

Anterior Cervical Discectomy with Fusion in Patients with Degenerative Cervical Disc Disease

Himdad Hadi Hameed (MBCChB)¹ and Emad Khaleel Hammood (MBCChB, FICMS (NS))²

Abstract

Background: Anterior cervical discectomy with fusion (ACDF) is challenging with respect to both patient selection and choice of surgical procedure.

Objective: To determine the age of patients with degenerative cervical disc disease undergoing surgery, to determine the clinical and radiological findings of degenerative cervical disc disease, and to find out the rate of success for relieving pain and radiculopathy.

Patients and Methods: This is a clinical prospective study of 50 patients (case series of patients with chronic degenerative cervical disease) operated on from October 2015 to October 2018. Their ages ranged from 48-78 years, they were treated with anterior cervical discectomy with fusion, and fusion was achieved with Polyether ether ketene (PEEK) cage. Follow up using visual analog scale (VAS), out of 10 scores, was done for at least one year after the operation (at six months, nine months and one year postoperatively) for both neck pain and shoulder pain (radicular pain).

Results: The mean age + SD was 63.8 + 8.4 years, 54% of the patients were females, 92% of the patients had single level ACDF, and 8% had multiple levels ACDF. The most common presentation in both genders was pain & radiculopathy (56%), followed by radiculopathy (28%), and less common presentation was pain alone (16%). The patient who has short history of the symptom (less than 6 months) gave good postoperative results and showed improvement in the symptom, 64% of the patients improved and 4% of them had no change. In the 2nd group (the symptom more than 6 months): 10 patients improved out of 16 (62.5%), four of them had no change and two of them deteriorated & re-operated for adjacent level.

Conclusion: ACDF is an effective treatment for pain & radiculopathy in selected patients with chronic degenerative cervical disease (CDCD) after one year of follow up.

Keywords: Chronic degenerative cervical disease, anterior cervical discectomy with fusion

Corresponding Author: Himdadhadi1@gmail.com

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¹ Ministry of Health - Erbil - Iraq

² College of Medicine-Hawler Medical University-Erbil-Iraq

Introduction

Cervical pain that is associated with cervical degenerative disc disease can be incapacitating and can compromise the quality of life. It has been shown on magnetic resonance imaging that many adults can have cervical degenerative disc disease without any associated clinical symptoms[1,2]. Conservative management is the initial preferred management for symptomatic patients with degenerative cervical disc disease. The majority of the patients respond well to conservative management[3]. Anterior cervical discectomy and fusion (ACDF) has been recommended for the subgroup of patients who do not respond to the conservative management [4,5]. In well-selected group of patients (i.e., significant radicular pain, younger age, single-level soft disc, matching radiological and clinical findings, and well-preserved neurological functions), ACDF has been shown to be associated with good outcome [6,7].

Commonly reported symptoms in Degenerative cervical disc disease (DCDD) are neck pain/stiffness, unilateral or bilateral limb/body pain, upper limb weakness, and numbness[8]. Other symptoms like: lower limb stiffness, weakness, with loss of stretch reflex and sensory loss, [9,10] paresthesia (tingling or pins and needles sensations), autonomic symptoms such as bowel or bladder incontinence, erectile dysfunction, or difficulty passing urine, imbalance/unsteadiness [10].

For the diagnosis we use: plain x-rays of the cervical spine provide good information regarding the bony anatomy [11, 12]. MRI

images show both bony detail and soft tissue detail such as spinal cord, nerve roots, and ligament's structures, abnormal increase in the cord signal suggests gliosis or intrinsic cord damage or atrophy which MRI can't distinguish between them and mechanical[13,14] CT's show excellent bony detail. Steps of surgery: [9, 10, 15]

Step 1 Patient's preparation: The patient lies on his back on the operative table and be given anesthesia, neck area is cleansed and prepped.

Step 2 Incision: A 3 cm skin incision is made on the right or left side of patient's neck. The surgeon will make a tunnel to the spine by moving aside muscles in the neck and retracting the trachea and esophagus medially while artery retracted laterally. Finally, the muscles that support the front of the spine are separated so the surgeon can clearly see the bony vertebrae and discs.

Step 3 Localization of the damaged disc: With the aid of X-ray the surgeon will insert thin needle into the disc to locate the affected disc. The vertebrae bones above and below the damaged disc are spread apart with a special retractor.

Step 4 Removal of the disc: The outer wall of the disc is cut. The surgeon will remove most of the disc material using small grasping tools, and then with the aid of surgical microscope the rest of the disc will be removed. Any disc material pressing on the nerves should be removed. The disc annulus is cut open and the disc material is removed with grasping tools.

Step 5 Decompress the nerve: Bone spurs that press on the nerve root are removed. The foramen, through which the spinal nerve exits, is enlarged. This procedure, called a foraminotomy.

Step 6 Prepare a bone graft fusion: Fusion cage. A bioplastic cage (PEEK) is filled with the leftover small bone pieces containing bone-growing cells and proteins. The graft is then inserted into prepared disk space.

Step 7 Close the incision: After achieving good homeostasis the retractors are removed. The muscle and skin will be sutured. Sterile Strips is placed across the incision.

The general complications of any surgery include bleeding, infection, blood clots (deep vein thrombosis), and reactions to anesthesia [15].

Specific complications related to ACDF may include: Hoarseness and swallowing difficulties, vertebrae failing to fuse, transitional syndrome, carotid or vertebral arteries injury, airway obstruction due to hemorrhage or laryngeal edema and nerve damage or persistent pain.

The study rationale: anterior cervical discectomy and fusion is proven effective treatment for relieving neck pain due to degenerative conditions of cervical spine; since most of the patients presents with radiculopathy, little is known as to the effectiveness of ACDF to relieve pain and improve function in patients with degenerative cervical disease.

The objectives of the study were: To determine the age of patients with degenerative cervical disc disease undergoing

surgery, to determine the clinical and radiological findings of degenerative cervical disc disease, and to find out the rate of success for relieving pain and radiculopathy.

Patients and Methods

A prospective case series study (review of cases) had been done in Hawler teaching hospital & Rozhawa emergency hospital in Erbil (Kurdistan-Iraq). The study included 50 patients affected with degenerative cervical disc disease and managed surgically by anterior cervical discectomy with fusion.

One or more of the following symptom and signs should be present in a patient in order to be included in the study: Persisting severe radicular pain not responding to the conservative treatment for three months, cervical radiculopathy with progressive paresis, and progressive weakness in the upper and lower limbs. In addition to that: MRI documented cervical canal stenosis with compression of the cervical nerve root and spinal cord, which most likely explain the clinical symptoms and signs.

The patients had attended the above mentioned hospitals during October 2015 to October 2018. Patients with cervical trauma, cervical neoplasm and cervical abscess had been excluded from the study. In each patient, the neurological assessment on arrival was performed using Nurick scale [16] which consists of 6 grades from zero to 5, starting from simple root involvement without spinal cord disease (grade 0) to the bed ridden patient (grade 5). The diagnosis was made by the magnetic resonance imaging (MRI). The same criterion was

subsequently applied for the evaluation of the outcome.

Surgery was performed for all the patients by putting the patient in supine position, under general anesthesia single transverse, small incision (3 cm) just anterior to the sterno-clidomastiod muscle, muscle separated reaching the anterior part of the spinal column (anterior body), the level was identified by the use of the X-ray, the discectomy of the affected level was performed. Removal of the posterior osteophyte (if present) will allow implanting of the PEEK cage in the desirable position.

Statistical analysis

Data were entered into the Statistical Package for Social Sciences (SPSS, version

22). Numerical variables were presented as means and standard deviations, and the categorical variables were presented as proportions. Fisher's exact test was used (instead of the Chi square) to compare proportions because the expected count of more than 20% of the table was less than 5. A 'p' value of ≤ 0.05 was considered as statistically significant.

Results

Fifty patients were included in the study, their mean age \pm SD was 63.86 ± 8.48 years, ranging from 48 to 78 years. The median was 63.5 years. Table 1 shows that around one third (32%) of the patients aged 60-69 years, and another 32% aged 70-79 years. More than half (54%) of the sample were females.

Table (1): Age and gender distribution of patients

	No.	(%)
Age (years)		
40—49	1	(2.0)
50—59	17	(34.0)
60—69	16	(32.0)
70—79	16	(32.0)
Gender		
Male	23	(46.0)
Female	27	(54.0)
Total	50	(100.0)

Results showed that most of the patients presented with grade 2 (slight difficulty in walking). Table (2) shows that a single level was affected in the majority (92%) of the patients.

Regarding the chief complaint, 56% of the patients had upper limb pain and paresthesia, 28% had upper limb paresthesia, and 16% had upper limb pain.

Table (2): Level affected and chief complaint of patients

	No.	%
Level		
Single level	46	(92.0)
Multiple levels	4	(8.0)
Chief complain		
Upper limb Pain	8	(16.0)
Upper limb pain & paresthesia	28	(56.0)
Upper limb paresthesia	14	(28.0)
Total	50	(100.0)

It is evident in Table (3) that C5-C6 level was affected in 86% of the patients, C5-C6 & C6-C7 (multiple levels) were affected in 8% of the patients, and the C4-C5 was affected in 6% of the patients.

Table (3): Distribution of the patients according to the level affected by using MRI

level affected	No.	%
C4-C5	3	(6.0)
C5-C6	43	(86.0)
C5-C6 & C6-C7	4	(8.0)
Total	50	(100.0)

Table (4) shows that there was no significant association between the number of the levels and the outcome ($p > 0.999$). Regarding the duration of the symptoms, 94.1% of the patients improved when the duration of symptoms was less than six months, 62.5% of patients improved when the duration of symptoms was ≥ 6 months ($p = 0.009$).

Table (4): Final outcome of the patient according to the level affected & duration of symptom before surgery

	Improved		Deteriorated		Unchanged		Total		P*
	No.	%	No.	%	No.	%	No.	%†	
No. of levels									
Single Level	40	(87.0)	2	(4.3)	4	(8.7)	46	(92)	
Multiple Levels	4	(100.0)	0	(0.0)	0	(0.0)	4	(8)	> 0.999
Total	44	(88.0)	2	(4.0)	4	(8.0)	50	(100.0)	
Duration of symptom (months)									
< 6	32	(94.1)	0	(0.0)	2	(5.9)	34	(68.0)	
≥ 6	10	(62.5)	2	(12.5)	4	(25.0)	16	(32.0)	0.009
Total	42	(84.0)	2	(4.0)	6	(12.0)	50	(100.0)	

*By Fisher's exact test. †Column % was calculated

It is evident in Table (5) that there was a significant decrease in the pain scores after the operation regarding neck pain and brachialgia ($p < 0.001$).

Table (5): Assessment of clinical outcome for pain in the neck and brachialgia using VAS score for pain

Type of pain	Mean \pm SD					P*
	Pre-operative	1 month	3 months	6 months	1 year	
Neck pain	7.78 \pm 0.89	5.94 \pm 1.00	4.02 \pm 0.89	1.90 \pm 0.74	2.86 \pm 1.37	<0.001
Brachialgia.	7.46 \pm 1.07	5.62 \pm 1.2	3.52 \pm 1.07	1.72 \pm 0.64	2.44 \pm 0.99	<0.001

*By Wilcoxon signed rank test comparing the mean ranks of pre-operative score with the mean ranks assessed 1, 3, 6, and 12 months after the operation

Table (6) shows that the fusion was attained in 34% of the patients six months after the operation. This rate increased to 72% nine months after the operation, and to 100% one year post-operatively.

Table (6): Fusion rates, six months, nine months, and one year after the operation

Follow up period	No.	% (n = 50)
Six months	17	(34.0)
Nine months	38	(72.0)
One year	50	(100.0)

The main complications were as follows: transient dysphagia (20%), cage subsidence (16%), transient hoarseness (14%), in addition to other complications mentioned in the table.

Table (7): Incidence of complications

Complication	No. of cases	%
Transient dysphagia	10	(20.0)
Cage subsidence	8	(16.0)
Transient hoarseness	7	(14.0)
Adjacent segment	3	(6.0)
Infection	2	(4.0)
Dural tear	1	(2.0)
Hematoma	0	(0.0)
Spinal cord injury	0	(0.0)

Discussion

The age range of our study sample was 48-78 years, and the median was 63.5 years. The median age was 47.5 years in a study done by Lied et al who showed that the age range of patients with DCDD was 28.3 to 82.8 years. [17]. Regarding the gender distribution, more than half (54%) of our patients were females, while it was 44% in the Lied study. The most

common presentation was pain & radiculopathy of the upper limb (56%), while in Lied et al study,[17] only 6.2% of the patients presented with upper limb pain and radiculopathy. The 2nd presentation was the upper limb parasthesia (28%), while in Lied et al study[17] it was 61.0%. The 3rd was upper limb pain alone, this occurred in 16 %

of cases, while in Lied et al study[17] it was 10.1%. As we noted the presentation of the pain & radiculopathy increased from (6.2 %) to the (56 %) and this could be attributed to improvement of the medical knowledge of the physicians who referred the cases, improvement in the diagnostic methods (MRI and EMG).

The most common level affected in our study was C5-C6 (86%), the second most common level affected was C6-C7 (8%). This coincide with the results of Lied et al[17]. While the most common level affected in a study done by Hukuda and Kojima[18] was C4-C5 and C6-C7.

The proportion of patients with single level was 92%, while it was 59% in Lied et al study[17]. The proportion of patients with multiple levels was 8%, while it was 41% in Lied et al study[17]. In a study done by Hukuda and Kojima[18] the majority (76%) of the patients had multiple levels disc disease which is much higher than the rate (8%) of our study. This may indicates that our patients had an early seeking treatment behavior than the patients of the mentioned study. The majority of the patients (88%) improved post-operatively, 4% deteriorated, and the rest (8%) remained in the same condition. Patients with multiple level diseases showed a better outcome (although the difference was not significant), and this could be due to small sample size (only four patients had multiple level diseases).

In our prospective study, cervical neck pain showed statistically significant relief ($P < 0.001$) throughout follow up till one year

using the VAS score for cervical neck pain (The visual analog scale (VAS) is a validated, subjective measure for acute and chronic pain. Scores are recorded by making a handwritten mark on a 10-cm line that represents a continuum between “no pain” and “worst pain). Song Kj et al. reported improvement of the clinical outcome after 3 level discectomy and cage fusion [19]. In this prospective study, we noticed that brachialgia mean score significantly improved according to the VAS score from 7.4 to 2.4 ($P < 0.001$). 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 [20]. Transient dysphagia occurred in 10 patients (20%), and transient hoarseness of voice in 7 patients (14%), 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 2 months, and it is due to unilateral affection of recurrent laryngeal nerve. De La Garza-Ramos and his colleagues reported a high incidence of dysphagia and transient hoarseness of voice in three and four levels stand-alone cage fusion [21, 22]. In our study we noticed mild increase of VAS score for neck pain from 1.9 at six months to 2.8 at 1 year and for brachialgia from 1.7 at six months to 2.4 at one year, 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 nearly the same results about the improvement of clinical symptoms with three levels stand-alone cervical cages with the use of allograft. [23], [24] Cage subsidence occurred when there is a decrease of the disc space ≥ 3 mm, from the original postoperative X-ray. In our prospective series study, the rate of subsidence was 8 cases (16%), and only two 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 in half of their cases with no effect on the clinical results. [20]. In our study, the rate of bone fusion was 34% at the end of the sixth months, 72% by the end of the nine months and 100% at one 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. Pereira EAC et al. observed these results in their study on patients requiring three and four-level discectomy and stand-alone cage fusion [25, 20].

Conclusions

Best results were obtained when the duration of the symptoms was short (less than 6 months) and with mild presenting symptoms before the irreversible neurological deficit occur. The number of the patients that returns to the work after 6 month was higher than the expected.

Recommendations

The decision of the surgical intervention should be done as soon as the conservative treatment fails and before the permanent neurological deficit occurs. Long term follow up needed in such cases.

Conflict of interest

The authors declare that there is no conflict of interest.

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