# Anatomical Cervical Cage Versus Autologous Bone Graft for Anterior Cervical Discectomy and Interbody Fusion In Patients with Cervical Disc Degeneration

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**ABSTRACT:**

**BACKGROUND:**

Anterior cervical discectomy and interbody fusion (ACDF) is a surgical technique used to treat a variety of cervical spine disorders, such as nerve root or spinal cord compression, cervical spondylosis, and cervical spinal stenosis (1,2).

**OBJECTIVE:**

To evaluate the clinical outcome of ACDF with an autologous iliac crest graft (AICG) versus ACDF with an artificial anatomical cervical cage made of polyethereterketone (PEEK) filled with artificial bone substitute for patients with cervical spondylosis.

**METHODS:**

This was a nonrandomized prospective study of 68 patients ( 28 females,41.2%), and (40 males,58.8%) with mean age of 59.4 years, who had symptomatic cervical disc degeneration (CCD) and underwent ACDF from 1st February 2010 till 1st of September 2013.

We divided the patients into two groups, group A made of 25 patients underwent ACDF by using AICG and group B made of 43 patients underwent ACDF by using anatomical cervical cage (PEEK) filled with bone substitute.

All patients were evaluated preoperatively and six months postoperatively by using Neck disability index (NDI), and Visual analogue scale (VAS) for radicular pain, neck pain and headache.

**RESULTS :**

For group A, the postoperative improvement in NDI was statistically significant, and for VAS the postoperative improvement was statistically significant for radicular pain, neck pain and headache.

For group B, the postoperative improvement in NDI was statistically significant, and for VAS the postoperative improvement was statistically significant for radicular pain, neck pain and headache.

The difference in postoperative improvement between group A and B was statistically not significant for NDI, and VAS (radicular pain, neck pain and headache).

**CONCLUSION:**

Both methods are effective in treating cervical spondylosis in selected patients.

No method is statistically superior to another in 6 months postoperative clinical outcomes by using NDI and VAS for radicular pain, neck pain and headache.

**KEY WORDS:** anterior cervical discectomy and fusion, auto bone graft, cage.

## INTRODUCTION:

The vast majority of patients with symptomatic cervical disc degeneration (CCD) respond well to conservative treatment[3].For no responders , surgical treatment using ACDF is an option for selected patients[4].

The anterior approach to the cervical spine for discectomy and fusion by insertion of an autologous iliac crest tricortical bone graft was first described by Robinson and smith in 1955[5].

In 1958,Cloward described a wide anterior cylindrical discectomy performed wit a special reamer combined with anterior fusion by the insertion of autologous iliac crest bone graft of the same shape[6].Several implants used to perform anterior interbody fusion were later described. Bagby et al developed the first interbody fusion cage [7].

The gold standard for ACDF has been fusion with an AICG [6,8].This is a relatively safe procedure with few complications [9,10], however, this surgical procedure has been hampered by iliac crest donor site morbidity. This has led to a

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growing interest in artificial cages made of various materials, including tantalum blocks, titanium, carbon fiber and polyetheretherketone (PEEK), to replace the AICG [11].

The aim of the current study is to compare the clinical outcome of ACDF with a tricortical autologous iliac crest bone graft versus ACDF with an artificial anatomical cage made of PEEK filled with bone substitute.

## PATIENTS AND METHODS:

A prospective nonrandomized study was carried out on 68 patients (28 females, 41.2% and 40 males, 58.8%), with an average age of 59.4 years ranging from 53.5 to 67 years, who had symptomatic cervical disk degeneration and underwent ACDF in the Medical city complex-orthopedic department and private job (Baghdad), from the first of February 2010 till the first of September 2013.

The inclusion criteria for this study were single level degenerative cervical pathology, persistant severe radicular pain not responding to conservative management for three months and cervical radiculopathy with progressive paresis.

The exclusion criteria were patients with fractures, infection, deformity, tumors, chronic systemic illnesses (such as ankylosing spondylitis, diabetes mellitus and rheumatoid arthritis) and cervical myelopathy.

Before surgery, all patients had plain anteroposterior and lateral cervical x –ray and MRI for cervical spine.

The patients were placed in supine position with their necks slightly extended, skin marker is used to confirm the involved spinal level with the use of fluoroscopy. Under general anesthesia, transverse right sided skin incision was made, the trachea and esophagus were retracted medially and neurovascular bundle with the sternocleidomastoid muscle laterally. After fluoroscopic confirmation of the affected level, a complete discectomy and bilateral nerve root decompression was always performed, even in patients with unilateral symptoms. The cervical column was placed in physiological lordosis with the help of a Casper screw distracter. The anterior part of the lower endplate of the upper vertebral body in the superior segment, and the upper endplate of the lower vertebral body were grinded. This was followed by cortical bone removal until the presence of pinpoint bleeding was confirmed.

In group A, which was made of 25 patients, we performed ACDF by using tricortical autologous iliac crest bone graft, this bone graft was harvested from the right iliac crest as a wedge shape with an anterior part height 1-2 millimeters longer than the posterior one, in order to form cervical lordosis and was inserted into the intervertebral space. Care was taken to preserve the anterior 2 centimeters of the iliac crest and the lateral cutaneous femoral nerve. The bone bed was waxed with bone wax. The distracter screw holes were plugged with bone wax to prevent postoperative bleeding.

In group B, which was made of 43 patients, we performed ACDF by using PEEK anatomical cervical cage which was filled by bone substitute and inserted into intervertebral space according to the trial measurements(figure 1).

In both groups A and B, we didn't use plate fixation. Wound drainage was not routinely used. The postoperative protocol included discharge from hospital one day after surgery with soft cervical collar protection for 3 weeks. Postoperative plain cervical x ray, anterioposterior and lateral were taken before discharging the patients from hospital (figure 2).

We follow the patients from both groups regularly and at 6 months postoperatively, we evaluated patient s satisfaction by using NDI and VAS for (radicular pain, neck pain and headache),( figure 3, and 4).

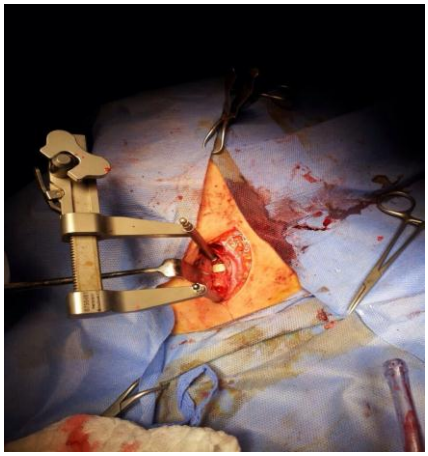

**Figure 1: Intraoperative photo.**

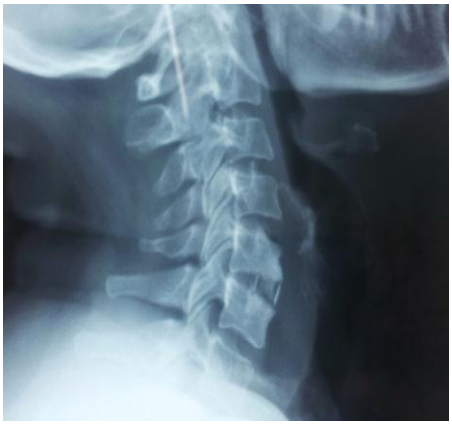

**Figure 2: postoperative lateral cervical x ray with cage.**

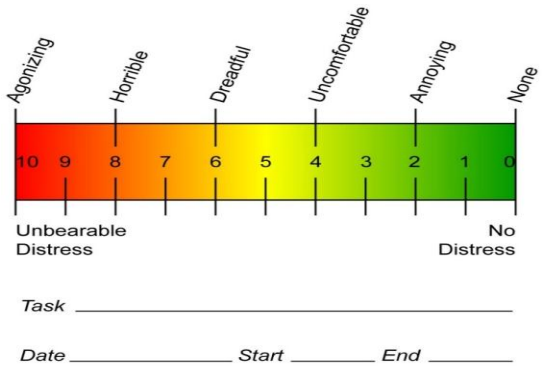


**Figure 3: Visual analogue scale (12).**

**NECK PAIN DISABILITY INDEX QUESTIONNAIRE**

PLEASE READ: This questionnaire is designed to enable us to understand how much your neck pain has affected your ability to manage your everyday activities. Please answer each section by circling the ONE CHOICE that most applies to you. We realize that you may feel that more than one statement may relate to you, but PLEASE JUST CIRCLE THE ONE. CHOICE WHICH MOST CLOSELY DESCRIBES YOUR PROBLEM RIGHT NOW.

| | |
|---|---|
| SECTION 1 - Pain Intensity<br><br>A I have no pain at the moment.<br>B The pain is very mild at the moment.<br>C The pain is moderate at the moment.<br>D The pain is fairly severe at the moment.<br>E The pain is very severe at the moment.<br>F The pain is the worst imaginable at the moment. | SECTION 6 - Concentration<br><br>A I can concentrate fully when I want to with no difficulty.<br>B I can concentrate fully when I want to with slight difficulty.<br>C I have a fair degree of difficulty in concentrating when I want to.<br>D I have a lot of difficulty in concentrating when I want to.<br>E I have a great deal of difficulty in concentrating when I want to.<br>F I cannot concentrate at all. |
| SECTION 2 -Personal Care (Washing, Dressing, etc.)<br><br>A I can look after myself normally without causing extra pain.<br>B I can look after myself normally, but it causes extra pain.<br>C It is painful to look after myself and I am slow and careful.<br>D I need some help, but manage most of my personal care.<br>E I need help every day in most aspects of self care.<br>F I do not get dressed, I wash with difficulty and stay in bed. | SECTION 7 - Work<br><br>A I can do as much work as I want to.<br>B I can only do my usual work, but no more.<br>C I can do most of my usual work, but no more.<br>D I cannot do my usual work.<br>E I can hardly do any work at all.<br>F I cannot do any work at all. |
| SECTION 3 - Lifting<br><br>A I can lift heavy weights without extra pain.<br>B I can lift heavy weights, but it gives extra pain.<br>C Pain prevents me from lifting heavy weights off the floor, but I can manage if they are conveniently positioned, for example, on a table.<br>D Pain prevents me from lifting heavy weights, but I can manage light to medium weights if they are conveniently positioned.<br>E I can lift very light weights.<br>F I cannot lift or carry anything at all. | SECTION 8 - Driving<br><br>A I can drive my car without any neck pain.<br>B I can drive my car as long as I want with slight pain in my neck.<br>C I can drive my car as long as I want with moderate pain in my neck.<br>D I cannot drive my car as long as I want because of moderate pain in my neck.<br>E I can hardly drive at all because of severe pain in my neck.<br>F I cannot drive my car at all. |
| SECTION 4 - Reading<br><br>A I can read as much as I want to with no pain in my neck.<br>B I can read as much as I want to with slight pain in my neck.<br>C I can read as much as I want to with moderate pain in my neck.<br>D I cannot read as much as I want because of moderate pain in my neck.<br>E I cannot read as much as I want because of severe pain in my neck.<br>F I cannot read at all. | SECTION 9 - Sleeping<br><br>A I have no trouble sleeping.<br>B My sleep is slightly disturbed (less than 1 hour sleepless).<br>C My sleep is mildly disturbed (1-2 hours sleepless).<br>D My sleep is moderately disturbed (2-3 hours sleepless).<br>E My sleep is greatly disturbed (3-5 hours sleepless).<br>F My sleep is completely disturbed (5-7 hours) |
| SECTION 5 - Headaches<br><br>A I have no headaches at all.<br>B I have slight headaches which come infrequently.<br>C I have moderate headaches which come infrequently.<br>D I have moderate headaches which come frequently.<br>E I have severe headaches which come frequently.<br>F I have headaches almost all the time. | SECTION 10 - Recreation<br>A I am able to engage in all of my recreational activities with no neck pain at all.<br>B I am able to engage in all of my recreational activities with some pain in my neck.<br>C I am able to engage in most, but not all of my recreational activities because of pain in my neck.<br>D I am able to engage in a few of my recreational activities because of pain in my neck.<br>E I can hardly do any recreational activities because of pain in my neck.<br>F I cannot do any recreational activities at all. |

COMMENTS:_____

_____

_____

NAME: _____ DATE: _____ SCORE: _____

**Figure 4: Neck disability index (13).**

## RESULTS :

A total of 68 patients (28 females and 40 males), with mean age of 59.4 years, underwent ACDF. In group A which is made of 25 patients (9 females and 16 males), the ACDF was done with use of AICG. In group B which is made of 43 patients (19 females and 24 males), the ACDF was done with use of PEEK cage filled with bone substitute. A student t test was performed for all the below results.

**For group A:**

**1- NDI:**

**Table 1**

| Group A | Before surgery | After surgery |
|---|---|---|
| Mean | 38.6480 | 16.4520 |
| Standard deviation | 5.0643 | 6.2977 |
| Standard error mean | 1.0129 | 1.2595 |

P value and statistical significance:

The two-tailed P value is less than 0.0001, this difference is considered to be extremely statistically significant.

**Confidence interval:**
95% confidence interval of this difference: From 18.6173 to 25.7747

**2-VAS for radicular pain**

**Table 2**

| Group A | Before surgery | After suregry |
|---|---|---|
| Mean | 7.7600 | 3.1600 |
| Standard deviation | 0.9695 | 1.1431 |
| Standard error mean | 0.1939 | 0.2286 |

P value and statistical significance:

The two-tailed P value is **less than 0.0001**, this difference is considered to be extremely statistically significant.

**Confidence interval:**
95% confidence interval of this difference: From 4.0285 to 5.1715

**3-VAS for neck pain**

**Table 3**

| Group A | Before surgery | After surgery |
|---|---|---|
| Mean | 6.8000 | 3.8400 |
| Standard deviation | 1.1180 | 0.9866 |
| Standard error mean | 0.2236 | 0.1973 |

P value and statistical significance:

The two-tailed P value is **less than 0.0001**, this difference is considered to be extremely statistically significant.

**Confidenceinterval:**
95% confidence interval of this difference: From 2.3585 to 3.5615

**4- VAS for headache**

**Table 4**

| Group A | Before surgery | After surgery |
|---|---|---|
| Mean | 6.3600 | 3.3600 |
| Standard deviation | 1.2207 | 0.7000 |
| Standard error mean | 0.2441 | 0.1400 |

P value and statistical significance

The two-tailed P value is less than 0.0001, this difference is considered to be extremely statistically significant.

**Confidenceinterval:**
95% confidence interval of this difference: From 2.4671 to 3.5329

**For group B:**

**1-NDI:**

**Table 5**

| Group B | Before surgery | After surgery |
|---|---|---|
| Mean | 36.9395 | 16.0791 |
| Standard deviation | 5.3334 | 5.9316 |
| Standard error mean | 0.8133 | 0.9046 |

P value and statistical significance

The two-tailed P value is **less than 0.0001**, this difference is considered to be extremely statistically significant.

**Confidenceinterval:**
% confidence interval of this difference: From 18.3819 to 23.3391

**2- VAS for radicular pain**

**Table 6**

| Group B | Before surgery | After surgery |
|---|---|---|
| Mean | 7.9070 | 3.5116 |
| Standard deviation | 0.8948 | 1.3518 |
| Standard error mean | 0.1365 | 0.2061 |

P value and statistical significance:

The two-tailed P value is less than 0.0001, this difference is considered to be extremely statistically significant

**Confidence of interval:**
95% confidence interval of this difference: From 3.9752 to 4.8155

**3-VAS for neck pain**

**Table 7**

| Group B | Before surgery | After surgery |
|---|---|---|
| Mean | 7.2326 | 3.8372 |
| Standard deviation | 0.9719 | 1.0675 |
| Standard error mean | 0.1482 | 0.1628 |

P value and statistical significance

The two-tailed P value is **less than 0.0001,** this difference is considered to be extremely statistically significant.

**Confidence interval:**
95% confidence interval of this difference: From 2.9543 to 3.8364

**4- VAS for headache**

**Table 8**

| Group B | Before surgery | After surgery |
|---|---|---|
| Mean | 6.5581 | 3.5349 |
| Standard deviation | 1.2402 | 0.7668 |
| Standard error mean | 0.1891 | 0.1169 |

P value and statistical significance:

The two-tailed P value **is less than 0.0001,** this difference is considered to be extremely statistically significant.

**Confidenceinterval:**
95% confidence interval of this difference: From 2.5804 to 3.4661

**Comparing the two groups' results:**

**1- NDI between group A &B**

**P value and statistical significance:**
The two-tailed P value equals **0.8077**, this difference is considered to be not statistically significant.

**Confidence interval:**
95% confidence interval of this difference: From -2.6737 to 3.4196

**2- Radiculer pain between group A &B**

**P value and statistical significance:**
The two-tailed P value equals **0.2786**, this difference is considered to be not statistically significant

**Confidence interval:**
95% confidence interval of this difference: From -0.9943 to 0.2910

**3- Neck pain between group A &B**

**P value and statistical significance:**
The two-tailed P value **equals 0.9915**, this difference is considered to be not statistically significant.

**Confidence interval:**
95% confidence interval of this difference: From -0.5188 to 0.5244

**4-Headache between group A & B**

**P value and statistical significance:**
The two-tailed P value **equals 0.3529,** this difference is considered to be not statistically significant.

**Confidence interval:**
95% confidence interval of this difference: From -0.5481 to 0.1983

## DISCUSSION:

Anterior cervical discectomy and decompression with interbody fusion can be a good surgical choice when conservative treatment for cervical dis herniation or cervical spondylosis fail[2,6,14,15].Discectomy alone may lead to inferior clinical results due to loss of disc height, narrowing of the neural foramen and to malalignment of the cervical spine because of the resulting kyphosis of the motion segment[16].Although tricortical autograft harvested from the iliac crest as interbody fusion material can provide satisfactory clinical results and fusion rates[2,17],complications rates at the donor site are around 20% [18,19],and could be a potential disadvantage of this technique. The complications include pain, hematoma, infection, lateral femoral cutaneous nerve injury, ilium fracture, peritoneal perforation, hernia and cosmetic problems[20,21].According to Sawin et al[22] in patients who experienced postoperative pain at the donor site for autogenous bone graft,36% of patients continued to experience pain one year postoperatively. The cage and bone substitute methods enjoy advantages that include reduced bleeding, operation time and skin scars during harvesting of bone graft materials [23]. Interbody cages provide initial stability and, by filling the disc space, require less structural bone graft and consequently reduce the morbidity associated with autogenous bone graft harvesting[7,17,18,24].Different types of cages are available to perform ACDF,including titanium cages, carbone fiber reinforced polymer (CFRP) cages, and polyetheretherketone (PEEK) cages[25]. Titanium cages can provide mechanical support, initial disc height maintenance, and restoration of sagital lordosis; however, unfavorable outcomes were reported in some studies [26,27,28]. Kolstand et al [24] reported several unfavorable outcomes following radiological parameter analysis after ACDF using a cylindrical titanium cage. In another study subsidence or migration of the titanium cages were observed, resulting in disc height collapse and kyphotic deformity [29]. Metallic cages are radioopague, which prevents clear observation of trabecular bone formation and of radiographic fusion signs[25].Carbone fiber cages(CFC) can be safe and effective and can lead to restoration of segmental alignment and solid fusion[30,31],however, high rates of subsidence have been reported following ACDF using CFC(29.2%) in some studies [32].According to Kettler et al [33] and Wilke et al [34] subsidence in the cage endplate arises from instability due to mobility of the cervical area following discectomy.Subsidence is variable with cage endplate design. Compared with bone segment, however, subsidence has been reported to occur at higher incidence [33].Reports suggest that endplate subsidence with cages significantly retains increased intervertebral disc space compared with that preoperatively. It is able to improve the overall sagittal alignment of the cervical vertebrae, and its severity and incidence have no effects on clinical outcomes [23]. In one study [23], the mean endplates subsidence was increased by approximately one millimeter in patients who receive a cage compared with patients who received autogenous bone graft. This difference was statistically significant. Because the period of bone union was prolonged in patients who received a cage, it is assumed that

the subsidence may be related to longer exposure to instability due to cervical movement [23].

In our study, we evaluated the patients in group A and B preoperatively and six months postoperatively for clinical satisfaction using NDI and VAS for (radicular pain, neck pain and headache), and there was statistically significant improvements in these parameters for both groups, but there was no statistically significant difference between group A and B. So, because of similar clinical outcomes and lack of donor site morbidity when using PEEK cage, we prefer fusion with PEEK cage to AICG, however cage fusion is more expensive because of the cost of the implant and bone substitute.

## CONCLUSION:

Both methods are effective in treating cervical spondylosis in selected patients. No method is statistically superior to another in 6 months postoperative clinical outcomes by using NDI and VAS for radicular pain, neck pain and headache.

***Limitations of our study:***

-The patients were not randomized to fusion with either AICG or PEEK cage. The type of fusion was in each case decided by the surgeon. This may cause bias in the material.

-The follow up evaluation was done by the surgeon and not an independent investigator; this may have influenced the final result.

-The current study is also limited by short term follow up. This will require further investigations.

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