

Does Cervical Plate Add Value in Single or Double Level Anterior Cervical Discectomy and Fusion?

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Abstract

Background Data: Optimal surgical approach for anterior cervical discectomy and fusion (ACDF) is still controversial. Some authors believe that addition of locking plate (ACDFP) has higher costs and longer operative time. Other surgeons believe that ACDFP have better clinical outcomes and more sound fusion. The debate is higher in single and double level ACDF.

Purpose: To compare the clinical and radiological outcomes in patients with single or double level cervical disc herniation operated by ACDF versus those operated by ACDFP.

Study Design: A retrospective, descriptive controlled, non-randomized, clinical case study.

Patients and Methods: Forty patients underwent ACDF. They were divided into two groups; ACDF group and ACDFP fixation group. Each group included 20 patients. They were operated between 2010 and 2017. Participants were evaluated pre-operatively and post-operatively 1, 3, 6, 9 and 12 months after surgery. Operative time, hospital stay and complications were assessed. Pain was scored by a VAS for both upper arm and cervical pain. The clinical outcomes were compared using Odom's criteria. Cervical fusion was assessed radiologically.

Results: The demographic data of the two groups of patients were fairly homogeneous and comparable. ACDFP group showed slightly better clinical outcome parameters in comparison to ACDF group including VAS for cervical pain (9 ± 5 versus 28 ± 11) and Odom's criteria scores (15 excellent outcome versus 10). Also ACDFP group showed slightly better radiological fusion rate (100%) in comparison to (85%) in ACDF group. Reported non-union was higher in ACDF group (15%) in comparison to ACDFP group (0%).

Conclusion: Our data suggest that the addition of cervical plate fixation to ACDF might leads to better clinical outcome and radiological fusion in single and double cervical disc disease. (2018ESJ155)

Keywords: anterior cervical fusion; anterior cervical plate; cervical discectomy; cervical fusion; Outcome

Introduction

Anterior cervical discectomy and fusion (ACDF) is a commonly performed procedure. Although disc arthroplasty is gaining popularity, the ACDF procedure

remains the gold standard. There is much controversy surrounding the role of anterior cervical locking plates for patients undergoing ACDF especially in single or double level ACDF.^{9,11} The indications for ACDF include radiculopathy, myelopathy,

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myelo-radiculopathy and traumatic instability. Anterior cervical discectomy without interbody fusion is practiced by some authors for degenerative disease⁷ however many authors now advocate fusion in addition to the discectomy.^{12,18}

There are various techniques for performing ACDF depending on surgeon preference, including the Cloward technique or discectomy and interposition graft.^{1,5} The interposition graft used may include autologous bone, allograft, synthetic material or metallic cages. ACDF is further modified by using anterior locking plates for stabilization (ACDFP). The additional costs and longer operative time involved in ACDFP have led investigators to examine for any significant difference in fusion and clinical outcome between ACDF and ACDFP patients. Some spine surgeons believe that ACDFP have better clinical outcomes and more sound fusion. The debate is higher in single and double level ACDF.^(???)

This study was designed trying to solve part of this dilemma and to see if adding cervical plate to ACDF would yield better results.

Patients and Methods

This study was designed as a retrospective descriptive controlled, non-randomized, clinical case study. Between February 2010 and July 2017 the medical records at Suez Canal area Hospitals (Ismailia, Egypt) were reviewed for a total of forty consecutive patients who met the inclusion criteria. Patients to have undergone one- or two-level cervical discectomy, and fusion with PEEK cage filled with hydroxyapatite calcium phosphates for degenerative cervical disease with or without cervical locking plate and suffered from either radiculopathy and or myelopathy were included. We excluded patients who had Corpectomy, discectomies at more than two levels, simultaneous posterior procedures, traumatic disc prolapse, severe comorbidity and inadequate follow-up. Patients were categorized into two groups; Group 1: included 20 patients who had ACDF, and Group 2: included 20 patients who had ACDF augmented with cervical locking plate fixation (ACDFP).

Preoperative assessment included patient history, physical examination and neurological examination. Imaging included antero-posterior,

lateral and dynamic lateral X-rays and MRI of the cervical spine. Clinical outcome was evaluated using Odom's criteria.¹⁴ Pain was evaluated using Visual Analog Scale (VAS) for both arm and axial cervical pain. Patients were scheduled for surgery after adequate conservative therapy and radiographically confirmed clinical diagnosis.

In ADCF group patients were operated with anterior disc discectomy (Smith Robinson technique)¹⁶ and fusion using standalone PEEK cage filled with Hydroxyapatite calcium phosphates. In ACDFP group fusion was augmented with an anterior cervical locking plate (Egyfix, Egypt™). All the patients were operated by the same surgeons. The cervical spine was approached through an anterior transverse incision on the right side of the neck. The anterior longitudinal ligament was excised over the disc space, and the anterior half of the disc was removed macroscopically. The remaining posterior part of the nucleus pulposus and the herniated fragment was removed under magnification with the Microscope. The cartilaginous end plate curettage was done to prepare for interbody fusion. The PEEK cage was filled with bone substitute as Hydroxyapatite calcium phosphates. Anterior cervical locking plate was added according to preference of surgeon. Postoperatively, patients operated without a plate were treated with a hard collar for 6 weeks and those operated with plate fixation wore a soft collar for 6 weeks.

In both groups of patients, duration of surgery, blood loss, and the duration of inpatient treatment were recorded. Intraoperative and perioperative complications were assessed.

Patients were followed at 1, 3, 6, 9 and 12 months after surgery. During follow up visits the following data were collected: location of pain; intensity of arm and cervical pain according to the VAS; neurological symptoms; medication, complications, recurrence of symptoms and subsequent need for further spinal surgery. Assessment of the patients' clinical outcome was evaluated using Odom's criteria.¹⁴ An excellent result includes; patients who were asymptomatic and had no impairment of their daily living and occupations, good results; intermittent discomfort but without interference with occupational activities, fair results; subjective

improvement but still significant limitations of physical activities and poor results; no improvement or deterioration.

Radiological interbody fusion was assessed at individual levels as observed on plain radiographs that were obtained postoperatively at each visit. Fusion was defined as a continuous bone bridge between the vertebrae seen in lateral X-ray in and around cages. Radiographic fusion was defined as no lucency between the cage and the vertebral body and evidence of remodeling. Persistent lucency was interpreted as a nonunion. Radiographs were examined for evidence of further ongoing cervical degeneration.

Results

The demographic data of the two study groups are presented in (Table 1) and showed that the preoperative data of both groups of patients were fairly homogeneous and comparable. Over all 40 patients divided into 2 groups 20 patients each were reported with complete data. In ACDF group, 12 patients had single level discectomy and 8 patients had double level discectomy. In ACDFP group, 11 patients had single level discectomy and 9 patients had double level discectomy. The mean age in ACDF group was 43.5 ± 18 (Range, 24-61) years in comparison to 41.5 ± 19 (Range, 24-64) years in the ACDFP group. There were 12 male patients in each group. Over all a positive smoking history was recorded in ten patients of the study group (25%) five patients in each group. There was no statistical significant difference between the two groups for these parameters.

The mean preoperative symptoms duration of the total patients was 20 ± 5 (Range, 1-90) months. Patients in the ACDF group had mean preoperative symptoms duration 19 ± 5 (Range, 1-84) months in comparison to 21 ± 4 (Range, 3-90) months in patients in the ACDFP group.

Figure 1 shows distribution of the operative level within the two study groups. About 57.5% of surgeries were done at C5-6 level either single or double level. In ACDF group 7 patients presented with radiculopathy, 10 patients presented with myelopathy and 3 patients presented with radiculomyelopathy. In comparison to 6 patients

presented with radiculopathy, 12 patients presented with myelopathy and 2 patients presented with radiculomyelopathy in ACDFP group. In regard to the perioperative findings in the 2 groups, the intraoperative blood loss, operative time and hospital stay were fairly comparable in both groups. (Table 2). The mean operative time of ACDF group was 130 ± 37 minutes in comparison to 140 ± 41 minutes in ACDFP group and this was statistically insignificant ($P=0.32$).

The Visual Analogue Scale for cervical pain in all patients showed statistically significant improvement in the ACDFP group all over the follow up period. (Figure 2) At 3 months follow up, the mean VAS for cervical pain was 39 ± 12 in ACDF group in comparison to 19 ± 9 in ACDFP group. ($P=0.019$). At 1 year follow up, the mean VAS for cervical pain was 28 ± 11 in ACDF group in comparison to 9 ± 5 in ACDFP group. ($P=0.017$). Also the Visual Analogue Scale for arm pain showed in significant better results in the ACDFP group (Figure 3).

Clinical outcome evaluated by Odom's criteria showed that ACDFP group showed statistically significant improvement in the clinical outcomes in comparison to ACDF group (Table 3) An excellent clinical outcome was more common in the ACDFP group (15 patients) compared with the ACDF group (10 patients); this was significant ($P=0.01$). However, for poor outcomes, in the study group, the ACDFP group had no poor results, with compared to one patient of the ACDF group); this was non-significant ($P=0.19$). (Table 3)

Radiological outcome of fusion for both plated and non-plated groups at 3 months, 6 months and 12 month showed that the ACDF group fusion at 3 months was 55%, at 6 months, 70% and at 12 months, 85%. Meanwhile ACDFP group fusion was 70%, 95% and 100% at the corresponding periods. At 1 year follow –up, there were 3 patients who showed non union in ACDF group. One patient had double level ACDF (both levels showed nonunion) and the other 2 patients had single level ACDF. Only one patient of the 3 was smoker.

Reported morbidities in this study were comparable in both groups except those related to fusion that occurred in ACDF group including; Nonunion ($N=3$), kyphosis ($N=2$) and graft extrusion

(N=1) (Table 4) Cases with nonunion and kyphosis was managed by medical treatment for pain, physiotherapy and epidural steroid injection. The case with graft extrusion (Figure 6) was managed surgically by iliac bone graft and plate fixation (ACDFP). The costs of surgery were higher in ACDFP group. The average cost of a case of ACDF was 15,000±1500 EGP. The average cost of a case of ACDFP was 18,500±1200 EGP. This was statistically significant (P=0.01).

Table 1. Demographic Data of Patients Reported in this Study

Parameters	ACDF		ACDFP	
	One level	Two levels	One level	Two levels
Patients number	12	8	11	9
Age	43±15 (24-61)	44±14 (26-58)	40±13 (27-63)	43±16 (24-64)
Sex (male/female)	7/5	5/3	7/4	5/4
Smokers	3	2	3	2
Duration of symptoms/ months	14±13 (1-80)	24±14 (1-84)	16±13 (3-72)	26±18 (4-90)

Table 2. Peri Operative Data of the Study Groups

Parameters	ACDF	ACDFP
Blood Loss (ml)	120±30 (90-180)	140±40 (100-190)
Surgical Time (min)	130±37 (90-180)	140±41 (100-190)
Days in hospital	1.7±1.3 (1-4)	0.9±1.5 (1-5)

Table 3. Clinical Outcome According to Odom's Criteria

Patients		Excellent	Good	Satisfactory	Poor
ACDF	One level	7	3	2	0
	Two levels	3	2	2	1
ACDFP	One level	8	3	0	0
	Two levels	7	1	1	0
P value between 2 groups		(P=0.01)	(P=0.10)	(P=0.007)	(P=0.19)

Table 4. Reported Morbidities in Patients of this Study

Parameters	ACDF	ACDFP
Vocal cord dysfunction (transient)	1	1
Dysphagia (transient)	1	2
Infection	0	1
Neurological deterioration	1 (Brown-Sequard)	0
Non union	3	0
Kyphosis	2	0
Graft extrusion	1	0

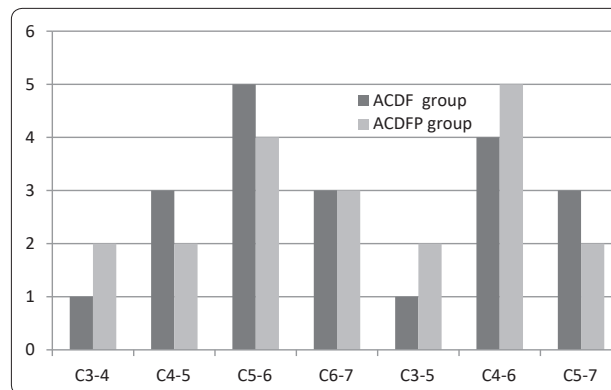


Figure 1. Distribution of level of surgery in the two groups of patients

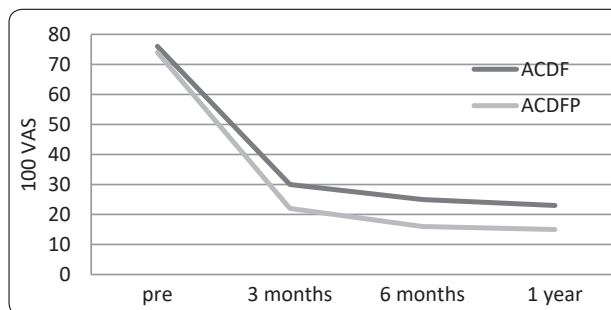


Figure 2. A significant reduction in VAS of cervical pain in ACDFP group in comparison to ACDF group

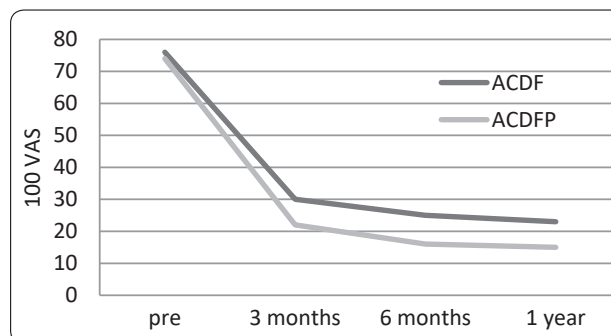


Figure 3. A significant reduction in VAS of arm pain throughout the observation period in the 2 study groups.

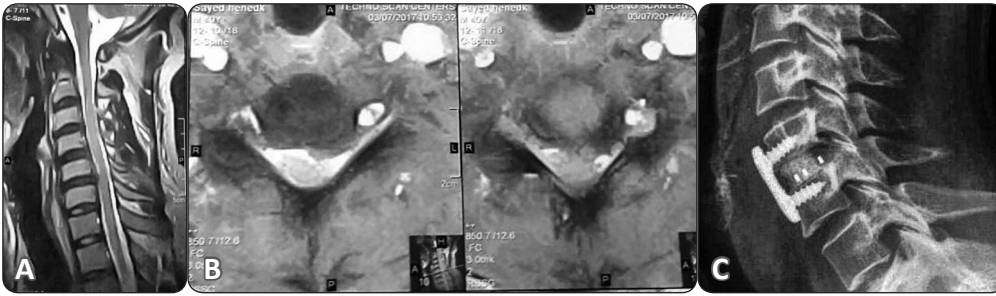


Figure 4. A and b: preoperative MRI cervical spine showing CDP C5-6. C: ACDFP was done and follow up X-ray cervical spine after 6 months showing bone fusion.

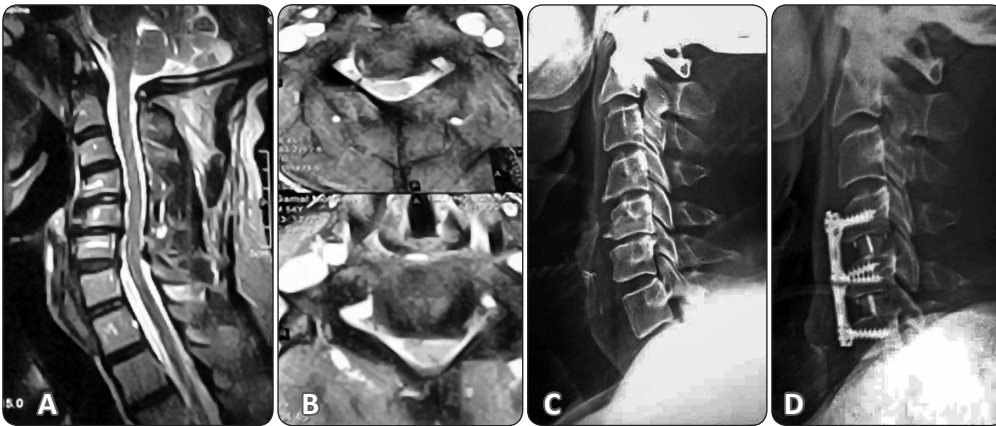


Figure 5. A and b: preoperative MRI cervical spine showing CDP C4-5 and C5-6. C: preoperative X-ray cervical spine showing narrowing of disc spaces. d: ACDFP was done and follow up X-ray cervical spine after 3 months showing bone fusion restoration of disc height.

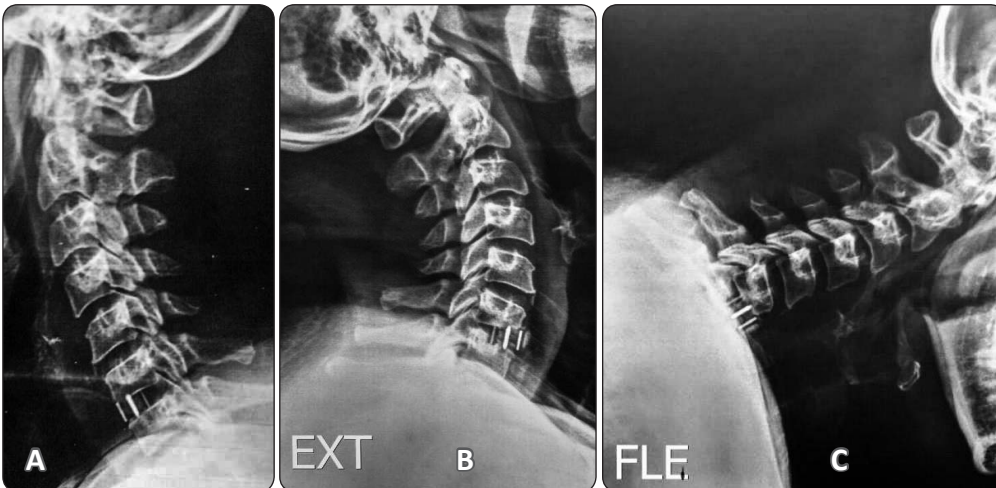


Figure 6. A: immediate postoperative X-ray cervical spine ACDF C6-7 b and c: 3 months postoperative X-ray cervical spine showing non-fusion and graft extrusion.

Discussion

This study included 40 patients who were divided into 2 groups equally. The demographic data were fairly homogeneous. ACDFP group showed slightly better clinical outcome parameters in comparison to ACDF group including VAS for cervical pain (09 ± 5 versus 28 ± 11) and Odom's criteria scores (15 excellent outcome versus 10). Also ACDFP group showed slightly better radiological fusion

rate (100%) in comparison to (85%) in ACDF group. Reported non-union was higher in ACDF group (15%) in comparison to ACDFP group (0%).

Studies comparing the results of ACDF and ACDFP were reviewed. Bose² described 97.9% fusion with plates with acceptable instrumentation-related morbidity, which improves with experience (10.7% instrument-related morbidity in the first 38 cases and 1.69% in last 59 cases). In our ACDFP group, we had 100% fusion rate. Cauthen⁴ reported 348

patients operated by ACDF and found 13% required an additional operation: 7% required revision fusion surgery with the addition of plate fixation. In our ACDF group, addition of plate was required in 5% of patients. Cauthen further reviewed 23 selected studies of ACDF. Total patients numbered 2037, in which he noted 92% solid fusion. He reviewed another six reports where fusion rates were shown by number of surgical cervical sites rather than number of patients; 847 surgical fusions were evaluated, of which 17% shown pseudoarthrosis. The author found the overall fusion rate for ACDF in the range of 80–92%. In our ACDF group, we had 85% fusion rate. Geisler et al,¹⁰ reviewed the literature and noted 4–26% non-union for ACDF for single level and 17–63% for two-level. His own study included 365 cases of which 147 had ACDFP and 218 ACDF. He had one patient with pseudo-arthrosis out of 147 for ACDFP. Of 218 patients with ACDF, 12 had pseudo-arthrosis, a rate of 10%. Caspar et al,³ reviewed 356 patients out of which 210 had ACDF and 146 ACDFP, and found that 12 out of 210 ACDFs had reoperation for pseudo-arthrosis and one out of 146 ACDFPs had surgery for pseudo-arthrosis. Schneeberger reported solid fusions for 100% in single-level and 87% in multi-level with overall fusion rate of 94% with ACDFP.¹⁷

The value of adding plate to ACDF is providing immediate stability and it has been advocated to promote fusion, decrease the need for external immobilization and improve the clinical outcomes.^{2,4,10}

One of the primary goals of anterior cervical discectomy and fusion is to obtain a solid arthrodesis between the vertebral bodies. Pseudoarthrosis has been shown to be a cause of clinical failure, which sometimes requires revision surgery to achieve solid fusion and clinical improvement.⁸ Although pseudoarthrosis is widely believed to be uncommon with single-level ACDF, the pseudoarthrosis rate may be proportional to the number of levels fused.^{6,13,15} Other factors that may influence arthrodesis rates include instrumentation, age, bone quality, nutrition, and other medical comorbidities. Tobacco use is associated with a higher nonunion rate. Patients should not offered surgery unless they were nonsmokers or had quit all tobacco use.¹⁰

In regard to our study, the addition of plate fixation for single or double level anterior cervical discectomy and fusion is a safe procedure with no significant increase in complication rates. The pseudoarthrosis rates are higher in the ACDF group (15%) in comparison to (0%) in ACDFP group. No nonunion occurred in the patients treated with plate fixation. There was less disc space collapse and kyphotic deformity with the plated fusions than with the nonplated fusions in which there were nonunion (N=3), focal segmental kyphosis (N=2) and graft extrusion (N=1). The complication rates for plated fusions are extremely low but the costs are higher. The average cost of a case of ACDF was 15,000±1500 EGP. The average cost of a case of ACDFP was 18,500±1200 EGP. This was statistically significant (P=0.01). Our study was limited by its small number of patients and a higher number is needed to confirm our surgical results.

Conclusion

Our data suggest that the addition of cervical plate fixation to ACDF might leads to better clinical outcome and radiological fusion in single and double cervical disc disease.

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[The authors report no conflict of interest](#)

الملخص العربي

هل اضافة شريحه عنقيه يضيف قيمه لعملية استئصال الغضروف العنقى مع اللحام الاحادى او المزدوج المستوى

المقدمه: التدخل الجراحى لاستئصال الغضروف العنقى مع اللحام مازال محل خلاف . يعتقد بعض الجراحيين ان اضافة شريحه عنقيه يزيد من كلفة الجراحه و زمن العمليه. و يعتقد البعض الاخر ان النتائج السريره و اللحام يكون اعلى مع اضافة الشريحه العنقيه.

الهدف: توضيح النتائج الجراحيه والاشعاعيه لعملية استئصال الغضروف العنقى مع اللحام الاحادى او المزدوج المستوى بدون مقابل مع اضافة شريحه عنقيه

تصميم الدراسه: دراسه لحالات اكلينيكيه على 40 مريض بالغ يعانون من غضروف عنقى احادى او ثنائى.

المرضى و الطرق: تم اجراء الجراحات من 2010 الى 2017 . تم متابعه الاعراض و العلامات و ملاحظه النتائج الاكلينيكيه. تم تقسيم المرضى على مجموعتين . المجموعه الاولى تم استئصال للغضروف العنقى مع عمل لحام بين اجسام الفقرات فى 20 مريض و المجموعه الثانيه تم اضافة شريحه عنقيه للاجراء السابق فى 20 مريض.

النتائج: اوضحت النتائج تقارب المجموعتين من المرضى من حيث الخصائص الديموجرافيه و الاعراض. تميزه مجموعته الشريحه العنقيه بارتفاع التحسن الاكلينيكى و انخفاض معدلات الالم و ارتفاع الالتحام العظمى بين الفقرات.

الاستنتاج: يتضح من هذه الدراسه ان اضافة الشريحه العنقيه يضيف قيمه لعملية استئصال الغضروف العنقى مع اللحام الاحادى او المزدوج المستوى. حيث يؤدى الى تحسن النتائج الاكلينيكيه مع تقليل الالم بالرقبه و الطرف العلوى و زياده نسب الالتحام.