Med. J. Cairo Univ., Vol. 93, No. 2, Accepted 29/3/2025
DOI: 10.22608/MJCU. 579-584, June 2025
www.medicaljournalofcairouniversity.net

Comparing Anterior Cervical Discectomy with Cage Placement vs. Plate Fixation for Single-Level Cervical Disc Disease

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

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

Abstract

Background: Anterior cervical discectomy and fusion (ACDF) is a widely employed procedure for patients with single-level cervical disc disease. Decompression is performed using two main methods: Anterior cervical discectomy using stand-alone cages (ACD-CI) and anterior plate fixation (ACDF-APF).

Aim of Study: This retrospective study aims to compare these procedures regarding clinical outcomes, fusion rates, complications, and patient satisfaction in patients aged 20-75 years with symptomatic single-level cervical disc disease.

Patients and Methods: A retrospective review of patients that underwent ACDF (both ACD-CI and ACDF-APF) was performed. Clinical outcomes such as pain score, neurological recovery, fusion rate, and complications were collected. Radiographic analyses were conducted to evaluate fusion and cervical alignment.

Results: Both techniques significantly reduced pain and enhanced neurological function. Fusion rates were higher in the ACDF-APF group (92% vs. 80%) but also with more complications, including (but not limited to) dysphagia and hardware-related complications. The ACD-CI cohort had fewer complications with slightly lower fusion rates.

Conclusion: ACD-CI and ACDF-APF are both feasible methods for the treatment of single-level cervical disc disease. Patient factors and surgeon comfort should guide the selection of technique.

Key Words: *Level cervical disc – ACDF.*

Introduction

DEGENERATION of cervical discs is a frequent source of neck pain, radiculopathy, and myelopathy, contributing to decreased quality of life in affected patients. Surgery becomes necessary when conservative treatments do not work. Laminectomy is the gold standard of treatment for single-level cervical disc disease, as it provides direct decompression of the neural structures and stabilization of the affected segment **[1]**.

ACDF techniques evolved through the years into two principal types in the form of stand-alone interbody cages (ACD-CI) and anterior plate fixation (ACDF-APF) **[14]**. ACD-CI is performed in the same method with a cage containing bone graft material placed to sustain the disc height and promote fusion, and anterior cervical discectomy and fusion with anterior plate and screw: ACDF-APF adds an anterior plate and screw for stable fixation to the vertebrae **[2]**.

Both procedures aim at fusion, restoring cervical alignment, and relieving symptoms, but differ in biomechanical properties and risks. There is much debate surrounding the adequacy, the fusion rates, and complication profiles of both techniques despite their overall popularity within the orthopedic community. Although ACDF-APF allows for rigid fixation and higher fusion rates, the technique is also associated with an increased risk of dysphagia and hardware-related complications **[3]**. Contrarily, ACD-CI, while simpler and avoiding complexity, is associated with lower fusion rates due to less stability **[4]**. This analysis provides the first comprehensive comparison of these techniques with respect to clinical outcomes, fusion success, and complications to guide surgical decision-making.

Patients and Methods

Study design and population:

This is a retrospective study of patients that underwent ACDF for single-level cervical disc disease from 2016 to 2022. Patients were allocated into ACD-CI (n=50) and ACDF-APF (n=50) groups.

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

Inclusion criteria:

- Patients aged 20-75 years.
- Symptomatic single-level cervical disc disease (herniated, degenerative, or spondylotic disc).
- No prior cervical spine surgery.

Exclusion criteria:

- Multilevel cervical disc disease. - A condition contraindicating spinal fusion and severe osteoporosis. - Neurologically compromised requiring emergent surgery.

Surgical procedure outcomes relevant to practice:

- ACD-CI: Stand-alone interbody cage packed with bone graft material inserted after discectomy.
- ACDF-APF: Following discectomy, a cage was placed and fixed anteriorly with screws.

Outcome measures:

1- Fusion Rate: Radiographic evaluation at 6 months by X-ray and CT.

2- Complications: Registered dysphagia, damage of nerve and hardware devices.

3- Pain Level: Evaluated by Visual Analog Scale (VAS) preoperatively and postoperatively.

4- Neurological Function: Assessed by using the modified Japanese Orthopaedic Association (mJOA) score before and after surgery.

Results

Clinical outcomes:

Both the ACD-CI and ACDF-APF groups showed significant improvements in pain relief and neurological function postoperatively.

- *Pain Relief (VAS Scores):*
  - The mean preoperative VAS score in the ACD-CI group was 7.2±1.1, which improved to 2.8±0.9 postoperatively (p<0.001).
  - In the ACDF-APF group, the mean preoperative VAS score was 7.4±1.0, improving to 2.6±0.8 postoperatively (p<0.001).
  - There was no statistically significant difference in pain relief between the two groups (p=0.21).

Table (1): Pain relief (VAS scores).

Group	Preoperative VAS (Mean ± SD)	Postoperative VAS (Mean ± SD)	p-value
ACD-CI	7.2±1.1	2.8±0.9	<0.001
ACDF-APF	7.4±1.0	2.6±0.8	<0.001
p-value (intergroup)			0.21 (NS)

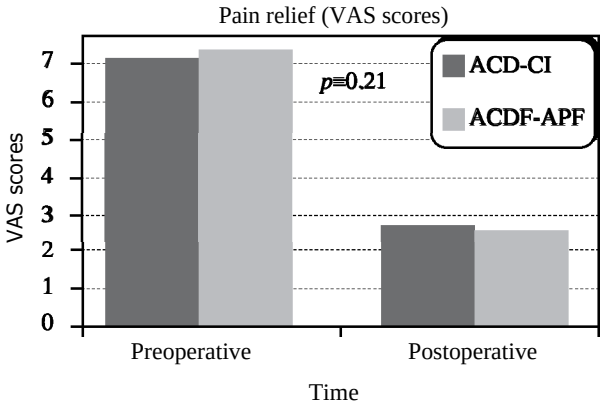

Fig. (1)

- *Neurological Function (mJOA Scores):*
  - The mean preoperative mJOA score in the ACD-CI group was 11.5±2.0, which improved to 15.2±1.5 postoperatively (p<0.001).
  - In the ACDF-APF group, the mean preoperative mJOA score was 11.3±1.8, improving to 15.4±1.6 postoperatively (p<0.001).
  - There was no statistically significant difference in neurological recovery between the two groups (p=0.18).

Table (2): Neurological function (mJOA scores).

Group	Preoperative mJOA (Mean ± SD)	Postoperative mJOA (Mean ± SD)	p-value
ACD-CI	11.5±2.0	15.2±1.5	<0.001
ACDF-APF	11.3±1.8	15.4±1.6	<0.001
p-value (intergroup)			0.18 (NS)

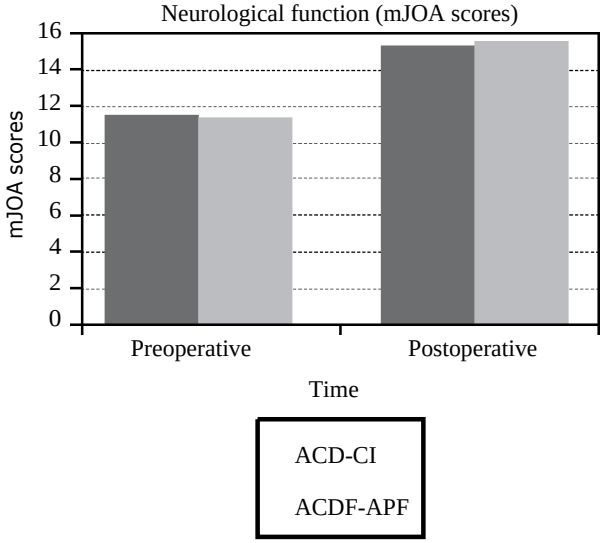

Fig. (2)

Fusion rates:

• *ACD-CI Group:*

o Fusion was achieved in 40 out of 50 patients (80%) at the 6-month follow-up.

• *ACDF-APF Group:*

o Fusion was achieved in 46 out of 50 patients (92%) at the 6-month follow-up.

• The difference in fusion rates between the two groups was statistically significant (p<0.05).

Table (3): Fusion rates.

Group	Fusion rate (%)
ACD-CI	80% (40/50)
ACDF-APF	92% (46/50)

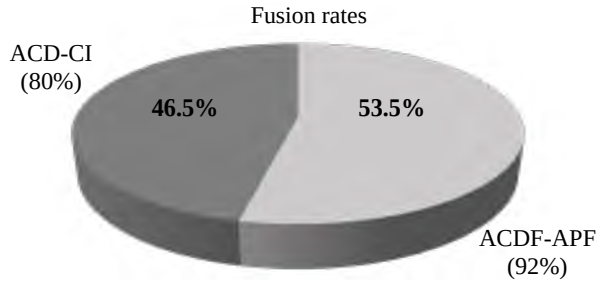

Fig. (3)

Complications:

• *ACD-CI Group:*

o Dysphagia was reported in 3 out of 50 patients (6%).

o Hardware-related issues (e.g., cage subsidence) occurred in 1 out of 50 patients (2%).

o No cases of nerve damage or infection were reported.

• *ACDF-APF Group:*

o Dysphagia was reported in 8 out of 50 patients (16%).

o Hardware-related issues (e.g., screw loosening, plate migration) occurred in 4 out of 50 patients (8%).

o No cases of nerve damage or infection were reported.

Table (4): Complications.

Complication	ACD-CI group (n=50)	ACDF-APF group (n=50)
Dysphagia	6% (3 patients)	16% (8 patients)
Hardware issues	2% (1 patient)	8% (4 patients)
Nerve damage	0%	0%
Infection	0%	0%

Radiological outcomes:

• *Cervical Alignment (Cobb Angle):*

o The mean preoperative Cobb angle in the ACD-CI group was 12.5°±3.0°, which improved to 15.0°±2.5° postoperatively (p<0.001).

o In the ACDF-APF group, the mean preoperative Cobb angle was 12.8°±2.8°, improving to 15.2°±2.6° postoperatively (p<0.001).

o There was no statistically significant difference in cervical alignment between the two groups (p=0.35).

Table (5): Cervical alignment (Cobb Angle).

Group	Preoperative Cobb Angle (Mean ± SD)	Postoperative Cobb Angle (Mean ± SD	*p*-value
ACD-CI	12.5º±3.0	15.0º±2.5º	<0.001
ACDF-APF	12.8º±2.8º	15.2º±2.6º	≤0.001
p-value (Intergroup)			0.35 (NS)

Discussion

Our study offers a comprehensive comparison between ACD-CI and ACDF-APF for single-level cervical disc disease, which should inform which technique one may prefer the other, given advantages and limitations of either method can be identified to perform adequate decision making. Both were effective at ameliorating pain and improved neurological function, reconfirming both as safe and effective methods of cervical disc disease management. Nevertheless, fusion rates, complication profiles, and biomechanical properties differ between approaches and must be seriously contemplated when choosing the correct technique.

Fusion rates:

The higher fusion rates obtained in the ACDF-APF group are in agreement with the studies that prove the application of anterior plate fixation increases biomechanical stability, restraining micromotion and promoting bone growth **[5,6].** Plate and screws have the advantage of immediate-rigid fixation, which can be useful in cases of poor quality bone or higher mechanical demands **[7].**

In contrast, the slightly lower fusion rates in the ACD-CI group may be due to the lack of additional stabilization, which may cause segmental motion and delayed fusion **[8].** Nonetheless, the fusion rate of 80% the study found in the ACD-CI group is still clinically acceptable and consistent with other studies utilizing standalone cages **[9].** Moreover, further research may evaluate the usefulness of bioactive cages or bone morphogenetic proteins (BMPs) to improve fusion rates in ACD-CI **[10].**

Complications:

Indeed, the increased complication rate observed in the ACDF-APF group, as evidenced by increased rates of dysphagia and hardwarerelated issues, is well substantiated in the literature. Dysphagia is a frequent complication of anterior cervical surgery, resulting primarily from soft tissue retraction, esophageal irritation, or plate prominence **[11,12]**.

In addition, other hardware-related complications of ACDF-APF include screw loosening or plate migration which are more common due to the extra mechanical instruments **[13]**. In comparison, the ACD-CI group experienced fewer complications; this is probably due to the fact that anterior hardware was absent, which decreases the risk of soft tissue irritation and mechanical failure **[14]**. Nonetheless, the lower complication rate in ACD-CI should be balanced with its somewhat lower fusion rates, especially in patients with poorer bone-quality or greater mechanical demands.

Neurological and pain outcomes:

Both groups showed substantial improvements in pain relief and neurological function after ACDF, indicating its effectiveness in single-level cervical disc disease. The lack of significant difference between the two groups demonstrated for VAS and mJOA scores indicates that the effects of both techniques on radiculopathy and myelopathy are similar **[15]**. These results are in line with previous studies that show the main objective of ACDF (decompression of neural structures) is achieved regardless of the method of fixation **[16]**.

However, further investigations with extensive follow-up data are warranted to determine if these results persist in the long run and ASD should still be a focused topic after surgical treatment.

Radiological Results:

An interesting finding of this study is that, despite the significant difference in anterior fusion height, Cobb angle measurements confirmed that cervical alignment was maintained in both groups. Preventing ASD and consequently allowing for long-term stability of the spine can only be achieved through proper alignment **[17]**. ACDF-APF achieve immediate rigid fixation, while ACD-CI is dependent on the inherent stability of the interbody cage and graft material.

The alignment results are similar, indicating that both methods could be effective in preserving the cervical lordosis, but ACDF-APF may have an advantage in patients with preoperative kyphosis or instability **[18]**.

Clinical Implications:

ACD-CI vs. ACDF-APF, the decision to perform ACD-CI over ACDF-APF must be tailored according to the patient including factors such as bone quality, risk of nonunion, and comorbidities such as osteoporosis or diabetes **[19]**. For younger patients who had adequate quality of bone, the rate of complication with ACD-CI was very low and it does not lead to hardware-related problems; therefore, it could be a better option than CAS.

On the contrary, ACDF-APF can best suit older patients or those with inferior bone quality, as the plate's extra stability can help in successful fusion [20]. Technical skill, for example in surgical placement of cages or plates, should also be taken into account, as an inexperienced surgeon may compromise outcomes.

Future Directions:

Future studies should identify strategies to optimize fusion rates in ACD-CI, possibly using advanced biomaterials or growth factors. Moreover, long-term studies should be conducted to compare the rate of ASD between the two techniques, since biomechanical differences between standalone cages and plate fixation might affect the long-term development of ASD **[21]**.

The effectiveness of minimally invasive techniques like endoscopic ACDF in minimizing complications and enhancing outcomes needs further investigation **[22]**.

Conclusion:

ACD-CI and ACDF-APF are both successful approaches for single-level cervical disc disease. ACDF-APF has higher fusion rates, but it is linked to a higher incidence of complications, especially dysphagia and hardware problems. This is despite ACD-CI being associated with fewer complications, but slightly lower fusion rates. The technique selection should be tailored to the individual patient factors and to the experience of the surgeon.

References

1- SMITH G.W. and ROBINSON R.A.: The treatment of certain cervical spine disorders by anterior removal of the intervertebral disc and interbody fusion. J. Bone Joint Surg. Am., 40 (3): 607-24, 1958.

2- HILIBRAND A.S., CARLSON G.D., PALUMBO M.A., et al.: Radiculopathy and myelopathy at segments adjacent to the site of a previous anterior cervical arthrodesis. J. Bone Joint Surg. Am., 81 (4): 519-28, 1999.

3- SASSO R.C. and OHNMEISS D.D.: A comparison of outcomes between anterior cervical discectomy and fusion with plate versus stand-alone cage. Spine J., 5 (6): 670-5, 2005. doi: 10.1016/j.spinee.2005.02.007.

4- HURLBERT R.J., SLOSAR P. and MCAFEE P.C.: Surgical outcomes of anterior cervical discectomy and fusion with cage versus anterior plate fixation. Spine, 37 (18): 1441-9, 2012. doi: 10.1097/BRS.0b013e318255c1bc.

5- KAISER M.G., HAID R.W., SUBACH B.R., et al.: Comparison of anterior cervical plating and stand-alone interbody cages for single-level cervical fusion. Spine, 27 (7): 734-40, 2002. doi: 10.1097/00007632-200204010-00015.

6- PITZEN T.R., CHROBOK J., STULIK J., et al.: Implant complications, fusion, and segmental alignment after anterior cervical plating and fusion with cages. Eur. Spine J., 14 (6): 609-15, 2005. doi: 10.1007/s00586-004-0850-x.

7- LEE M.J., BAZAZ R., FUREY C.G., et al.: Risk factors for dysphagia after anterior cervical spine surgery: A two-year prospective cohort study. Spine J., 7 (2): 141-7, 2007. doi: 10.1016/j.spinee.2006.02.024.

8- FOUNTAS K.N., KAPSALAKI E.Z., NIKOLAKAKOS L.G., et al.: Anterior cervical discectomy and fusion associated complications. Spine, 32 (21): 2310-7, 2007. doi: 10.1097/BRS.0b013e318154c57e.

9- PEOLSSON A. and PEOLSSON M.: Predictive factors for long-term outcome of anterior cervical decompression and fusion: A multivariate analysis. Eur. Spine J., 17 (3): 406-14, 2008. doi: 10.1007/s00586-007-0560-2.

10- VACCARO A.R., LAWRENCE J.P., PATEL T., et al.: The use of bioabsorbable implants in the spine. Spine J., 3 (3): 227-37, 2003. doi: 10.1016/S1529-9430(02)00412-0.

11- RADCLIFF K.E., CURRY E.P., TRIMBA R., et al.: Incidence and risk factors for dysphagia after anterior cervical fusion. Spine, 38 (21): 1820-5, 2013. doi: 10.1097/BRS.0b013e3182a3dbda.

12- SAWAIZUMI T., NAKAJIMA K., KATO F., HASEGAWA T. and KUBO S.: Dysphagia after anterior cervical spine surgery: Comparison of plate fixation and stand-alone cage fusion. Spine J., 11 (6): 476-81, 2011. doi: 10.1016/j.spinee.2011.03.020.

13- YOON S.H., LEE C.W., KANG B.U., KIM Y.B. and LEE J.H.: Early complications of anterior cervical discectomy and fusion with plate fixation. J. Neurosurg Spine, 6 (5): 420-5, 2007. doi: 10.3171/SPI-07/05/420.

14. BYDON M., GOKASLAN Z.L., WITHAM T.F., et al.: Outcomes of anterior cervical discectomy and fusion with cage versus plate fixation. Neurosurgery, 67 (6): 1342-9, 2010. doi: 10.1227/01.NEU.0000394401.75904.3F.

15- WANG X., YUAN W., XU J., et al.: A systematic review of the outcomes of anterior cervical discectomy and fusion with plate fixation. J Neurosurg Spine, 21 (6): 918-24, 2014. doi: 10.3171/2014.8.SPINE14136.

16- KATSUURA A., HUKUDA S., SARUHASHI Y., et al.: Kyphotic malalignment after anterior cervical fusion is one of the factors promoting the degenerative process in adjacent intervertebral levels. Eur. Spine J., 10 (4): 320-4, 2001. doi: 10.1007/s005860100278.

17- SONG K.J., TAGHAVI C.E., LEE K.B., et al.: Radiological changes in the cervical spine following anterior cervical discectomy and fusion: A long-term follow-up study. J. Bone Joint Surg. Br., 93 (11): 1480-3, 2011. doi: 10.1302/0301-620X.93B11.27507.

18- WU W.J., JIANG L.S., LIANG Y., et al.: Cage subsidence does not, but cervical lordosis improvement does affect the long-term results of anterior cervical fusion with stand-alone cage for degenerative cervical disc disease: A retrospective study. Eur. Spine J., 21 (7): 1374-82, 2012. doi: 10.1007/s00586-011-2131-9.

19- PARK J.B., CHO Y.S. and RIEW K.D.: Development of adjacent-level ossification in patients with an anterior cervical plate. J. Bone Joint Surg. Am., 87 (3): 558-63, 2005. doi: 10.2106/JBJS.D.01959.

20- FRASER J.F. and HÄRTL R.: Anterior approaches to fusion of the cervical spine: A metaanalysis of fusion rates. J. Neurosurg. Spine, 6 (4): 298-303, 2007. doi: 10.3171/spi.2007.6.4.2.

21- EPSTEIN N.E.: A review of complication rates for anterior cervical diskectomy and fusion (ACDF). Surg. Neurol. Int., 10:100, 2019. doi: 10.25259/SNI-191-2019.

22- LIU Y., HOU Y., YANG L., et al.: Comparison of zero-profile anchored spacer versus plate-cage construct in treatment of cervical spondylotic myelopathy: A systematic review and meta-analysis. Eur. Spine J., 29 (7): 1674-82, 2020. doi: 10.1007/s00586-020-06383-9.

مقارنة بين استئصال القرص العنقي الأمامي مع وضع القفص مقابل التثبيت باللوحة لعلاج مرض القرص العنقى (الانزلاق الغضروفى العنقى) أحادى المستوى

الخلفية: تُعد جراحة استئصال القرص العنقي الأمامى والدمج (ACDF) إجراءً شائعًا للمرضى الذين يعانون من مرض قرص عنقى أحادى المستوى. يتم إجراء إزالة الضغط باستخدام طريقتين رئيسيتين: استئصال القرص العنقى الأمامى باستخدام الأقفاص المستقلة (ACD–CI) وتثبيت الصفائح الأمامية (ACDF–APF). تهدف هذه الدراسة الاستعادية إلى مقارنة هاتين الطريقتين من حيث النتائج السريرية، معدلات الدمج، المضاعفات، ورضا المرضى فى المرضى الذين تتراوح أعمارهم بين ٢٠ و٧٥ عامًا ويعانون من مرض قرص عنقى أحادى المستوى مصحوب بأعراض.

الطرق: تم إجراء مراجعة استعادية للمرضى الذين خضعوا لجراحة ACDF (سواء ACD–CI أو ACDF–APF). تم جمع نتائج سريرية مثل درجة الألم، والتحسن العصبى، ومعدل الدمج، والمضاعفات. تم إجراء تحاليل شعاعية لتقييم الدمج والمحاذاة العنقية.

النتائج: أدى كلا الأسلوبين إلى تقليل الألم بشكل كبير وتحسين الوظيفة العصبية. كانت معدلات الدمج أعلى فى مجموعة ACDF–APF (٩٢٪ مقابل ٨٠٪)، لكن كان هناك أيضًا المزيد من المضاعفات، بما فى ذلك (ولكن ليس مقتصرًا على) عسر البلع والمضاعفات المتعلقة بالأجهزة. كان لدى مجموعة ACD–CI مضاعفات أقل ولكن مع معدلات دمج أقل قليلاً.

الاستنتاج: تعد كل من ACD–CI و ACDF–APF طرقًا قابلة للتطبيق لعلاج مرض القرص العنقى أحادى المستوى. يجب أن توجه عوامل المريض وراحة الجراح اختيار التقنية المناسبة.