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MULTI-LEVEL ACDF USING STAND-ALONE PEEK CAGES FOR THE TREATMENT OF DEGENERATIVE CERVICAL MYELOPATHY& CLINICAL AND RADIOLOGICAL ASSESSMENT.

# Multi-level ACDF using stand-alone PEEK cages for the treatment of degenerative cervical myelopathy: Clinical and radiological assessment.

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## Abstract

**Background Data:** Degenerative cervical myelopathy is a complex neurologic disorder that usually develops insidiously, although abrupt deterioration in function can occur. The natural history of cervical myelopathy is highly variable, with some patients having progressive disability, whereas others have a mild course. The treatment of cervical myelopathy may be conservative or surgical, depending on the severity of symptoms at initial examination.

**Purpose:** The aim of this work is to assess the clinical improvement as well as the bony fusion in patients with cervical myelopathy treated by multi-level ACDF using stand-alone PEEK cages.

**Study design:** Clinical study

**Patients and Methods:** The material of this study consisted of 20 patients with cervical myelopathy. The mean age was 52 years. 55% of the patients were males. The patients were assessed pre-operatively and post-operatively using the European Myelopathy Scoring (EMS). Fusion was assessed by X-ray at the end of follow up.

**Results:** The mean operative time per level was 70 minutes. The mean blood loss was 150 ml. There were no intraoperative complications. The mean pre-operative EMS was 8 points (6-11). At the end of follow up, the mean EMS improved to 14 points (11-18).The difference between the pre-operative and end follow up EMS was statistically significant ($P < 0.001$). 2 levels (3.3%) out of 60 showed x-ray evidence of pseudoarthrosis.

**Conclusions:** Multi-level ACDF using stand-alone PEEK cages filled with local bone graft has many advantages in treating patients with degenerative cervical myelopathy. These include; minimal intraoperative and postoperative complications (including complications of anterior plating), avoidance of donor site morbidity, satisfactory clinical outcomes, and high fusion rate. (2014ESJ061)

**Key words: cervical myelopathy, stand-alone cages, PEEK, ACDF**

## Introduction

Degenerative cervical myelopathy is a complex neurologic disorder that usually develops insidiously, although abrupt deterioration in function can occur.[11,23] The natural history of cervical myelopathy is highly variable, with some patients having progressive disability, whereas others have a mild course.[19] In its severe form, a syndrome involving upper and lower motor neuron signs may coexist with sensory abnormalities, resulting in spastic gait, upper and lower extremity weakness, muscle atrophy, and sphincteric dysfunction.[3] Neck pain and limited mobility of the cervical spine may be the first symptoms in some patients.[13] A number of different causes can lead to cervical myelopathy including acute cervical disc herniation, degenerative cervical disc disease, degenerative changes on top of previous trauma or congenital abnormality, and idiopathic ossification of the posterior longitudinal ligament. The pathophysiology for the myelopathic clinical features of cervical myelopathy is due to a combination of mechanical[2] and vascular factors[27] that damage the spinal cord.

Treatment of cervical myelopathy may be conservative or surgical, depending on the severity of symptoms at initial examination. Conservative treatment includes neck immobilization with a collar, physiotherapy and medical treatment resulting in reported improvement rates of only 30–50%.[19]Consequently, current clinical practice recommends surgical decompression for any patient with severe or progressive symptoms. Surgical series using both anterior and posterior approaches report excellent or good outcomes in approximately 70% of patients.[5,28,31] Currently, titanium cage and polyetheretherketone (PEEK) cage are available for the treatment of multi-level disc pathology. Each type of cage has its own characteristics. Titanium cages have been criticized to produce more cage subsidence due to higher elasticity modules. Nevertheless, due to structural properties titanium implants are likely to provide a good immediate stability and osseointegration, and several clinical studies demonstrated successful results after implantation of titanium cages.[14,15,29] PEEK cages have a modulus of elasticity closely resembling that of cortical bone, which might lead to advantages in load sharing and stress distribution. This might result in a lower subsidence rate with less loss of cervical lordosis.[9,10]

The aim of this work is to assess the clinical improvement as well as the bony fusion in patients with cervical myelopathy treated by multi-level ACDF using stand-alone PEEK cages.

## Patients and Methods

The material of this study consisted of 20 patients with cervical myelopathy. The mean age was 52 years. 55% of the patients were males. The pre-operative duration of symptoms in our study ranged from 2 months to 12 months with a mean of 5.85 ± 4.13 months. The number of patients who had duration of symptoms less than 3 months was 6 patients (30%); the number of patients who had duration of symptoms ranging from 3 months to 6 months was 6 patients (30%); while the number of patients who had a duration of symptoms of more than 6 months was 8 patients (40%). All patients showed clinical signs of cervical myelopathy e.g. exaggerated tendon jerks, inverted brachioradialis reflex, positive Babinski sign, positive Hoffman sign and ataxic gait. 17 patients (85%) showed pre-operative upper and lower limb muscle weakness (Grade II- IV) and 10 patients (50%) suffered from sphincteric incontinence. Regarding walking status; 10 patients (50%) were able to walk alone, 9 patients (45%) used walking aid during walking and one patient (5%) was wheel chaired.

The diagnosis of cervical disc disease was made sure by X-rays MRI, and CT of cervical spine. 12 patients (60%) showed myelomalacia of the cord (Figure 1). CT was done in all cases to exclude ossification of the posterior longitudinal ligament (OPLL). 8 patients (40%) showed two levels, 4 patients (20%) showed 3 levels, and 8 patients (40%) showed 4 levels cervical disc disease. The total levels operated were 60. The most affected level was C5/6 (20 segments), C4/5 (16 segments), C6/7 (13 segments), and C3/4 (11 segments). The patients were assessed pre-operatively and at the end of follow up using the European Myelopathy Scoring (EMS).[30] Bone fusion was assessed at the end of follow up using X-ray following the criteria of Peolsson et al,[24] (the operated level will be considered fused when there is bridging bone anterior or though the cage and pseudoarthrosis will be considered when there is no bridging bone at all). The follow up period ranged from 12-20 months with a mean of 14 months.

***Surgical technique:***

Supine position with neutral position of the head. Standard right sided anterior approach (Cloward-Robinson). Transverse incision was made for two levels pathology and longitudinal incision for 3 or 4 levels pathology. Identification of the disc level using C-arm. Removal of the disc material followed by microscopic decompression and removal of posterior longitudinal ligament were carried out under distraction.

Preparation of the endplate using sharp curette, determination of the size of the cage, application of PEEK cage after being filled with local bone graft. Release of distraction and check for the cage stability. The procedure was repeated in every pathological level (Insertion of cage after each level discectomy). C-arm control of all cages position. Redon drainage followed by closure in layers. Post-operative Philadelphia neck collar for 2 months.

## Results

The mean operative time per level was 70 minutes. The average blood loss was 150 ml per level. There were no intraoperative complications. Early post-operative complications included only dysphagia which occurred in only 3 patients (15%) for duration of time ranging from 3 days to one week. During this period patients were given fluids and soft food.

Regarding neurological deficits; Pre-operatively, 17 patients (85%) showed upper and lower limb muscle weakness (Grade II- IV) while at the end of follow up, 2 patients (10%) only still suffering from muscle weakness (Grade IV). The difference was statistically significant (P< 0.001). Pre-operatively, 10 patients (50%) suffered from sphincteric incontinence and at the end of follow up all patients were continent. The difference was statistically significant (P< 0.002). Regarding preoperative walking status; 10 patients (50%) were able to walk alone, 9 patients (45%) used walking aid during walking and one patient (5%) was wheel chaired. At the end of follow up, 19 patients (95%) were able to walk alone and one patient (5%) used walking aid (walker).

The mean pre-operative EMS was 8 points (6-11). 8 patients (40%) had moderate disability and 12 patients (60%) had severe disability. At the end of follow up, the mean EMS improved to 14 points (11-18). 15 patients (75%) were normal (no disability), 4 patients (20%) had mild disability and one patient (5%) had moderate disability. The difference between the pre-operative and end follow up EMS was statistically significant (P < 0.001).

According to the pre-operative duration of symptoms, the patients were divided into 3 groups; less than 3 months, from 3-6 months and more than 6 months. The difference between pre-operative EMS scores in the three groups was not statistically significant while post-operative scores was statistically significant {r(p) = -0.533}. This means that the post-operative EMS scores were inversely related to the duration of symptoms.

Based on digital X-rays, radiological fusion was reported in 58 segments (96.7%) (Figure 2). The pseudoarthritic levels were C3-C4 and C6-C7 in a patient who underwent 4 levels fusion (C3-C7) (Figure 3). The patient did not require any further management till now as she was asymptomatic at the end of follow up (15 months).

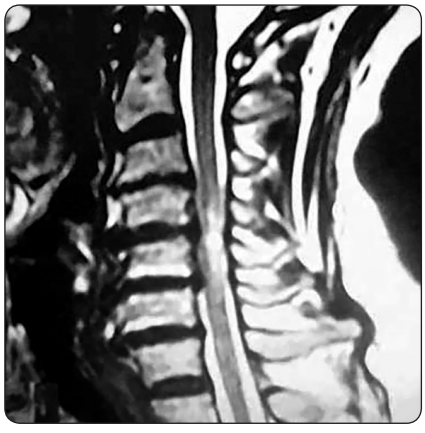

***Figure 1:*** Sagittal MRI image showing myelomalacia opposite C4-C6

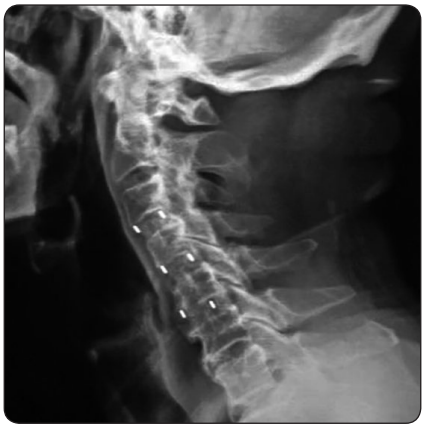

***Figure 2:*** Lateral X-ray of cervical spine showing radiological fusion C3-C6

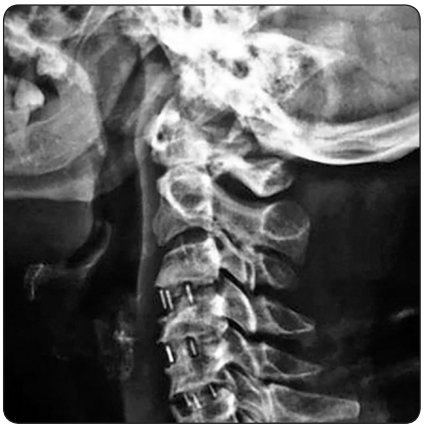

***Figure 3:*** Lateral X-ray of cervical spine showing pseudoarthrosis C3-C4 and C6-C7

## Discussion

Degenerative cervical myelopathy usually develops due to disc herniation, osteophyte formation at endplates, and uncovertebral joints. According to this pathophysiology, anterior decompression of the spinal cord is the most direct treatment of degenerative cervical myelopathy.

In the past few years, implantation of artificial disc prosthesis has been proved to be an effective and safe alternative option in a single and double level disc pathologies.[16,22,32] However, anterior cervical discectomy and fusion (ACDF) remains the gold standard in the surgical treatment of the patients with multilevel cervical myelopathy, resulting in good results and less complications.[20,26]

The use of stand-alone cage technology in cervical spondylosis was first introduced by Bagby.[1] Stand-alone cages have been widely applied in a single and double level pathologies.[12,18] Recently, spine surgeons started to use the stand-alone cage construct in multilevel cervical disc disease.[4,8,15] Hwang et al,[15] evaluated titanium cage fusion in three-level and four-level anterior cervical discectomies with and without anterior plate fixation. They reported a low complication rate and a shorter hospital stay in the group without plate fixation and concluded that stand-alone cage in multilevel cervical disc disease are better than with plate fixation. These results have been also confirmed by Cho et al,[8] who included a group of 26 patients with three-level disease undergoing stand-alone PEEK cage fusion and reported also satisfactory results comparable with graft-plate construct. The same subject has been studied by Buccieroet al,[4] who applied standalone PEEK cage fusion in four-level cervical disc disease. They concluded that this method of treatment is an effective procedure for the treatment of multiple level cervical disc disease. Chen et al,[6] came to the conclusion that in surgical treatment of multilevel degenerative cervical myelopathy, PEEK cage is superior to titanium cage in maintenance of intervertebral height and cervical lordosis, resulting in better clinical outcomes in the long-term follow-up.

Our study included 20 patients with degenerative cervical myelopathy. The mean pre-operative EMS was 8 points. 8 patients (40%) had moderate disability and 12 patients (60%) had severe disability. At the end of follow up, the mean EMS improved to 14 points. 15 patients (75%) were normal (no disability), 4 patients (20%) had mild disability and one patient (5%) had moderate disability. Total improvement rate was 95%. In comparison with Chiles et al,[7] they reported that there were 50% improvement among myelopathic patients managed with cage while 33.3% ran a stationary course and one case suffered from minimal deterioration. All over improvement incidence among their patients was set to be 79.7 at follow up period of 7 years.

Matge and leclercq[21] reported 50% improvement in myelopathic patients managed with cages while Profeta et al,[25] reported18% of non-improvement in myelopathy patients managed with graft and in 11.5% in patients managed with cages.

In our series, the total number of operated levels was 60. The total number of segments fulfilling fusion criteria on digital x-ray at the end of follow up was 58 segments (96.7%). Pseudo-arthrosis occurred in only two segments (3.3%). In comparison, Klingler et al,[17] reported ACDF in 51 levels using PEEK cages. Fusion occurred at (65%) after 20 months, while pseudo-arthrosis occurred in (35%). In this study, the PEEK cages were not filled with bone graft. On the other hand, Chen et al,[6] in their study using PEEK cages filled with local bone graft in 31 patients (each with 3 levels disc pathology), reported 100% fusion rate after 7 years follow up.

## Conclusion

Multi-level ACDF using stand-alone PEEK cages filled with local bone graft has many advantages in treating patients with degenerative cervical myelopathy. These include; minimal intraoperative and postoperative complications, avoidance of donor site morbidity, satisfactory clinical outcomes, and high fusion rate.

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## الملخص العربي

### لحام الفقرات العنقية متعدد المستويات باستخدام الأقفاص المستقلة لعلاج الاعتلال النخاعي بالفقرات العنقية التقييم السريري والإشعاعي

**الخلفية العلمية:** الاعتلال النخاعي بالفقرات العنقيه هو اضطراب عصبي معقد عادة ما يتطور ببطء، على الرغم من ذلك فأن التدهور المفاجئ في الوظائف يمكن أن يحدث. التاريخ الطبيعي للاعتلال النخاعى بالفقرات العنقيه متغير بدرجة كبيرة، فبعض المرضى يعانون من الإعاقة التقدمية، في حين أن البعض الآخر يسيربمسار معتدل. علاج الاعتلال النخاعي بالفقرات العنقيه قد يكون تحفظى أو جراحي، وهذا يتوقف على شدة الأعراض عند الفحص الأولي.

**الغرض:** الهدف من هذا العمل هو تقييم التحسن الاكلينيكي فضلا عن الاندماج العظمي في المرضى الذين يعانون من الاعتلال النخاعي بالفقرات العنقيه الذى تم علاجه بلحام الفقرات العنقيه متعدد المستويات باستخدام الأقفاص المستقله.

**تصميم الدراسة:** دراسة اكلينيكية

**المرضى والطرق:** تكونت هذه الدراسة من ٢٠ مريضا يعانون من الاعتلال النخاعي بالفقرات العنقيه. وكان متوسط العمر ٥٢ عاما. وكانت ٥٥٪ من المرضى ذكور. وسيتم تقييم المرضى قبل الجراحة وبعد العملية باستخدام المقياس الأوروبي للاعتلال النخاعي. وسيتم تقييم لحام الفقرات العنقيه فى نهاية فترة المتابعه بواسطة الأشعة السينية.

**النتائج:** كان وقت العمليه للمستوى الواحد ٧٠ دقيقة. كان متوسط فقدان الدم ١٥٠ مل. لم تكن هناك مضاعفات أثناء العملية. قبل الجراحة، كان المقياس الأوروبي للاعتلال النخاعي ٨ نقاط (٦–١١). وفي نهاية المتابعة تحسن المقياس إلى ١٤ نقطه (١١–١٨). وكان الفرق بينهما ذات دلالة إحصائية. أظهرت الأشعة السينية ان بمستويان (٣,٣٪) من أصل ٦٠ أدلة لم يتم الالتحام.

**الإستنتاج:** لحام الفقرات العنقيه متعدد المستويات باستخدام الأقفاص المستقله لعلاج الاعتلال النخاعي بالفقرات العنقيه له كثير من المميزات. وتشمل هذه؛ الحد الأدنى من المضاعفات أثناء العملية و ما بعد الجراحة، نتائج السريرية مرضية، وارتفاع معدل لحام الفقرات.