with multilevel stenosis, with four-level involvement being the most common (37.5%), reflecting the progressive nature of degenerative cervical disease in the elderly population. This observation aligns with reports by Fehlings *et al.,* where multilevel cervical stenosis was frequently observed in surgical cohorts, particularly among older patients. [8]

Symptom duration appeared to have a significant impact on postoperative recovery. Patients with symptoms lasting less than six months demonstrated excellent outcomes, with all patients achieving mJOA scores >15. Conversely, those with longer symptom durations, particularly over 18 months, had poorer outcomes, with most patients scoring <12 postoperatively. These findings underscore the importance of early diagnosis and timely surgical intervention in CSM, corroborating earlier studies by Tetreault et al., which emphasized that prolonged symptom duration is associated with irreversible neurological deficits and limited functional recovery. [9]

Preoperative mJOA scores were also strongly predictive of postoperative outcomes. Patients with higher baseline scores (≥15) achieved complete recovery in 75% of cases, whereas none of the patients with scores <12 achieved complete recovery, and a small proportion experienced worsening. This gradient in recovery aligns with literature demonstrating that preoperative neurological status is one of the strongest predictors of postoperative improvement in CSM.[9] In particular, Kawaguchi *et al.,* reported that patients with mild preoperative impairment demonstrated greater postoperative gains compared to those with severe baseline deficits. [10]

Similarly, preoperative Nurick grading demonstrated a clear correlation with recovery outcomes. Patients with grades 0–2 achieved high rates of complete recovery (75–100%), while patients with grades 3 and 4 showed no complete recovery, with some experiencing partial recovery or even worsening. These findings are consistent with prior studies that have utilized the Nurick scale, showing that lower grades correlate with better functional outcomes following decompressive surgery. [11] The concordance between mJOA and Nurick scales in our cohort highlights the reliability of both tools in assessing baseline severity and predicting postoperative recovery.

Our findings also suggest that multilevel stenosis, though common in the cohort, did not preclude favorable outcomes in patients with shorter symptom duration and higher preoperative scores. This observation is supported by studies indicating that multilevel laminoplasty or decompression can yield satisfactory neurological recovery when performed early, even in extensive disease. [12] However, outcomes were less favorable in patients with prolonged symptoms and severe baseline impairment, reinforcing the need for careful patient selection and counseling regarding realistic expectations.

CONCLUSION

In conclusion, our study demonstrates that early surgical intervention in cervical spondylotic myelopathy leads to better neurological outcomes, with patients exhibiting shorter symptom duration, higher preoperative mJOA scores, and lower Nurick grades achieving the highest rates of complete recovery. Multilevel stenosis was common in this cohort, but favorable recovery was still observed in patients with mild baseline deficits. Conversely, prolonged symptom duration and severe preoperative impairment were associated with limited improvement and occasional deterioration. These findings highlight the critical importance of timely diagnosis and intervention, as well as the predictive value of preoperative neurological status for postoperative recovery.

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