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Evaluation of results of anterior cervical discectomy and fusion by stand-alone peek cage for the treatment of double level cervical spondylotic myelopathy

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Abstract

Objective: To evaluate the results of Anterior Cervical Discectomy and Fusion by Stand-alone PEEK cage for the treatment of double level cervical spondylotic myelopathy.

Background: Cervical spondylotic myelopathy is a common cause of neck pain and radiating arm pain which develops when one or more of the intevertebral discs in the cervical spine start to degenerate. Anterior cervical discectomy and fusion (ACDF) is the gold standard treatment for degenerative cervical spine disease. Multiple techniques and modalities of fixation are used in ACDF, among them use of Stand-alone PEEK cage is standard one. To counteract the complications with the plating for ACDF, Stand-alone cage concept was constructed and favourable outcomes have been described with a low rate of dysphagia. Stand-alone PEEK cage provides immediate load bearing support to the anterior column and may facilitate fusion.

Materials & methods: This retrospective study was conducted in the spine unit of Orthopaedic Surgery department of Bangabandhu Sheikh Mujib Medical University, Shahbag and other private hospitals in Dhaka, Bangladesh from January 2016 to December 2021. A total number of 50 patients with cervical spondylotic myelolopathy with two level involvement confirmed by MRI were selected for the study who were failed to improve after conservative treatment. Outcome was evaluated by using visual analog score (VAS), Modified Odom`s criteria, Nurick's grading and fusion rate by Bridwell's criteria.

Results: Mean patient age was 48.4 ± 6.49 years. Male: female ratio 2:1. Pre-operatively, mean VAS score was 7.13±1.51 whereas post-operatively VAS score was decreased significantly to 0.47±0.64 after 12 months of follow up (p value <0.001). Neurological outcome was assessed by Nurick grading system, where all patients were in grade I (80%), grade II (14%) & grade III (6%) pre-operatively. Post-operatively at 12 months follow up, maximum patients (92%) were in grade 0 (p value <0.001). Radiological fusion was assessed by Bridwell fusion criteria, fusion was found in 80% and 90% of patients after 6 and 12 months follow up. Overall improvement was assessed by modified Odom's score; excellent improvement was seen in majority patients after 12 months of post-operative follow up (86%)

Conclusion: ACDF by stand-alone PEEK cage is the preferred technique for the treatment of double level cervical spondylotic myelopathy with excellent functional outcome. This can be used with minimum risk as well as excellent fusion rate.

Keywords : Cervical spondylotic myelopathy, ACDF, standalone PEEK cage.

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Introduction

Cervical spondylotic myelopathy (CSM) is a disorder of the spinal cord due to compression of the cord by degenerative disease depicted at radiological examinations [1]. Myelopathic or upper motor neuron lesion findings (e.g, hyper-reflexia and gait disturbance) are the typical manifestations of this disorder [2]. Patients may also present with radiculopathy due to degenerative process including bulging or tear of annulus, herniation of disc material into the canal causing pressure effect over the spinal cord and nerve roots [3]. Myelopathic hand signs, Grip release sign, Hoffman's sign, Romberg test along with gait disturbances (broad based and hesitant) are common in advanced conditions. Changes in the pattern of bladder and bowel dysfunction are also found in about 20% -50% of the patients [4]. Surgical procedures performed in cervical myelopathy are aimed at relieving spinal cord compression, as well as achieving stabilization. Anterior cervical discectomy and fusion (ACDF) is the established gold standard treatment for degenerative cervical spine disease both for radiculopathy and for myelopathy [5]. Interbody fusion rate is about 92% by ACDF [6]. Various techniques for performing ACDF depending on surgeon preference are available. Cervical cages of different materials have been used like titanium, PEEK cage and carbon fiber [7]. ACDF with PEEK cage provides good functional outcome and fusion rate following surgery [8]. ACDF by stand-alone PEEK cage provides immediate load bearing support to the anterior column and may facilitate fusion and also has the advantage of mitigating the complications associated with anterior plating [9]. The aim of this study is to evaluate the results of ACDF by Stand-alone PEEK cage for the treatment of double level cervical spondylotic myelopathy.

Figure 1: *Stand-alone PEEK cage.*

Materials and methods

This retrospective study was conducted in the spine unit of Orthopaedic Surgery department of Bangabandhu Sheikh Mujib Medical University, Shahbag, Dhaka from January 2016 to December 2021. A total number of 50 patients with cervical spondylotic myeloradiculopathy with two level involvement confirmed by MRI were selected for the study who were failed to improve after conservative treatment. Patients having involvement of one level, infection, tumor or fracture of vertebra were excluded from the study. Patients were followed up at 3 months, 6 months, finally. Outcome was measured by using visual analogue score (VAS) for pain, Nurick Grading for neurological status, Bridwell criteria for radiological fusion & finally overall improvement was evaluated by Modified Odom´s criteria. All the data were compiled and sorted properly and the quantitative data was analyzed statistically by using Statistical Package for Social Science (SPSS-26). P <0.001 was considered as the level of significance.

Surgical procedure

Patient was positioned supine. The Gardener-wells tong traction was applied. A sandbag was placed in between shoulder blades to extend the neck. Patient's head was rotated slightly to the opposite of the planned approach site. Transverse skin incisions were made over the targeted disc levels. The platysma muscle was identified and incised longitudinally. The esophagus was identified and retracted medially, while the sternocleidomastoid and underlying carotid sheath was retracted laterally. The pre-vertebral fascia was divided, and the longus colli musculature was further retracted. Intra-operative radiograph was obtained to confirm the appropriate cervical levels. The entire disc was removed with a rongeur. The entire disc, vertebral body endplates were decorticated. Stand-alone PEEK cages were inserted and fixed with screw in desired position after measuring with template.

Position was checked by fluoroscope. Hemostasis was ensured by gel foam and electrocautery. A drain tube was kept in situ.

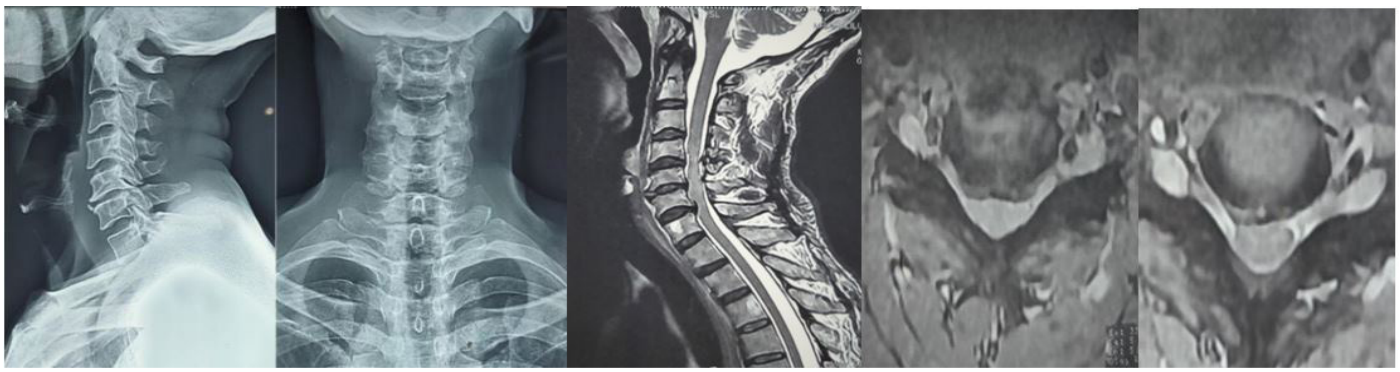

Figure 2: *Pre-operative X-ray and MRI showing degenerative changes with herniated disc causing cord compression at C5/C6 and C6/C7 levels.*

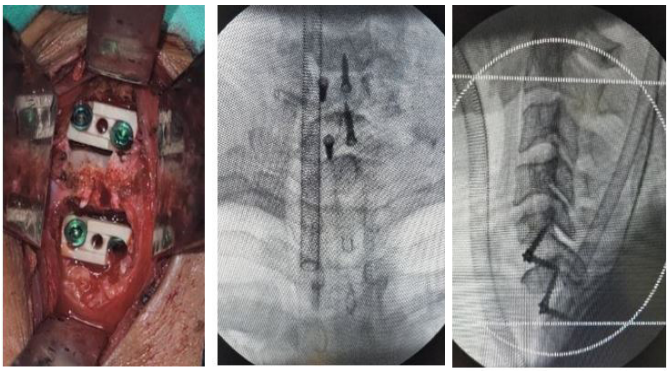

Figure 3: *Per-operative picture and C-arm image showing double level stand-alone cages*

Figure 4: *X-ray cervical spine A-P and lateral view showing Stand-alone PEEK cages at C5/6, C6/7 level.*

Table 2: *Mean VAS score in all patients at different time points (n=50).*

Time point	Mean ± SD	Range (Minimum-Maximum)	*P* value
Pre-operative	7.13 ± 1.51	5-10	
After 1 month	2.87 ± 0.52	2-4	
After 3 months	1.53 ± 1.06	0-3	
After 6 months	1.06 ± 0.88	0-3	
After 12 months	0.47 ± 0.64	0-2	<0.001

Platysma, subcutaneous layer and skin were closed in layers. Sterile dressing was applied over the wound and cervical collar was applied before extubation. Patients were encouraged to ambulate on the 5th post-operative day.

Results

Mean patient age was 48.4 ± 6.49 years. Among them, 33 were men and 17 were women with a male: female ratio 2:1. Patient demographic characteristics are illustrated in Table I. C5-6, C6-7 were most commonly involved disc levels (56%), following in decreasing order C4/5, C5/6 (26%), C4/5, C6/5 (18%). All of the study patients had neck pain and motor weakness in upper and lower extremities. 44 patients (88%) had myelopathic signs and 42 patients (84%) had gait difficulty. Sensory changes in both extremities were seen in 33 patients (66%).

Table 1: *Demographic characteristics of patients (n=50).*

Patient characteristics	
Sex:	
Male	33(66%)
Female	17(34%)
Age (years):	48.4±6.49
Level of disc space involvement:	
C4/5, C5/6	13(26%)
C5/6, C6/7	28(56%)
C4/5, C6/7	9(18%)
Occupation:	
Service holder	13(26%)
Day labourer	15(30%)
Housewife	5(10%)
Farmer	10(20%)
Businessman	7(14%)
Clinical presentation:	
Neck pain	50(100%)
Motor weakness in upper and lower extremities	50(100%)
Myelopathic Signs	44(88%)
Gait difficulty	42(84%)
Sensory disturbance in upper and lower extremities	33(66%)

Table 3: *Comparison of Nurick grading at different time points (n=50).*

Nurick grading	Pre-operative n (%)	After 1 month n (%)	After 3 months n (%)	After 6 months n (%)	After 12 months n (%)
Grade 0	0 (0)	20 (40)	40 (80)	43 (86)	46(92)
Grade I	40 (80)	23 (46)	10 (20)	7 (14)	3 (6)
Grade II	7 (14)	7 (14)	3 (6)	0 (0)	0 (0)
Grade III	3 (6)	0 (0)	0 (0)	0 (0)	0 (0)
Grade IV	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Grade V	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
P value		>0.05	<0.001	<0.001	<0.001

Table 4: *Assessment according to Bridwell fusion criteria (n=50).*

Bridwell grade	After 3 months n (%)	After 6 months n (%)	After 12 months n (%)	*P* value
Grade I	0 (0)	40 (80)	46 (92)	<0.001 (comparing 3 months follow up to 12 months)
Grade II	40 (80)	7 (14)	3 (6)	
Grade III	10 (20)	3 (6)	0 (0)	
Grade IV	0 (0)	0 (0)	0 (0)	

Table 5: *Assessment according to modified Odom's criteria (n=50).*

Status	After 1 month n (%)	After 3 months n (%)	After 6 months n (%)	After 12 months n (%)	*P* value
Excellent	30 (60)	35 (70)	40 (80)	43 (86)	<0.001 (Comparing 1 month follow-up to 12 months)
Good	13 (26)	6 (12)	6 (12)	3 (6)	
Fair	6 (12)	6 (12)	3 (6)	3 (6)	
Poor	0 (0)	0 (0)	0 (0)	0 (0)	

Pre-operatively, mean VAS score of all patients was 7.13±1.51 (5-10) whereas post-operatively VAS score was decreased significantly after 6 and 12 months of follow up 1.06±0.88 and 0.47±0.64 respectively. (p value <0.001). Neurological outcome was assessed by Nurick grading system, where all patients were in grade I (80%), grade II (14%) & grade III (6%) pre-operatively. Post-operatively at 3, 6, 9 and 12 months follow up, maximum patients were in grade 0 (80%, 86% and 92% respectively) with significant difference compared to pre-operative status (p value <0.001). Radiological outcome was assessed by Bridwell fusion criteria, radiological fusion was found in majority of patients after 6 and 12 months follow up (80% and 92%, respectively) (p value <0.001). Overall improvement was assessed by modified Odom's score, excellent improvement was seen in majority patients after 3, 6 and 12 months of post-operative follow up (70%, 80% and 86%, respectively) (p value <0.001). Perioperative complications were seen in 10 (20%) patients wherein 4 (8%) patients had transient paraparesis, 3 (6%) patients had transient dysphagia, 3 (6%) patients had dural injury. Average postoperative hospital stay was 3±1.2 days which was ranged 3-5 days.

Discussion

In this study, average age of all patient was 48.4 ± 6.49 years (ranging from 35-62 year) with majority belonged to 50-59 years of age (53.3%). Almost similar result was found by Moon et al. (2010) [10]. In this study, most of the patients were male (66%) with a male to female ratio was 2:1. Kim also found male to female ratio of 2:1 in their study (Kim et al. 2017) [11]. In present study, maximum patients were day labourer (30%) who have to carry heavy objects that may contribute to cervical disc prolapse which was also suggested by Kelsey et al. (1984) [12]. All of the study patients had neck pain and motor weakness in upper and lower extremities. 44 patients (88%) had myelopathic signs and 42 patients (84%) had gait difficulty. Sensory changes in both extremities were seen in 33 patients (66%). These are nearer to the study of Shiban et al. (2015) [13]. C5-6, C6-7 were most commonly involved disc levels (56%), following in decreasing order C4/5, C5/6 (26%), C4/5, C6/5 (18%). Quite similar result was observed by Moon et al. (2010) [10] and Topuz et al. (2009) [14] in two different studies.

In this study, mean preoperative VAS score was 7.13±1.51 (5-10) whereas post-operatively VAS score was decreased significantly after 1, 3, 6 and 12 months of follow up (2.87±0.52, 1.53±1.06, 1.06±0.88 and 0.47±0.64 respectively), which is statistically significant (P <0.001). Similar result was observed by Choi et al. (2016) [15]. According to Nurick grading system at 12 months of post-operative follow up, 46 patients (92%) were in grade 0 level and 3 patient (6%) in grade I level. Islam et al. (2020) [16] reported 90.6% in grade 0 level and 6 patients (9.4%) in grade I level in follow up according to Nurick grading in a study on 64 patients. According to Bridwell fusion grading system, radiological fusion (grade I) was found in majority patients after 6 and 12 months of follow up (80% and 92% respectively) which is similar to the study of Wang et al. (2013) [17]. Overall improvement was assessed by modified Odom's score where postoperative outcome at 12 months follow-up demonstrated 86% patients had excellent outcome and 6% had good outcome. Almost similar result was found by Liao et al. (2008) [18]

Perioperative complications were seen in 10 patients (20%). 4 patients (8%) developed transient paraparesis who all improved within 6 months. 3 patients (6%) had transient dysphagia which resolved within 2 weeks. 3 patients (6%) had dural injury which was treated per operatively by application of gel foam and no further leakage of CSF postoperatively. No patient developed surgical site infection. Choi et al. (2016) [19] found smilar results. Postoperative average hospital stay was 3 ± 1.2 days (range: 3-5 days) in this study which was comparable to Niu et al. (2010) [20].

Conclusion

The use of stand-alone PEEK cage in a 2-level cervical interbody fusion achieves satisfactory improvements in both clinical outcomes and fusion. So, it can be concluded that ACDF with standalone PEEK cage can be an ideal technique for the treatment of patients with double level cervical spondylotic myelopathy with excellent postoperative outcome and good fusion rate

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