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ORGINAL ARTICLE

Comparative Study between Outcome of Anterior Cervical Discectomy and Fusion with Cages Only Versus Cages and Plate in Cases with Cervical Spondylosis

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ABSTRACT

Background: Cervical spondylosis is a disorder affecting the discs and vertebrae of the cervical spine due to age-related wear. The aim of this study is to compare the clinical and radiological outcomes of anterior cervical discectomy and fusion (ACDF) in two or more consecutive levels with cages only versus cages and plate, and to clarify the effect of adding a plate on cervical lordosis.

Methods: A total of 50 adult patients with two or more consecutive levels of degenerated cervical discs were randomly allocated to two different procedures of ACDF. The patients were divided into two groups; group (A) included 25 patients who were operated by cages only and group (B) included 25 patients who were operated by cages and plate. Patients were followed up for six months postoperatively. Visual analogue scale (VAS) and neck disability index (NDI) were used to evaluate the clinical outcomes. Radiological outcomes included measurements of C2-7 cobb angle, segmental angle and segmental height in upright cervical spine radiographs.

Results: The mean age of the patients in group A was 53.75±3.45 while in group B was 54.68±4.42. The mean operative time and blood loss were significantly higher in group B (p=0.00). There was no significant difference between the two groups regarding the mean hospital stay. The mean VAS and NDI scores have significant postoperative improvement in both groups**.** Complications were significantly higher in group B. The mean measurements of C2-7 cobb angle, segmental angle and segmental height significantly improved postoperatively with better results in group B.

Conclusion: ACDF with cages only or with cages and plate for two or more consecutive levels has provided comparable improvement in clinical outcomes. However, ACDF with cages and plate has resulted in better radiological outcomes than with cages only with regard to improvement in cobb angle, segmental lordosis and segmental height. The complications were found to be higher in the plating group. The spine surgeon should take these findings into consideration when operating on patients with two or more consecutive levels undergoing ACDF.

Keywords: Cervical, Cage, Fusion, plate.

INTRODUCTION

Degenerative Cervical spine disease affects the cervical vertebral bodies and intervertebral discs leading to disc prolapse and osteophytes formation [1]. It is related primarily to age being apparent in most of patients over 40 years [2,3].

Cervical spondylosis is the most common cause of radiculo-myelopathy [4]. Radiculopathy is caused by root compression or narrowing of intervertebral foramina, while myelopathy is due to cord compression [5]. Cervical disc herniation occurs when the nucleus of the disc gets out of its normal space. The nucleus compresses the annulus, causing disc bulge then, the nucleus herniates through the annulus compressing the nerve root or the cord or both. Also, the nucleus releases inflammatory chemical mediators that irritate the nerves causing pain [6,7].

Manifestations of radiculopathy include arm pain with or without weakness depending on the compressed root. Features of myelopathy include quadriparesis, hypertonia, hyperreflexia and sphincteric disturbances. Sustained cord compression may lead to ischemia, demyelination, and neuronal apoptosis in the cord [8].

The best diagnostic modality for cervical degenerative disease is magnetic resonance imaging (MRI) as it gives information about root and/or cord compression, its cause, level, degree of canal stenosis and pathology in the cord, and excludes other causes of cord compression like tumors [9].

Bailey was the first to do ACDF in 1950 [10]. Plate was added to avoid complications of using a graft as it may increase stability, fasten fusion and correct cervical lordosis [11].

PATIENTS AND METHODS

Technical design:

This is a prospective comparative study comparing ACDF in two or more consecutive levels using cages only or with adding a plate. Adult patients (≥18 years) were recruited from March 2018 till October 2018. Patients with severe neck pain or radiculopathy not responding to conservative treatment for three months, two or more levels of cervical disc degeneration and stable cervical spine were included in the study, while patients with cervical trauma, neoplasia, infection or instability were excluded. 25 patients underwent ACDF with cages only (group A) and 25 patients underwent ACDF with cages and plate (group B). All patients were followed up for six months postoperatively. PEEK (Polyetheretherketone) and titanium plates (Egifix®) were used.

Written informed consent was obtained from all participants. The study was approved by the Institutional review board (IRB) of the Faculty of Medicine, Zagazig University (no. 4365/25-2-2018). The study was done according to The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Surgical technique:

The level was marked with the aid of C-arm fluoroscopy and a horizontal skin incision was utilized. The skin was undermined off the platysma which is cut longitudinally. The tissue plane medial to sternomastoid muscle was dissected and omohyoid muscle was swept medially. The trachea and esophagus were retracted medially and the carotid sheath and sternomastoid muscle were retracted laterally. The level was verified again using the C-arm with a spinal needle in the interspace. Bipolar cautery and incision of the prevertebral fascia was done. The medial edges of the longus coli muscles were retracted laterally for 2-3 mm with the aid of bipolar coagulation to expose the interspace underneath. The disc space was incised with a 15 scalpel blade. The discectomy was performed with curettes and rongeurs; a Casper retractor or sometimes a vertebral body spreader was used to help in the exposure. The posterior longitudinal ligament was incised. The subligamentous space was probed with a blunt nerve hook. The posterior osteophytes were removed with a small Kerrison rongeur. Decompression of the roots was verified with the blunt nerve hook. Fusion was performed at this time by placing the cage in the interspace and same steps were performed at other levels. The plate was added if planned. C-arm check of the position of the cages and plate is carried out [12].

Radiological and clinical assessment:

All patients had preoperative lateral standing cervical X-ray and cervical MRI. They were evaluated by lateral X-ray on the second postoperative day and after six months. These measurements were obtained: **Cervical lordosis (cobb angle):** the angle between the lower endplate of C2 and C7 **(Figure 1a)**, **Segmental angle:** the angle between the upper

endplate of the superior vertebra and the lower endplate of the inferior vertebra in the segment **(Figure 1b)**, and **Segmental height:** distance between the midpoint of the superior and inferior vertebra in the segment **(Figure 1c)**. The patients were evaluated clinically by the visual analogue scale (VAS) [13] and the neck disability index (NDI) [14].

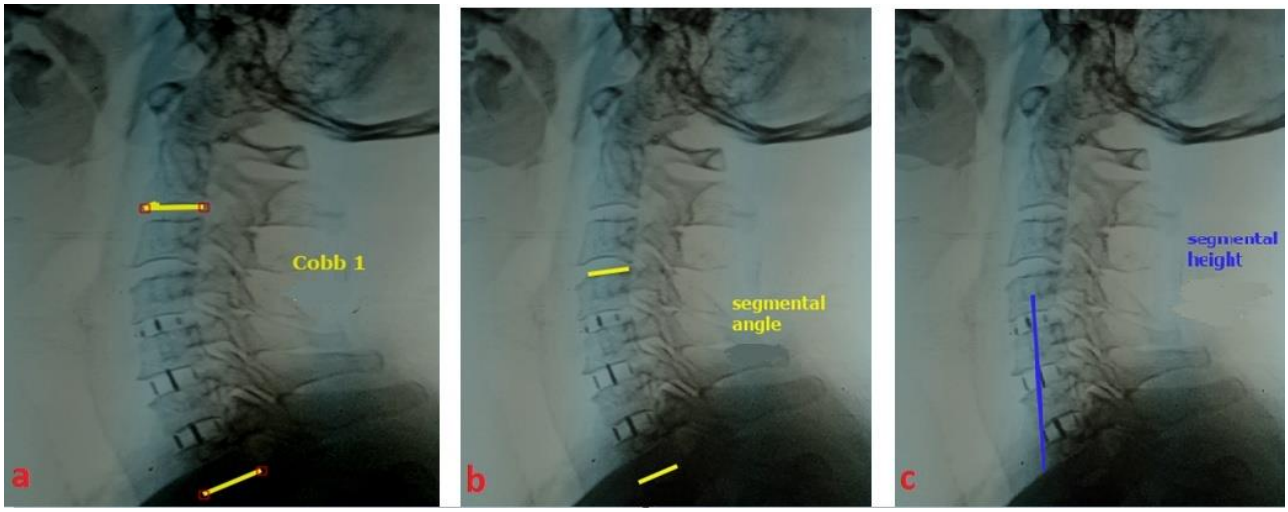

Figure (1) a) Cobb angle, **b)** segmental angle and **c)** segmental height

Statistical analysis:

Data were obtained by history, examination and radiological investigations. Outcome measurements were reported, entered and analyzed using Microsoft Excel. Data were imported into Statistical Package for the Social Sciences (SPSS) software. According to its type, qualitative data was represented as number and percentage while quantitative data was represented as mean ± SD. The following tests were used to test differences for significance; difference and association of qualitative variables by Chi square test (X2) and Differences between quantitative independent groups by t test or Mann Whitney test and paired by paired t or sign test. P value was set at <0.05 for significant and <0.001 for highly significant results.

RESULTS

Clinical outcome:

The mean age of patients in group A was 53.75±3.45 while in group B was 54.68±4.42. Both groups were age and gender matched **(Table 1).**

The mean operative time in our study was significantly higher in group B (182.77±14.16) than in group A (118.22±11.63) (p=0.00). The mean amount of blood loss was significantly higher in group B (152.77±14.16) than in group A (56.11±11.63) (p=0.00). There was no significant difference between the two groups regarding the mean hospital stay. **(Table 2).**

The mean scores VAS (of neck and arm pain) and NDI improved significantly postoperatively in both groups compared to preoperative scores **(Table 3).**

Complications:

For detailed postoperative complications, see **(Table 4)**. Patients who developed new neurological deficits postoperatively were in the form of motor weakness and postoperative MRI revealed root compression. Those patients were operated again for decompression with gradual improvement of the motor power postoperatively.

Dysphagia and hoarseness of voice were significantly higher in group B. Dysphagia as well as hoarseness of voice were mild and improved after few days in all cases.

System (i.e., instrumentation) related complications were in the form of screw pull out six months postoperatively. The patient was operated again for revision and the screw was removed. There was a solid fusion of that segment. The patient complained of dysphagia that gradually improved postoperatively **(Table 4).**

Radiological outcome:

There was a significant improvement in the mean measurements of C2-7 cobb angle, segmental angle and segmental height

postoperatively compared with preoperative measurements with better results in group B **(Table 5).**

Table (1): Age and sex distribution among study participants (N=50).

			Group A (Cages only) (N=25)	Group B (Cages & Plate) (N=25)	t/ X2	P value
Age			53.75±3.45	54.68±4.42	-0.852	0.351
Sex	Male	N (%)	13 (52%)	11 (44%)	0.08	0.77
	Female	N (%)	12 (48%)	14 (56%)		
Total		N (%)	25 (100%)	25 (100%)		

Table (2): Operative time, amount of blood loss and hospital stay among study participants (N=50).

	Group A (Cages only) (N=25)	Group B (Cages &Plate) (N=25)	t/ X2	P value
Operative time	118.22±11.63	182.77±14.16	-4.214	**0.00****
Amount of blood loss	56.11±11.63	152.77±14.16	-5.091	**0.00****
Hospital stay	2.77±0.83	2.55±0.72	0.603	0.555

Table (3): Pre and postoperative VAS (of neck and arm pain) and NDI scores among study participants (N=50).

		Preoperative	Postoperative	Paired t/Sign	P value
Group A (Cages only) (N=25)	VAS neck	5.11±0.78	1.0±0.7	9.041	**0.00****
	VAS arm	5.58±0.97	1.2±0.62	10.112	**0.00****
	NDI	45.55±3.16	15.0±1.87	23.846	**0.00****
Group B (Cages & Plate) (N=25)	VAS neck	5.11±0.78	0.77±0.62	10.614	**0.00****
	VAS arm	5.61±0.87	0.95±0.42	9.985	**0.00****
	NDI	44.77±3.15	14.0±1.73	34.424	**0.00****

Table (4): Complications among both groups

			Group A (Cages only) (N=25)	Group B (Cages & Plate) (N=25)	X2	P
Complications	NO	N (%)	20 (80%)	15 (60%)	0.27	0.59
	YES	N (%)	5 (20%)	10 (40%)		
New neurological deficit		N (%)	1 (4%)	1 (4%)	0.00	1.0
Infection		N (%)	1 (4%)	1 (4%)	0.00	1.0
Dysphagia		N (%)	5 (20%)	9 (36%)	4.5	**0.03***
Hoarsening of voice		N (%)	4 (16%)	8 (32%)	5.3	**0.02***

		Group A (Cages only) (N=25)	Group B (Cages & Plate) (N=25)	X2	P
System (instrumentation) related complications	N (%)	0 (0%)	1 (4%)	2.25	0.13
Total	N (%)	25 (100%)	25 (100%)		

Table (5): Pre and postoperative C2-7 cobb angle, segmental angle and segmental height among study participants (N=50).

		Preoperative	Postoperative	Paired t/Sign	P value
Group A (Cage only) (N=25)	C2-7 cobb angle	9.5±1.55	18.87±1.62	9.664	**0.00****
	Segmental angle	7.72±0.67	19.47±1.57	12.193	**0.00****
	Segmental height	3.77±2.1	5.35±2.0	-9.882	**0.00****
Group B (Cages & Plate) (N=25)	C2-7 cobb angle	9.7±1.57	19.05±1.5	23.364	**0.00****
	Segmental angle	7.51±0.45	21.73±1.14	18.214	**0.00****
	Segmental height	3.82±2.2	5.42±1.98	-8.214	**0.00****

DISCUSSION

The current literature shows considerable debates about ACDF at two or more consecutive levels [15].

This study evaluated the ACDF results when performed with or without plate fixation on 50 patients suffering from two or more consecutive levels of cervical degenerative disc disease who were unresponsive to conservative treatment.

Satisfactory clinical and radiological results have been reported in recent clinical studies on multilevel ACDF using cages only particularly regarding improvement of global lordosis and preoperative pain [16,17].

Postoperative cervical malalignment, such as kyphotic deformity, is of clinical interest, because it is considered responsible for symptom recurrence and adjacent segment disease (ASD) in the long term.

This study found an improvement in postoperative VAS and NDI scores in both groups. There was an improvement in cervical lordosis in both groups, but more in the plating group.

Perrini et al. [15] conducted a retrospective study on cervical spinal alignment after two levels of ACDF using cages with or without plate fixation and compared the clinical and radiological outcomes and found a comparable clinical outcome between the ACDF-plate group and the ACDF-cage group. They concluded that both groups presented a significant immediate postoperative improvement in segmental angle and segmental height, which were preserved only in the ACDF-plate group, leading to a significant group difference at twelve months after surgery.

Accordingly, at the last follow-up, the segmental angle of the ACDF cage group decreased to the preoperative values. The use of an anterior plate produced a 6° average lordotic increase in segmental angle which was preserved at the one-year radiological follow-up. A relevant finding of their study is that supplementation of an anterior plate significantly improved the segmental lordosis without additional morbidity. Although the two groups were not significantly different in the preoperative segmental angles, at the last radiological follow-up more than 90% of patients with plating presented a segmental lordosis that was observed only in 42% of patients with stand-alone cages. They concluded that greater preservation of segmental lordosis is associated with the use of anterior plate fixation that is required to permanently reverse the curve in case of preoperative segmental kyphosis [15].

Burkhardt et al. [18] reported that the use of anterior plate fixation after two level ACDF is

significantly related to postoperative improvement in segmental height and segmental lordosis. Similarly, **Song et al.** [19] reported that a noticeable increase in segmental height and a better postoperative lordosis are associated with plate augmentation in one- or two-level ACDF when compared to no plating. Their results and the recent literature suggest that the plates allow for the maintenance of segmental lordosis and prevent secondary development of kyphotic deformity, although the long-term effect of segmental loss of lordosis is still a matter of research [18-21].

In our study, we found that the group of ACDF with cages and plate (group B) had more operative time and blood loss than the group of cages only (group A).

Regarding complications, dysphagia and hoarseness of voice were more common in group B patients presumably due to long duration of surgery and traction on the esophagus or the recurrent laryngeal nerve respectively.

Perrini et al. [15] found that the surgical morbidity between the two groups was comparable and mainly consisted of transient disturbances of swallowing, implying that significant esophageal irritation was not induced by using the plate augmentation.

Also **Moustafa et al.** [22] found no significant difference as regard the amount of blood loss between both groups (p=0.23).

Hwang et al. [17] found that increased lordosis, long-term stabilization, increased segmental and foraminal heights were provided using the titanium cage–assisted ACDF. In both groups; lower pain levels and good neurological outcomes were achieved. The cage-assisted fusion without plate fixation was better than with plate fixation in terms of lower complication rate and shorter hospital stay.

limitations of the study

The limited number of patients requires larger studies to evaluate the results in a more conclusive method and to detect the safest and most effective measure for the management of multiple level cervical degenerative disc disease.

CONCLUSION

ACDF with cages only or with cages and plate for two or more consecutive levels has provided comparable improvement in clinical outcomes. However, ACDF with cages and plate has resulted in better radiological outcomes than with cages only with regard to improvement in cobb angle, segmental lordosis and segmental height. The complications were found to be higher in the plating group. The spine surgeon should take these findings into consideration when operating on patients with two or more consecutive levels undergoing ACDF.

Conflict of interest: No

Financial disclosure: No

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