

Long-Term Results of Multiple Anterior Cervical Discectomy with Cage Fusion Technique: Results of Multiple Centre Study

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Abbreviations: ACDF = Anterior cervical discectomy and fusion; MRI = Magnetic resonance imaging; C.T = Computed tomography; VAS = Visual analogue scale

Abstract

BACKGROUND: Cervical herniation is commonly treated by anterior cervical discectomy and fusion (ACDF) if conservative management has failed in relief of the patient's symptoms. Disc fusion is needed after ACDF as anterior longitudinal ligament will be absent after doing the operation, especially if multiple levels are needed. The occurrence of complications as cage subsidence and adjacent segment failure related to the length of follow up as they are increasing in percentage is directly proportional to the length of follow up.

AIM: Analysis of the results for patients who underwent 3 levels of ACDF with cage fusion for short term and long term follow up in multiple centres as the visual analogue score for neck pain & brachialgia.

METHODS: This retrospective cohort series of 68 patients selected out of 136 patients suffering from 3 levels of degenerative cervical disc disease who were unresponsive to adequate conservative therapy. All cases were treated at one of the neurosurgery departments of 3 different hospitals (Naser institute for research and treatment hospital, Haram hospital for research and treatment and Misr university for science and technology) by the same surgical team in the period from February 2012 to February 2017.

RESULTS: We found in this study;68 patients fulfilling the inclusion criteria, of the 29 patients underwent 3 levels of ACDF starting from C3-4 (42.65%) and 39 patients who underwent 3 levels of ACDF starting from C4-5 (57.35%). Clinical assessment for VAS pain score for both neck pain and radiculopathy were done before the surgery and immediately post-operative and during each time follow up visit and we found statistically significant immediate postoperative improvement. ($P < 0.05$)

CONCLUSION: Stand-alone three levels of an anterior cervical discectomy with cage fusion technique improved the clinical outcomes on long term follow up.

Introduction

A cervical herniation is commonly treated by anterior cervical discectomy and fusion (ACDF) if conservative management has failed to relieve the patient's symptoms. The usage of cervical intervertebral disc replacement with cage achieves immediate load-bearing support, restoration of disc height, intervertebral foraminal decompression and facilitates interbody fusion [1]. Cage subsidence is considered a major long-term complication after insertion of a cervical intervertebral cage [1], [2]. Another important complication is the occurrence of adjacent segment failure after fusion of intervertebral disc whether it is single fusion or multiple levels [3], [4], [5], [6].

Fusion is needed after ACDF as anterior longitudinal ligament will be absent postoperatively, especially if multiple levels are operated upon [7]. For that reason, some authors prefer to do fixation with fusion while others have shown that fusion alone would give the same results as fixation with fusion [7], [8].

The occurrence of complications such as cage subsidence and adjacent segment failure is related to the length of follow up as their increase in percentage is directly proportional to the length of the follow up [5], [9], [10], [11], [12].

Neck pain and brachialgia are the main symptoms that result from cervical disc subsidence and adjacent segment failure due to narrowing of the intervertebral foramen in some cases [14].

We reviewed and analysed data from patients who underwent 3 levels ACDF cage fusion for short term and long term follows up in multiple centres regarding the visual analogue scale (VAS) for neck pain and brachialgia [15].

Material and Methods

This retrospective cohort series of 68 patients selected from a total of 136 patients suffering from three levels of degenerative disc disease who were unresponsive to adequate conservative therapy. They were operated at neurosurgery department of 3 different hospitals (Naser institute for research and treatment (MOH), Haram hospital for research and treatment (MOH) and Misr university for science and technology, by the same surgical team in the period from 2012 to 2017. Patients were selected from the data saved in each hospital with these inclusion criteria: 1) degenerative disc herniation with or without osteophytes, 2) brachialgia and neck pain were the main complains of these patients, 3) all patients underwent 3 levels ACDF with no other procedure in the cervical spine. Any patient with recurrence or history of previous cervical posterior laminectomy were excluded from the study. The sheets of all patients included in the study included proper history is taken from the patients and complete general and neurological examination (Table 1).

Table 1: Frequency of preoperative clinical symptoms. (No. = numbers of cases, % = percentage)

Symptom	No.	%
Brachialgia	68	100
Neck pain	64	94.1
Numbness	64	94.1
Motor weakness	39	57.3
Sphincter disorder	12	17

The selected patients (68) in the three hospitals underwent three levels ACDF with the insertion of intervertebral disc cage of the PEEK type and using a synthetic graft to enhance fusion (Figure 1).

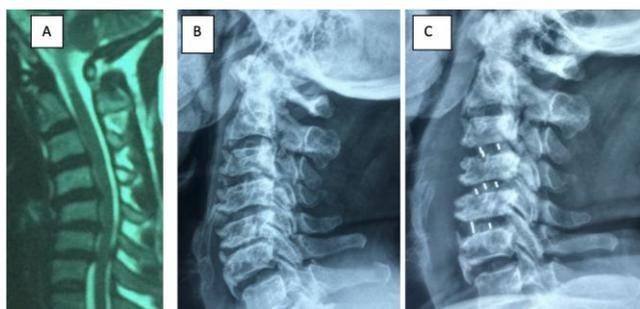


Figure 1: A) Preoperative MRI showing C3-4, C4-5, and C5-6 disc prolapse; B) Preoperative X-ray of the cervical spine lateral view of the 3 levels showing osteophyte disc complex; C) Postoperative X-ray lateral view of the cervical spine showing good positioning of 3 cages of the C3-4, C4-5, and C5-6

The mean age was 57.1 years (range from 46 to 71 years). 30 of our 68 cases were females, while the other 38 cases were males. Follow up using visual analog scale (VAS) was done for at least 3 years postoperative at 3 months, 6 months, 1 year, 2 years and three years postoperative for both neck pain and shoulder pain (radicular pain) out of 10 points with words that convey “no pain” at one end and “worse pain” at the opposite end (Table 2).

Table 2: Incidence of complications

Complication	No. of cases	Percentage %
Transient dysphagia	11	16.17
Transient hoarseness	6	8.82
Infection	1	1.47
Hematoma	0	0
Dural tear	2	2.94
Spinal cord injury	4	5.88
Cage subsidence	20	29.41
Adjacent segment pseudarthrosis	8	11.76
	11	16.17

Statistical analysis

Statistical analysis was done using IBM SPSS statistics version 20. Data were presented as mean ± standard deviation, frequencies and range. All the numerical data were analysed by analysis of variance (ANOVA). Non-numerical data were analysed using chi-square. A probability value (P-value) less than 0.05 was considered statistically significant.

Results

We found in this study, 68 patients fulfilling the inclusion criteria. 29 patients underwent 3 levels ACDF starting from C3-4 (42.65%) and 39 patients underwent 3 levels ACDF starting from C4-5 (57.35%). Preoperative complaints of the patients obtained from their sheets are listed in Table 1. Postoperative assessment of the patients was done immediately postoperative, and the follow up was done after 3 months, 6 months, 1 year, 2 years and 3 years with overall complications are shown in (Table 3), also at the end of 3 years there is no pseudarthrosis.

Table 3: Frequency of clinical improvement

Symptom	No. of cases improved	Percentage %
Brachialgia	59	86.76
Neck pain	53	82.81
Motor weakness	31	79.48
numbness	54	84.45
Sphincter disorder	7	58.33

Clinical assessment for VAS pain score for both neck pain and radiculopathy were done before the surgery and immediately post-operative and during each, for follow up visit, and we found statistically significant improvement immediately postoperative after (P < 0.05). Assessment of VAS for both neck pain and brachialgia done at the 3 months and six months follow-ups were statistically

insignificant compared to the immediate post-operative assessment ($P < 0.05$), while in the follow up at 1, 2, 3 years the VAS score for neck pain and brachialgia became worse in comparison of the immediate post-operative. Patients VAS score for both neck pain and brachialgia both pre-operative and post-operative, immediate, 3 months, 6 months, 1, 2, 3 years is given in Table 2. Motor weakness improved gradually after surgery up to six months postoperative, and in our study 31 out of 39 patients improved (79.48%), numbness improved in 54 patients out of 64 (84.43%) and sphincter disorder improved in 7 patients out of 12 patients (58.33%) (Table 4).

Table 4: Assessment of clinical outcome for pain in the neck and brachialgia using VAS score for pain

Type of pain	Values are mean \pm standard deviation						
	Preop.	1 month	3 months	6 months	1 year	2 years	3 years
Neck pain	7.1 \pm 1.0	2.2 \pm 1.2	2.3 \pm 1.2	2.3 \pm 1.2	2.9 \pm 1.3	3.4 \pm 1.3	3.6 \pm 1.4
Brachialgia	7.5 \pm 1.1	2.2 \pm 1.1	2.1 \pm 1.1	2.1 \pm 1.1	2.6 \pm 1.1	3.9 \pm 1.1	3.5 \pm 1.2

Cage subsidence was reported at the end of the study in 20 cases (29.41%), and in four cases we needed to do revision surgeries with plate fixation as the patients do not improve conservatively (Figure 2).

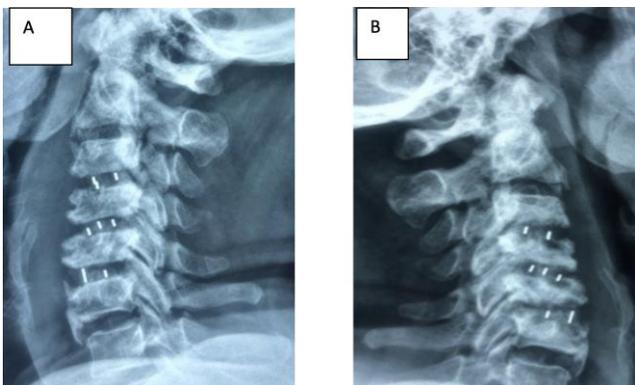


Figure 2: A) Three months postoperative C3-4, C4-5, and C5-6 cervical intervertebral cages with good placement of cages; B) One year postoperative follow up of the same patient showing cage subsidence of the three cages

Adjacent segment failure has been noted in 8 cases, 11.76% (Figure 3).

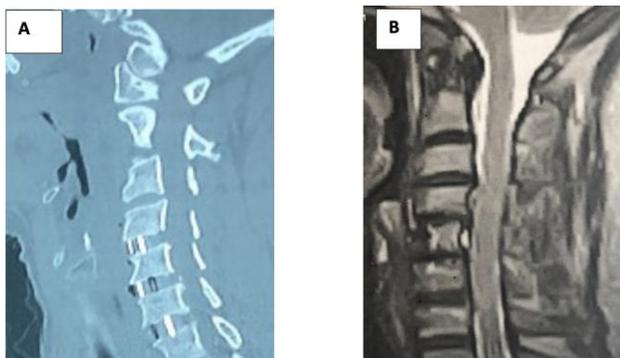


Figure 3: A) Postoperative C.T scan of the cervical spine of a patient complaining of axial pain after doing ACDF with the insertion of C4-5, C5-6, and C6-7 cages; B) MRI cervical spine of the same patient showing adjacent segment failure at the level of C3-4

Fusion of the intervertebral disc was assessed radiologically through detection of the presence of trabecular bone across the interfaces without any lucencies between the cage and the endplate of the vertebra and in our study at 6 months the rate of pseudarthrosis was 16.17% (11/68 patients) while at the end of study at 3 years it was 100% (Table 5) and (Figure 4).

Table 5: Incidence of fusion rate. Values are in percentage

Follow up period	No. of cases	Percentage %
1 year	53	77.9
2 years	64	94.1
3 years	68	100

A case ACDF with the insertion of C3-4, C4-5, and C5-6 showing good fusion is shown in Fig. 4.



Figure 4: A case ACDF with the insertion of C3-4, C4-5, and C5-6 showing good fusion

Discussion

Anterior cervical discectomy (ACDF) and placement of intervertebral cage were commonly performed for patients with single-level and double-level pathologies as stand-alone without fixation to degenerative cervical disc disease. Many authors also recommend the same procedure for three levels of cervical disc disease [16], [17]. The idea for putting the intervertebral cervical cage with synthetic bone material is to restore the disc height, enhance bone fusion and lastly working as weight shearing device [18], [20]. Some authors noted that stand-alone cage fusion in three cervical levels without plate fixation has more complications than cage fusion with fixation [20].

In our retrospective study, cervical neck pain

showed statistically significant relief ($P < 0.05$) throughout follow up till 3 years using the VAS score for cervical neck pain. Song KJ et al. reported improvement of the clinical outcome after 3 level discectomy and cage fusion [19]. In this retrospective study, we noticed that brachialgia significantly improved according to the VAS score from 7.5 ± 1.1 to 2.2 ± 1.1 with ($P < 0.01$). Zajonz D et al. reported his work on 17 patients with a stand-alone cage on 33 cervical cages with the postoperative improvement of brachialgia in spite of cage subsidence [23]. Transient dysphagia occurred in 11 patients (16.17%), and transient hoarseness of voice in 6 patients (8.82%), the cause of dysphagia in this study is not well known, and it may be explained by long-time of retraction of the oesophagus or manipulations on its wall during surgery. Also, hoarseness of voice is usually transient and disappeared after 3 months, and it is due to unilateral affection of recurrent laryngeal nerve. De La Garza-Ramos R and his colleagues reported a high incidence of dysphagia and transient hoarseness of voice in three and four levels stand-alone cage fusion [2], [21].

In our study we noticed mild increase of VAS score for neck pain (from 2.3 ± 1.2 at 3 months to 3.6 ± 1.4 at 3 years) and for brachialgia (from 2.1 ± 1.1 at 3 months to 3.5 ± 1.2) and this might be due to new osteophyte formation, mild instability, disc subsidence and loss of cervical lordotic curvature. Liu Hong et al., reported in their series of 25 patients the same results about the improvement of clinical symptoms with three levels stand-alone cervical cages with the use of allograft [4], [22]. Cage subsidence occurred when there is a decrease of the disc space ≥ 3 mm, from the original postoperative X-ray. In our retrospective series study, the rate of subsidence was 20 cases (29.41%), and only four of them required plating at six months, and the rest of patients improved on conservative management. The causes of cage subsidence may be due to over distraction, aggressive removal of the endplate and improper large size of the cage placed. Reducing the rate of subsidence could be achieved by avoiding these causes. Zajonz D et al., in their retrospective cohort study on 33 cervical segments that were treated by ACDF with stand-alone cage fusion in 17 patients and noted the occurrence of cage subsidence was observed in half of their cases with no effect on the clinical results [23].

Adjacent segment failure is defined as degeneration of the adjacent disc superior to the fusion levels or inferior to them [21]. In our study 8 patients (11.76%) developed adjacent segment disease during the follow-up time. Clinical improvement was achieved with conservative management and required no further intervention. Song KJ et al. noted the same observation when they operated on 21 patients with a degenerative cervical spinal disease requiring three levels ACDF using PEEK cages and plate fixation [19].

In our study, the rate of bone fusion was 77.9% at the end of the first year, 94.1% by the end of the 2nd year and 100% at 3rd year. The criteria of bone fusion are the presence of bone formation between the cage and vertebral endplate, lack of motion during dynamic cervical X-ray and confirmed by doing a C.T scan of the fused levels. The results at the end of the third year reached 100% in our study due to using plate fixation for the four cases who developed cage subsidence. Pereira EAC et al. observed these results in their study on patients requiring three and four-level discectomy and stand-alone cage fusion [6], [23].

In conclusion, stand-alone three levels anterior cervical discectomy with cage fusion technique improved the clinical outcomes on long term follow up, disc subsidence and adjacent segment disease did not affect the clinical results.

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Availability of Data and Materials

They are available from the corresponding author on responsible request. E-mail of the corresponding author (hamdi.nabawy@gmail.com)

Authors' contributions

HN performed study design, wrote the manuscript, the main surgeon in all cases, did the statistical analysis and revision of the work. ML helped in the study design, helped HN in the cases done in Misr University, and revised the paper. MW helped in the surgeries, collecting data and references and helped in the statistical analysis.

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