

ORIGINAL ARTICLE

CERVICAL DISC REPLACEMENT WITH POLYETHERETHERKETONE CAGES: CLINICAL EXPERIENCE WITH 151 CASES

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Background: There is active debate amongst surgeons regarding best available method for cervical inter-body fusion. This study evaluates success of disc replacement with polyetheretherketone (PEEK) cage in patients operated for cervical radiculopathy or myelopathy. **Methods:** This case series was conducted between 2008 and 2012 during which 151 patients were treated with cervical inter-body fusion with PEEK cages. PEEK cages were packed with cancellous bone taken from iliac crest. The duration of follow up was 1 year. Subsidence, fusion, cage migration, and/or breakage were assessed using serial cervical X-Rays. **Results:** Mean age was 42.6 years with standard deviation of 9.37. No implant insufficiency was observed in any case while fusion rate was 100%. **Conclusion:** Many techniques and materials are available for use in vertebral inter-body fusion. The use of PEEK cage seems to be a good alternative in that it has minimal complications and gives excellent results in skilled hands and gives results comparable to other options.

Keywords: Cervical discectomy, inter body implant, PEEK cage

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INTRODUCTION

Surgery for cervical disc problems is a commonly performed procedure in neurosurgical practice. Cervical cage implantation has been in use for the past decade however there is active debate amongst surgeon regarding which of the various methods available is best for cervical inter-body fusion. The most popular options currently practised are iliac crest auto-graft (gold standard), polyetheretherketone cages and Titanium (TTN) cages.¹

In our experience, we will focus on PEEK cages used for anterior cervical discectomy and fusion (ACDF). PEEK cages have been used for almost a decade. PEEK is a semi crystal polyaromatic linear polymer which is elastic and radiolucent. PEEK polymers are obtained by step-growth polymerization by the di-alkylation of bisphenolate salts. Typical is the reaction of 4, 4'-difluorobenzophenone with the disodium salt of hydroquinone, which is generated in situ by deprotonation with sodium carbonate. The reaction is conducted around 300 °C in polar aprotic solvents such as diphenyl sulphone.² In vivo, PEEK has been found to be biocompatible, resistant to thermal and ionizing radiation, all the while having biomechanical properties similar to cortical bone which is purported to give a more natural result than other options. The reason for this is that PEEK has a modulus of elasticity very similar to bone material obtained following a laminectomy. Due to these reasons, the utility of PEEK has expanded from spine to hip surgery and now to cranioplasties.³

In this study we have evaluated the efficacy of PEEK cage replacement in patients with cervical discogenic disorders.

MATERIAL AND METHODS

This case series was conducted in department of Neurosurgery, Combined Military Hospital, Peshawar. Over a 3 year period between July, 2008 and July, 2011, a total of 151 single or bi-level cervical discectomies were performed in our department. There were 103 males and 48 females. All patients were clinically examined and underwent plain MRI of cervical spine. Inclusion criteria included clinical evidence of radiculopathy, myeloradiculopathy, myelopathy or neck pain and failure of adequate conservative treatment for 6-8 weeks.

The cage is a radio-transparent trapezoidal-shaped and slightly wedged implant (Figure 2). It has two pins respectively on the superior and inferior borders and two radio-opaque lines in the external walls (vertical white lines on X-rays, see Figure-6) and a hollow inner cavity which is subsequently filled with a bone graft harvested from the iliac crest or another site.⁴

The operative procedure was performed by an anterior approach and disc material was resected under a microscope (Figure-1). Spinal cord and nerve roots were decompressed in routine fashion. After decompression trial cages were used to assess the exact size. The selected size was then filled with cancellous bone taken from iliac crest through limited incision and was then introduced into the disc space with the help of manual axial distraction (Figure-2). Figure-3 shows the PEEK cage in place. Intra-

operative C-arm imaging was done to determine spinal level and after the cage was put in place, correct placement (Figure-4). Anterior titanium plating was done in cases with bi-level peek cage placement. This was not done in cases of single level replacement. Philadelphia cervical collar was used in all cases in the immediate postoperative period for 2 weeks and was continued for 6 weeks in patients with bi-level cage placement.

RESULTS

Mean age was 42.6 years standard deviation of 9.37. The clinical data is summarized in table-1.

No blood transfusion was required in any case. The mean hospital stay was 5 days (range 4–9 days). Patients follow up ranged between 6 months and 2 years. All the patients were followed with cervical x-rays to assess fusion, cage migration, subsidence or breakage. No x-rays were taken in the immediate postoperative period because cage position was confirmed intra-operatively using an image intensifier. First post-operative x-ray was done at 2 weeks with further dynamic films taken at 3 months and 6 months respectively to assess fusion as evidenced by bone formation across the cage and not movement of >2

degrees on flexion/extension films. One patient developed subcutaneous neck hematoma which was drained. There was no infection in any case.

Cervical inter-body fusion was uneventful in follow-up. We did not observe cage migration, subsidence, or breakage in any case. Similarly there was no complication related to titanium plate in any case. Radiculopathy didn't improve in one of our patients with single level but could not be explained by postoperative clinical and radiological assessment. Radiculopathy improved in all the 15 patients with myeloradiculopathy (100%) however myelopathy improved in only 7 of them (46.6%). Axial neck pain improved in all of our patients and similarly poor grip and numbness improved in all 7 patients.

Outcome in terms of functionality was excellent except for patients presenting with myeloradiculopathy with all patients returning to their jobs following surgery. Only 5 of 15 patients (33.3%) with myeloradiculopathy returned to their previous jobs. Disc space height was restored in all patients (Figure-3 and Figure-4).

There were no complications related to donor site iliac crest harvest of cancellous bone.



Figure-1: Resected disc material



Figure-2: Cage filled with cancellous bone

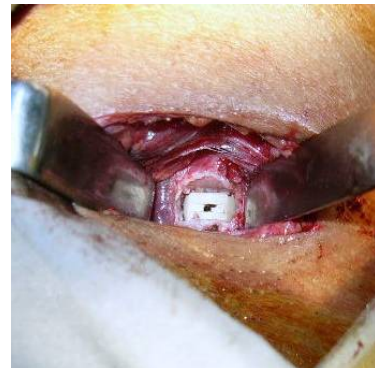


Figure-3: Cage in place

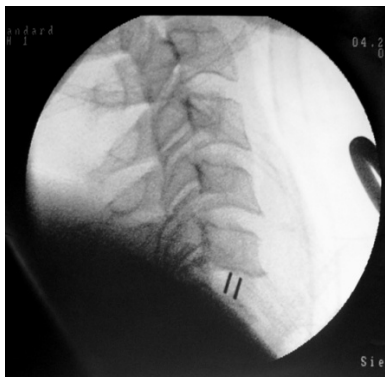


Figure-4: Intraoperative C-arm image

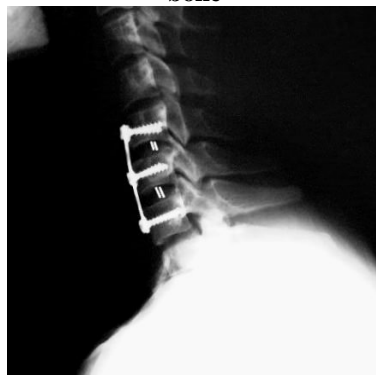


Figure-5: Multi level PEEK cages with plate



Figure-6: Single level PEEK cage

Table-1: Clinical Presentation of Patients

Total Patients	Number of patients
Male	103
Female	48
Clinical Presentation	
Unilateral brachialgia	114
Bilateral brachialgia	10
Axial neck pain	5
Myeloradiculopathy	15
Poor grip and numbness	7
Level of involvement	
Single level	
C3/4	2
C4/5	17
C5/6	96
C6/7	23
Bi-level	
C4/5, C5/6	1
C5/6, C6/7	12

DISCUSSION

Anterior cervical discectomy has been accepted as a standard treatment for cervical disc herniation. Whether inter-body fusion is necessary after ACD remains controversial and different techniques have shown to give similar outcomes.⁵⁻⁷ Wilson *et al* reported excellent results after ACD alone in 85% of patients. It has been accepted that loss of disc height and increase motion are involved in the pathophysiology of spondylosis.⁸ There is no universally accepted method. The ideal implant has not yet been found. Sontag has advocated ACD alone and fusion should be performed when instability occurs. In recent times there has been an increasing trend towards the usage of cervical disc spacers for inter-body fusion.^{5,9} There have been studies aimed at using PEEK-on-PEEK as a bearing surface material in TDR without fusion to overcome the shortcomings with fusion but the results were very poor.¹⁰

The PEEK cage is a polyetheretherketone which provides strength and stiffness in the intervertebral space. Biomechanical studies on peek cages have demonstrated adequate physiological values.^{6,7} The resistance to pressure is 4170N (Newton) under a static position and 2160 N under a dynamic position. The elastic properties of peek cage are similar to bone. It stimulates osteoblastic activity and inhibits osteoclastic activity.¹¹⁻¹⁵

The main goal of cervical spine surgery is adequate neural decompression, inter-body replacement and fusion. With auto-logous iliac crest graft the fusion rate was 97% as reported by Brown *et al*, where Savolainen has reported 98% fusion rates. Fusion rates with titanium cages rates 98%. When compared with these data, fusion rate with PEEK cages presented in this study seems to be superior to auto-genous bone grafts and titanium cages. In different studies, fusion with peek cages showed excellent resistance to crushing.^{12,15-18} In our

cases we did not observe any cage related complication. We used S5, S6, and S7 size cages to achieve and maintain adequate foraminal space. We used cancellous bone from iliac crest to fill the cages through a small incision. In cases where bi-level replacement was performed, we used anterior titanium plating for fixation. However, this was purely at the surgeon's discretion since studies have suggested that the teeth on the surface of the upper and bottom titanium pins are sufficient to hold the PEEK cage in place and prevent cage migration.¹¹

There was no donor site complication in our series however other series have reported up to 10–18% of cases with donor site complications.¹³ Another advantage of PEEK cage is its radio transparency. It is compatible with MRI and CT imaging. This feature provides good postoperative spinal cord and nerve root imaging without implant artefact. Bone fusion can be easily evaluated with postoperative x-rays. The titanium pins can identify the cage position as well as the inter-vertebral height. The biocompatibility was excellent and no allergic reaction in any case occurred. It was comparable to a study done by Serdar Kahraman *et al*, a clinical experience for PEEK cages for cervical inter body replacement.¹¹

A related study among sheep comparing PEEK with titanium was done recently demonstrating the two materials producing excellent fusion and comparable results using similar volumes of bony graft.¹⁹ How this applies to human subjects with degenerative bone disease and spinal nerve involvement is yet to be seen.

CONCLUSION

In our clinical experience, we found PEEK cages to be safe, easy to use and effective as an alternative to solid bone graft after Anterior cervical discectomy in patients who can afford it financially especially in our setup. Whether this technique will evolve into the standard of care remains to be seen.

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