

*Research Article*

## Role of Plates in Multiple-Level Anterior Cervical Disc Fusion



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### Abstract

**Background:** ACDF is a standard procedure for cervical disc prolapse, addition of anterior plating is increasingly becoming a viable option for neurosurgeons especially in multiple level cervical disc prolapse. **Aim:** Comparing between patients who complained of multiple level cervical disc prolapse who underwent ACDF without plates v with plates. **Patient and Methods:** This clinical & radiographic retrospective study was performed on 20 patients with multiple level cervical disc prolapse. Half of these patients underwent ACDF without plates and the other Half underwent ACDF with anterior plating. **Results:** Age of patients involved in this study ranged from 30 to 68 years old in both groups with a mean of 47 and 52 respectively. Regarding sex of patients, in the first group 5 were male and 5 were female while in the second group 7 were male and 3 were female. All complained of Neck Pain, 17 had Brachialgia and 3 with myelopathy. in the first group 9 patients had double level prolapse and one with triple level prolapse while in the second group 5 patients had double level and 5 had triple level disc prolapse. Regarding neck & arm pain, all patients showed significant improvement with no significant difference between two groups. There were no major complications encountered. **Conclusions:** Both procedures were comparable in achieving pain relief and functional improvement. Although the plate method was superior to the cage alone method in terms of fusion rate and reduced cage subsidence than that of cage alone, short-term outcome was almost the same.

**Keywords:** ACDF, Cervical disc prolapse, Cervical Plate, Cervical Cage, Fusion

### Introduction

Cervical spondylosis is a term that encompasses a range of progressive degenerative changes that affect all the components of the cervical spine<sup>(1)</sup> Its symptoms include neck pain and stiffness and can be accompanied by more serious manifestations as radicular symptoms when there is compression of neural structures<sup>(2)</sup>

Most people with spondylotic changes of the cervical spine on radiographic imaging remain asymptomatic. The most frequently affected levels are C6-C7, followed by C5-C6<sup>(3)</sup>

The prevalence of cervical disc herniation increases with age for both men and women and is most common in their third to fifth decades of life. It occurs more frequently in females, accounting for more than 60% of cases.<sup>(4-7)</sup>

The pathophysiology of herniated discs is thought to be a combination of mechanical compression of the nerve by the bulging nucleus pulposus and a chemical process in the form of local increase in inflammatory cytokines. Compressive forces can result in varying degrees of microvascular damage, which can range from mild compression producing

obstruction of venous flow that causes congestion and edema, to severe compression, which can result in arterial ischemia. Herniated disc material and nerve irritation may induce the production of inflammatory cytokines<sup>(8, 9)</sup>

Typically, patients with cervical spondylosis complain of neck pain accompanied with shoulder pain as a first symptom which can progress to affect motor power and sensation in the form of tingling and numbness in the extremities and brachialgia<sup>(10)</sup>

Clinical Examination is crucial in diagnosing Cervical Spondylosis; Provocative examination tests include Spurling Sign, Hoffman Sign, and L'hermitte sign. Spurling test can help diagnose acute radiculopathy while Hoffman test and L'hermitte sign can be used to assess for the presence of spinal cord compression and myelopathy<sup>(11)</sup>

Imaging plays an important role in confirming diagnosis of cervical disc prolapse, and is vital in indicating role of surgery. Modalities vary ranging from simple Xray to detect spondylotic changes upto CT spine, but MRI on the cervical spine remains the Gold standard for detecting disc bulge or herniation for its sensitivity to soft tissue structures<sup>(12-14)</sup>

Conservative management (neck collar, medical treatment, physiotherapy) is the first line in management of cervical spondylosis as 75-90 % of patients will improve.<sup>(15)</sup>

Indications for surgical intervention include severe or progressive neurological

compromise and significant pain that is refractory to conservative measures. There are several techniques described based on pathology. The gold-standard remains the anterior cervical discectomy with fusion (ACDF)<sup>(16, 17)</sup>

### Patients and Methods

This retrospective study was conducted on 20 patients with cervical disc prolapse who were admitted to Minia University Hospital from period of March 2020 to September 2021. Patients in this study were divided into 2 equal groups, where the first group underwent ACDF without plating while the second group underwent ACDF with plating. Patients included in this study fulfilled the following inclusion criteria:

1- patients suffering from multiple level disc prolapse indicated for surgery, 2- patients with neurological affection, 3- patients who are medically fit, 4- patients accepting to do surgery. All patients were subjected to thorough clinical examination. Neuroimaging studies included magnetic resonance imaging in all cases. Results of surgery were analysed.

In this study we used the VAS pain score to evaluate postoperative neck and arm pain, and Assessment of fusion in plain X-ray was done with Bridwell Interbody Grading System:

All patients were followed for at least 6 months in our outpatient clinic.

An informed written consent was taken from each patient prior to the operation. This consent was done according to the guidelines of Faculty of Medicine Research Ethics Committee (FMREC), Minia University, El-Minia, Egypt.

Grade	Description
I	Fused with remodelling and trabeculae present
II	Graft intact, not fully remodelled and incorporated, but no lucency present
III	Graft intact, potential lucency present at top and bottom of graft
IV	Fusion absent with collapse or resorption of graft

**Table 1:** showing clinical presentation of participating patients.

Clinical Presentation	Number	Percentage
Neck Pain	20	100%
Right Brachialgia	7	35%
Left Brachialgia	6	30%
Bilateral Brachialgia	4	20%
Myelopathy	3	15%

**Table 2:** showing affected cervical levels in participating patients in both groups

Radiology	ACDF without plate fixation (n = 10)	ACDF with plate fixation (n = 10)
Double level (C4-5, C5-6)	4 (40%)	2 (20%)
Double level (C5-6, C6-7)	5 (50%)	3 (30%)
Triple level (C3-4, C4-5, C5-6)	1 (10%)	5 (50%)

**Table 3:** showing the VAS neck pain score in participants pre and postoperative.

VAS score of neck pain	ACDF without plate fixation (n = 10)		ACDF with plate fixation (n = 10)		p value
	Mean	Range	Mean	Range	
VAS Neck Pain Pre operative	5.8	4 – 8	4.4	3 - 7	<b>0.063</b>
VAS Neck Pain immediate Post operative	3.9	1 – 6	3.4	1 - 6	<b>0.367</b>
VAS Neck Pain 6 months Post operative	1.9	1 – 3	1.5	1 - 2	<b>0.3</b>

**Table 4:** showing the VAS arm pain score in participants pre and postoperative.

VAS score of arm pain	ACDF without plate fixation (n = 10)		ACDF with plate fixation (n = 10)		p value
	Mean	Range	Mean	Range	
VAS arm Pain Pre operative	6.1	4 – 9	6.2	5 – 9	<b>0.725</b>
VAS arm Pain immediate Post operative	1.8	1 – 2	1.2	1 – 2	<b>0.009*</b>
VAS arm Pain 6 months Post operative	1.4	1 – 2	1.7	1 – 2	<b>0.189</b>

**Table 5:** showing fusion rate of the two groups of participants:

Fusion rate	ACDF without plate fixation (n = 10)	ACDF with plate fixation (n = 10)	p value
• Grade 1	7 (70%)	9 (90%)	<b>0.264</b>
• Grade 2	3 (30%)	1 (10%)	



**Fig. (1): MRI sagittal T2 image showing cervical disc prolapse at C5-6, C6-7**



**Fig. (2): MRI axial T2 image showing cervical disc prolapse at C5-6, C6-7**



**Fig. (3):** Intra-operative image showing Cage inserted into disc-space



**Fig. (4):** X-Ray showing C5-C6 and C6-C7 cages (Sagittal View)



Fig. (5): MRI showing C5-C6 and C6-C7 disc prolapse (Sagittal View)



Fig. (6): MRI showing C5-C6 and C6-C7 disc prolapse (Axial View).



**Fig. (7): Intra-operative image showing Cage and plate insertion**



**Fig. (8): X-Ray showing C5-C6 and C6-C7 cage with plate (Sagittal View)**

### Surgical procedure

The procedure is done with the patient under general anaesthesia. A prophylactic antibiotic is given just prior to beginning surgery. The patient is placed in the supine position on the operating table. The procedure is usually done on the right side. A transverse skin incision is typically used unless extensive exposure of three or more levels is required. The incision is opened sharply, and the platysma muscle is identified. A supraplatysmal dissection can be performed in a superior-inferior orientation either bluntly with Metzenbaum scissors or monopolar cautery. The platysma is opened at its medial border, elevated, and incised horizontally again using scissors or monopolar cautery.

Next, the medial border of the sternocleidomastoid is identified, and the natural avascular plane is then developed between the trachea and esophagus medially and the carotid sheath laterally. retractors are used to provide initial exposure of the anterior vertebral column and the adjacent longus colli muscles. The prevertebral fascial layer is opened sharply to expose the anterior longitudinal ligament medially and the longus colli muscles laterally. The medial attachment of the longus colli muscles is released and elevated by subperiosteal dissection using either a key periosteal elevator or monopolar electrocautery.

Self-drilling Caspar distraction pins are positioned at the midline of the vertebral bodies adjacent to the planned discectomies. The distractor is placed over the pins, and an appropriate amount of distraction is applied to achieve adequate disk height. The anterior longitudinal ligament and disk anulus are incised with a no. 11 or no. 15 blade, taking care taken to cut toward the disc midline to avoid injury to structures bilaterally. After the anterior portion of the disc is incised, the remainder of the disc is completely removed using currets. the posterior edge of the inferior vertebral body is then removed using the Kerrison 1 ml. The vertically oriented fibers of the posterior longitudinal ligament aid in its

identification. A 4–0 Karlin forward- or back-angled curette. Types of Cages used were PEEK cages (Size 5, 6, 7) (Large or Small). The vertebral end plates are decorticated using a curette. Slight over-distraction of the Caspar pins can allow for a tight cage fit. Once an appropriate cage is selected and prepared, the cage is gently tapped into place, leaving it recessed 1 or 2 mm beneath the anterior surface of the vertebral body. the plate can be centered medially or laterally on the spine. It is held in position manually or by using plate-holding pins. Once all screws are completely tightened, the screws are locked to the plate using the available lock mechanism to prevent screw back out. Before wound closure hemostasis was obtained. An operative drain was used. Finally intraoperative radiographs were obtained to document good position of the cage, plate (if used) and instrumentation.

### Results

The age of both groups was almost the same with a range of 30-65 years and a mean of 47 years in the first group and 52 years in the second group. in the first group there were 5 males and 5 females while in the second group - who had plate fixation – there were 7 males and 3 females.

All our patients were presented with Neck Pain. 17 of them complained of Brachialgia (7 were right Brachialgia, 6 were left Brachialgia, and 4 were Bilateral Brachialgia) with the remaining 3 complaining of myelopathy.

9 patients had double level cervical disc prolapse in the first group (4 of them had C4-5, C5-6 prolapse and the remaining 5 had C5-6, C6-7 prolapse) and 1 patient had 3 level discs prolapse who underwent ACDF without plating due to inability to afford the plate.

The second group which contained Patients who underwent ACDF with cage-plate construct were as follows: 5 had double level cervical disc prolapse (2 of them had C4-5, C5-6 prolapse and the remaining 3 had C5-6, C6-7 prolapse) and the remaining 5 patients had 3 level discs prolapse.



Patients who underwent ACDF with cage only had operative time ranging from 1.5h to 2.15h with mean 1.83, while patients who underwent ACDF with plate fixation ranged from 1.5h to 2.75h with mean =2. The difference showed no statistical significance ( $p=0.165$ )

The blood loss in the first group ranged from 100-250 ml with a mean of 170 ml, while patients in the second group had blood loss ranging 150-250 ml with mean 185, though the difference showed no statistical significance ( $p=0.347$ )

Regarding VAS Neck pain, in the first group Mean score of patients pre-operative was 5.8 ranging from (4-8) and improved to 3.9 (range 1-6) immediately post-operative and 1.9 (range 1-3) six months post-operative.

As regards to the second group Mean VAS neck pain of patient's pre-operative was 4.4 ranging from 3-7 and improved to 3.4 (range 1-6) immediately post-operative and 1.5 (range 1-2) six months post-operative

As regards VAS arm pain, the first group patients showed a Mean of 6.1 pre-operative ranging from 4-9 and improved to 1.8 (range 1-2) immediately post-operative and 1.4 (range 1-2) six months post-operative.

While in the other group of patients who underwent ACDF with plate: the Mean VAS score pre-operative was 6.2 ranging from 5-9 and improved to 1.2 (range 1-2) immediately post-operative and 1.7 (range 1-2) six months post-operative

30% of patients suffered from immediate post-operative dysphagia, but in 6 months follow up this value decreased significantly. In the 6 months follow up no patients of Group 1 had any residual dysphagia while patient of Group 2 reported 1 patient who had residual dysphagia which can be explained by the fact that in plate fixation, we needed more exposure thus causing more lateral dissection and manipulation.

Only one patient complained of hoarseness of voice in cage only patients while 2 patients of the cage-plate construct

group complained of hoarseness of voice and subsided in one month at most.

Grading of Fusion was considered according to Bridwell inter-body fusion grading system showed that in patients who underwent ACDF without cage had fusion of Grade 1 in 70% and Grade 2 in 30% of the patients while patients who underwent ACDF with plate insertion had Fusion Grade 1 in 90% of patients and Grade 2 in the rest (after 6 months follow up)  $p=0.264$

### Illustrated Cases

**Case 1-** patient 52-year-old housewife with a 3-year history of neck pain. Over the last 3 months she had developed Right arm pain not responding to medical treatment or physiotherapy. She had no chronic diseases and performing no regular exercise, On Examination she was Full Motor Power, intact sensation right brachialgia and no myelopathic features were detected.

- MRI cervical Spine revealed C5-C6 and C6-C7 disc prolapse (fig.1, 2)

- Patient underwent anterior cervical discectomy and fusion via cage insertion with satisfactory results (fig 3)

- X-Ray was done post-operative showing well positioned cages. (Fig .4)

**Case 2-** a 49-year-old worker with a 4-year history of neck pain. Over the last 5 months he had developed Right arm pain not responding to medical treatment or physiotherapy. He had no chronic diseases and performing no regular exercise.

- On Examination she was Full Motor Power, intact sensation right brachialgia and no myelopathic features were detected.

- MRI cervical Spine revealed C5-C6 and C6-C7 disc prolapse (fig. 5,6)

- Patient underwent ACDF via cage insertion and plate fixation (fig. 7)

- X-Ray showed well positioned cage and anterior plate. (Fig. 8)

### Discussion

The age of both groups was almost the same with a range of 30-65 years and a mean of 47 years in the first group and 52 years in the second group.in the first

group there were 5 males and 5 females while in the second group - who had plate fixation – there were 7 males and 3 females. thus most of our patients were of middle age group in contrast with Cervical Canal stenosis which mainly affects older age groups (Mean 60)

This agrees with Chen, Lü, Wang, Li, & Kuang, 2016<sup>(18)</sup> where Group A (patients who underwent ACDF without plate fixation) were 28 patients (18 male, 10 female) with age 54.2 years (range 41–64) and Group B (patients who underwent ACDF with plate fixation) were 26 patients (15 male, 11 female) with age 54.8 years (range 38–63) and the ratio between male and female is 60% to 40% respectively.

regarding clinical presentation of the two compared groups: All our patients were presented with Neck Pain. 17 of them complained of Brachialgia (7 were right Brachialgia, 6 were left Brachialgia, and 4 were Bilateral Brachialgia) with the remaining 3 complaining of myelopathy. And it was noted that the 3 patients who complained of Myelopathy had Cord Signal which wasn't present in the remaining patients.

This agrees with Barakat et al., 2019<sup>(19)</sup> with who reported that regarding the clinical picture, the most common symptoms where Neck pain + radiculopathy with 70%, after which came Radiculomyelopathy with 20% and Myelopathy with 10%.

Regarding levels affected, 9 patients had double level cervical disc prolapse in the first group (4 of them had C4-5, C5-6 prolapse and the remaining 5 had C5-6, C6-7 prolapse) and 1 patient had 3 level disc prolapse who underwent ACDF without plating due to inability to afford the plate whereas The second group which contained Patients who underwent ACDF with cage-plate construct were as follows: 5 had double level cervical disc prolapse (2 of them had C4-5, C5-6 prolapse and the remaining 3 had C5-6, C6-7 prolapse) and the remaining 5 patients had 3 level

disc prolapse this is comparable to Barakat et al., 2019<sup>(19)</sup> where it reported that the most common operated levels in the plate group were C5-6 (60%) followed by C4-5 (30%), while in the cage group the most common levels were C5-6 (70%), followed by C6-7 level (20%) and agrees with Aziz, Sonkawade et al., 2020<sup>(20)</sup>

As for operative time, our results agree with the results of Chen et al., 2016<sup>(18)</sup> where the operative time was shorter in the patients who underwent ACDF only (mean 114 min) compared with the patients who underwent ACDF with plate fixation (mean 139min) ( $P < 0.05$ )

regarding intra operative Blood Loss: patients who underwent ACDF with cage only had blood loss ranging from 100-250 ml with mean 170 ml while patients who underwent ACDF with cage plate complex had blood loss ranging 150-250 ml with mean 185 ml, This agrees with Chen et al., 2016<sup>(18)</sup> where blood loss in the group that underwent ACDF with cage had mean 159 ml while patients who underwent ACDF with cage plate complex had blood loss mean 188ml.

Regarding VAS Neck pain, as stated previously, in the first group the mean score of patient's pre-operative was 5.8 ranging from (4-8) and improved to 3.9 (range 1-6) immediately post-operative and 1.9 (range 1-3) six months post-operative. while the second group had a Mean VAS neck pre-operative pain of 4.4 ranging from 3-7 and improved to 3.4 (range 1-6) immediately post-operative and 1.5 (range 1-2) six months post-operative

This agrees with Elsayed & Sakr, 2019 (21) where reported that in postoperative results in their study, there was a statistically significant relief of cervical pain after surgery in both groups ( $P < 0.05$ ) but no significant difference between the two groups ( $P = 0.64$ )

Our results regarding VAS arm pain pre and post-operatively showed that in the first group patients showed a Mean of 6.1 pre-operative ranging from 4-9 and

improved to 1.8 (range 1-2) immediately post-operative and 1.4 (range 1-2) six months post-operative.

While in the other group of patients who underwent ACDF with plate: the Mean VAS score pre-operative was 6.2 ranging from 5-9 and improved to 1.2 (range 1-2) immediately post-operative and 1.7 (range 1-2) six months post-operative

This agrees with Fountas et al., 2007<sup>(22)</sup> where the pre-op mean VAS arm pain score was  $7.67 \pm 2.15$  in the cage-only group and  $6.5 \pm 1.85$  in the cage-with-plate fixation group. The follow-up mean VAS at 12 months was  $3.57 \pm 1.94$  in the two-level cage-only group and  $5.12 \pm 1.34$  in the cage-with-plate fixation group. Although the VAS score was significantly lower in the cage-only group ( $p=0.026$ ), the follow-up mean VAS at 24 months was not significantly different.

In our study regarding dysphagia immediate post-operative, 30% of patients suffered from immediate post-operative dysphagia, but in 6 months follow up this value decreased significantly. In the 6 months follow up no patients of Group A had any residual dysphagia while one patient of Group B had residual dysphagia which can be explained by the fact that in plate fixation, we needed more exposure thus causing more lateral dissection and manipulation. But as for hoarseness of voice, it was transient and occurred in only one patient in the first group and two patients in the second group and the voice returned to normal in all patients within one to two weeks. This is comparable to Elsayed & Sakr, 2019<sup>(21)</sup> results in their series, that stated that transient dysphagia occurred in 5 (22.7%) of 22 non-plated patients while transient hoarseness of voice occurred in two (10.5%) of group A patients and in four (28.6%) of group B patients. The hoarseness lasted only for few days in all cases and resolved spontaneously

Grading of Fusion was considered according to Bridwell inter-body fusion grading system showed that in patients who underwent ACDF without cage had

fusion of Grade 1 in 70% and Grade 2 in 30% of the patients while patients who underwent ACDF with plate insertion had Fusion Grade 1 in 90% of patients and Grade 2 in the rest (after 6 months follow up)  $p=0.264$

this agrees with Joo, Lee, Kwon, Rhee, & Lee, 2010<sup>(23)</sup> where fusion rates were 90.9%<sup>(20/22)</sup> in the ACDF with cage alone group, 95%<sup>(19/20)</sup> in the ACDF with plate fixation group

In our studies no patients of Group 2 complained of Cage subsidence but 1 patient (10%) of Group 1 suffered from cage subsidence in 6 months follow up

This agrees with Chen et al., 2016<sup>(18)</sup> where subsidence rates were higher in patients who underwent ACDF with cage only. Cage subsidence at 6 months occurred in 13/84 segments in group A and 5/78 segments in group B ( $P = 0.08$ )

### Conclusions

ACDF with or without plate fixation in more than two-level cervical discectomies achieves good stability and functional outcome. Both procedures were comparable in achieving pain relief and functional improvement. Although the plate method was superior to the cage alone method in terms of fusion rate and reduced cage subsidence than that of cage alone, short-term outcome was almost the same.

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