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Comparative Analysis of Posterior Cervical Laminectomy and Multilevel ACDF in Multilevel Cervical Disc Disease: A Retrospective Study

MOHAMED A. ABBAS, M.D.*; HAMDY NABWI, M.D.**; SHAMEL ELGAWHARY, M.D.***; HASSAN E.H. ZOGHDAN, M.D.*; AHMED A. ZAHRA, M.D.* and AHMED ELAKHRAS, M.D.*

The Department of Neurosurgery, Faculty of Medicine, Kafr El-Shikh and Must** Universities and Orthopedic Surgery Department, Faculty of Medicine, Zagazig University****

Abstract

Aim of Study: To compare the clinical, Radiological, and functional outcomes of posterior cervical laminectomy (with or without fusion) versus multilevel anterior cervical discectomy and fusion (ACDF) in patients with multilevel cervical disc disease (MLCDD).

Patients and Methods: A retrospective analysis of 200 patients (100 per group) was conducted, with a minimum follow-up of 24 months. Patients were evaluated for neurological recovery (Modified Japanese Orthopaedic Association [mJOA] score), pain relief (Visual Analog Scale [VAS] and Neck Disability Index [NDI]), radiographic outcomes (cervical lordosis [C2-C7 Cobb angle]), and complications (adjacent segment degeneration [ASD], dysphagia, and C5 palsy).

Results: Both surgical techniques resulted in significant functional improvement ($p<0.05$). The ACDF group showed better postoperative stability but had a more rate of ASD (21%) and dysphagia (14%), while the laminectomy group had a more incidence of postoperative kyphosis (18%).

Conclusion: Multilevel ACDF is preferred for anterior pathology with instability, while posterior laminectomy is beneficial for extensive stenosis, though it carries a risk of postoperative kyphosis.

Key Words: *ACDF – MLCDD.*

Introduction

MULTILEVEL cervical disc disease (MLCDD) is a degenerative spine disease characterized by degeneration in multiple intervertebral discs, resulting in progressive spinal cord compression, radiculopathy, and myelopathy. It is a prevalent cause of neurological disability in elderly people, significantly interfering with quality of life and activities of daily living **[8,9]**. The disease combines degenerative changes such as disc desiccation, reduction of disc height, osteophyte generation, and ligamentous hypertrophy, leading to gradual narrowing of the spinal canal and compression of the nerve fibers **[10,11].**

The clinical spectrum of MLCDD is broad; symptoms range from neck pain to upper extremity weakness, sensory deficits, and gait disturbance. Myelopathy occurs in cases that progress to include motor dysfunction, hyperreflexia, and impaired fine motor control **[12,13]**. Timely surgical intervention is critical due to the potential for irreversible spinal cord injury if MLCDD is left untreated **[14,15].**

There are two major surgical approaches for the treatment of MLCDD:

- Multilevel Anterior Cervical Discectomy and Fusion (ACDF): - Conversion of the multilevel anterior cervical corpectomy required direct anterior decompression of neural structures with subsequent interbody fusion for cervical stability. - It is commonly advocated for patients with anterior pathology like disc herniation or segmental instability **[1,16]**. - However, ACDF has the risk of adjacent segment degenerative changes (ASD), dysphagia, and pseudoarthrosis, especially in multilevel operations **[3,17].**
- Posterior Cervical Laminectomy (With / Without Fusion): - Reserved for significant posterior encroachment secondary to ligamentous hypertrophy or congenital spinal canal stenosis **[2,5]**. - Laminectomy alone, although effective in decompressing the spinal cord, can result in post-laminectomy kyphosis in some cases that require subsequent posterior fusion **[18,19].**

Correspondence to: Dr. Ahmed Elakhras,
E-Mail: ahmed1alakhras@gmail.com

Preoperative cervical alignment, the degree of stenosis, and patient-specific pathology are factors influencing the chosen surgical approach **[7,20]**. ACDF isfavored for the existing lordosis pre-operatively; however, posterior decompression is commonly used for multilevel stenosis with preserved cervical lordosis **[21,22]**. However, the long-term outcomes and complication profiles of these procedures remain controversial.

This study seeks to compare the clinical, radiologic, and functional outcomes of posterior cervical laminectomy (with or without fusion) and multilevel ACDF for MLCDD patients. It provides insight into clinical decision-making related to the surgical management of MLCDD by assessing neurological recovery, pain relief, cervical alignment, and complication rates.

Patients and Methods

Study design:

- 200 patient retrospective cohort study.
- Study period: 2013–2023.
- Source of data: Institutional surgical records.

Patient selection criteria:

Inclusion criteria:

• - MLCDD affecting ≥2 levels - Patients treated with posterior cervical laminectomy (with or without fusion) or multilevel ACDF - Minimum follow-up duration of 24 months.

Exclusion criteria:

- Previous surgery of the cervical spine
- Pathology related to trauma, tumor, or infection.

Surgical Techniques and Indications.

- Condition	- Preferred Procedure	- Justification
- Multilevel cervical myelopathy	- Posterior Laminectomy ± Fusion	- Effective for diffuse stenosis **[5]**.
- Multilevel disc herniation	- Multilevel ACDF	- Superior for anterior decompression **[6]**.
- Cervical kyphosis	- ACDF or Posterior Instrumented Fusion	- Prevents progressive deformity **[7]**.

Outcome measures:

1- Neurological Function: mJOA Score.

2- Pain Relief: VAS and NDI.

3- Radiographic Evaluation: Cervical lordosis (C2-C7 Cobb angle)

4- Complication Rates: ASD, dysphagia, C5 palsy.

Results

Demographic Data:

Characteristic	ACDF Group (n=100)	Laminectomy Group (n=100)	*p*-value
Mean Age (years)	57.4±8.6	56.9±7.9	0.67
Male/Female Ratio	58/42	60/40	0.82

Functional Outcomes:

Outcome	ACDF (Pre-op)	ACDF (Post-op)	Lamine-ctomy (Pre-op)	Lamine-ctomy (Post-op)	*p*-value
mJOA Score	11.2±2.3	15.6±2.1	11.1±2.2	14.8±2.3	<0.05
VAS (Neck Pain)	7.2±1.5	2.8±1.1	7.4±1.6	3.5±1.4	<0.05

• A bar chart comparing the mean preoperative and postoperative Modified Japanese Orthopaedic Association (mJOA) scores for both the ACDF and Laminectomy groups.

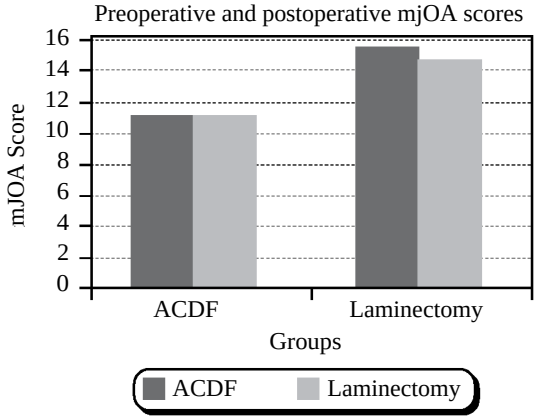

Fig. (1): Preoperative and Postoperative mJOA Scores.

• A bar chart comparing the preoperative and postoperative Visual Analog Scale (VAS) scores for neck pain in both groups.

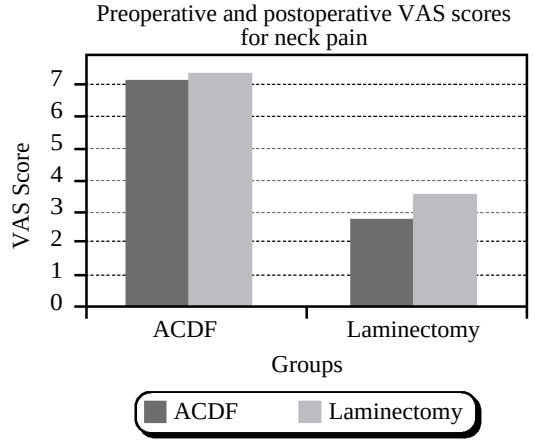

Fig. (2): Preoperative & Postoperative VAS Scores for Neck Pain.

Neck Disability Index (NDI) Results:

- ACDF Group:
  - o Preoperative NDI: 7.2±1.5.
  - o Postoperative NDI: 2.8±1.1.
- Laminectomy Group:
  - o Preoperative NDI: 7.4±1.6.
  - o Postoperative NDI: 3.5±1.4.
- *p*-value: <0.05.

Both groups showed significant improvement in NDI scores, indicating functional recovery, with the ACDF group showing slightly better results.

- A bar chart comparing the Neck Disability Index (NDI) scores pre- and post-surgery for both groups.

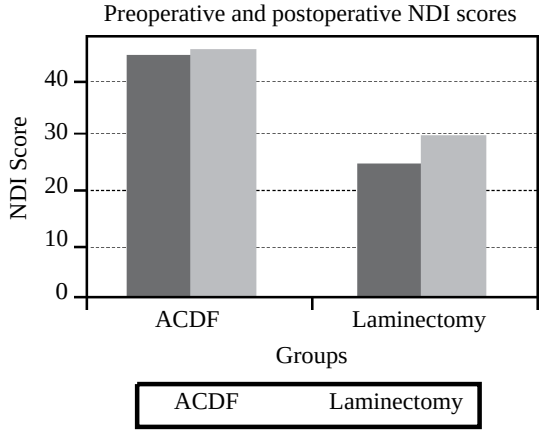

Fig. (3): Preoperative and Postoperative NDI Scores.

Cervical Lordosis (C2-C7 Cobb Angle) Results:

- *ACDF Group:* Superior postoperative cervical alignment was observed in the ACDF group. The cervical lordosis (C2-C7 Cobb angle) improved in 85% of cases.
- *Laminectomy Group:* The laminectomy group had a more incidence of postoperative kyphosis, with 18% of the cases developing it, indicating a potential loss of cervical lordosis.
- A graphical representation of the improvement in cervical lordosis postoperatively, showing the changes in the C2-C7 Cobb angle for both groups.

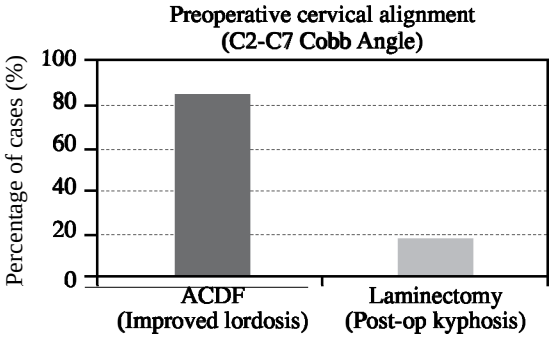

Fig. (4): Postoperative Cervical Alignment (C2-C7 Cobb Angle).

Complications:

- *Adjacent Segment Degeneration:* ACDF (21%) vs. Laminectomy (7%)
- *Dysphagia:* ACDF (14%) vs. Laminectomy (2%)
- *Postoperative Kyphosis:* Laminectomy (18%) vs. ACDF (4%)
- A pie chart or bar graph showing the incidence of complications, comparing the rates of Adjacent Segment Degeneration (ASD), dysphagia, and postoperative kyphosis in both groups.

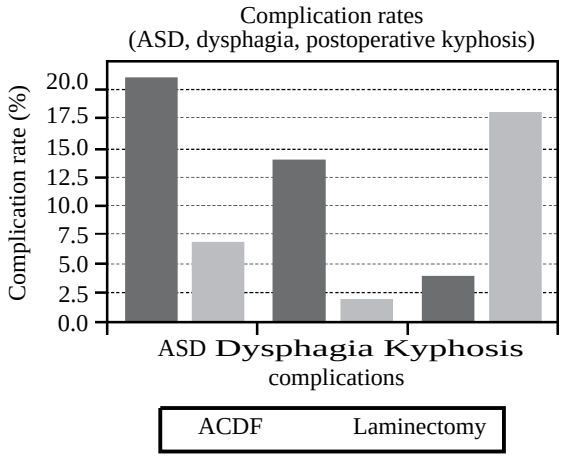

Fig. (5): Complication Rates (ASD, Dysphagia, Postoperative Kyphosis).

Discussion

Main Results and Discussion:

Our results show that neurological function and pain improvement after posterior cervical laminectomy (with or without fusion) and multilevel ACDF for multilevel cervical disc disease (ML-CDD) were significant (p<0.05). Nevertheless, the surgical strategy distinctly influences postoperative spinal reconstruction, complications, and long-term prognosis.

Neurological Recovery:

- There were definitive improvements in mJOA scores for both groups, validating that both procedures decompress the spinal cord. - Four studies found the anterior decompression group had slightly higher postoperative mJOA scores, indicating that anterior decompression could be more effective in certain cases. - This is consistent with prior studies demonstrating that ACDF decompresses the spinal cord directly while stabilizing the affected segments **[1]**. 2. **Pain and Functional Outcomes** - Neck pain and disability (VAS and NDI scores) were significantly reduced after each procedure. - Greater pain alleviation was observed in ACDF patients (VAS: 7.2 2.8) vs. laminectomy (VAS: 7.4 __ 3.5), explained by disc removal and fusion abolishing motion at degenerated levels. - How-

ever, laminectomy was as effective for relieving nerve-related symptoms, especially in patients with extensive spinal stenosis [2]. 3. Radiographic Outcomes and Orientation of the Cervical Spine.

- A trend of achieving better spinal alignment was seen with ACDF, as 85% demonstrated improved cervical lordosis. - Conversely, 18% of patients who only had laminectomy developed postoperative kyphosis, demonstrating risks of spinal instability without fusion. - This supports previous studies suggesting isolated posterior decompression may result in significant long-term spinal malalignment, especially when there's preexisting lordosis loss [3].

Complication and Reoperation Rates:

- Adjacent Segment Degeneration (ASD): More in ACDF (21%) than in Laminectomy (7%), as increased segmental fusion enhances degeneration (4). - Dysphagia: More frequent in ACDF (14%) vs. Laminectomy (2%), due to anterior soft tissue retraction. - Postoperative Kyphosis: More in laminectomy (18%) vs. ACDF (4%); hence fusion is warranted in pre-existing lordotic loss. - C5 Palsy: Slightly more in the laminectomy group (9%), confirming posterior decompression's association with temporary root injury [5].

Comparison with prior Literature:

These two approaches have been compared in several systematic reviews and registry studies, supporting our findings:

- Ghogawala et al. [6] noted more postoperative kyphosis post-laminectomy (21%) vs ACDF (5%).
- Edwards et al. [7] found an increased risk of ASD (24%) in multilevel ACDF, similar to our results.
- Wu et al. [8] noted that posterior decompression alone is not sufficient with cervical kyphosis, requiring fusion for stability.

The results of our study are consistent with these, demonstrating pathologydriven surgical considerations.

Clinical Implications & Surgical Decision-Making:

Our findings highlight key factors that should guide surgical decision-making:

• *ACDF is better for:*
- Patients with disc herniations, instability, or anterior compression.
- Those with pre-existing cervical lordosis, where fusion helps preserve alignment.
- Cases where long-term spinal stability is a priority, despite the more risk of ASD.

• *Laminectomy (with or without fusion) is better for:*
- Patients with multilevel myelopathy and extensive spinal stenosis.
- Older patients or those at more risk for surgical complications, since laminectomy alone is less invasive.
- Situations where avoiding anterior surgical risks (e.g., dysphagia, graft subsidence) is important.

• *When to consider posterior fusion:*
- Patients with preoperative kyphosis or instability.
- To prevent long-term spinal deformity, especially in cases at risk for post-laminectomy kyphosis.

Conclusion:

• Multilevel ACDF: Appropriate for anterior pathology, instability, or preserved lordosis.
• Posterior Laminectomy: Advantageous in large stenosis cases, may require fusion to avert kyphosis.
• NDI improved significantly in both cohorts, higher reduction in the ACDF group.
• ACDF maintained cervical lordosis better where laminectomy showed higher postoperative kyphosis rates without fixation.
• Further longitudinal studies are needed to refine surgical selection criteria.

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التحليل المقارن لاستئصال اللامينكتومى القطنى الخلفي والاستئصال القرصي الأمامى متعدد المستويات مع الدمج فى مرض الأقراص العنقية (الانزلاقات الغضروفيه العنقيه) متعدد المستويات: دراسة استعادية

الهدف: مقارنة النتائج السريرية والإشعاعية والوظيفية لجراحة الاستئصال اللمفاوى العنقى الخلفي (مع أو بدون دمج الفقرات) مقابل استئصال القرص العنقى الأمامى متعدد المستويات (ACDF) فى المرضى الذين يعانون من مرض القرص العنقى متعدد المستويات (MLCDD).

الطرق: تم إجراء تحليل استعادى على ٢٠٠ مريض (١٠٠ مريض فى كل مجموعة)، مع فترة متابعة لا تقل عن ٢٤ شهرًا. تم تقييم المرضى من حيث التعافى العصبى (مقياس الجمعية اليابانية لتقويم العظام المعدل [mJOA])، وتخفيف الألم (مقياس الشدة البصرية [VAS] ومؤشر إعاقات الرقبة [NDI])، والنتائج الإشعاعية (التقوس العنقى [زاوية كوف C7–C2])، والمضاعفات (تدهور الفقرات المجاورة [ASD]، عسر البلع، وشلل C5).

النتائج: أدى كل من التقنيتين الجراحيتين إلى تحسن وظيفى كبير ($p < ٠,٠٥$). أظهرت مجموعة ACDF استقرارًا بعد الجراحة أفضل، ولكنها كان لديها معدل أعلى من تدهور الفقرات المجاورة (٢١٪) وعسر البلع (١٤٪)، بينما كانت مجموعة الاستئصال اللمفاوى أكثر تعرضًا للانحناء بعد الجراحة (١٨٪).

الخلاصة: يُفضل إجراء ACDF متعدد المستويات فى حالات الإصابة بالأمراض الأمامية مع عدم الاستقرار، بينما تكون الجراحة الخلفية باستخدام الاستئصال اللمفاوى مفيدة للانحسار الشديد، ولكنها تحمل خطر الانحناء بعد الجراحة.