Al-Azhar International Medical Journal

Volume 4 | Issue 12 Article 1

2023
Section: Neurosurgery

# Cages Alone Versus Plate Fixation with Cages after Four Levels Anterior Cervical Discectomy

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## How to Cite This Article

Elshafei, Karim Mohamed Mohamed; Ewaiss, Ibrahim Gamel; Fawi, Taha Mohamed Adel; and Mostafa, Hamdi Nabawi (2023) "Cages Alone Versus Plate Fixation with Cages after Four Levels Anterior Cervical Discectomy," *Al-Azhar International Medical Journal*: Vol. 4: Iss. 12, Article 1.
DOI: https://doi.org/10.58675/2682-339X.2129

ORIGINAL ARTICLE

# Cages Alone Versus Plate Fixation with Cages after Four Levels Anterior Cervical Discectomy

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**Abstract**

*Purpose*: **This study assessed clinical and radiological outcomes to support the surgical decision of anterior cervical discectomy and fusion (ACDF) using cages alone versus cage-with-plate fixation in patients with four-level spondylotic myelopathy of the cervical spine.**

*Methods*: **This study enrolled 30 patients with four levels of cervical spondylotic myelopathy. The C group ($n = 15$) was subjected to ACDF using four cages, and the C and P group ($n = 15$) had additional plate fixation. They were followed up clinically and radiologically for at least 12 months. Scheduled for surgical intervention in the neurosurgery department of Misr University and hospitals of Al Azhar University and Nasr Institute from October 2020 to September 2021.**

*Results*: **The operative time was significantly shorter in the Cage alone group. Neck and arm pain decreased after surgery in the two groups. The fusion percentage was 92 %. The C2−C7 Cobb's angle increased significantly following surgery in both groups with no significant intergroup difference. Postoperative complications were more common in patients who underwent plate fixation procedures.**

*Conclusion*: **In this small-scale study involving 30 patients, we explored the outcomes of ACDF including patients' radiological and clinical data using cages alone versus plate fixation with cages after four-level ACD. Our analysis revealed that both techniques are similarly effective in improving patient outcomes. However, postoperative complications were more common in patients who underwent plate fixation procedures.**

*Keywords:* Anterior cervical discectomy and fusion, Cervical plate, Cervical spondylotic myelopathy, Four-level cervical disc

## 1. Introduction

Cervical spondylotic myelopathy (CSM) is characterized by a variety of neurological symptoms, such as pain in the neck, disturbances in gait, or Quadriplegia, and can lead to spinal cord dysfunction and a decrease in quality of life, particularly in individuals aged 55 and over.[1]

For mild cases, conservative treatment is recommended, which includes rest, analgesics, steroids, physiotherapy, and cervical braces.[2]

In most cases, surgery is used to treat CSM,[3] with either anterior and posterior approaches or both. Anterior approaches use anterior plates, cervical corpectomy, and fusion, while posterior approaches tend to be used for diseases with three or more levels of involvement.[4] The use of a cage-alone technique may be associated with cage subsidence, however, the optimal treatment for multi-level CSM remains to be determined.[5]

Traditionally, a plate has been employed to strengthen the fusion between the intervertebral discs and to reduce the risk of cage subsidence.[6] However, this can result in complications such as tracheal or neurovascular damage, degeneration of the adjacent segment, and difficulty in swallowing.[7] On the other hand, the cage-alone technique may result in additional complications such as cage subluxation, kyphosis deformity, or pseudarthrosis.[8]

The aim of this study: by comparing the outcomes of cages alone versus plate fixation with cages after four-level ACD, this prospective study aims to

Accepted 18 September 2023.
Available online 30 December 2023

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https://doi.org/10.58675/2682-339X.2129

provide valuable insights into the optimal surgical approach. The results will not only aid surgeons in making informed decisions but also contribute to improving patient outcomes and quality of life.

## 2. Patient and methods

### 2.1. Type of study and study location

This study enrolled 30 patients with four levels of spondylotic myelopathy of the cervical spine CSM scheduled for surgical intervention in the neurosurgery department of Misr University and hospitals of Al-Azhar University from October 2020 to September 2021. All participants were medically and radiologically evaluated, and those with moderate symptoms were enrolled after they had not responded to conservative medical care. All participants received written informed consent to fulfill before enrollment in the study.

To be eligible for participation in this study, patients were required to be adults with symptoms of the disc herniation of the spine that were not responsive to conservative treatment or were not indicated for such treatment. Computed tomography (CT) or MRI was used to confirm disc herniation with the spinal cord and nerve root compression of four adjacent disc levels. Criteria that were not eligible for inclusion in the study included continuous ossification or combination of ossifying posterior longitudinal ligaments, developmental stenosis; dysphagia, severe cervical malformations, a history of noninvasive malignancy, or known allergies to the components of the devices.

Before surgery, a comprehensive medical history was recorded, and general and neurological examinations were conducted. The pain was evaluated using the visual analog scale (VAS) and the Grade of Myelopathy and Functional State was assessed using the Nurick Scale.[9] The Sensory System Examination (Romberg test) included both superficial and deep sensations.[10] The Cervical Cobb Angle was measured.[11] The neck disability index was also used.

### 2.2. Surgical technique

During the surgical procedure, patients were positioned supine with their necks in a hyperextended position. The surgical site was exposed through a standard anterior approach. A moveable microscope was used to look up and down and from side to side. The bone wax was used only cautiously for particularly large and posterior sinuses. The posterior cortical bone and osteophyte were drilled away with a high-speed air drill until only an eggshell thickness remained. The drill was cooled with irrigation. The remaining flakes of bone and osteophytes were removed with curettes. Decompression was extended laterally until the lateral edge of the vertebra began to curve forward. If the posterior longitudinal ligament was floppy and bulging back into decompression, it was left alone. If 35 41 53 56 thick, it was removed, and the dura was exposed. The ligament was elevated with a sharp hook, incised, and then removed with a narrow punch after separating it from the dura with a special flat hook. Preparing for cage insertion began with curetting the end plate, sparing its anterior part, making lipcover the cage, and preventing the cage from slippage. The cages used were the Equifax peek cervical interbody cages. They have an anatomical shape and safe anchorage with a serrated surface and Antibackout teeth. The plate used was Medtronic ATLANTIS Anterior Cervical Plate System. Radiography was done at the end of the surgery, and then a drain was inserted, and the platysma and skin were closed. A neck collar was described for all cases.

### 2.3. Postoperative management

The patient's progress was evaluated through clinical and radiological follow-up on the first day, as well as after 6 and 12 months. The Nurick scale was used to assess the grade of myelopathy and functional status, while the VAS was utilized to evaluate neck and radicular pain. Daily limitations after cervical spine surgery were measured using the neck disability index (NDI),[12] and Odom's criteria determined the functional outcome. The classification of Vavruch and colleagues was applied to assess the outcome of the anterior cervical fusion.[13] Additionally, changes in cervical lordosis and progressive kyphosis were excluded by measuring the C2–C7 Cobb angle on the first day, as well as after 6 and 12 months.

### 2.4. Ethical approval

The study was approved by Al-Azhar University's Faculty of Medicine in Cairo and Misr University of Science and Technology. Before the commencement of the trial, all patients provided written consent after being provided with a clear explanation of the possible negative consequences.

### 2.5. Statistical methods

We utilized IBM SPSS Statistics version 23 (IBM Corp., Armonk, NY, USA) for our statistical analysis. Our approach involved several tests to examine

both qualitative and quantitative data in the two groups. Specifically, we employed the Cochran Q chi-square test. Statistically significant if the *P*-value is less than 0.05. Additionally, we utilized the Mann–Whitney test and the paired *t*-test or Wilcoxon signed-ranks test.

## 3. Results

The results show that both groups were similar in terms of age and sex, as indicated in Table 1. Additionally, there was no significant variation between the two groups in terms of their Nurick and NDI scores, and arm and neck pain VAS scores before the operation. Most patients in both groups had motor deficits that affected their upper limbs. For more information on other clinical signs, please refer to Table 2.

Table 3 shows the clinical and radiological outcomes of surgery. The operative time was significantly shorter in the Cage group ($P < 0.001$).

*Table 1. Demographic characteristics of the two studied groups.*

| | C group | C and P group | *P*-value |
|---|---|---|---|
| Number of patients | 15 | 15 | |
| Age (y) | 55.0 ± 5.8 | 55.9 ± 6.2 | 0.674 |
| Sex (Male/Female) | 11/4 | 10/5 | 1.000 |
| Neck pain VAS score | 7 (4–9) | 6 (4–8) | 0.182 |
| Arm pain VAS score | 6 (3–8) | 6 (4–9) | 0.022 |
| Numbness | 12 (80.0 %) | 8 (53.3 %) | 0.121 |
| Limb Heaviness | 11 (73.4 %) | 13 (86.7 %) | 0.651 |
| Brachialgia | 11 (73.4 %) | 8 (53.33 %) | 0.256 |
| Sphincteric disturbance | 7 (46.0 %) | 7 (46.0 %) | 1.000 |
| Nurick score | 2.8 ± 0.8 | 3.1 ± 0.7 | 0.332 |
| Neck Disability Index score | 29 ± 5 | 27 ± 5 | 0.387 |
| C2–C7 Cobb's angle (degrees) | 8.0 (4.5–18.0) | 7.0 (3.0–18.0) | 0.902 |

The data are displayed as either the mean± the standard deviation or the median within a given range.

*Table 2. Summary of clinical signs.*

| | C group | C and P group | *P*-value |
|---|---|---|---|
| Number of patients | 15 | 15 | |
| Upper limb weakness | 14 (93.3 %) | 15 (100 %) | 1.000 |
| Upper and lower limb weakness | 9 (60.0 %) | 11 (73.3 %) | 0.439 |
| Sensory disturbance | 6 (40.0 %) | 5 (33.3 %) | 0.705 |
| Spasticity | 8 (53.3 %) | 11 (73.3 %) | 0.256 |
| Hyperreflexia | 12 (80.0 %) | 14 (93.3 %) | 0.598 |
| +ve Babinski sign | 12 (86 %) | 10 (67 %) | 0.361 |
| +ve Hoffmann reflex | 6 (40.0 %) | 4 (26.6 %) | 0.682 |
| Ankle clonus | 8 (53.3 %) | 7 (46.7 %) | 0.464 |

Data are presented as numbers (%).

*Table 3. Summary of operative variables and surgical outcome.*

| | C group | C and P group | *P*-value[a] |
|---|---|---|---|
| Number of patients | 15 | 15 | |
| Operative time (min) | 142 ± 28 | 197 ± 27 | <0.001 |
| Neck pain VAS score | | | |
| Preoperative | 7 (4–9) | 6 (4–8) | 0.074 |
| After 12 months | 4 (2–6) | 5 (3–7) | 0.033 |
| *P*-value[b] | 0.001 | 0.022 | |
| Arm pain VAS score | | | |
| Preoperative | 6 (3–8) | 6 (4–9) | 0.816 |
| After 12 months | 3 (1–6) | 3 (1–5) | 0.901 |
| *P*-value[b] | 0.001 | 0.001 | |
| Nurick score | | | |
| Preoperative | 2.8 ± 0.8 | 3.1 ± 0.7 | 0.332 |
| After 12 months | 1.4 ± 0.6 | 1.7 ± 0.6 | 0.252 |
| *P*-value[b] | <0.001 | <0.001 | |
| Neck Disability Index score | | | |
| Preoperative | 29 ± 5 | 27 ± 5 | 0.387 |
| After 12 months | 15 ± 4 | 16 ± 5 | 0.420 |
| *P*-value[b] | <0.001 | <0.001 | |
| Cobb angle (degree) | | | |
| Preoperative | 8.0 (4.5–18.0) | 7.0 (3.0–18.0) | 0.902 |
| After 12 months | 16.0 (0.1–25.0) | 16.0 (6.0–20.0) | 0.567 |
| *P*-value[b] | 0.036 | 0.004 | |
| Intraoperative Blood loss (ml) | 155 ± 42 | 175 ± 61 | 0.323 |
| Hospital stays (days) | 3 (2–6) | 4 (3–6) | 0.005 |

The data are displayed as either the mean± the standard deviation or the median within a given range.
[a] Comparison of the two groups.
[b] Compared with preoperative value.

### 3.1. Clinical outcome

After surgery, both groups experienced a significant drop in neck and arm pain. However, the Cage group had significantly higher neck pain scores ($P = 0.033$). Postoperative arm pain scores were similar in both groups ($P = 0.901$). There were no noteworthy differences in Nurick and NDI scores between the two patients' groups after surgery ($P = 0.252$ and $P = 0.420$, respectively). Blood loss did not differ significantly between the two patients' groups ($P = 0.323$). The hospital stay was longer significantly in the Cage and Plate patients' group ($P = 0.005$).

### 3.2. Radiological outcome

At the last follow-up, only 2 out of 15 patients (13.3 %) in the C group had pseudarthrosis. However, they remained asymptomatic and were treated conservatively. As a result, the overall fusion rate for types 2 A, 1 B, and 1 A was 92.0 %. Before surgery, there was no significant difference in the cervical Cobb's angle between the Cage and Cage and Plate groups ($P = 0.902$). After surgery, there was a significant increase in cervical Cobb's angle for both

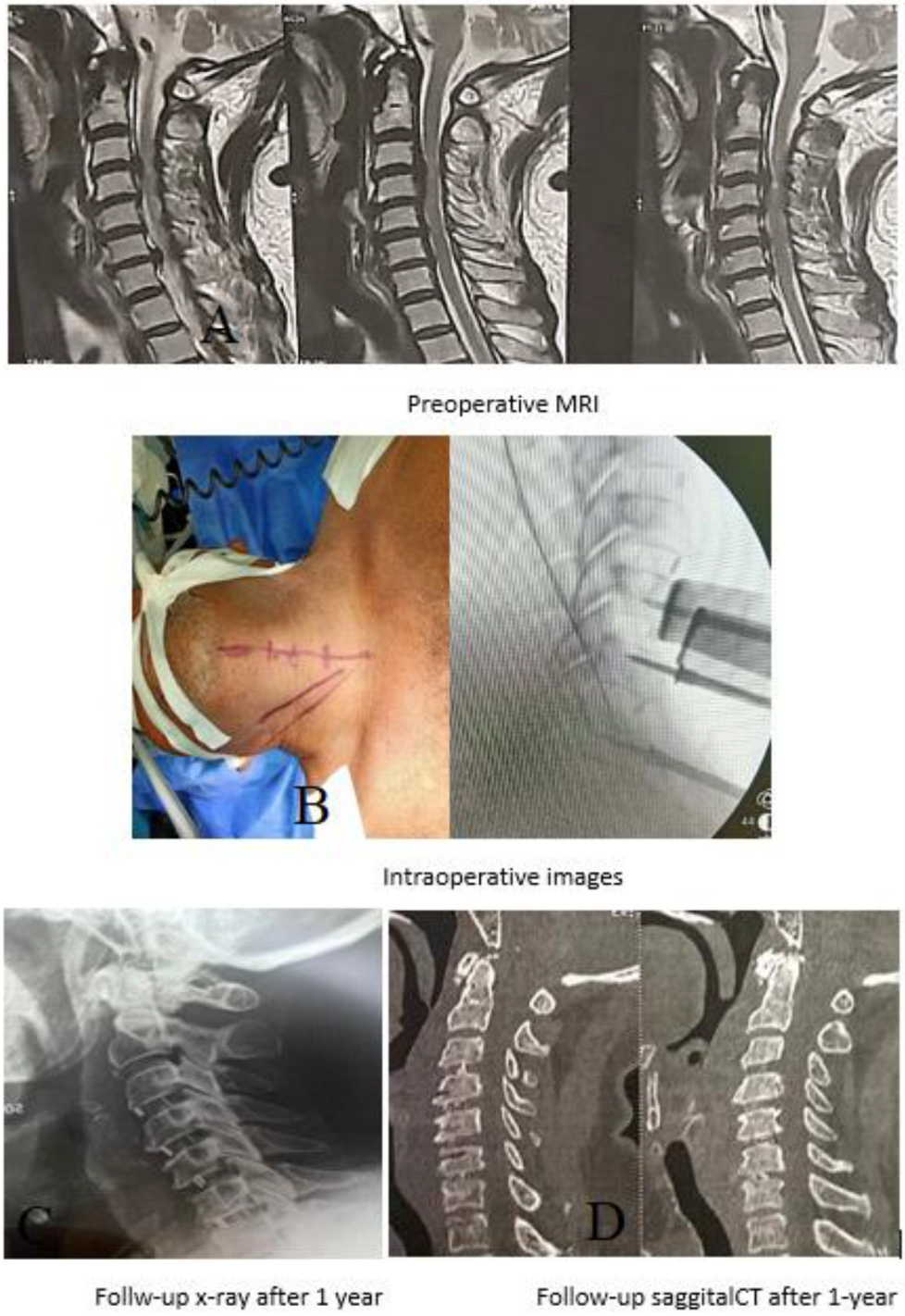


*Fig. 1. A 61-year-old man had neck pain for three years, with numbness in his upper and lower limbs for two years. (A) MRI showed cervical stenosis at multiple levels between C3 and C7. (B) He had a four-level anterior cervical discectomy and fusion and had good results. (C, D) radiography showed solid fusion and good alignment.*

patients' groups (Table 2). Furthermore, there was no significant difference in the postoperative Cobb's angle between the Cage and Cage and Plate groups ($P = 0.567$).

### 3.3. Functional outcome

Odom's criteria indicate that both the Cage and Cage and Plate patients' groups had mostly good or

excellent outcomes, with only one poor satisfaction case in each group.

### 3.4. Complications

The Cage group had fewer cases of dysphagia (3 cases) compared with the Cage and Plate group (11 cases). The Cage group had one case of temporary weakness, two infections, and one patient with incidental durotomy and transient C6 radiculopathy. The Cage and Plate group had one case each of infection and weakness, and 20 % of patients experienced transient hoarseness. One patient in the Cage and Plate group developed dysphagia three months postsurgery, but it was resolved with revision surgery. There were no major complications like device failure, neurological deterioration, myelopathy worsening, vascular injury, hematoma, or mortality during the follow-up period (Figs. 1 and 2).

## 4. Discussion

For decades, ACDF has been a popular treatment option for cervical spondylosis. ACDF provides direct decompression, restores intervertebral space height, and ensures stability of the cervical spine.[14] However, due to postoperative complications, there has been a shift towards using cages alone instead of

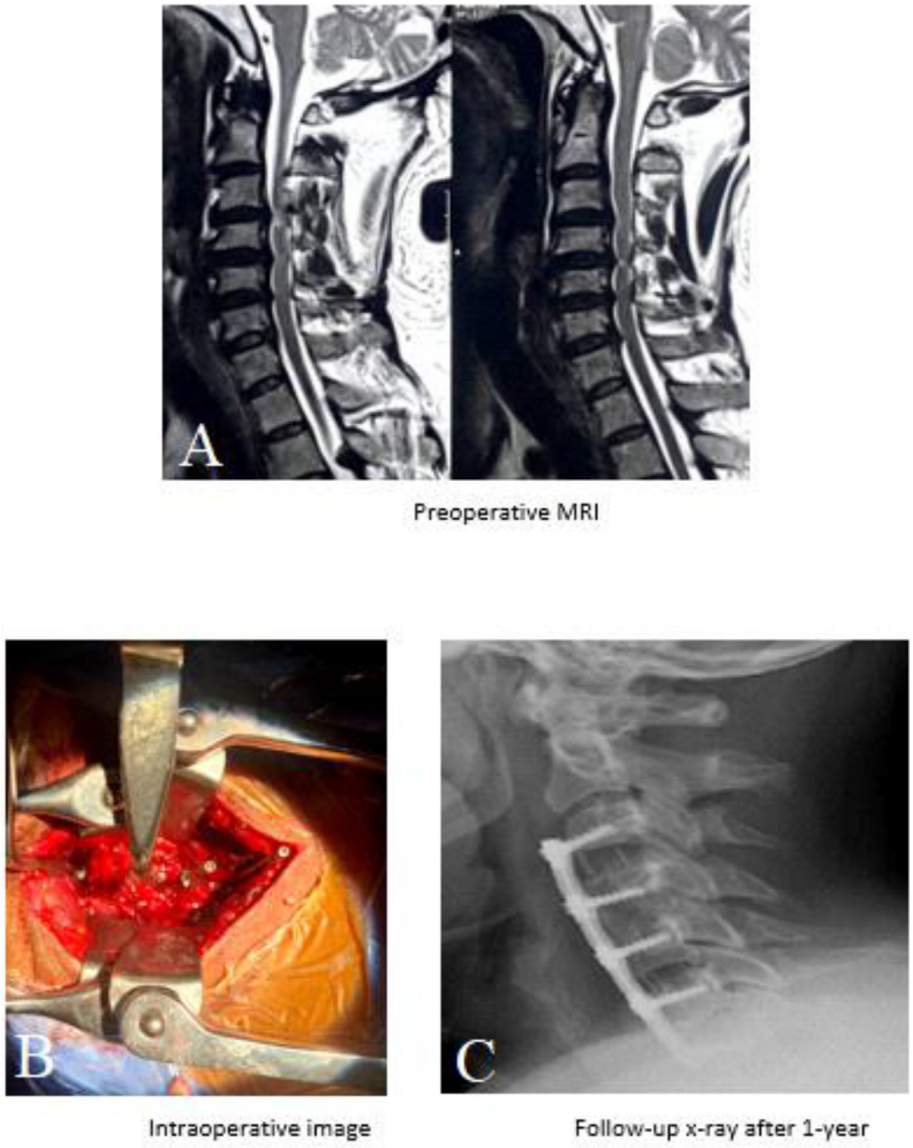


*Fig. 2. A female had neck pain for 16 months and experienced heaviness, tingling, and numbness in her limbs. (A) MRI scans showed cervical stenosis at C3–C7. (B) She had a successful anterior cervical discectomy and fusion surgery at those levels and (C) good alignment and fusion were shown in follow-up radiography.*

plate fixation. This article discusses the reasons behind this evolving preference and its implications in the treatment of cervical spondylosis.

Despite its benefits, ACDF is not without its drawbacks. Postoperative complications, such as dysphagia (difficulty swallowing), adjacent segment degeneration, and pseudarthrosis (failure of bone fusion), have been reported. These complications can lead to patient discomfort, revision surgeries, and increased healthcare costs. As a result, surgeons have sought alternatives to minimize these risks.

In this study, it was found that using cages alone or with plate fixation significantly decreased neck and arm pain and improved Nurick and NDI scores, as well as functional outcomes, for patients with 4-level Cervical spondylosis. The cage and plate technique took longer to perform than cage-only procedures, but blood loss was similar between the two. The total fusion rate was 92 %, with only two (13.3 %) patients in the cage-only group experiencing pseudarthrosis. Both procedures significantly increased the cervical Cobb angle, with no significant difference between the two groups. Neck pain was significantly lower in the cage-only group than in the cage and plate group. The complication rate was similar between the two groups, except for transient dysphagia, which was more frequent in the cage and plate group ($P = 0.003$). There were no instances of device failure or cerebrospinal fluid leakage.

Patients with multilevel CSM may have higher rates of complications and pseudarthrosis with 4-level ACDF due to extensive soft tissue dissection.[8] However, ACDF with polyetheretherketone (PEEK) cages and plates is safe and effective for 4-level CSM with satisfactory mid-term outcomes.[15–17]

Another retrospective study reported better results with plate fixation than the cage-alone regarding a higher rate of solid fusion, more disc height, and less frequent cage subsidence and segmental kyphosis. Similarly, the pseudarthrosis rate and revision surgery were less common after plate fixation. However, both patient groups had similar clinical outcomes.[6]

Shousha and colleagues evaluated the necessity of additional posterior instrumentation with cage fusion. They found that additional instrumentation did not provide better outcomes in terms of NDI and solid bony fusion. Also, loss in disc height and lordosis angle was more but not statistically significant in cases without posterior instrumentation.[18]

In a study comparing surgical results of multiple-level ACDF, patients were divided into two groups: those who underwent cage fusion alone (group A) and those who underwent cage fusion with plate (group B).[19] Nine patients in the study had a 4-level disease. The fusion rate was 78 % in group A and 85 % in group B. Both groups had similar surgical outcomes and patient satisfaction.

A study was conducted to compare the outcomes of ACDF in multiple levels using cages only versus cages and plates in 50 subjects. The study followed patients for 6 months postsurgery, and it was found that plate fixation resulted in longer operative time and higher blood loss than cages only. Both techniques showed significant improvement in VAS and NDI scores after surgery, and there was a significant improvement in the cervical Cobb angle, segmental angle, and height. However, the cage and plate method showed better results. The study also found that complications were significantly higher with plate fixation.[20]

### *4.1. Conclusion*

In this small-scale study involving 30 patients, we explored the outcomes of ACDF including patients' radiological and clinical data using cages alone versus plate fixation with cages after four-level ACD. Our analysis revealed that both techniques are similarly effective in improving patient outcomes. However, postoperative complications were more common in patients who underwent plate fixation procedures.

## Authorship

All authors have substantial contributions to the article.

## Disclosure

The authors have no conflict interest to declare about the content of this article.

### Conflicts of interest

None declared.

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