Original Investigation

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Radiological and Clinical Comparison of the Results of Patients with Fusion and Unfusion Cervical Anterior Microdiscectomy with the Help of Cases and Literature

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ABSTRACT

Objective: In this study, we aimed to show the superiority of fused anterior cervical discectomy and fusion (ACDF) with fuseless ACD by comparing the clinical and radiological follow-up results of patients with ACD and ACDF.

Methods: Between 2001 and 2005, 67 patients with cervical disc disease, who underwent anterior cervical intervention, were included in this study. Fifty patients underwent ACD. In 31 cases, cage system and osteoinductive graft material (demineralized bone matrix, KOP) were used and 11 cases were treated with plate anterior cervical discectomy in addition to cage system. The mean follow-up period was 12 months (6 months-18 months) in the ACD group. The mean follow-up period in the ACDF group was 12 months (6 months-18 months). All ACD and ACDF patients were evaluated according to the criteria of direct cervical grafillary and Odem criteria taken at the postoperative early period, 6 months and 12 months.

Results: Fifty-five patients with ACD and 42 patients with ACDF were included in the study group. The mean age of the patients in the ACD group was 41 years (the youngest was 29, the oldest was 59 years old) and the mean age of the ACDF group was 46 years (the youngest was 30, the oldest was 69 years old). The difference was not statistically significant ($p>0.05$). There was no decrease in intervertebral disc height and foramen height in patients undergoing ACDF. No kyphosis was seen in ACDF patients.

Conclusion: According to the patient group who underwent ACD and ACDF and followed for 24 months, it was seen that the intervertebral disc height, foramen height and cervical lordosis were preserved in ACDF. No intervertebral cage was seen in the cervical corpus in any patient of ACDF. Clinical and radiological findings showed that clinical and radiological outcomes of patients with ACDF were better than ACD patients. The necessity of fusion of the anterior cervical discectomy and the use of instrumentation are discussed in the literature. Because of this reason, the results of our study will be meaningful in terms of contributing to future research.

Keywords: Cervical disc herniation, anterior cervical discectomy, fusion, cage

INTRODUCTION

Cervical disc hernia (CDH) is a disease that affects the spinal cord and roots and is most frequently encountered in the thirties of life. CDH can cause the development of radiculopathy/myelopathy (1,2). The first surgical treatment for this disease was implemented by Sir Victor Horsley in 1895 with a posterior approach, but later anterior approaches became more popular and successful. Smith and Robinson first described the anterior cervical discectomy and fusion (ACDF) method in 1955 and Cloward in 1958. After this period, the anterior approach has become preferable in CDH (2). However, in 1960, Hirch's successful results by applying ACD

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without fusion caused some controversy about the need for fusion (2,3).

In recent years, when instability has developed in the cervical vertebra, instrumentations developed for stabilization and fusion by placing cervical plaque from the anterior to the cervical vertebra has started a new era in CDH surgery. Whether or not there is a need for fusion after ACD have carried on the discussions about the indications and suitability of the materials (autografts, allografts, etc.) to date (2,4).

In this study, patients who underwent ACD and ACDF surgery for CDH between 2001-2005 were evaluated retrospectively. In both surgical methods, preoperatively and postoperatively conducted 4-way direct cervical radiographs of the patients were compared and the results were discussed in the light of the current literature.

METHODS

This study consists of 67 patients who were operated with the diagnosis of CDH in Bakırköy Mental and Neurological Diseases Hospital, Clinic of Neurosurgery between 2001-2005. After the data of these patients were evaluated retrospectively, they were found to be appropriate for our study and included. Patients who developed fracture, dislocation, and instability after cervical trauma were not included in our study. Preoperative neurological examination information, radiological examinations and surgical reports of all patients included in this study were examined. Patients who underwent single and double level surgery and ACD and ACDF were included in the study. Patients operated with the posterior approach were not included in this study. Written consent was obtained from patients participating in the study to add their records to the study. The examinations were collected in accordance with the Helsinki Ethics Committee Declaration. Since our research is a retrospective study, the ethics committee permission has not been obtained.

According to the clinical evaluation results, the cases in our study were divided into 3 groups. The group with radicular pain and motor-sensory and reflex disorders was named as radiculopathy group. Patients with spastic paresis, walking problem, muscle atrophy, bladder dysfunction constituted the myelopathy group. The patients whose two symptoms were detected at the same time were named as radiculomyelopathy group. In their neurological examination, patients with symptoms of 2nd motor neuron in one or more root areas such as radicular pain (unilateral or bilateral), paresis, decreased deep tendon reflexes (DTR), dermatomal sensory damage, and atrophy were evaluated in the radiculopathy group. In their examinations, patients with 1st motor neuron findings such as pain in the neck and interscapular area, increase in DTRs regardless of radicular pain, pathological reflex, patella or achilles clone, and muscle tone prominence were evaluated in the myelopathy group. In the myeloradiculopathy group, myelopathy and radiculopathy symptoms were associated. All patients underwent 4-way cervical radiography and preop cervical magnetic resonance imaging before surgery. Some patients underwent preop cervical computed tomography and electromyography to ensure the level of clinical origin. When the surgical reports were examined, soft intervertebral disc was detected in one group of patients, while spondylosis was detected in others. In postoperative direct cervical radiography, lordosis loss, anterior opening, narrowing of the foramen, reduction in intervertebral space, superior end plate (Sup-EP), inferior end plate (Inf-EP) length and osteophytes were evaluated.

In the lateral cervical x-ray examination, the angle formed by the posterior line of the C2 spine corpus and the posterior line of the C7 spine corpus was used to calculate the cervical angle (Figure 1). If the axis is <0°, it is considered kyphosis, if the axis is 0° - 10° it is flat, and if the axis is >10 ° it is considered lordosis. When the angle between the posterior line of the spine corpus above the space from the CDH and the posterior line of the corpus below was calculated and it gave the segmental angle. If the axis was <0°, it was considered kyphosis, and if the axis was >1° it was considered lordosis.

The angle to the anterior was assessed by the Gore method and the Martins rating system was adopted (3,5). Martins divided the patients into 4 groups according to the cervical vertebra line after surgery. It was considered excellent if normal cervical lordosis developed, if lordosis decreased and anterior angle was 5°< it was considered good, if anterior angle was 5°-15° it was moderate and if it was 15°> it was considered bad. 25 of the patients included in our study had ACD and 42 of them had ACDF. Anterior cervical plate implant was also present in 11 of the ACDF cases. The surgical indications for both groups were the same.

The surgical approach was ACD in both groups. Osteophytes were routinely taken in surgeries and posterior longitudinal ligament (PLL) was opened. In the ACDF group, titanium and peek cage implants were placed for fusion. Demineralized bone matrix, bone chips, synthetic graft were applied to create bone fusion. Following surgery, patients were advised to use cervical collar for 6-8 weeks. Routine cervical direct radiography was performed at regular intervals during the observation interval (1 month-36 months). Surgical satisfaction results of the cases were reported using the Odom criteria (2).

Statistical Analysis

SPSS 21.0 package program was used in the statistical analysis of the data obtained (SPSS, Chicago, IL, USA). Continuous data are summarized as mean ± standard deviation, while categorical data are summarized in numbers and percentages. For comparisons between groups, chi-square test (χ^2) was used to evaluate two categorical independent groups. $P<0.05$ value was taken as statistical significance level.

RESULTS

Twenty-five of 67 cases, which constituted the population of our study, were treated with ACD, and 42 with ACDF. In 11 cases from the ACDF group, fusion with anterior cervical plate was also present. Twenty-two patients from the ACD group were treated from a single space and 3 patients from 2 spaces. From the

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ACDF group; 23 patients were treated from a single space and 19 patients from 2 spaces. The mean age of the patients in the ACD group was 41 (29-59), and the mean age of the patients in the ACDF group was 46 (30-69). There was no statistically significant difference (p>0.05). The mean age of all patients was calculated as 45 (29-69). Thirty of the cases were male (44.7%) and 37 were female (55.2%) (Figure 2).

While there were 13 female patients in the ACD group, the mean age of the female patients in this group was 42. The number of female patients in the ACDF group was 24 and the mean age was 43. The number of men in the ACD group was 12, and the mean age was 44. In the ADCF group there were 18 males and the mean age was 42 (Figure 3).

The complaint detected in all cases was in the form of pain hitting left, right or two arms. Neck pain was the most common additional complaint (92%). According to the order of accompanying complaints; in 50% of the cases, there was numbness in the arms, in 41%, there was a loss of strength in the arms, and in 1%, headache.

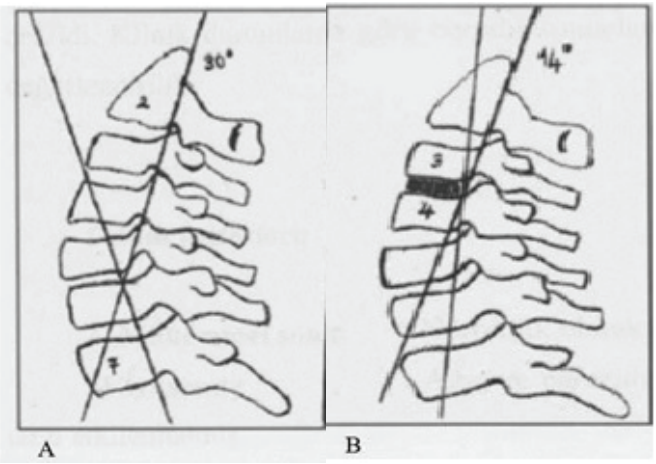

Figure 1. (4,5) Calculation of the angle formed by the lines drawn from the posterior border of the C2 vertebra corpus and the posterior border of the C7 vertebra corpus. A) Evaluation of cervical angulation by lateral cervical radiography in the neutral position (measuring the angle of C2-7 is shown schematically 30°). B) Evaluation of the segmental angulation with the lateral cervical radiography in the neutral position (C3-4 segmental angulation is shown schematically 14°)

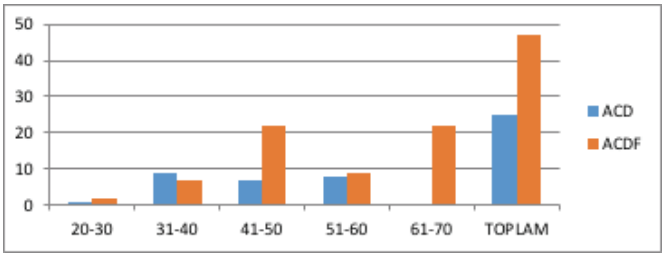

Figure 2: Age distribution of patients in anterior cervical discectomy and anterior cervical discectomy and fusion groups
ACD: Anterior cervical discectomy, ACDF: anterior cervical discectomy and fusion

The cases were evaluated in 3 different groups according to their neurological symptoms. Fifty-five (82%) cases were evaluated in radiculopathy, 1 (1.49%) case was myelopathy and 11 (16.4%) cases were evaluated in myeloradiculopathy group (Table 1).

Neurological and physical examination of all cases were done in detail. In the first examination of cases in the ACD and ACDF group; dermatomal sensory defect was detected in 40 (60%) patients, reflex changes in 36 (54%) cases, and varying degrees of paresis in 34 (51%) cases (Table 2).

Routine two-way cervical direct radiographs were performed for preoperative and postoperative follow-ups as radiological examinations. In preoperative evaluation, no cervical listhesis was detected in the ACD group. Cervical listhesis was detected in 10 patients (23.8%) in the ACDF group. Loss of lordosis was detected in 12 patients (48%) in the ACD group and 40 patients (95.2%) in the ACDF group. Osteophyte was detected in 17 (68%) patients in the ACD group, and 38 patients (90.4%) in the ADCF group. Narrowing foramen was observed in 10 cases (40%) in the ACD group and 26 cases (61.9%) in the ACDF group (Table 3).

Before the operation, all patients received anti-inflammatory and analgesic therapy, 30 patients received cervical collar support for 2-4 weeks, and 27 patients received physical therapy and rehabilitation treatment. However, despite all these treatments, there was no significant improvement in their complaints.

Forty-four of the cases were diagnosed as single and 23 of them had two levels CDH. It was determined that the C5-C6 disc space was the most treated level in both groups. The C6-C7 level was the second frequently treated level. The levels C4-C5 and C3-C4 were treated, respectively. The number of levels operated with the diagnosis of CDH was 100 (Table 4).

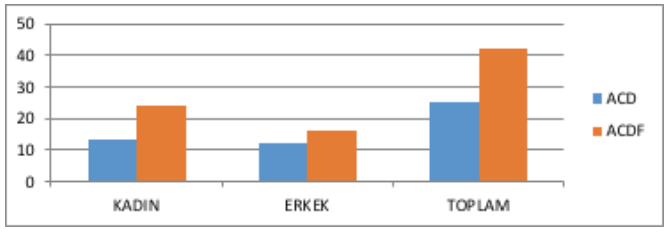

Figure 3: Gender distribution of patients in anterior cervical discectomy and anterior cervical discectomy and fusion groups
ACD: Anterior cervical discectomy, ACDF: anterior cervical discectomy and fusion

Table 1. Proportion of clinical findings of patients in anterior cervical discectomy and anterior cervical discectomy and fusion groups

Clinical Finding	ACD		ACDF		Total	
	n	%	n	%	n	%
Radiculopathy	22	88%	33	78.5%	55	82.08%
Myelopathy	0	0%	1	2.3%	1	1.49%
Myeloradiculopathy	3	12%	8	19.2%	11	16.41%
Total	25	100%	42	100%	67	100%

ACD: Anterior cervical discectomy, ACDF: anterior cervical discectomy and fusion

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The herniations were either midline or laterally located, in the form of a hard or soft disc. Twenty-five patients received ACD and 42 patients received ACDF. Of the 67 patients, 46 patients were single level and 21 patients were two level, and 88 intervertebral disc spaces were operated with an anterior approach. Thirty-one patients in the ACDF group had a cage system for fusion, 11 patients had cage and plaque.

The length of hospitalization after the intervention was the same in the ACD and ACDF group and was on average 2 days. The mean follow-up duration was 12 months (6 months-18 months) in both groups. All patients who underwent ACD and ACDF were evaluated with postoperative early period (postoperative within the first two days), cervical direct radiographs performed at the end of 6th and 12th months and according to Odom's criteria.

Table 2. Physical examination findings of patients in anterior cervical discectomy and anterior cervical discectomy and fusion groups

Physical examination findings	ACD		ACDF		Total	
	n	%	n	%	n	%
Paresis						
Paresis on the arm	12	48%	22	52.3%	34	50.7%
Hemiparesis	0	0%	0	0%	0	0%
Quadriparesis	0	0%	0	0%	0	0%
Reflex						
Hypoactive	10	40%	17	40.4%	27	40.2%
Hyperactive	3	12%	6	14.2%	9	13.4%
Normoactive	12	48%	17	40.4%	39	58.2%
Cannot be taken	0	0%	1	2.3%	1	1.4%
Pathological reflex						
Hoffman	3	12%	9	21.4%	12	17.9%
Clonus	0	0%	1	2.3%	1	1.4%
Babinski	0	0%	0	0%	0	0%
Sensory defect	10	40%	30	71.4%	40	59.7%
Atrophy	2	8%	6	14.2%	8	11.9%
Walking disorder	0	0%	1	2.3%	1	1.4%
Sphincter defect	0	0%	1	2.3%	1	1.4%

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Table 3. Preoperative direct cervical X-ray findings of patients in anterior cervical discectomy and anterior cervical discectomy and fusion groups

Preoperative direct graph findings	ACD		ACDF		Total	
	n	%	n	%	n	%
Narrowing in the space	12	48%	28	66.6%	40	59.7%
Osteophyte presence	17	68%	38	90.4%	32	82%
Foramen stenosis	10	40%	26	61.9%	36	53.7%
Loss of lordosis	12	48%	40	90.4%	52	77.6%
Cervical slip	0	0%	10	23.8%	10	14.9%

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While the excellent postoperative early outcome rate in the ACDF group was 28.5%, it was 20% in the ACD group. However, the rate of good evaluation in the ACDF group was 57.1%, while it was 60% in the ACD group. The "excellent + good" result rate was 85.7% in the ACDF group and 80% in the ACD group (Table 5).

While the excellent outcome rate in the ACDF group at the 6th month was 33.3%, it was 12% in the ACD group. At the same time, the rate of good evaluation of the ACDF group was 59.5%, while it was 68% in the ACD group. The "excellent + good" result rate was 92.8% in the ACDF group and 80% in the ACD group (Table 6).

While the excellent outcome rate in the ACDF group at the postoperative 12th month was 35.7%, it was 12% in the ACD group. At the same time, the good outcome of the ACDF group was 62%, while it was 72% in the ACD group. The "excellent + good" result rate was 97.6% in the ACDF group and 84% in the ACD group (Table 7).

The measurements of preoperative and postoperative 7 parameters were taken using cervical direct graphs (Figure 4).

Intervertebral disc space	1st measurement
Foramen height	2nd measurement
Superior end plate	3rd measurement
Inferior end plate	4th measurement
Loss of lordosis	5th measurement
Presence of osteophyte	6th measurement

Figure 4. Parameters evaluated in the study

Table 4. Classification of patients in anterior cervical discectomy and anterior cervical discectomy and fusion groups according to operated disc spaces

Operated disc spaces	ACD		ACDF		Total	
	n	%	n	%	n	%
Single level						
C3-4	0	0%	1	2.3%	1	1.4%
C4-C5	4	16%	3	7.1%	7	10.4%
C5-C6	8	32%	13	30.9%	21	31.3%
C6-C7	10	40%	4	9.5%	14	20.8%
C7-T1	0	0%	1	2.3%	1	1.1%
Two level						
C3-C4/C5-C6	0	0%	1	2.3%	1	1.4%
C3-C4/C4-C5	0	0%	0	0%	0	0%
C4-C5/C5-C6	1	4%	4	9.5%	5	7.4%
C5-C6/C6-C7	2	8%	15	35.7%	17	25.3%
Total	25	100%	42	100%	67	100%

ACD: Anterior cervical discectomy, ACDF: anterior cervical discectomy and fusion

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Preoperative osteophyte, segmental angle presence and lordosis loss are significantly higher in ACDF group than ACD group ($p<0.05$). There was no statistically significant difference between the groups in terms of early postoperative osteophyte, lordosis loss and segmental angle ($p>0.05$). It was found that 12th month lordosis loss and segmental angle presence were significantly higher in ACD group than ACDF group ($p<0.05$ and $p<0.001$) (Table 8).

The ACDF group's early postoperative, mean 6th and 12th month disc space were significantly higher than that of the ACD group. When the means of preoperative disc space of both groups were calculated, there was no statistically significant difference ($p>0.05$). The mean preoperative foramen height of the ACD group was found to be significantly higher than that of the ACDF group ($p<0.05$). There was no statistically significant difference between groups in terms of preoperative, early postoperative, 6th and 12th month Sup-

Table 5. Postoperative early satisfaction results of patients in anterior cervical discectomy and anterior cervical discectomy and fusion groups

Postoperative early period	Excellent		Good		Medium		Poor		Total	
	n	%	n	%	n	%	n	%	n	%
ACD (dingle level)	4	18.1%	14	63.7%	3	13.6%	1	4.6%	22	100%
ACD (double level)	1	33%	1	33%	1	33%	0	0%	3	100%
ACDF (fusion with cage) (Single Level)	7	36.8%	11	57.8%	1	5.3%	0	0%	19	100%
ACDF (fusion with cage) (two levels)	4	33.3%	5	41.7%	2	16.7%	1	8.3%	12	100%
ACDF (fusion with cage + plate) (single level)	0	0%	1	100%	0	0%	0	0%	1	100%
ACDF (fusion with cage + plate) (two levels)	1	12.5%	6	75%	1	12.5%	0	0%	8	100%
Anterior cervical corpectomy + cylindrical cage + plate	0	0%	1	50%	1	50%	0	0%	2	100%

Odom's Criteria (1958)
ACD: Anterior cervical discectomy, ACDF: anterior cervical discectomy and fusion

Table 6. Postoperative 6th month satisfaction results of the patients in anterior cervical discectomy and anterior cervical discectomy and fusion groups

Postoperative 6th month	Excellent		Good		Medium		Poor		Total	
	n	%	n	%	n	%	n	%	n	%
ACD (single level)	3	13.6%	15	68.2%	4	18.2%	0	0%	22	100%
ACD (double level)	0	0%	2	66.7%	1	33.3%	0	0%	3	100%
ACDF (fusion with cage) (single level)	7	36.9%	12	63.1%	0	0%	0	0%	19	100%
ACDF (fusion with cage) (two levels)	5	41.7%	6	50%	1	8.3%	0	0%	12	100%
ACDF (fusion with cage + plate) (single level)	0	0%	1	100%	0	0%	0	0%	1	100%
ACDF (fusion with cage + plate) (two levels)	2	25%	5	62.5%	1	12.5%	0	0%	8	100%
Anterior cervical corpectomy + cylindrical cage + plate	0	0%	1	50%	1	50%	0	0%	2	100%

Odom's Criteria (1958)
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Table 7. Postoperative 12th month satisfaction results of patients in anterior cervical discectomy and anterior cervical discectomy and fusion groups

Postoperative 12th month	Excellent		Good		Medium		Poor		Total	
	n	%	n	%	n	%	n	%	n	%
ACD (single level)	3	13.6%	16	72.8%	3	13.6%	0	0%	22	100%
ACD (double level)	0	0%	2	66.7%	1	33.3%	0	0%	3	100%
ACDF (fusion with cage) (single level)	7	36.8%	12	63.2%	0	0%	0	0%	19	100%
ACDF (fusion with cage) (two levels)	5	41.7%	7	58.3%	0	0%	0	0%	12	100%
ACDF (fusion with cage + plate) (single level)	1	100%	0	0%	0	0%	0	0%	1	100%
ACDF (fusion with cage + plate) (two levels)	2	25%	5	62.5%	1	12.5%	0	0%	8	100%
Anterior cervical corpectomy + cylindrical cage + plate	0	0%	2	100%	0	0%	0	0%	2	100%

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EP means (p>0.05). There was no statistically significant difference between groups in terms of preoperative, early postoperative, 6th and 12th month Inf-EP means (p>0.05) (Table 9).

In the ACD group, early postop disc space and foramen height values were found to be significantly decreased compared to preoperative status (p<0.00l). In the ACD group, 6-month evaluation, disc space and foramen height values were found to be significantly decreased compared to preoperative values (p<0.001). In the ACD group, in the 12th month, disc space and foramen height values were found to be significantly decreased compared to preoperative values (p<0.001) (Table 10).

In the ACDF group, early postoperative, 6th, 12th month disc space and foramen height were found to increase significantly (p<0.001). In the ACDF group, early postoperative, 6th, 12th month superior and Inf-EP and foramen height results were found to be significantly decreased when compared with preoperative values (p<0.001) (Table 11).

Complications

Minor complications were seen in ACD and ACDF groups. Although wound site infection was observed in 1 patient in the ACD group and postoperative pain complaint was observed in four of the ACDF patients, these complaints resolved completely between the 3rd day and the 1st week. It was observed that these pains continued for 2 weeks to 3 months in 2 patients in the ACDF group and resolved completely after 3 months. In 8 patients from the ACD group, pain complaints decreased between postoperative week 1 and month 2, and complaints persisted in 3 patients. There was transient hoarseness in 8 patients, 3 in the ACD group and 5 in the ACDF group. However, it was observed that completely healed within the postoperative first month. No major complications such as perioperative dural injury, vascular injury were observed. No surgical mortality was observed. There were no patients who underwent wrong level discectomy in either group. Osteophyte formation was detected in 4 patients from the ACD group at the operation level or adjacent level. No such formation was found in the ACDF group. Postoperative pseudoarthrosis did not develop in either group. In all patients in the ACD group, angulation was detected in 8 patients in the postoperative 1st-3rd month control direct cervical radiographs. In 16 patients from the ACD group, disc height loss was observed in disc space, and in 9 patients, slight height loss was observed. A decrease in lordosis was detected in 12 patients in the ACD group. In the ACDF group, complications such as angulation, decrease in disc space and decrease in lordosis were not encountered. There were no complications related to the materials used for fusion in the ACDF group (Table 12).

Table 8. Comparison of early postoperative and 12th month osteophyte, lordose loss and segmental angle presence of the patients in anterior cervical discectomy and anterior cervical discectomy and fusion groups

Early postoperative	ACD	ACDF	p
	n %	n %	
Loss of lordosis	17 68.0 8 32.0	31 73.8 11 26.2	0.26 0.610
Osteophyte	25 100.0	42 100.0	-
Segmental Angle	25 100.0	60 100.0	-
12th month			
Loss of lordosis	15 60.0 10 40.0	42 97.7 1 2.3	0.000
Osteophyte	25 100.0	43 100.0	-
Segmental Angle	12 42.9 16 57.1	52 86.7 8 13.3	18.47 0.000

ACD: Anterior cervical discectomy, ACDF: anterior cervical discectomy and fusion

DISCUSSION

One of the most important goals of spinal surgery is to maintain or restore the sagittal balance of the spine. The normally expected cervical angle is lordotic, and the angle range is between 10° and 40° (6,7). Recently, ACD has become a more preferred surgical method because it is useful and easier to apply. However, the need for fusion has begun to be discussed (8,9). With the anterior method, neurovascular structures can be decompressed, osteophytes can be removed if fused and the height of the disc space can be maintained. The ligamentum flavum is not expected to fold, and relaxation in the foramen becomes more pronounced.

Table 9. Results of disc space, foramen height, inferior end plate and superior end plate measurement result of preoperative, postoperative 6th and 12th months of patients in anterior cervical discectomy and anterior cervical discectomy and fusion groups

Disc space	ACD		ACDF		p
	Mean	SD	Mean	SD	
Preoperative	6.26	1.10	5.89	1.71	0.300
Postoperative	5.00	1.19	9.67	0.95	0.000***
6th month	4.57	1.03	9.65	0.92	0.000***
12th month	4.11	0.99	9.58	1.00	0.000***
Foramen Height					
Preoperative	11.54	1.45	10.56	2.23	0.036*
Postoperative	10.57	1.57	13.25	2.20	0.000***
6th month	10.25	1.55	13.23	2.17	0.000***
12th month	9.79	1.42	13.13	2.06	0.000***
Sup-EP					
Preoperative	23.07	3.11	23.92	3.03	0.229
Postoperative	22.54	3.31	22.05	2.55	0.460
6th month	22.64	3.27	22.49	2.01	0.793
12th month	23.11	3.13	22.19	2.56	0.155
Inf-EP					
Preoperative	23.29	3.09	23.01	3.08	0.649
Postoperative	22.02	3.13	21.81	2.75	0.131
6th month	23.00	3.10	21.04	2.70	0.055
12th month	23.61	3.01	22.20	2.74	0.043

ACD: Anterior cervical discectomy, ACDF: anterior cervical discectomy and fusion, SD: standard deviation, Sup-EP: superior end plate, Inf-EP: inferior end plate

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Table 10. Comparison of disc space, foramen height, superior end plate and inferior end plate of the patients in acd group of direct graphies in preoperative-early postoperative preoperative-6th month, preoperative-12th month

Anterior cervical discectomy group											
	Preoperative		Early postoperative			6th month			12th month		
	Mean	SD	Mean	SD	p	Mean	SD	p	Mean	SD	p
Disc space	6.26	1.10	4.56	1.05	0.000***	4.56	1.05	0.000***	4.07	1.00	0.000***
Foramen height	11.54	1.45	10.25	1.55	0.000***	10.25	1.55	0.000***	9.79	1.42	0.000***
Sup-EP	23.07	3.11	22.64	3.27	0.130	22.64	3.27	0.130	23.11	3.13	0.130
Inf-EP	23.29	3.09	23.00	3.10	0.284	23.00	3.10	0.284	23.61	3.01	0.284

ACD: Anterior cervical discectomy, SD: standard deviation, Sup-EP: superior end plate, Inf-EP: inferior end plate

Table 11. Comparison of disc space, foramen height, superior end plate and inferior end plate of the patients in anterior cervical discectomy and fusion group of direct graphies in preoperative-early postoperative preoperative-6th month, preoperative-12th month

Anterior cervical discectomy and fusion group											
	Preoperative		Early postoperative			6th month			12th month		
	Mean	SD	Mean	SD	p	Mean	SD	p	Mean	SD	p
Disc space	6.04	1.67	9.67	0.95	0.000***	9.65	0.92	0.000***	9.58	1.00	0.000***
Foramen height	10.56	2.23	13.25	2.20	0.000***	13.23	2.17	0.000***	13.13	2.06	0.000***
Sup-EP	23.75	3.07	22.05	2.55	0.000***	22.49	2.01	0.000***	22.19	2.56	0.000***
Inf-EP	23.35	2.91	21.81	2.75	0.000***	21.84	2.76	0.000***	22.26	2.74	0.000***

SD: Standard deviation, Sup-EP: superior end plate, Inf-EP: inferior end plate

In a study of complications, Bertalanffy and Eggert (10) found that in some of the reexplorations performed due to postoperative morbidity, pressure on the neural tissue developed due to the expansion and folding of PLL.

In the anterior approach, there are two types of operations, ACD and ACDF, for CDH (11). The opponents that fusion is necessary considers that thanks to the bone implant placed in the intervertebral space; biomechanical stability develops in the early period, fusion is easier, osteophytes regress and foramen are relieved (10). According to the Robinson et al.'s fusion results; solid fusion theoretically eliminates neural irritation by limiting movement at the fusion level, and at the same time, this allows osteophytes to resorb. In addition, they found that spinal cord/nerve root manipulation was not required in the anterior approach, that the bone graft preserved the height of the disc space and expanded the neural foramen. However, in their same study, they also stated that by performing ACDF, it eliminated possible compression to the spinal cord/nerve roots due to folding in PLL and ligamantum flavum (12).

In some studies, they stated that in anterior interventions performed in SDH, kyphosis developed in the late period secondary to closing the disc space after decompression. The necessity of fusion application has been advocated due to the decrease in foramen width after kyphosis and related root findings (13-15). However, segmental kyphosis in ACD develops in many cases. Studies have shown that segmental kyphosis, which may develop after ACD, causes problems in neighboring regions and sagittal angles (16-21).

Table 12. Complication rates in patients in anterior cervical discectomy and anterior cervical discectomy and fusion groups

Complications	ACD	ACDF	Total
	n%	n%	n%
Wound site infection	-	-	-
Postoperative pain	9 (36%)	6 (14.2%)	15 (22.3%)
Temporary hoarseness	2 (8%)	5 (11.9%)	7 (10.4%)
CSF fistula (dura damage)	-	-	-
Hematoma	-	-	-
Vascular injury	-	-	-
Esophagus/tracheal perforation	-	-	-
Wrong space expansion	-	-	-
Graft infection	-	-	-
Mortality	-	-	-
Total	11 (44%)	11 (26.1%)	22 (32.8%)

ACD: Anterior cervical discectomy, ACDF: anterior cervical discectomy and fusion

Cages placed in the intervertebral space for fusion after ACD are used frequently in practice today. Especially easy application, maintaining physiological disc height, providing distraction, correcting angular instability, and fusion with bone implant are considered to be more preferred because it is thought to be superior in the treatment planned (17).

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Cages, which are the cornerstone of fusion surgery, provide reliable clinical and radiological successes, alone or in combination with fixation systems (cervical plates). The most important task of the cages is to create fusion in the vertebral corpus. In addition, they maintain the height of the original disc space and provide resistance to axial weight, which is evident in the first periods (19,20). Based on these important tasks, we found in our study that the disc space intervened, especially in the tests performed after the use of the cage, preserves the physiological dimension and we stated in our study.

In order to evaluate the indications and advantages of cage use, it is necessary to evaluate factors such as the time spent in surgery, painless mobilization, the need to use postoperative cervical collar, the duration of postoperative neck pain, whether there is a loss of disc space after 6 months and fusion time (17). Although these are the criteria we base in our study, the results we obtained are in line with the literature.

Bohlman (22) found that 95% of the patients they operated with the Smith-Robinson method relieved upper extremity pain and 69% neck pain.

Galera and Tovi (23) in their series of 146 cases where they applied ACDF, reported the rate of pain recovery as 78% in the early postoperative period. In addition, Aronson et al. (24) stated the superiority of ACDF in the relief of upper limb pain associated with soft intervertebral disc herniation in patients treated with the ACD technique.

Joint spacing and foramen height are rearranged by ACDF method. Decompression is higher in ACDF patients than ACDF. It is more evident in the ACDF group that the pain complaint passes early. They stated that neural foramen height may decrease in ACD and therefore may cause upper limb pain to continue (25).

96% of the cases in our series applied to our clinic with arm and neck pain. In postoperative early ACD group; It was determined that the pain of 5 patients persisted for a while and it eased slightly compared to preoperative pain. In one patient, his pain was still observed at the 6th month follow-up. In the ACDF group, complaints of pain occurred in 6 patients in the first period and resolved within 1-week. In one case, it was found that this complaint was completely gone after 6 months. These values in our study were found to be compatible with the literature (4,22,24).

It has been stated in the literature that neural foraminal distraction cannot be achieved in ACD and the protrusion of ligamantum flavum to the canal cannot be reduced. In ACD, the disc space is collapsed, and kyphosis develops rapidly. This kyphosis is generally less than 5° and its clinical significance is not fully known. Spontaneous fusion rate varies between 28-100%. In addition, 10% of patients develop painful discogenic syndrome with radiculopathy. A significant portion of these patients may need surgery again (17).

In our series, 22 patients had single level and three patients had two level ACD. Preoperative, early post-operative, post-operative 6th month and post-operative 12th month direct cervical radiographs of all patients were compared. In our study, it was observed that disc spaces collapsed, foramen height was lost, and in some cases, the current lordosis loss continued postoperatively. In the 42 patients forming the ACDF group, preoperative two-way direct cervical and post-operative radiographs were compared. It was determined that there was no collapse in the disc spaces, the disc spaces were distracted, and that the foramen heights were preserved and even increased. In addition, it was observed that existing preoperative lordosis losses, anterior angles and cervical shifts improved in the early post-operative period. Measurements of patients in both groups were compared statistically. The advantage of using cages and plates was that they maintain the intervertebral disc space and foramen height, reduce morbidity, correct deformity, stabilize until arthrodesis, and provide mechanical strength against axial loads.

CONCLUSION

Watters and Levinthal (26) have shown that patients who have received ACDF decreased their current symptoms and complaints compared to those with ACD, and achieved superior results in the late period. Similar results were found in our research. Namely; we found that improvement of our cases started rapidly in the first periods and complaints and symptoms improved completely in late controls. Therefore, we think that intervertebral fusion using single and two-level degenerative disc disease using cage system, plate and bone fusion is a simple and reliable method if performed in accordance with the indications we have specified in our study.

What we would especially like to emphasize in our study is that, as stated in other studies, ACDF maintains the height of physiological disc space, prevents foramen height loss and contraction, thereby preventing nerve compression and reducing morbidity.

Ethics Committee Approval: Since our research is a retrospective study, the ethics committee permission has not been obtained.

Informed Consent: Written consent was obtained from patients participating in the study to add their records to the study.

Peer-review: Internally peer-reviewed.

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