

## Role of Anterior Cervical Plating in Management of Two and Three Levels Anterior Cervical Discectomy and Fusion Cage

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**Abstract:** Anterior cervical discectomy has gained immense popularity since its introduction in the 1950s by **Smith** and **Robinson** as well as **Cloward**. Today the technique has become a mainstay in the treatment of degenerative cervical spondylosis, intervertebral disc herniation, radiculopathy, and spinal instability. High rates of pseudarthrosis and high rates of kyphotic deformity in multilevel anterior cervical procedures created a need for an anterior internal cervical fixation device. The development of the first anterior plate and screw system by Böhler in 1964s set into motion an evolution of anterior cervical plate designs in an effort to provide optimum anterior internal fixation for the cervical spine. Our study included 46 patients radiologically and clinically documented cervical degenerative disc disease scheduled for surgery, 26 patients (group A) had 2 levels ACDF subdivided to 13 patients without plate and other 13 had plate, 20 patients (group B) had 3 levels ACDF subdivided to 10 patients without plate and other 10 had plate. Patients were discharged from hospital with rigid cervical collar for 6 weeks with patients without plate and 2 weeks with patients with plate and followed radiologically and clinically for 12 months.

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### 1. Introduction

Patients with cervical spine related problems can be systemically approached by dividing their presentations into axial neck pain, radiculopathy, myelopathy, or some combination of these three groups. Axial neck pain refers to pain along the spinal column and its related Paraspinal musculature. Cervical radiculopathy is characterized by pain radiating into the arm which may be accompanied by sensory and /or motor changes into radicular distribution. (*Guez M et al., 2002*).

Cervical spondylotic myelopathy is the development of long tract signs as a result of long stay compression on the cervical spinal cord. (*Karpova et al., 2013*).

The natural history of these conditions suggests that for the most Part of patients with axial symptoms are best treated without surgery Whereas some patients with radiculopathy will continue to be disabled by their pain and may be candidate for surgery. Patients presented with moderate to severe myelopathy will likely Benefit from surgical intervention in attempt to alter the natural history of disease process the major goal of surgery in this sitting is to halt the progression of the disease. Improvement in motor, sensory and gait are clearly desired but they are the second goal of surgery (*Coughlin and Klezl, 2012*).

Patients with multiple cervical discs most probably presented with cervical myelopathy which can be treated surgically with anterior or posterior decompression. the exact mechanism of neurological damage from spondylotic myelopathy is unknown, but both direct neural compression and diminished blood flow have been suggested as potential causes (*Yamaura I et al., 2002*).

Direct compression by the cord and nerve root by bulging or herniated discs. spondylotic pars and / or uncovertebral osteophyte occurs on the anterior surface of neural elements. so direct decompression of the cord and nerve roots can only be accomplished with an anterior approach (*James and Joel et al., 2010*).

Anterior cervical discectomy and fusion, as originally described by Robinson (*Robinson RA et al., 1962*), is highly successful procedure for the treatment of neural compression caused by disc material or osteophyte however, the incidence of nonunion and graft collapse rises with increase in the number of segments to be fused (*Swank ML et al., 1997*).

The anterior approach allows direct visualization of the entire space and wide decompression of the anterior aspect of cervical spinal cord and nerve roots. It may be undertaken in cases of multiple level diseases, and interbody fusion may be performed if required. (*William, 2000*).

Normal motion of the cervical spine may aggravate spinal cord damage precipitated by direct mechanical static compression. During flexion, the spinal cord lengthens and becomes stretched over the ventral osteophytic ridges. During extension, the ligamentum flavum may buckle into the spinal cord causing reduction of available space for the spinal cord (*William, 2000*).

Cloward (*CLOWARD, RB et al., 1958*) first described the anterior approach as an option for cervical disc herniation and cervical spondylosis in cases in which iliac crest bone graft fusion was performed the clowered fusion procedure has undergone several technical modifications and there is now no consensus regarding the best technique. The various advantages and the types associated with the different procedures are still debated in literature (*Savolian S et al., 1998*).

Inter-body fusion cages are hollow implants that restore physiological disc height, allow bone growth within and around them, thus stimulating bone fusion. they have been developed to prevent disc space collapse and its relevant clinic-radiological consequences, as well as the donor site morbidity reported in conjunction with autologous bone graft procedures. The primary complications related to the implantation of fusion cages are subsidence into the adjacent vertebral bodies, cage dislocation, non-union related instability, painful pseudo-arthritis. (*Du et al., 2014*).

According to the literature, fusion rate decrease significantly in multi-level surgery and some authors recommended the addition of plate system to improve the results. (*Cote P et al., 2013*) (*Hacker RJ et al., 2000*) (*Gilbert TJ et al., 2000*).

**Aim of the work**

The aim of this study was to evaluate clinical and radiological outcome of two and three anterior cervical discectomy and fusion by cages with and without additional rigid anterior cervical plate fixation.

**2. Materials and methods**

A prospective study conducted on a 46 patients aged from 30-60 years who complain of radiculopathy and/or radiculomyelopathy due to degenerative cervical discs prolapse not relived by conservative treatment so were surgically treated. Patients are divided into group (A) consists of 26 patients have two-level cervical discs herniation, 13 of them treated by two-level PEEK anterior cervical discectomy and fusion (ACDF) with rigid locked anterior cervical plate and the other 13s without plating, group (B) consists of 20 patients have three-level cervical discs herniation. 10 of them treated by three-level PEEK (ACDF) with rigid locked anterior cervical plate and the other 10s without plating. The study will focus on operating room time, hospital stay, overall cost, clinical outcome, radiological outcome including plain X-ray and MRI and time to return to normal activities including work.

All the patients will be followed up clinically immediately postoperative and at regular 3 months intervals for a minimum period of one year.

**Statistics**

Statistical presentation and analysis of the present study was conducted, using the mean, standard error, student t- test and Chi-square, by SPSS VI 7.

**3. Results**

Table (1) show that no significant difference between patients had plate or without plate in both groups as regard age.

Table (1): The patient's mean age at the time of operation (years).

Age				
Groups	Without plate		With plate	
	Mean ± SD		Mean ± SD	
Two levels	47.308 ± 7.227		47.462 ± 7.633	
Three levels	53.400 ± 4.993		54.000 ± 4.807	
			T-test	P-value
			t	
			-0.053	0.958
			-0.274	0.787

Table (2) show that no significant difference was found between both groups as regard presentation.

Table (2): Presentation pattern among the studied cases. R (Radiculopathy), M (Myelopathy), RM (Radiculomyelopathy).

Presentation		without plate		With plate		Total		Chi-square	
		N	%	N	%	N	%	X <sup>2</sup>	P-value
Two levels	R	5	19.23	8	30.77	13	50.00	1.510	0.470
	M	1	3.85	1	3.85	2	7.69		
	RM	7	26.92	4	15.38	11	42.31		
	Total	13	50.00	13	50.00	26	100.00		
Three levels	R	2	10.00	2	10.00	4	20.00	0.410	0.815
	M	1	5.00	2	10.00	3	15.00		
	RM	7	35.00	6	30.00	13	65.00		
	Total	10	50.00	10	50.00	20	100.00		

Table (3) shows that no significant difference between both groups as regard duration of presentation.

Table (3): Mean duration of presentation (Months).

Duration of presentation (months)						
Groups	Without plate		With plate		T-test	
	Mean ± SD		Mean ± SD		t	P-value
Two levels	5.000 ± 2.345		4.308 ± 1.843		0.837	0.411
Three levels	7.000 ± 1.826		6.500 ± 1.509		0.667	0.513

Table (4) shows that no significant difference between both groups as regard disc levels affected.

Table (4): Frequency of disc levels affected and operated upon.

Level		Without plates		With plate		Total		Chi-square	
		N	%	N	%	N	%	X <sup>2</sup>	P-value
Two levels	3-5.	4	15.38	3	11.54	7	26.92	0.254	0.881
	4-6.	5	19.23	5	19.23	10	38.46		
	5-7.	4	15.38	5	19.23	9	34.62		
	Total	13	50.00	13	50.00	26	100.00		
three levels	3-6.	4	20.00	4	20.00	8	40.00	0.000	1.000
	4-7	6	30.00	6	30.00	12	60.00		
	Total	10	50.00	10	50.00	20	100.00		

Table (5) shows that no significant difference between both groups as regard hospital stay.

Table (5): postoperative hospital stay period.

Hospital stay (days)						
Groups	Without plate		With plate		T-test	
	Mean ±SD		Mean ± SD		t	P-value
Two levels	4.077 ± 0.494		4.077 ± 0.277		0.000	1.000
Three levels	4.000 ± 0.000		4.100 ± 0.316		-1.000	0.331

Table (6) show that no significant difference between both groups as regard cage extrusion in (6 months).

Table (6): Cage extrusion rate in 6 months.

Extrusion of cage in (6 months)		Without plate		With plate		Total		Chi-square	
		N	%	N	%	N	%		
Two levels	No	12	46.15	13	50	25	96.15	1.04	0.308
	Yes	1	3.85			1	3.85		
	Total	13	50	13	50	26	100		
Three levels	No	8	40	10	50	18	90	2.222	0.136
	Yes	2	10			2	10		
	Total	10	50	10	50	20	100		

Table (7) shows that no significant difference between both groups as regard pseudarthrosis in (6 months).

Table (7): pseudarthrosis rate in 6 months.

Pseudarthrosis in (6 months)		Without plate		With plate		Total		Chi-square	
		N	%	N	%	N	%		
Two levels	No	9	34.62	13	50	22	84.62	2.659	0.103
	Yes	4	15.38	0	0	4	15.38		
	Total	13	50	13	50	26	100		
Three levels	No	6	30	10	50	16	80	2.813	0.093
	Yes	4	20	0	0	4	20		
	Total	10	50	10	50	20	100		

Table (8) shows that no significant difference between both groups as regard pseudarthrosis in (12 months).

Table (15): pseudarthrosis rate in 12 months.

Pseudarthrosis in (12 months)		Without plate		With plate		Total		Chi-square	
		N	%	N	%	N	%		
Two levels	No	13	50	13	50	26	100	0.00	1.00
	Yes	0	0	0	0	0	0		
	Total	13	50	13	50	26	100		
Three levels	No	6	30	10	50	16	80	0.952	0.329
	Yes	4	20	0	0	4	20		
	Total	10	50	10	50	20	100		

Table (9) shows that no significant difference between both groups as regard Fusion in (6 months).

Table (9): Fusion rate in 6 months.

Fusion (6 months)		Without plate		With plate		Total		Chi-square	
		N	%	N	%	N	%		
Two levels	No	6	23.08	4	15.38	10	38.46	0.650	0.420
	Yes	7	26.92	9	34.62	16	61.54		
	Total	13	50	13	50	26	100		
Three levels	No	5	25	2	10	7	35	0.879	0.348
	Yes	5	25	8	40	13	65		
	Total	10	50	10	50	20	100		

Table (10) shows that no significant difference between both groups as regard Fusion in (12 months). But in group B was significant.

Table (10): Fusion rate in 12 months.

Fusion (12 months)		Without plate		With plate		Total		Chi-square	
		N	%	N	%	N	%		
Two levels	No	5	19.23	1	3.85	6	23.08	1.95	0.162
	Yes	8	30.77	12	46.15	20	76.92		
	Total	13	50	13	50	26	100		
Three levels	No	6	30	1	5	7	35	5.495	0.019*
	Yes	4	20	9	45	13	65		
	Total	10	50	10	50	20	100		

Table (11) shows that no significant as regard complication of plate in (12 months)

Table (11): Complication of plate in 12 months.

Plate complication (12months)		With plate	
		N	%
Two levels	No	13	50.00
	yes	0	0.00
	Total	13	50.00
Three levels	No	9	45.00
	yes	1	5.00
	Total	10	50.00

**4. Discussion**

Since its popularization the ventral approach for cervical spine surgery has been used for numerous conditions of the cervical spine including, traumatic, degenerative, neoplastic, and infectious lesions. The ventral approach is particularly useful for the treatment of cervical spondylotic myelopathy caused by ventral compression of the spinal cord. Single or multiple levels cervical discectomy can be used to decompress the spinal cord and nerve roots. After a discectomy, an appropriate bone graft (autogenous or allograft) can be placed in the defect to restore structural integrity and to maintain the cervical lordosis. A review of the literature shows that the

likelihood of complications after ventral cervical surgery varies with the number of levels fused, the type of bone graft, and whether the ventral grafting is supplemented with instrumentation. Although the reported results of single level anterior cervical discectomy with graft are uniformly good, the rates of pseudarthrosis formation and graft migration are higher in multilevel anterior cervical discectomy cases (*Herkowitz HN, 1995. (Yablon IC, et al,1995).*)

**Our study** to asses the efficacy of anterior cervical discectomy and fusion (ACDF) with cage alone compared with ACDF with plate instrumentation for radiologic and clinical outcomes in two levels and three levels cervical degenerative

disease. 46 patients radiologically and clinically documented cervical degenerative disc disease scheduled for surgery, 26 patients (group A) had 2 levels ACDF subdivided to 13 patients without plate and other 13 had plate, 20 patients (group B) had 3 levels ACDF subdivided to 10 patients without plate and other 10 had plate.

(*Kyung Jin Song, et al., 2011*) included twenty one patients, who had undergone three-level anterior cervical arthrodesis with a cage and plate construct for degenerative cervical spinal disorder from November 2001 to April 2007.

(*Yong-Hun Joo, et al., 2010*) included patients with cervical degenerative disc disease from September 2004 to December 2009 were assessed retrospectively. A total of 42 patients received all ACDF at two level cervical lesion. Twenty-two patients who underwent ACDF with cage alone were compared with 20 patients who underwent ACDF with plate fixation.

(*Ralph J, et al., 2007*) analysed the differences in clinical and radiological outcome of anterior cervical discectomy and fusion for cervical degenerative disease, with and without the addition of an anterior cervical locking plate.

**Many author** followed-up the patients for at least 12 months, with the same selected criteria and average mean age 54 years with no big difference between our study in the male/female ratio; and also used the standard Smith-Robinson approach with some of them opened from left side (*Kyung Jin Song, et al., 2011, Yong-lion Joo, et al., 2010, Ralph J, et al., 2007, Sang Woo Kim, et al., 2001, Wang JC, et al., 2001, Wang JC, et al., 2000*).

**In our study** among group A there were 15 males (57.69%) and 11 females (42.31%), where in group B there were 15 males (75%) and 5 females (15%). In group A there were 19 (73.08%) patients non-smoker and 7 (26.92%) smoker, where in group B there were 17 (85%) patients non-smoker and 3 (15%) smokers. The mean age in group A was  $47.462 \pm 7.633$  years, where in group B was  $54.000 \pm 4.807$  years. In group A the commonest presentation is radiculopathy seen in 13 (50%) patients of followed by radiculomyelopathy 11 patients (42.31%) and 2 patients (7.69%) myelopathy, where in group B the commonest one is radiculomyelopathy 13 patients (65%) followed by radiculopathy 4 (20%) and myelopathy 3 (15%). The mean duration of complaint was  $4.308 \pm 1.843$  months in group A, where in group B was  $6.500 \pm 1.509$  months.

The mean follow-up duration was 12 months. Patients were selected for surgery based on results of their clinical examination, history of cervicobrachialgia, myelopathy and/ or sphincter dysfunction refractory to conservative treatment. Their

imaging studies of X rays and MRI were showing the presence of a two or three levels cervical disc disease between C3 and C7 explaining their clinical status. Exclusion criteria were systemic infection or metabolic disease except DM, active malignancy, acute trauma and rheumatoid disease.

Surgical procedures were performed using the standard anterior cervical microdiscectomy with Smith-Robinson anterior approach via a right-sided skin incision under slight distraction. The posterior longitudinal ligament was excised thoroughly to ensure adequate neural decompression. Gentle decortication of the endplate was performed using a curette leaving bleeding subchondral bone for proper fusion. Bone fragments obtained during resection are collected for grafting. The size and height of the suitable cage is determined using a series of templates. The cage is packed with the bone graft and implanted into the disc space. The distraction is removed leaving the cage under compression. A lateral plain radiograph is obtained to check the position of the cage and the alignment of cervical spine. Anterior cervical locking plate was applied according to the length of the fused segments. A lateral plain radiograph is obtained to check the position of screws regarding to the neural canal.

#### **Regarding subsidence rate:**

##### **Two level**

(*Yong-Hun Joo, et al. 2010*) who reported Subsidence rate of ACDF with cage alone were 31.81% (7/22) and ACDF with plate fixation were 30% (6/20) ( $p = 0.928$ ) and it was not significant. Where (*Wang JC, et al., 2000*) reported that there was significantly less graft collapse ( $P = 0.0001$ ) and it was significant in the patients without plates than in those who had fusion with plate (0.3 mm).

**in our study** It was no significant differences between patients who had plate in comparison to those without plate,  $p$  was 0.000 and this was not significant.

##### **Three levels**

(*Tae Hyung Jeon and Joo Kyung Sung, 1999*) graft materials related complications (collapse of graft) were significantly high in group 2 without plate ( $p < 0.01$ ). Where (*Wang JC, et al., 2001*) and (*Kyung Jin Song, et al., 2011*) who reported subsidence rates of ACDF with cage and plate in 5 patients (23.8%) with an average of 2.8 mm and it was not significant.

**In our study** it was significant difference between patients who had plate in comparison to those without plate. 4 patients without plate had subsidence (20%), no subsidence happened with patient had plate:  $X^2$  is 5,000 and  $P$  value is 0.025 and this was significant.

#### **Regarding to fusion rate:**

##### **Two levels**

(*Yong-Hun Joo, et al., 2010*) who reported fusion

rates were 90.9% (20/22) in ACDF with the cage alone group. 95% (19/20) in ACDF with the plate fixation group ( $p=0.966$ ). Also (*Tae Hyung Jeon and Joo Kyung Sang, 1999*) reported that the overall fusion rate did not show any difference between the two groups.

**In our study** fusion rate within (12 months) showed that no significant difference between patients had plate in comparison to those 7 patients (26.92%) without plate had fusion, 9 patients (34.62%) with plate had fusion.  $X^2$  is 0.650 and P value is 0.420 and this was not significant.

Three levels

(*Sang Woo Kim, et al, 2001*) The successful fusion rate of multilevel cervical fusion was as seen with anterior cervical plate fixation (97% vs. 75%) and (*Ralph J, et al., 2007*) who reported significantly higher fusion rate 98 fusion was noted in the plating group as compared to 93.5% in the non-plating group (fisher exact test,  $p= 0.029$ ) and it was significant. Where (*Wang JC, et al, 2001*) and (*Tae Hyung Jeon and Joo Kyung Sang, 1999*) reported that the over all fusion rate didn't show any differences between the two groups.

In our study fusion rate within (12 months) showed significant difference between patients who had plate In comparison to those without plate since 6 patients (30%) without plates had no fusion. While one patient (5%) with plate had no fusion,  $X^2$  is 5.495 and p value is 0.019 and this was Significant.

Regarding Extrusion of cage:

(*Ralph J, et al., 2007*) who reported that with 10% of patients is without plate group requiring revision surgery for graft extrusion and (*Sang Woo Kim, et al., 2001*) and (*Beum Ja Jong, et al., 1997*) who reported that the most notable postoperative complications of the group operated without the cervical plate were migration of the bone graft (3.3%) but it was not significant. Where (*Tae Hyung Jeon and Joo Kyung Sang, 1999*) reported that graft materials related complications (extrusion of graft) were significantly high in group 2 without plate ( $p<0.01$ ) and it was significant.

**In our study** extrusion of cage in (12 months) showed no significant difference between patients who had plate in comparison those without plate where in group A (two levels) 1 (3.83%) patient without plate had cage extrusion,  $X^2$  is 1.040 and P value is 0.308 and this was not significant. And in group B (three levels) 2 (10%) patients without plate had cage extrusion,  $X^2$  is 2.222 and P value is 0.136 and this was not significant.

**Regarding to pseudarthrosis**

(*Wang JC, et al, 2001*) who reported of the 59 patients, 14 had a pseudarthrosis (7 in each group). The pseudarthrosis rates were 18%(7 of 40) for

patients with plating and 37% (7 of 19) for patients without significant statistics. Where (*Wright IP, Einsenstein SM, 2007*) reported that In 43 patients having two levels fusion, 12 patients demonstrated pseudarthrosis (28% of patients) at total of 18 levels (21% of levels) and it was significant. Also (*Wang JC, et 2000*) reported that of the 60 patient, 7 had a pseudarthrosis. The Pseudarthrosis rates were 0% for patients with plating and 25% for those with no plating. This difference was statistically significant ( $P = 0.003$ ) and it was significant.

**In our study** pseudarthrosis In (12 months) showed that no significant difference between patients had plate in comparison to those without plate where in group A no patients had pseudarthrosis and in group B 4 (20%) patients without plate had Pseudarthrosis, 2 (10%) patients with plate had pseudarthrosis,  $X^2$  is 0.952 and P value is 0.329 and this was not significant.

**Regarding complication of plate:-**

(*Kyung Jin Song,, et al, 2011*) who reported that loosening of the plate and screw occurred in 3 patients (14.3%) but there were no clinical problems and this was not significant. Also (*Baum Ju Jang, et al, 1997*) who reported that the group operated with the cervical plate was screw loosening (4.2%) and it was not significant. There was no one reported anything significant regarding plate complication.

**In our study** complication of plate In (12 months) showed that no significant in group A no complication. and in group B 1 patient 5% with plate had two loose screws,  $X^2$  is 1.053 and P value is 0.305 and this was not significant.

## Conclusion

Comparing ACDF cage with and without plate fixation, we found that ACDF cage with plate fixation is superior to those without fixation regarding fusion rate, pseudoarthrosis, clinical outcome and patient satisfaction especially with three levels ACDF cage instead of increasing operation time and for long term the cost will be not significant because patients will not need for any medication and reoperation and will return to their job early.

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