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Research Article

Functional Outcome of Multilevel Cervical Laminectomy and Instrumentation with Lateral Mass Screw for Multilevel Cervical Myelopathy

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Abstract

Background: Posterior cervical laminectomy and instrumentation is procedure to treat multilevel cervical myelopathy. In this study we evaluate the outcome of multilevel cervical laminectomy and stabilization with lateral mass screw fixation in patients with multilevel cervical spine myelopathy and its outcome in terms of spinal cord decompression, neurological function, and spinal alignment.

Materials and Method: This was a prospective and retrospective single-center study of patients who underwent Posterior Cervical Laminectomy and Fixation for Cervical Myelopathy. The study was performed at the Civil Hospital Ahmedabad's Orthopaedic department in Ahmedabad from 2022 to 2024. During this period, 50 patients (total group) were eligible for inclusion, and we obtained complete preoperative and follow-up data at 3, 6, 9 and 12 months for 50 patients.

Result: In our study, it consisted of 50 patients with 12 months of follow-up. Majority of the patients in the study were total 40 male and 10 female. Most common level operated was C4-C6. The average age of patients was 56 years. Younger age and lesser duration of symptoms is associated with better outcome. Both Nurick grading and mJOA grading should be used to evaluate cervical spine patients as both provide an insight into the grade of disease and the improvement on successful decompression. Nurick grade preoperatively, postoperatively and 3,6, 12 months follow up were 2.9, 2.3 and 1.5, 1, 0.4 respectively, which is clinically significant ($p=0.0001$ and $p<0.05$), and depicts a good clinical outcome related to solid fusion and decompression. Mean mJOA preoperatively, postoperatively and 3,6, 12 months follow up were 1.8, 1.2 and 0.9, 0.3, 0.04 respectively. mJOA score improved significantly at follow up ($p=0.0001$ and $p<0.05$). In this study, the mean NDI preoperative, postoperative and 3,6, 12 months follow up were 56.6%, 42.8% and 30.2%, 19.8%, 13.1% respectively. NDI has decreased significantly at follow up ($p=0.0001$ and $p<0.05$), which is consistent with the fact that fusion leads to decreased motion at affected segment and thus decreased neck pain and discomfort. Pain in the neck was also assessed by VAS scores which preoperatively, postoperatively and 3,6, 12 months follow up were 6.2, 4.8 and 3.2, 1.8, 1.2 respectively. Pain VAS has decreased significantly ($p= 0.0001$ and $p<0.05$) in this study and consistent with the findings of neck disability index pointing towards a good clinical outcome in patients of acdf. Fusion was found to be an extremely important parameter for determining outcome. NDI scores were found to be significantly higher among patients in whom fusion was not achieved or has yet to be achieved. Neck VAS scores were also found to be significantly less among the patients who achieved fusion. Almost all patients have maintained their lordotic curve in cervical spine post operatively.

Conclusion: The multilevel cervical laminectomy and instrumentation with lateral mass screw for multilevel cervical myelopathy is a safe technique that provides decompression of the spinal cord, prevents the development of kyphotic spinal deformity and significant improvement in NURICK & MJOA score with decrease in neck pain and discomfort which is assessed via VAS score.

Keywords: *Cervical Laminectomy, Cervical Myelopathy, Decompression, Lateral Mass Screw*

Introduction

Cervical spondylosis secondary to degeneration of intervertebral disc, facet joints, posterior longitudinal ligament, ligamentum flavum, and ossification of posterior longitudinal ligament (OPLL) are the most common causes of cervical myelopathy which can lead to irreversible neurological impairment {1,2,3. Anterior decompressive procedure consists of anterior discectomy and fusion or corpectomy and fusion {4,5}. Posterior decompressive procedure consists of either laminoplasty or laminectomy with or without instrumentation {6,7,8}. The pathophysiology behind cervical myelopathy is direct compression of the cord and ischemic insult to the cord as a result of reduced blood flow. Multilevel anterior surgery is associated with complications such as increased surgical trauma and increased incidence of pseudarthrosis, graft dislodgement, and implant failure as the number of level increases. It is also associated with increased incidence of adjacent segment degeneration and neurological deterioration. {9,10,11,12} However, Multilevel cervical laminectomy with lateral mass screw fixation provides immediate stability, hence prevents the development of kyphotic deformity and adjacent segment degeneration by the prevention of osteophyte formation.{13,14,15}

This study evaluates the outcome of multilevel cervical laminectomy and stabilization with fixation in patients with multilevel cervical spine myelopathy and its outcome in terms of spinal cord decompression, neurological function, and spinal alignment.

Materials and Method

This was a prospective and retrospective single-center study of patients who underwent Posterior Cervical Laminectomy and Fixation for Cervical Myelopathy. The study was performed at the Civil Hospital Ahmedabad's Orthopaedic department in Ahmedabad from 2022 to 2024.

During this period, 50 patients (total group) were eligible for inclusion and we obtained complete preoperative and follow-up data at 3, 6, 9 and 12 months for 50 patients.

Inclusion Criteria

The inclusion criteria were

1. One or more of the following symptoms and signs of cervical myelopathy, with consent given for surgery:
    a. Persistent severe radicular pain not responding to conservative management for three months.
    b. Cervical radiculopathy with progressive paresis.
    c. Selected cases with myelopathy secondary to cervical spinal canal stenosis.
    d. Selected cases with mainly neck pain and less radicular pain.

2. MRI- documented cervical disc disease with compression of cervical nerve roots or spinal cord and myelopathy, which most likely explain the clinical symptoms and signs.

Exclusion Criteria

The exclusion criteria were

1. Cervical neoplasia.
2. Ongoing cervical infection.
3. Not giving consent.

4. Critically ill patients and not fit for surgery.

Diagnostic Work-Up

The diagnostic work-up included

1. Clinical and neurological examination.
2. Cervical MRI.

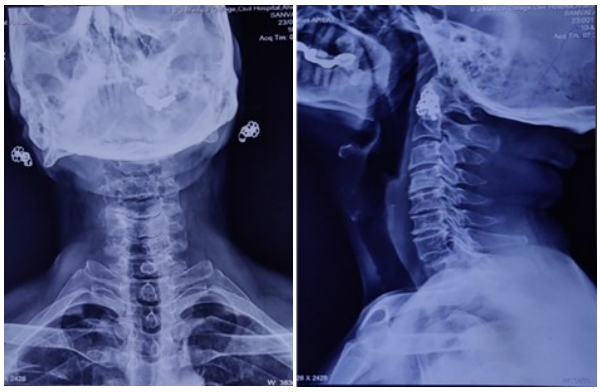


Figure 1. *Preoperative Imaging.*

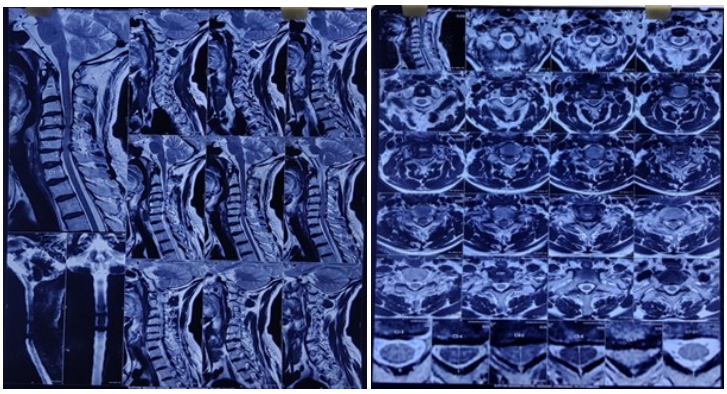


Figure 2. *Preop X-rays*

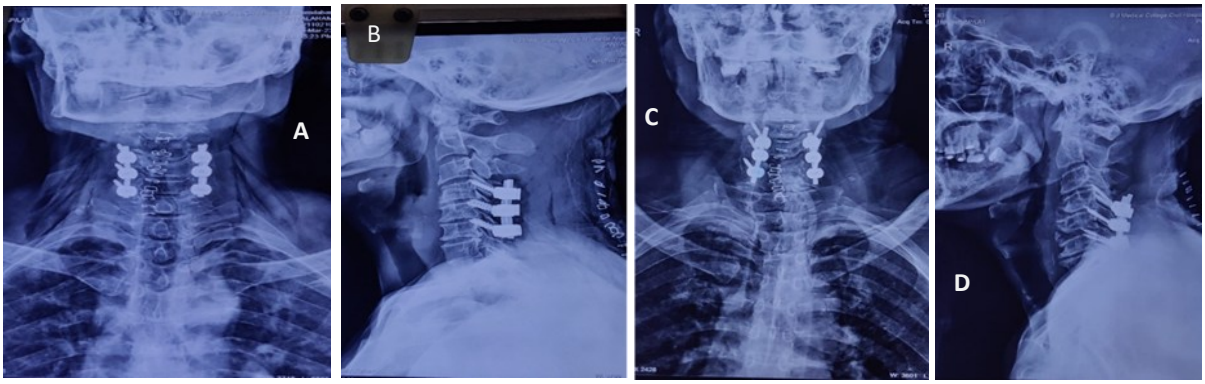


Figure 3. *A & B Immediate postoperative X-ray of cervical spine anteroposterior and lateral views following C4–C6 laminectomy and instrumentation done with lateral mass screw at C4, C5 and C6. Figure C&D. Figure year follow-up X-ray of the same patient showing well-maintained alignment of the cervical spine. Screws and rods are in good position.*

Posterior Cervical Laminectomy and Fixation

In all patients, we used a posterior midline approach to the cervical spine with skin incision. A self- retractor was mounted after verification of the levels of interest using fluoroscopy.

In most patients, a magnification loupe was used. After doing subperiosteal dissection, lateral recess was exposed. After confirming surgical level pan field elevator placed into facet joint.

Small depression in lateral mass just medial to center for all levels done using 2mm burr identify Starting point for drill bit.

Tract for placing lateral mass screw drilled using drill bit depending upon size of the lateral mass with appropriate angle and confirmed with a ball tipped probe. 3.5 mm screws of appropriate length placed, and position confirmed using fluoroscopy.

Laminar troughs created just medial to the lateral masses until ligament flavum was visualized. flavum was resected using Kerrison rongeur.

Lamina was elevated using leskell rongeurs and angled curets in en bloc fashion from distal to Proximally.

End caps placed along with appropriately sized rods into screw heads with final tightening.

A single dose of cepho sulbactum (30 mg/kg), which was used as infection prophylaxis was administered 15- 30 min before the skin incision.

Closure done along layers with absorbable and non-absorbable sutures and sterile dressing kept. sterile drain was placed for wound drainage.

Postoperative Care

The patients were observed in a recovery unit for the first 4 - 6 h after surgery and were then transferred to the regular orthopaedic ward.

All patients were mobilized with a philadelphia stiff collar within 24 h after surgery.

Almost all patients were discharged from our hospital 48-72 h after surgery.

All patients were encouraged repeatedly to participate in normal activities 6-14 weeks after surgery.

A final clinical examination was performed 6 months after surgery in our outpatient clinic.

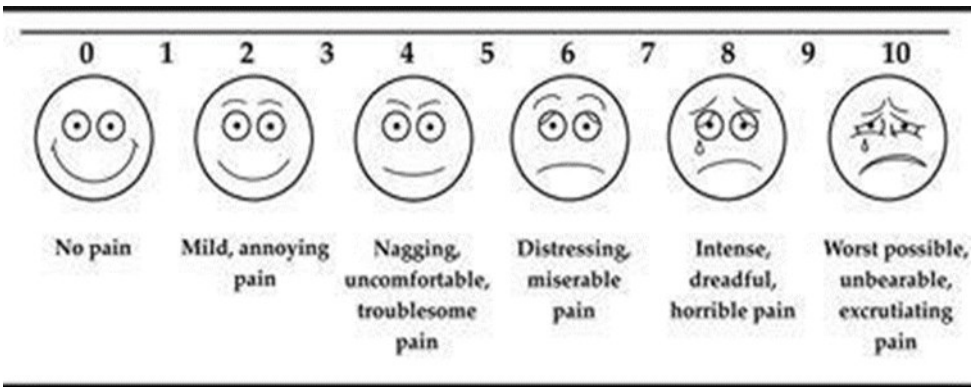
Prospective Registration of Clinical Parameters

The parameters registered the day before surgery included age, sex, symptom duration before surgery (months), previous surgery for CDD, previous neck trauma, working status, radicular pain, neck pain, headache, myelopathy (yes/no), and paresis (muscular strength graded according to the Nurick grade and mJOA grade. Each of the pain categories was scored using a VAS, where 0 indicated no pain and 10 represented extreme pain.

The parameters registered during surgery included: level fused (C3/C4, C4/C5, C5/C6, C6/7 or C7/Th1).

The following parameters were registered at the follow-up visit in our outpatient clinic: radicular pain, NDI, myelopathy (a diagnosis of myelopathy required neurological signs of upper motor neuron affection as Babinski sign, hyperreflexia or increased muscular tone), paresis, Nurick grade, mJOA grade, radiographic features, fusion and working status.

Visual Analogue Scale



Section 1: Pain Intensity

- ☐ I have no pain at the moment
- ☐ The pain is very mild at the moment
- ☐ The pain is moderate at the moment
- ☐ The pain is fairly severe at the moment
- ☐ The pain is very severe at the moment
- ☐ The pain is the worst imaginable at the moment

Section 2: Personal Care (Washing, Dressing, etc.)

- ☐ I can look after myself normally without causing extra pain
- ☐ I can look after myself normally but it causes extra pain
- ☐ It is painful to look after myself and I am slow and careful
- ☐ I need some help but can manage most of my personal care
- ☐ I need help every day in most aspects of self care
- ☐ I do not get dressed, I wash with difficulty and stay in bed

Section 3: Lifting

- ☐ I can lift heavy weights without extra pain
- ☐ I can lift heavy weights but it gives extra pain
- ☐ Pain prevents me lifting heavy weights off the floor, but I can manage if they are conveniently placed, for example on a table
- ☐ Pain prevents me from lifting heavy weights but I can manage light to medium weights if they are conveniently positioned
- ☐ I can only lift very light weights

Section 4: Reading

- ☐ I can read as much as I want to with no pain in my neck
- ☐ I can read as much as I want to with slight pain in my neck
- ☐ I can read as much as I want with moderate pain in my neck
- ☐ I can't read as much as I want because of moderate pain in my neck
- ☐ I can hardly read at all because of severe pain in my neck
- ☐ I cannot read at all

Section 5: Headaches

- ☐ I have no headaches at all
- ☐ I have slight headaches, which come infrequently
- ☐ I have moderate headaches, which come infrequently
- ☐ I have moderate headaches, which come frequently
- ☐ I have severe headaches, which come frequently
- ☐ I have headaches almost all the time

Section 6: Concentration

- ☐ I can concentrate fully when I want to with no difficulty
- ☐ I can concentrate fully when I want to with slight difficulty
- ☐ I have a fair degree of difficulty in concentrating when I want to
- ☐ I have a lot of difficulty in concentrating when I want to
- ☐ I have a great deal of difficulty in concentrating when I want to
- ☐ I cannot concentrate at all

Nurick Grade

Grade 0	Root symptoms only or normal
Grade 1	Signs of cord compression; normal gait
Grade 2	Gait difficulties but fully employed
Grade 3	Gait difficulties prevent employment, walks unassisted
Grade 4	Unable to walk without assistance
Grade 5	Wheelchair or bed bound

mJOA GRADING

Assessment of Fusion

Criterion	Points
Motor function	
Paralysis	1
Upper extremity	
Fine motor function massively decreased	2
Fine motor function decelerated	3
Discreet weakness in hands or proximal arm	4
Normal function	5
Motor function	
Unable to walk	1
Lower extremity	
Need walking aid on flat floor	2
Need handrail on stairs	3
Able to walk without walking aid, but inadequate	4
Normal function	5
Sensory	
Upper extremity/lower extremity/trunk	
Apparent sensory loss	1
Minimal sensory loss	2
Normal function	3
Bladder function	
Urinary retention	1
Severe dysfunction	2
Mild dysfunction	3
Normal function	4
Total score	0–17

The lower the score the more severe the deficits. Normal function 16 + 17, grade 1: 12–15, grade 2: 8–11, grade 3: 0–7. Weight of the criterion in percentage of 17 points: upper extremity 23.5%; lower extremity 23.5%; sensory 3 × 11.8% (total: 35.4%); bladder and bowel function 17.6%

Following parameters were taken into consideration when evaluating fusion.

1. Bridging bone between the end plates;
2. No sign of implant failure of the posterior cervical fixation and
3. Less than 50% of radiolucency covering the outer surface of the implant

Database and Statistical Analyses

Database was collected from all patients on pro forma basis and recorded in data registration program. Radiographic calculations were done on Surgimap software, and use of t test and histogram and bar charts was done to calculate the relevant data.

Table 1 General Characteristics.

Demographic Data	
Total number of patients	50
Male	40
Female	10
Average age of Patients	56 years
Maximum age	85 years
Minimum age	30 years
Months of Follow up	12 months

Table 2. Cervical Level.

Level	Number of patients
2 level	01
3 level	34
4 level	15
5 level	-

Level	Number of patients
C3-C5	12
C4-C6	22
C3-C6	10
C5-T1	02
C4-C7	02
C3-C4	02

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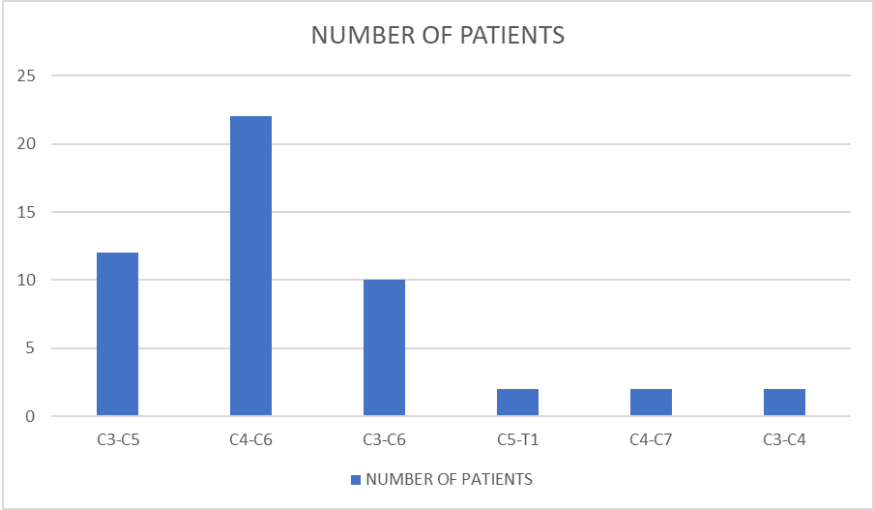
Level	Number of patients
C3-C5	12
C4-C6	22
C3-C6	10
C5-T1	02
C4-C7	02
C3-C4	02

Most common Level: C4-C6



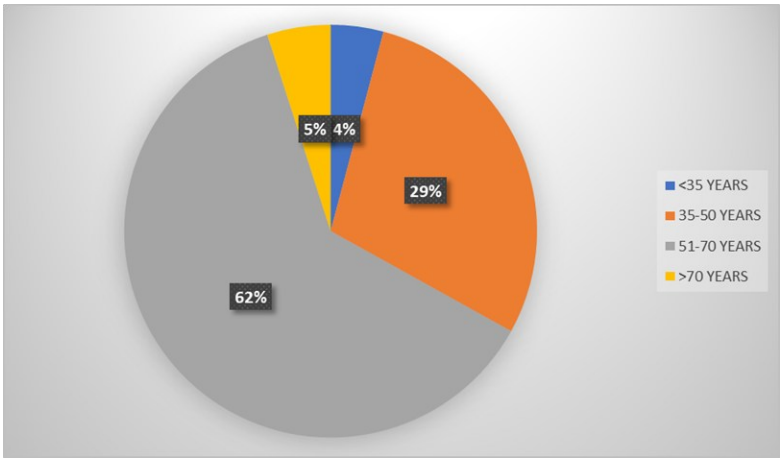


Table 4. Age Wise Distribution.

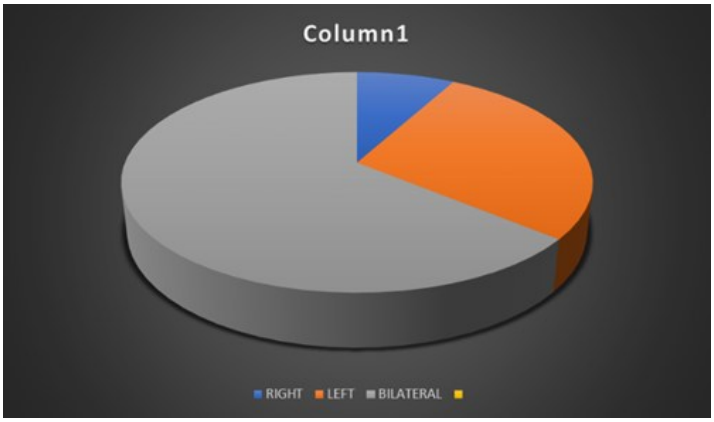
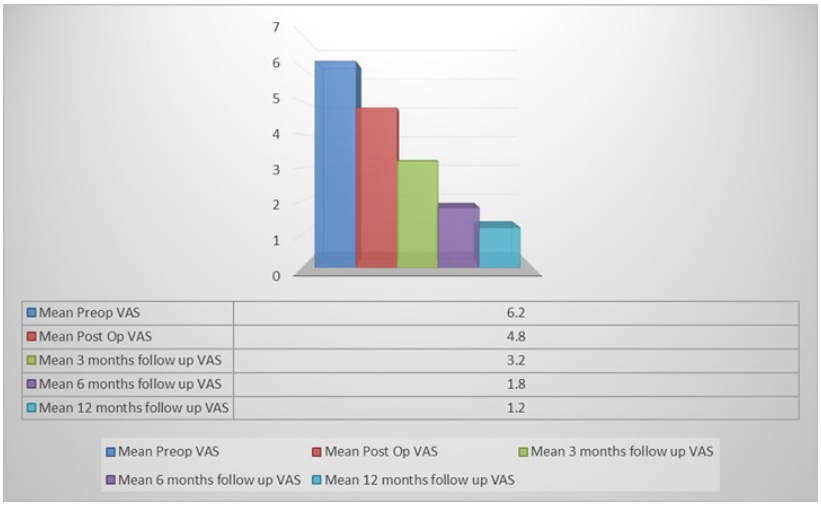


Table 5. Radicular Pain with Hand Grip Weakness

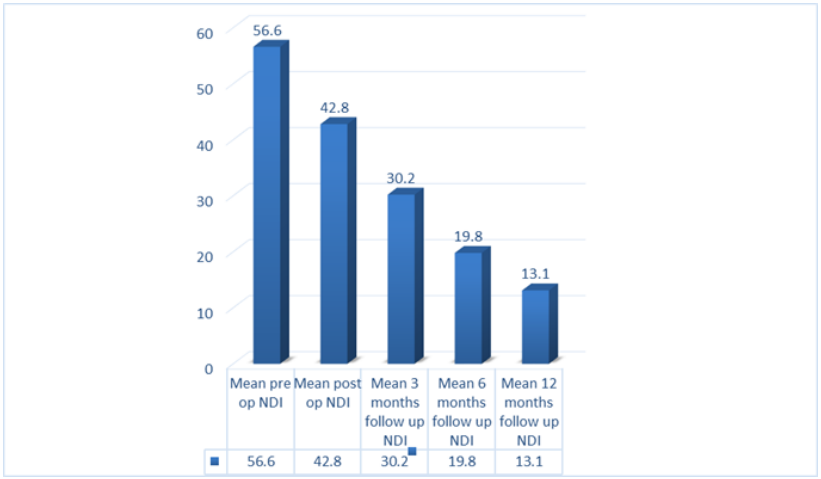
Neck Pain Vas Score



On applying ANOVA for repeated measures of mean VAS of preop, postop and mean VAS of followup at 3,6,12 months the F-value is 211.43 and the p- value is 0.0001. The result is significant at $p < 0.05$, showing that neck pain is significantly less post operatively and at subsequent follow ups.

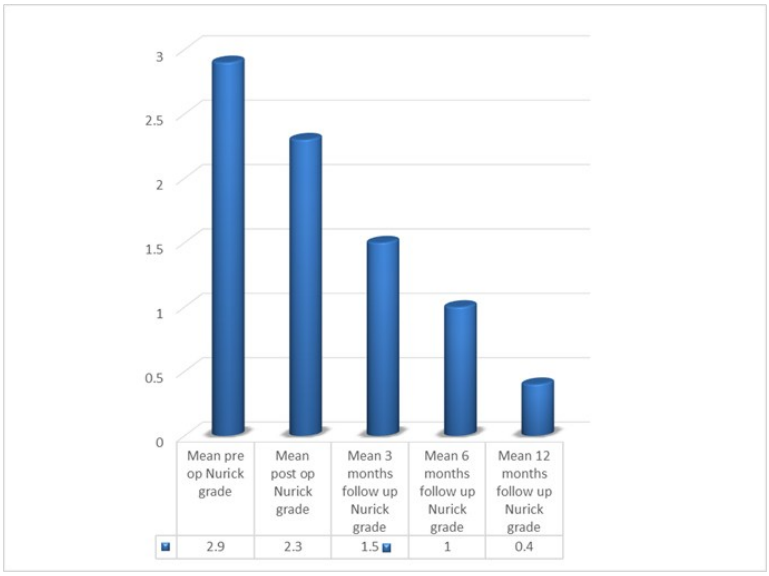
Neck pain has decreased significantly over the period of 1 year.

NDI SCORE (%)



On applying ANOVA on repeated measures on mean NDI preop, postop and mean followup NDI at 3, 6, 12 months the f value is 259.93, the p-value is 0.0001. The result is significant at $p < 0.05$. Showing improved clinical outcome

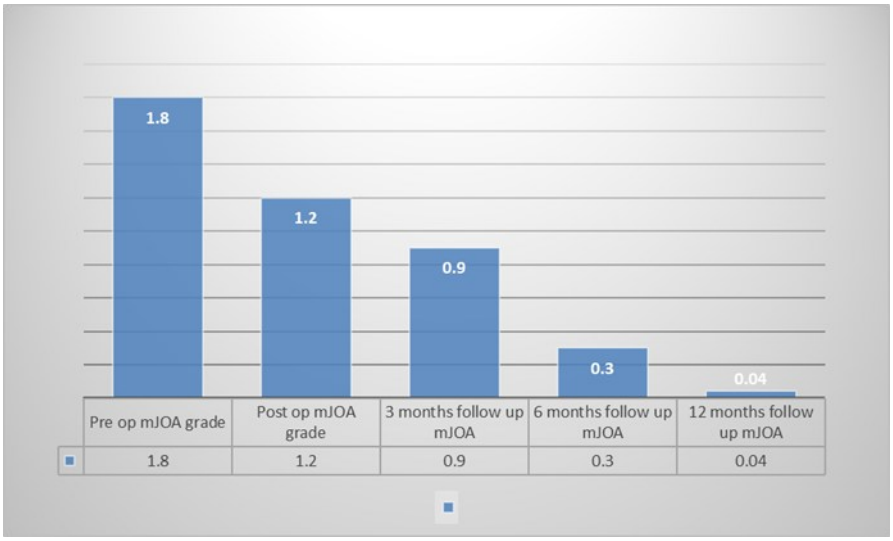
Nurick Grade



On applying ANOVA for repeated measures on Mean Nurick Grade Preop, Postop and Follow up at 3, 6, 12 months, The F-value is 99.31 and p value is

<0.0001. The result is significant at $p < 0.05$. Showing that there is significant improvement in Nurick grades and no signs of any deterioration.

mJOA GRADE



On applying ANOVA for repeated measures on Mean mJOA score preop, postop and Mean mJOA score followup at 3,6,12 months, The F-value is 56.16 and p- value is 0.0001 The result is significant at $p < 0.05$. Which means that mJOA score has improved significantly at subsequent visits.

FUSION AT OPERATED LEVEL

All patients achieved fusion by 1 year of follow up

Discussion

Posterior stabilization techniques have been employed with good results using wires, hooks, screws, and rod systems. The advantages of posterior cervical approach include direct visualization of facet dislocations and decompression of the central canal and neural foramina. However, disadvantages include a relatively longer operative duration, increased muscle dissection, postoperative neck pain, increased blood loss, and a relatively higher risk of surgical site infection. On the other hand, anterior cervical approach enables decompression of the spinal canal by removing the disc, thus avoiding neurological deterioration by further disc displacement.

This study addresses the issues of “safety and efficacy” of our described free hand lateral mass screw insertion which have been described in detail. The results suggest that depending on the spinous processes and the facet joint space as guidelines to anatomical insertion of screws is easy, feasible, accurate, and safe.

When placing screws into the small area of the lateral mass without fluoroscopic guidance, malposition can be avoided by relying on anatomical landmarks. Choosing the entry point 1 mm medial and 1 mm inferior to the central point of the lateral mass, aligned with the projected trajectory, enhances both safety and accuracy. Therefore, ensuring the initial screw placement is as precise as possible is essential to achieve safe outcomes. In this study, no screw-related injuries occurred, even when screws inadvertently deviated from the planned trajectory. This highlights the safety and reliability of the free-hand technique in lateral mass screw placement.

Multilevel cervical laminectomy with lateral mass screw fixation provides immediate stability, thereby preventing the development of kyphotic deformity and adjacent segment degeneration through the inhibition of osteophyte formation. The primary goal in treating multilevel cervical myelopathy is to achieve adequate decompression while preserving the stability of the cervical spine.

Comparison to previous studies

Results of our study can be compared with similar studies done in the past. In a similar study conducted by Kumar et al., {16} they concluded that, after cervical laminectomy and fusion for cervical myelopathy, 80% of patients had good clinical outcome and 76% of patients showed improvement in myelopathy scores. In their study, none of the patients had worsening of neurological symptoms, instability, or progression of kyphosis. They also stated that patients with better preoperative neurological status were likely to improve more as compared to patients with poor neurological status.

In a study conducted by Chang et al.{8} on 58 patients with multilevel cervical myelopathy who underwent cervical laminectomy and fusion with lateral mass screw, mJOA scores improved significantly in 85.5%, while 14.5% of patients showed no improvement. None of the patients had deterioration of mJOA score in their study. All patients showed radiographic fusion in dynamic X-ray done at an average followup duration of 11.9 months. Four patients had C5 nerve root palsy and one patient had superficial wound infection which settled without any sequelae.

Huang et al.{17} retrospectively studied 32 patients who were treated with cervical laminectomy and fusion with lateral mass screw for cervical myelopathy. The patients were evaluated by Nurick's grading for clinical evaluation, and X-ray and MRI were done for radiological assessment both preoperatively and postoperatively in their study. Nurick's grading showed significant improvement in 22 patients, 9 patients showed no improvement. However, none of the patients had worsening of Nurick's grading. Postoperative MRI showed compression in one patient and myelomalacic change in 15 patients which was same in preoperative MRI. However, these patients had significant neurological recovery similar to patients who did not show compression or myelomalacic changes. One patient had pseudarthrosis, three patients had wound infection which required reoperation, and two patients had C5 nerve root palsy which settled gradually without any intervention.

Houten and Cooper{15} studied 38 patients with cervical myelopathy who underwent laminectomy and instrumentation with lateral mass fixation. The patients were evaluated clinically with mJOA score, Cooper scale, and 5-point muscle grading. X-ray and MRI were done both preoperatively and postoperatively for the assessment of cervical spine alignment and adequacy of decompression. Clinically significant improvement was seen in 97% of patients with mJOA scale improved to 15.8 from 12.9. Cooper scale also showed significant improvement from 1.8 to 0.7 for upper extremities and 1.0–0.4 for lower extremities. X-rays done at mean followup of 5.9 months showed no change in the alignment of cervical spine. Postoperative MRI showed significant improvement in compression grading from 2.46 to 0.16.

They concluded that multilevel cervical laminectomy with instrumentation is an effective procedure with minimum morbidity, adequate cord decompression, and provides immediate stability. The authors also concluded that neurological outcome was similar to anterior procedures and avoided the complications associated with anterior procedures and multilevel laminectomy without instrumentation.

Study	Type of study	Significant differences detected
Manzano et al.,[14] 2012	Prospective	CLF worse NDI, SF-36, ROM, greater cost, longer operative time
Yuan et al.,[15] 2015	Prospective	CLF lower ROM
Fehlings et al.,[13] 2017	Prospective	CLP greater improvements in mJOA
Heller et al.,[9] 2001	Retrospective	CLF more complications, lower Nurick scores
Woods et al.,[21] 2011	Retrospective	No statistically significant differences observed
Highsmith et al.,[17] 2011	Retrospective	CLF improvement in VAS-neck but not in CLP; CLF higher complications, higher cost
Lee et al.,[28] 2016	Retrospective	CLF cases with C5 palsy (C5P-LF) longer recovery time, more severe weakness (compared to C5P-LP)
Lau et al.,[20] 2017	Retrospective	CLF more bleeding, longer hospitalization
Blizzard et al.,[18] 2017	Retrospective	CLF more nerve palsy, complications, decreased ROM, higher cost
Stephens et al.,[16] 2017	Retrospective	CLF improved VAS-neck; CLP improved NDI, small loss of cervical lordosis

CLP, cervical laminoplasty; CLF, cervical laminectomy with fusion; NDI, Neck Disability Index; SF-36, Short Form 36; ROM, range of motion; mJOA, modified Japanese Orthopaedic Association; VAS, visual analogue scale.

Functional Discussion

1. Both Nurick grading and mJOA grading should be used to evaluate cervical spine patients as both provide an insight into the grade of disease and the improvement on successful decompression. Both Nurick grade and mJOA grade were taken into consideration in the present study.
2. Nurick grade preoperatively, postoperatively and at 3, 6, 12 months follow up were 2.9, 2.3 and 1.5, 1, 0.4 respectively, which is clinically significant ($p=0.0001$ and $p<0.05$), and depicts a good clinical outcome related to solid fusion and decompression.
3. Mean mJOA preoperatively, postoperatively and at 3, 6, 12 months follow up were 1.8, 1.2 and 0.9, 0.3, 0.04 respectively. mJOA score improved significantly at follow up ($p=0.0001$ and $p<0.05$).
4. In this study, the mean NDI preoperative, postoperative and 3, 6, 12 months follow up were 56.6%, 42.8% and 30.2%, 19.8%, 13.1% respectively. NDI has decreased significantly at follow up ($p=0.0001$ and $p<0.05$), which is consistent with the fact that fusion leads to decreased motion at affected segment and thus decreased neck pain and discomfort.
5. Pain in the neck was also assessed by VAS scores which preoperatively, postoperatively and at 3, 6, 12 months follow up were 6.2, 4.8 and 3.2, 1.8, 1.2 respectively. Pain VAS has decreased significantly ($p=0.0001$ and $p<0.05$) in this study and is consistent with the findings of neck disability index pointing towards a good clinical outcome in patients of ACDF.

Radiological Discussion

1. Fusion was found to be an extremely important parameter for determining outcome. NDI scores were found to be significantly higher among patients in whom fusion was not achieved or has yet to be achieved. Neck VAS scores were also found to be significantly less among the patients who achieved fusion.
2. mJOA and Nurick grades were significantly better in patients in which fusion was already attained.
3. Almost all patients have maintained their lordotic curve in cervical spine postoperatively.

Summary

Demographic outcome

- This was a prospective + retrospective study.
- Study consisted of 50 patients with 12 months of follow up.
- Majority of the patients in the study were males.
- Most common level operated was C4–C6.
- The average age of the patients was 56 years. Younger age and lesser duration of symptoms is associated with better outcome.

Functional Outcome

- Neck pain Visual Analogue Score decreased significantly postoperatively and at subsequent follow ups.
- Neck Disability Index decreased significantly postoperatively and at subsequent follow ups.
- Nurick grade was improved significantly postoperatively and at subsequent follow ups.
- mJOA grade was improved postoperatively and at subsequent follow ups.
- No significant complications were noted at 12 months follow up period.

Radiological Outcome

- All the patients achieved solid fusion on operated level by 12 months.
- Only one patient developed kyphotic deformity in follow up, rest all having improved radiological outcome at subsequent follow ups.

Conclusion

The multilevel cervical laminectomy and instrumentation with lateral mass screw for multilevel cervical myelopathy is a safe technique that provides decompression of the spinal cord, prevents the development of kyphotic spinal deformity and significant improvement in Nurick & mJOA score with decrease in neck pain and discomfort which is assessed via VAS score.

Conflict of Interest

The authors declare no conflicts of interest.

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