Original Article

Skip Laminectomy versus Laminoplasty for Treatment of Multilevel Cervical Myelopathy: A Comparison of Outcomes

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ABSTRACT

Background: Multilevel cervical myelopathy (MCM) is a progressive neurological disorder caused by spinal cord compression. Posterior decompressive procedures such as laminoplasty and skip laminectomy are commonly employed, but their comparative outcomes remain unclear, particularly in regional populations. This study compared postoperative outcomes of skip laminectomy and laminoplasty.

Methods: This randomized controlled trial was conducted at Sir Ganga Ram Hospital from March 2023 to March 2024. Forty-eight patients aged 35–65 years with MRI-confirmed multilevel cervical spondylotic myelopathy (≥3 levels) were enrolled and randomized using computer-generated allocation into skip laminectomy (n=24) or open-door laminoplasty (n = 24). Patients with kyphosis, ≤2 involved levels, prior cervical surgery, trauma, infection, or need for fixation were excluded. Primary variables included operative time, intraoperative blood loss, cervical range of motion, pain (VAS), and neurological status (Nurick grade). Outcomes were assessed preoperatively, at 3, and 6 months. Neurological improvement was defined as a ≥1-grade reduction in Nurick score. Operative time was recorded from incision to closure, and blood loss was calculated as suction volume after subtracting irrigation volume. Data were analyzed using SPSS v24.0, with p-value <0.05 considered statistically significant.

Results: Mean age was comparable between groups (skip laminectomy: 50.67; laminoplasty: 49.13; p-value >0.05). Operative time was significantly shorter in the skip laminectomy group compared with laminoplasty (97.08 ± 31.05 vs. 127.42 ± 34.73 minutes; p-value = 0.03). Intraoperative blood loss was also significantly lower in the skip laminectomy group (75.79 ± 2.23 vs. 282.63 ± 1.27 mL; p-value <0.001). No significant differences were observed in Nurick grade, pain, or cervical range of motion at baseline, at 3 months, or at 6 months of follow-up (p-value >0.05).

Conclusion: Both procedures produced comparable neurological, pain, and functional outcomes in MCM; however, skip laminectomy demonstrated superior intraoperative efficiency with reduced operative time and blood loss.

Keywords: Multilevel cervical myelopathy; Skip laminectomy; Laminoplasty; Surgical outcomes; Range of motion

INTRODUCTION

The cervical spinal canal typically measures 17–18 mm in diameter and contains neural structures, meninges, ligaments, and epidural fat.[1] Cervical spine myelopathy (CSM), resulting from spinal cord dysfunction, presents with symptoms ranging from balance issues to paralysis and incontinence, depending on the extent and location of compression.[2] Common causes include cervical spondylosis, ossification of the posterior longitudinal ligament (OPLL), trauma, and tumors.[3] Surgical intervention is recommended for progressive symptoms or failure of conservative management, with decompressive techniques demonstrating favorable outcomes in halting disease progression and improving neurological function.[4] Cervical spondylotic myelopathy (CSM) is the leading cause of spinal cord dysfunction in the adult population.[5] Surgery provides greater improvement in functional status compared to non-surgical treatments.[6] Laminectomy is a standard posterior decompression procedure, but it may lead to complications such as axial

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pain, reduced neck mobility, and postoperative kyphosis.[7,8] Due to higher complication rates in multilevel anterior surgeries, posterior approaches like laminoplasty and skip laminectomy are increasingly preferred.[9] Laminoplasty, developed in Japan in the 1970s, expands the spinal canal while preserving spinal alignment and motion.[10] Alternatively, the laminectomy introduced in the 1990s avoids muscle detachment by selectively removing the laminae at alternate levels, thus preserving the posterior musculature.[11,12] It has shown benefits including shorter operative time, reduced blood loss, improved axial pain outcomes, and preserved cervical motion.[13]

However, data comparing skip laminectomy and laminoplasty remain inconclusive, with few direct comparisons available. Locally, there is insufficient evidence to determine which approach offers superior outcomes for multilevel cervical spondylotic myelopathy. The objective of this study was to compare the postoperative outcomes of skip laminectomy and laminoplasty to inform surgical decision-making.

PATIENTS AND METHODS

This randomized controlled trial was conducted at Sir Ganga Ram Hospital, Lahore, over one year from March 03, 2023, to March 02, 2024. Ethical approval was taken from the Institutional Review Board, Fatima Jinnah Medical University (Reference No. 07/MS-Neurosurgery/IRB). A total of 48 patients with multilevel cervical spondylotic myelopathy (MCSM) were included. Multilevel cervical spondylotic myelopathy (MCSM) was characterized by two or more levels of spondylotic changes on MRI and clinical myelopathy.

Sample size was determined with 80% power and a significance level of 5% by estimating the difference in postoperative cervical range of motion (ROM) between the skip laminectomy (Group A) and laminoplasty (Group B) groups.[14] Twenty-four patients were allocated to each group through computer-generated randomization. Patients aged 35 to 65 years, of either gender, with MRI-confirmed MCSM involving more than two cervical levels and either lordotic or straight cervical spine alignment were included in the study. Patients were excluded if only two or fewer levels were involved, if kyphosis was present, if fixation or fusion was indicated, or if they had undergone prior cervical spine surgery.

Group A underwent skip laminectomy, where full or partial laminectomies were performed at alternate levels without detaching key muscle attachments such as the semispinalis cervicis and multifidus. The cephalad portion of the lower lamina and ligamentum flavum was removed to decompress the spinal cord. Group B underwent open-door laminoplasty, in which a trough was drilled at the lamino-facet junction from C2 to C7 while preserving the supraspinous and interspinous ligaments. The lamina on the open side was elevated with a Penfield dissector and secured with plates or sutures, thereby expanding the spinal canal.[15,16] All procedures were performed in the prone reverse Trendelenburg position under aseptic conditions, with the cervical spine immobilized. Data were collected preoperatively and at 3 and 6 months postoperatively using a purpose-built proforma. In addition to demographic details and clinical presentation, specific study parameters included cervical range of motion ratio, visual analog scale (VAS) for pain, and Nurick grade. Intraoperative data included operative time and blood loss. What constituted improvement was a drop of at least 1 point in the Nurick grade at the 3- or 6-month follow-up. Improvement was classified as slight (<25%), moderate (25-50%), marked (>50%), or none (<10%) based on the percentage change relative to the baseline. Procedural effectiveness was defined as a statistically significant improvement in neurological status (Nurick grade), pain (VAS), and/or cervical range of motion compared with baseline. Neurological improvement was defined as a ≥1-grade reduction in Nurick score at 3 or 6 months.

SPSS version 24.0 was used to analyze the data. Frequencies and percentages were used to describe qualitative factors such as symptoms and gender. Depending on the data distribution, means and standard deviations, or medians and interquartile ranges, were used to summarize quantitative variables. Normality was evaluated using the Shapiro-Wilk test. Independent sample t-tests were used for normally distributed data; otherwise, the Mann-Whitney U test was used. The Wilcoxon Rank Sum test was used to compare Nurick grades and median VAS scores. The chi-square test was used to assess the relationship between the ROM ratio and the VAS score at six months. A p-values below 0.05 were regarded as statistically significant.

RESULTS

The mean age was comparable between the two groups, with Group A at 50.67 ± 8.91 years and Group B at 49.13 ± 8.38 years, and duration of symptoms (5.04 + 2.01 (years) for Group A and 5.25 + 1.96 (years) for Group B). Similarly, the mean BMI was 30.79 ± 5.02 kg/m^2 in Group A and 30.17 ± 4.21 kg/m^2 in Group B. In terms of gender distribution, Group A had 14 males (58.3%) and 10 females (41.7%), while Group B had 13 males (54.2%) and 11 females (45.8%). The mean intraoperative time among both groups was 97.08 + 31.05 minutes in Group A vs. 127.42 + 34.73 minutes in Group B (p-value = 0.03). Mean intraoperative blood loss in group A was 75.79 + 2.23 mL compared to group B (282.63 + 1.27 mL, p-value <0.001)

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Table 1: Comparison of VAS among groups

Variables	Group A	Group B	p-value
Pain at presentation (VAS)	8.54 + 0.93	7.83 + 0.963	0.13
Pain at 3rd month (VAS)	1.38 + 1.09	1.46 + 0.977	0.78
Pain at 6th month (VAS)	0.92 + 0.12	0.79 + 0.73	0.61

Table 2: Comparison of Nurick Grade and Range of Motion between Group A (Skip Laminectomy) and Group B (Laminoplasty)

Time Point	Group A (Mean ± SD)	Group B (Mean ± SD)	p-value
Nurick grade			
At presentation	3.20 ± 0.721	2.83 ± 0.868	0.11
At 3rd month	2.75 ± 0.608	2.46 ± 0.588	0.098
At 6th month	3.09 ± 1.41	3.36 ± 1.59	0.29
Range of motion (degrees)			
At presentation	52.42 ± 6.69	50.92 ± 6.60	0.438
At 3rd month	64.33 ± 5.01	62.67 ± 5.93	0.301
At 6th month	71.00 ± 8.38	72.96 ± 7.37	0.395

Postoperative outcome in terms of pain is compared in Table 1.

Table 2 summarizes the comparison of Nurick Grade and cervical range of motion (ROM) between the two groups. At baseline, the Nurick Grade between Group A (3.20 ± 0.721) and Group B (2.83 ± 0.868; p-value = 0.110) was similar. Similarly, no significant differences were observed at the 3rd month (p-value = 0.098) or the 6th month (p-value = 0.290), indicating comparable neurological recovery between the two groups over time. Regarding cervical range of motion, both groups showed progressive improvement postoperatively. The mean ROM at presentation was 52.42 ± 6.69 in Group A and 50.92 ± 6.60 in Group B (p-value = 0.438), with no statistically significant difference. At the 3rd month, Group A had a mean ROM of 64.33 ± 5.01 compared to 62.67 ± 5.93 in Group B (p-value = 0.301), and at the 6th month, the ROM was 71.00 ± 8.38 in Group A and 72.96 ± 7.37 in Group B (p-value = 0.395), again with no significant difference. Overall, the results demonstrate that both skip laminectomy and laminoplasty are equally effective in improving Nurick Grade and in preserving or enhancing cervical ROM over a 6-month follow-up period.

DISCUSSION

Two commonly used posterior surgical approach techniques for treating multilevel degenerative cervical myelopathy (DCM) are laminoplasty and laminectomy with fusion.[17] However, the choice between these procedures remains debated and often depends on surgeon preference. Laminoplasty preserves the posterior cervical structure and reduces the risk of postlaminectomy membrane formation. Still, it may lead to complications such as axial pain, reduced range of motion (ROM), and loss of cervical lordosis.[18,19]

The current study compares skip laminectomy and open-door laminoplasty with respect to operative outcomes and clinical improvement. Most participants in the present study were over 45 years old, with a higher prevalence among males. This observation is consistent with epidemiological evidence indicating that degenerative cervical changes increase with age and are more common in men.[20] Boden and colleagues reported cervical disc abnormalities in approximately 14% of individuals younger than 40 years and up to 57% of those older than 40 years, emphasizing the age-related progression of cervical degeneration.[21]

In the present study, skip laminectomy demonstrated significantly shorter operative time (97.08 ± 31.05 minutes vs. 127.42 ± 34.73 minutes) and lower intraoperative blood loss (75.79 ± 2.23 mL vs. 282.63 ± 1.27 mL) compared with laminoplasty. However, both groups showed comparable improvements in Nurick grade, cervical ROM, and pain scores at 3 and 6 months postoperatively, with no statistically significant differences in these outcomes. These findings are consistent with those reported by Sivaraman and colleagues, who observed reduced operative time and blood loss in the skip laminectomy group, along with lower complication rates such as axial pain and restricted mobility.[22]

Recent comparative studies and systematic reviews also support the effectiveness of posterior decompression techniques for multilevel cervical myelopathy. Laminoplasty provides adequate decompression while preserving cervical motion and minimizing the risk of postoperative instability compared with laminectomy with fusion.[23] A propensity-matched analysis further demonstrated comparable neurological recovery between laminoplasty and laminectomy with fusion, although

laminoplasty was associated with preservation of cervical motion and lower perioperative morbidity.[24]

Meta-analyses comparing laminoplasty and skip laminectomy have reported favorable operative parameters for skip laminectomy, including shorter operative time and reduced intraoperative blood loss, while neurological recovery and cervical alignment outcomes remain comparable between the two techniques.[25]

CONCLUSIONS

In patients with MCSM, the laminoplasty and skip laminectomy groups showed no significant differences in postoperative pain, Nurick Grade, or range of motion. In terms of operating time and blood loss, the skip group had slightly better intraoperative results. A longer-term investigation should be conducted to clarify the clinical outcomes of the two groups.

Author Contributions: SF conceived and designed the study, performed data analysis and interpretation, drafted the manuscript, and critically revised it for important intellectual content. SS, TS, and AB contributed to study conception and design and data analysis and interpretation. DS contributed to data analysis and interpretation and drafting of the manuscript. TAA contributed to data acquisition, study design, and data analysis and interpretation. All authors critically revised the manuscript, approved the final version, and agree to be accountable for all aspects of the work.

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