

Comparison of the outcomes of cage-stand-alone with cage-with-plate fixation in one level and two levels for treating cervical disk diseases

ABSTRACT

Introduction: Anterior cervical discectomy and fusion (ACDF) surgery is an accepted method for many spinal cord abnormalities. The purpose of this study was to evaluate the outcomes of treating patients with spinal cord lesions at one level or two levels through ACDF with cage-stand-alone (ACDF-CA) and ACDF with cage-with-plate fixation (ACDF-CP) surgery and comparing these results with each other.

Methods: In this prospective, cross-sectional, descriptive study, eighty patients undergoing ACDF surgery were enrolled according to the inclusion and exclusion criteria. Demographic data, before and after surgery findings, and clinical symptoms were investigated. Data were collected by means of visual analog scale (VAS) and Neck Disability Index (NDI) questionnaires. The adverse effects and surgical outcomes were evaluated based on Odom's criteria and patients' satisfaction. The collected data of the groups were then compared and assessed.

Results: There was no significant difference between the groups in regards of gender, age, duration of surgery to visit, surgical level, preoperative and postoperative VAS and cervical range of motion, preoperative NDI, results based on Odom's criteria, and satisfaction of patients ($P > 0.05$). The VAS, NDI, and range of motion scores were significantly reduced in the four groups after the operation compared to the preoperative stage. Postoperative NDI scores in the ACDF-CA group at one level were significantly lower than other groups ($P < 0.05$).

Conclusion: Both of the methods revealed acceptable outcomes in comparison to the preoperative stage, and despite some minor differences, there are generally no significant differences in outcomes and complications.

Keywords: Anterior cervical discectomy and fusion, cage, cage with plate, one level, two levels

INTRODUCTION

Anterior cervical discectomy and fusion (ACDF) is an accepted surgical procedure for many spinal cord and cervical abnormalities such as spondylolysis, intervertebral disc herniation, fractures, and neoplastic lesions, first developed in the 1950s by Smith and Robinson.^[1] This surgical technique is considered a relatively safe and effective method for the mentioned cases, as well as degenerative spinal cord diseases. However, complications such as incomplete decompression, recurrence of myelopathy due to degeneration, protrusion of adjacent segment, and bone fractures have been reported for it.^[2] To establish a stable fusion, the graft should be capable of osteogenesis, osteoinduction, and osteoconduction. Autograft and allograft are used in this method, and autograft includes all three of the mentioned characteristics.^[3]


Iliac and fibula bones are commonly used as autologous grafts, and the role of the fibula in maintaining disc height is reported to be more significant.^[4] These lesions also have some imperfections, for example, autograft involves complications such as seroma, hematoma, femoral neck

MOHAMMADREZA ETEMADIFAR, ALI ANDALIB, HOSSEIN SHAFIEE, MILAD KABIRI SAMANI¹

Department of Orthopedic Surgery, Al Zahra Educational Hospital, Isfahan University of Medical Sciences, Isfahan,

¹School of Medicine, Mazandaran University of Medical Sciences, Sari, Iran

Address for correspondence: Dr. Ali Andalib, Department of Orthopedic Surgery, Al Zahra Educational Hospital, Isfahan University of Medical Sciences, Isfahan, Iran. E-mail: draliabdlib@gmail.com

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fractures, and infections.^[1,5] On the other hand, the allograft is more expensive than autograft and may have a lower fusion rate and a higher risk of infection.^[6] Using artificial grafts or prosthetics such as cage can be helpful in reducing the time of surgery alongside having fewer side effects and more fusion rate than autograft.^[7,8] Cage-stand-alone (CA) and cage-with-plate fixation (CP) are two techniques in this regard.^[9] The presence of the plate helps maintain the stability of the fusion structure, and the CA method is more beneficial in terms of ease of use plus reducing surgical time and blood loss.^[10] Comparison of CA with CP has revealed different results in several studies. Some studies have shown higher levels of fusion and decreased subsidence levels in the CP technique than the CA method.^[11,12] Some other studies have reported the absence of any differences between the two methods.^[10,13] In other studies, reduction in complications such as dysphagia and the possibility of early postoperative discharge are discussed as the superiority aspects of the CA method.^[14] Considering the differences between the results of similar studies and the limited number of studies which compared these two methods in one and two levels, the purpose of the current study was to evaluate the outcomes of treating patients with spinal lesions in one level or two levels through ACDF-CA and ACDF-CP methods and compare these results with each other.

METHODS

In this prospective, cross-sectional, descriptive study, eighty ACDF surgery candidate patients, who were referred to the orthopedic clinics of Al-Zahra and Kashani Hospitals in Isfahan between 2015 and 2017, were selected and involved in the study. The sample size of the patients included twenty patients with ACDF-CA surgery in one level, twenty patients with ACDF-CA surgery in two levels, twenty patients with ACDF-CP in one level, and twenty patients with ACDF-CP in two levels who all fulfilled the inclusion criteria for entering the study. It should be noted that the sampling continued until the involvement of twenty patients in each group. The inclusion criteria for the study included patients who underwent ACDF-CA and ACDF-CP surgery aged between 20 and 70 years, which at least 2 months had passed from their surgery. Patients who had incomplete records or imaging data, special medications employed within the treatment period such as corticosteroids, had a history of postoperative re-trauma, or did not consent to participate in the study were excluded from the study. Demographic data (age and sex), clinical symptoms, radiological findings, and cervical spine X-ray, and magnetic resonance imaging before surgery were the evaluated data of the study. The tools for collecting information in this study were the visual analog scale (VAS) (the score of

postoperative pain that was rated between 0 and 10 according to the patient's statement) and questionnaire of Neck Disability Index (NDI) (before and after surgery). The NDI is a marker for neck disability rating with ten questions including pain intensity, personal care, lifting, reading, headaches, concentration, work, driving, sleeping, and recreation. Each question is scored from 0 to 5 points. In the end, the questionnaire score is demonstrated in percentage. It should be noted that higher scores obtained from this questionnaire would indicate more disability of the patients.^[15] Surgery levels were C3-C4-C5, C4-C5-C6, and C5-C6-C7, and the interval between vertebrae was determined based on the patient's X-ray imaging data. The cervical range of motion (cROM) was measured before and after surgery. It is worth mentioning that the anterior cervical approach was the method used for surgery. Side effects of the procedure include displacement, subsidence, screw loosening, and respiratory or esophagus complications. Furthermore, the outcomes of the surgery based on Odom's criteria were excellent (improved symptoms and abnormal findings before the operation), good (persistence of symptoms at a minimal level before surgery), fair (definite relief of some preoperative symptoms, slightly improved other symptoms with residual root irritation with transient pain), and poor (worsened or unchanged symptoms).^[16] Patients' satisfaction from the surgical operation was also documented as completely satisfied, satisfied, and dissatisfied.

Statistical analysis

The data of this study were entered into SPSS v. 22 software Statistical Package for the Social Sciences (SPSS, IBM, Chicago, IL), and Chi-square test was used to compare the qualitative data between the groups. The one-way ANOVA test was used for quantitative data. Paired samples *t*-test was used to evaluate the results before and after surgery. Quantitative data were presented as the mean and standard deviation and qualitative data were presented as frequency or percentage. The $P < 0.05$ was considered as a significant relationship.

RESULTS

In this study, patients were divided into four groups: ACDF-CA in one level (15 males and 5 females), ACDF-CA in two levels (11 males and 9 females), ACDF-CP in one level (13 males and 7 females), and ACDF-CP in two levels (9 men and 11 women). Furthermore, there was no significant difference between the groups according to gender, age, duration of surgery to visit, and surgical level ($P > 0.05$). Patient's demographic information is summarized in Table 1.

VAS, NDI, and range of motion were measured before and after surgery. Paired sample *t*-test showed a significant decrease in VAS,

NDI, and range of motion scores after surgery compared with the preoperative stage in the four groups ($P < 0.001$). Furthermore, according to one-way ANOVA test, there was no significant difference between the groups in regards to VAS and range of motion before and after surgery operation and NDI before surgery operation ($P > 0.05$), but there was a significant difference between the groups according to the NDI scores in the postoperative period, as the postoperative NDI scores in the ACDF-CA group in one level were lower than the other groups ($P < 0.0001$) [Table 2].

Patients' surgery outcomes were discussed according to Odom's criteria and patients' satisfaction with the surgery,

as most patients were in a good state based on the Odom's criteria, and most of the patients were satisfied with their surgery. There was also no significant difference between the groups in regards to Odom's criteria for patients' satisfaction ($P > 0.05$) [Table 3].

Among the complications found in this study, only one case (5%) of the ACDF-CA in two levels had displacement, and no other complications such as subsidence, screw loosening, and respiratory or esophageal problems were seen in other groups. Furthermore, There was no significant difference in postoperative complications between the groups ($P = 0.38$).

Table 1: Demographic information of patients in four study groups

Variable	ACDF-CA in one level	ACDF-CA in two levels	ACDF-CP in one level	ACDF-CP in two levels	P
Number	20	20	20	20	-
Sex (%)					
Male	15 (75)	11 (55)	13 (65)	9 (45)	0.24*
Female	5 (25)	9 (45)	7 (35)	11 (55)	
Age (years), mean±SD	45.55±14.03	44.60±12.57	47.90±13.30	48.95±12.11	0.69**
Surgery duration till visit (months), Mean±SD	3.61±1.26	4.37±1.84	3.55±1.60	3.35±1.44	0.18**
Surgical level (%)					
C3-C4-C5	1 (5)	0	3 (15)	2 (10)	0.58**
C4-C5-C6	9 (45)	12 (60)	9 (45)	8 (40)	
C5-C6-C7	10 (50)	8 (40)	8 (40)	10 (50)	

*Chi-square test, **One-way ANOVA, ACDF-CA - Anterior Cervical Discectomy and Fusion-age alone; ACDF-CP - Anterior Cervical Discectomy and Fusion-cage and plate; SD - Standard deviation

Table 2: Changes in the measured parameters of the study groups before and after surgery

Variable (mean±SD)	ACDF-CA in one level	ACDF-CA in two levels	ACDF-CP in one level	ACDF-CP in two levels	P
VAS					
Before surgery	6.80±1.76	7.05±1.31	7.25±1.33	7.45±1.43	0.54
After surgery	3.95±1.53	4.35±1.26	4.70±1.49	5.05±1.60	0.11
NDI					
Before surgery	33.60±7.72	36.50±9.26	36.10±8.01	40.30±8.59	0.10
After surgery	21.95±5.17	28.80±6.50	29.80±7.64	33.20±7.98	<0.0001
cROM (degrees)					
Before surgery	42.40±7.44	36.60±7.42	38.80±7.91	39.15±12.42	0.25
After surgery	34.10±6.95	31.75±5.97	32.35±6.64	32.40±9.65	0.77

*One-way ANOVA, ACDF-CA - Anterior Cervical Discectomy and Fusion-cage alone; ACDF-CP - Anterior Cervical Discectomy and Fusion-cage and plate; VAS - Visual analog scale; NDI - Neck disability index; cROM - Cervical range of motion; SD - Standard deviation

Table 3: Results of surgery in the studied groups

Variable	ACDF-CA in one level	ACDF-CA in two levels	ACDF-CP in one level	ACDF-CP in two levels	P
Odom's criteria					
Excellent	7 (35)	3 (15)	3 (15)	4 (20)	0.61
Good	10 (50)	14 (70)	12 (60)	9 (45)	
Fair	2 (10)	2 (10)	2 (10)	3 (15)	
Poor	1 (5)	1 (5)	3 (15)	4 (20)	
Patients' satisfaction					
Completely satisfied	10 (50)	6 (30)	8 (40)	6 (30)	0.56
Satisfied	8 (40)	13 (65)	10 (50)	10 (50)	
Dissatisfied	2 (10)	1 (5)	2 (10)	4 (20)	

*Chi-square test, ACDF-CA - Anterior Cervical Discectomy and Fusion-cage alone; ACDF-CP - Anterior Cervical Discectomy and Fusion-cage and plate

DISCUSSION

ACDF-CA and ACDF-CP are discussed in various studies from the perspective of postoperative pain, neck disability after surgery, the different cROM rates, and side effects of surgery. These studies evaluated one level, two levels, and even three levels, but studies which compared the levels with each other are limited. In this study, age, sex, surgery duration, and surgical levels were not different between the groups. In all of the examined groups, VAS, NDI, and range of motion were significantly reduced after surgery compared to the preoperative state. Furthermore, VAS and range of motion after surgery did not reveal statistically significant differences between all of the methods [Figure 1]. This result is consistent with the results of various studies in this regard. However, Lee *et al.* studied different ACDF techniques at one level and stated that ACDF-CP technique was significantly more effective than ACDF-CA in reducing postoperative VAS.^[17] In the study of Song *et al.*, who compared ACDF-CA with ACDF-CP in one level and two levels, the VAS score in the ACDF-CA group was higher than in the other group.^[18] In the ACDF-CA technique, due to the lack of strong fixations to maintain the stability of the device, the anatomical differences between individuals, and the limited designs of the embedded device, micromotions may occur occasionally, which leads to a slower bone fusion process. Together with the increased tension in the posterior cervical region, these factors together can explain the causes of the pain difference in the two methods. In our study, postoperative NDI in the ACDF-CA group in one level was lower than in other groups. In a study by Kim *et al.*, who similarly evaluated ACDF with cage-only and ACDF-CP in one level and two levels, postoperative NDI in cage-only in one level group was lower than the CP group.^[10] Comparison of NDI after surgery in two levels did not demonstrate significant differences in both groups. These findings are consistent with the results of our study. On the other hand, Chen *et al.* who studied ACDF-CA and ACDF-CP in three levels suggested that postoperative NDI had a significant improvement rather than preoperative state, and postoperative differences were not significant between the two methods.^[19] Other relative studies have been conducted with similar results in this regard.^[20] It is possible that the reason for these results is the plate used or complications such as adjacent segmental degeneration which occurs less in cage-only technique. In our study, based on Odom's criteria, the outcomes of the surgery were evaluated, which revealed no significant differences between the groups. In addition, the patients' satisfaction of the surgery operation was observed in most of the cases, without significant differences in all groups. In most of the methods evaluated, no complications were observed. In a study by



Figure 1: A 38-year-old female patient undergoing an anterior cervical discectomy and fusion with cage due to the C5-C6 cervical disc, as in the X-ray, the distance between the lower and upper vertebrae that are fused in the postoperative period (b) was no different from the preoperative graph (a)

Lee *et al.*, who used this criterion in a similar way, the results did not reveal significant differences between groups in one level.^[17] No complications such as neurological disorders have also been reported in this study. These results are consistent with our findings. In a study by Song *et al.*, the results were analyzed using Robinson's criteria, which did not report any significant differences in the examined methods.^[18] In their study, complications have been reported for both methods. Pseudarthrosis, need for revision operation, and anterior migration of cage were significantly higher in the group treated with the ACDF-CA method. Hardware problems such as plate bending or screw back-out were reported more in the ACDF-CP group. The incidence of adjacent level degeneration and swallowing difficulties was similar in both groups. The more significant occurrence of pseudoarthrosis in the ACDF-CA group seems to be related to the development of cage subsidence and kyphotic deformity. Failure to maintain stability in the ACDF-CA method (which does not utilize plate) can also be the reason for more cage displacement in this process. In this regard, although the results of this study are not similar to our findings, they can be explained in the light of the above considerations.

Study limitations

One of the limitations of the present study is the lack of involvement of a control group for comparing the results. Furthermore, the fusion rate has not been evaluated in different groups. Moreover, details of VAS, NDI and range of motion at different times are not provided. In addition to other facts, costs of each method have not been investigated in this study. These items should be considered in further studies in this regard.

CONCLUSION

ACDF-CA and ACDF-CP in one level and two levels revealed acceptable postoperative outcomes than before surgery. The complications of these methods are negligible and satisfaction level after surgery is high. Although the ACDF-CA method in one level may be associated with decreased neck disability, the results of these methods are generally the same. Further studies with more sample sizes are recommended to evaluate the cost efficiency of these methods and more precise details such as VAS or NDI measurements at different times should be provided.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

- Song KJ, Choi BY. Current concepts of anterior cervical discectomy and fusion: A review of literature. *Asian Spine J* 2014;8:531-9.
- Xu L, Sun H, Li Z, Liu X, Xu G. Anterior cervical discectomy and fusion versus posterior laminoplasty for multilevel cervical myelopathy: A meta-analysis. *Int J Surg* 2017;48:247-53.
- Giannoudis PV, Dinopoulos H, Tsiridis E. Bone substitutes: An update. *Injury* 2005;36 Suppl 3:S20-7.
- Bishop RC, Moore KA, Hadley MN. Anterior cervical interbody fusion using autogeneic and allogeneic bone graft substrate: A prospective comparative analysis. *J Neurosurg* 1996;85:206-10.
- Tuchman A, Brodke DS, Youssef JA, Meisel HJ, Dettori JR, Park JB, *et al.* Autograft versus allograft for cervical spinal fusion: A systematic review. *Global Spine J* 2017;7:59-70.
- Delloe C, Cornu O, Druze V, Barbier O. Bone allografts: What they can offer and what they cannot. *J Bone Joint Surg Br* 2007;89:574-9.
- Viswanathan VK, Manoharan SR. To plate or not to plate after a single- or two-level anterior cervical discectomy: Fusion with cage-plate construct or stand-alone cage. *Asian Spine J* 2017;11:1-3.
- Park HW, Lee JK, Moon SJ, Seo SK, Lee JH, Kim SH, *et al.* The efficacy of the synthetic interbody cage and grafton for anterior cervical fusion. *Spine (Phila Pa 1976)* 2009;34:E591-5.
- Jacobs W, Willems PC, Kruyt M, van Limbeek J, Anderson PG, Pavlov P, *et al.* Systematic review of anterior interbody fusion techniques for single- and double-level cervical degenerative disc disease. *Spine (Phila Pa 1976)* 2011;36:E950-60.
- Kim SY, Yoon SH, Kim D, Oh CH, Oh S. A prospective study with cage-only or cage-with-plate fixation in anterior cervical discectomy and interbody fusion of one and two levels. *J Korean Neurosurg Soc* 2017;60:691-700.
- Fraser JF, Härtl R. Anterior approaches to fusion of the cervical spine: A metaanalysis of fusion rates. *J Neurosurg Spine* 2007;6:298-303.
- Fountas KN, Kapsalaki EZ, Nikolakakos LG, Smisson HF, Johnston KW, Grigorian AA, *et al.* Anterior cervical discectomy and fusion associated complications. *Spine (Phila Pa 1976)* 2007;32:2310-7.
- Choi MK, Kim SB, Park CK, Kim SM. Comparison of the clinical and radiologic outcomes obtained with single- versus two-level anterior cervical decompression and fusion using stand-alone PEEK cages filled with allograft. *Acta Neurochir (Wien)* 2016;158:481-7.
- Overley SC, Merrill RK, Leven DM, Meaie JJ, Kumar A, Qureshi SA, *et al.* A matched cohort analysis comparing stand-alone cages and anterior cervical plates used for anterior cervical discectomy and fusion. *Global Spine J* 2017;7:394-9.
- Vernon H, Mior S. The neck disability index: A study of reliability and validity. *J Manipulative Physiol Ther* 1991;14:409-15.
- Odom GL, Finney W, Woodhall B. Cervical disk lesions. *J Am Med Assoc* 1958;166:23-8.
- Lee CH, Hyun SJ, Kim MJ, Yeom JS, Kim WH, Kim KJ, *et al.* Comparative analysis of 3 different construct systems for single-level anterior cervical discectomy and fusion: Stand-alone cage, iliac graft plus plate augmentation, and cage plus plating. *J Spinal Disord Tech* 2013;26:112-8.
- Song KJ, Taghavi CE, Lee KB, Song JH, Eun JP. The efficacy of plate construct augmentation versus cage alone in anterior cervical fusion. *Spine (Phila Pa 1976)* 2009;34:2886-92.
- Chen Y, Lü G, Wang B, Li L, Kuang L. A comparison of anterior cervical discectomy and fusion (ACDF) using self-locking stand-alone polyetheretherketone (PEEK) cage with ACDF using cage and plate in the treatment of three-level cervical degenerative spondylopathy: A retrospective study with 2-year follow-up. *Eur Spine J* 2016;25:2255-62.
- Zhou J, Li X, Dong J, Zhou X, Fang T, Lin H, *et al.* Three-level anterior cervical discectomy and fusion with self-locking stand-alone polyetheretherketone cages. *J Clin Neurosci* 2011;18:1505-9.