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Outcome of Multilevel Anterior Cervical Discectomy and Fusion without plating

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Abstract

Background & objectives: The safety and efficacy profile of stand-alone polyetheretherketone cages has been questioned in the management of patients with more than one cervical disc disease. In this article, we evaluated the idea of safety of multilevel anterior cervical discectomy and fusion, without using a plate and the achieved pain relief.

Methods: In this study, retrospectively we reviewed 30 patients diagnosed with multilevel cervical disc disease (total 69 segments) due to degenerative changes, disc herniation, and/or osteophyte formation. They complained of axial neck pain and/or radiculopathy not responding to non-surgical measures. All the included subjects treated for more than one-disc disease using stand-alone polyetheretherketone. With minimum 2-years of regular, clinical and radiological follow up. We have assessed the patient for criterions defined for cage subsidence and protrusion, as well as pain assessment pre and postoperatively using the visual analog score.

Results: we assessed 22 patients (73.3%) for two level pathology and 8 patients (26.7%) with three level diseases. Mean age was 48.2±8.9 years. Female to male ratio was (1.1:1). The most common segment involved was C5-6 segment in 83.3%. The pre-operative visual Analogue Score for axial neck pain 6.3±3.05 and radiculopathy 6.8±2.2 was decreased post-operatively to 2±1.3 points respectively. Subsidence and protrusion assessed by measurement of serial X rays and one patient 3.3% developed subsidence in 2 adjacent levels which is statistically not significant. No incidence of cage protrusion was detected.

Conclusions: Multilevel anterior cervical discectomy and fusion without plating provide good fusion, low subsidence rate, stability provided by the cage with excellent pain improvement.

Keywords: Multilevel anterior cervical discectomy; Anterior cervical discectomy and fusion without plating; Subsidence.

Introduction

Neck and arm pain are the second most common complaint presented to our neurosurgery clinics after lower back pain. Cervical nerve root compression in the exiting foramina produces distinct clinical syndromes that can be correlated between clinical and radiological evaluation. Axial neck pain results from degenerative changes and nerve root impingement, especially in upper cervical levels. The degenerative process is caused by changes in the biomechanics and biology of the vertebrae and disc material that increases with aging. Decreased number of chondrocytes, changes in properties, or decrease of various proteins and biological materials contribute to degeneration[1]. The resultant degeneration of discoligamentous complex ranges from disc material destruction, loss of disc space height,

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and hypertrophy of the ligaments. Changes in the strength of the joint facets or in the uncinate processes can result in increased mobility and development of osteophytes and stenosis. These contribute to foraminal and spinal canal stenosis, producing various clinical pictures of radiculopathy, neck pain and myelopathy[2-3]. Nearly 90% of cervical disc diseases are managed conservatively; however, severe pain not responding to conservative management, progressive neurological deficit, and myelopathy cases are treated surgically[4]. The standardized and the most commonly used procedure for cervical disc disease is anterior cervical discectomy and fusion, which was first described by Cloward, Robinson, and Smith in the 1950s. It was also used for correcting cervical alignment, cervical spine tumors, and traumatic fractures or disc prolapses. In the early literature, they have used autologous bone grafts (tricortical iliac crest graft). However, changes occurred in the techniques and materials.Synthetic materials such as titanium, carbon fiber, and polyetheretherketone (PEEK) cages are used to replace the iliac crest graft and related complications at the donor site[5-6]. This approach achieves good to excellent outcomes with relatively low complication rates in treating single-level disc disease[7].Cage designs with proper angulations restore spinal lordosis and filling the cage with autologous or synthetic bone substitutes with proper width and depth would resist disc space collapse and subsidence into the adjacent vertebral endplates until solid bony fusion is established[7]. Trapezoidal and wedge-shaped designs introduced by early 2000s[8]. Both aim to mimic the healthy anatomy of the cervical spine while increasing segmental stiffness and expanse contact. Trapezoidal cages inversely match vertebral endplates to increase cage stability in lateral bending, flexion, and axial rotation. The wedge-shaped cage has an anterior slope, anterior margin is higher than posterior by 1 to 2 mm., by this means the natural lordosis will be restored.The overall idea of using stand-alone cages, especially in single-level disease depends on the disc space distraction before cage insertion, and the resultant compression from the ligaments and residual annulus fibrosus will hold the cage in place until solid fusion bridges[5].On the contrary, treating multilevel pathology is more challenging and many controversies surface during decision making. Several studies have raised concerns about subsidence and failure of stand-alone cages[9-10]. Some authors advocate using an anterior plate in cases of more than one level ACDF to reinforce the construct to exercise increasing fusion rate, maintaining alignment, improve pain and decrease incidences of cage subsidence and protrusion[12]. Anterior plating is not without limitations and is related to additional complications over stand-alone cage procedures, the foremost common being early postoperative dysphagia, which in rare cases can reach chronic dysphagia. Other complications include screw migration leading to soft tissue damage and adjacent-level degeneration in cases of inappropriately sized or misaligned plates[13.]In this article, we investigated the success rate of multilevel ACDF without anterior plating, in terms of pain outcome as well as the incidence of subsidence and cage protrusion.

Patients and methods

In this article, we selected 30 patients retrospectively, who were treated for multilevel cervical disc disorder with a minimum of two years of follow up. The study was carried out from 2016 to 2018. The exclusion criteria were single prolapsed cervical disc, posterior cord compression, ossified posterior longitudinal ligament, infection, tumor, and traumatic disc prolapse. they were operated on using a PEEK cage with synthetic bone graft as a stand-alone device without reinforcement with anterior plating. The study was done with agreement of

ethical committee of Kurdistan Board of Medical Specialties and informed consent taken from the participants. We follow the patients with regular (immediate postoperative, 3 months, 1 year, and 2 years) cervical spine X-rays to evaluate cage subsidence, protrusion, as well as pre- and post-operative pain assessment using Visual analog scale. Subsidence was defined as major if cage migration into adjacent vertebral body by more than 2mm. and protrusion defined as cage migrating out of the disc space and crossing anterior or posterior edge of adjacent vertebral body.The surgical site was marked by fluoroscopy and exposure done through standard approach, microscope assisted discectomy done, posterior longitudinal ligament opened, end plates cleaned from cartilages carefully by curettage. Appropriately sized PEEK cages filled with synthetic bone paste, the location and size of the cage was confirmed by fluoroscopy.Data were analyzed using the Statistical Package for Social Sciences (SPSS, version 25). Wilcoxon signed ranks test was used to compare the median of the VAS before and after the operation. A p-value of $\leq$ 0.05 was considered statistically significant

Results

Thirty patients were included in the study. Their mean age ± SD was 48.2 ± 8.88 years, the age range was 31 – 66 years, and the median was 48.5 years. Table 1 shows that the highest proportion of the patients (43.3%) were aged 40-49 years, and 30% were aged 50-59 years. More than half (53.3%) of the sample were females.

Table (1): Age and gender distribution.

	No.	(%)
Age (years)		
< 40	4	(13.3)
40-49	13	(43.3)
50-59	9	(30.0)
≥ 60	4	(13.3)
Mean (±SD)	48.2	(±8.88)
Gender		
Male	14	(46.7)
Female	16	(53.3)
Total	30	(100.0)

Two cages have been used for the majority (73.3%) of the patients, and three cages have been used for the rest. C5-C6 was the most commonly affected level (83.3%), C4-C5 level was affected in 60% of the patients, and the C3-C4 level was affected in 53.3% of the patients, Figure 1.

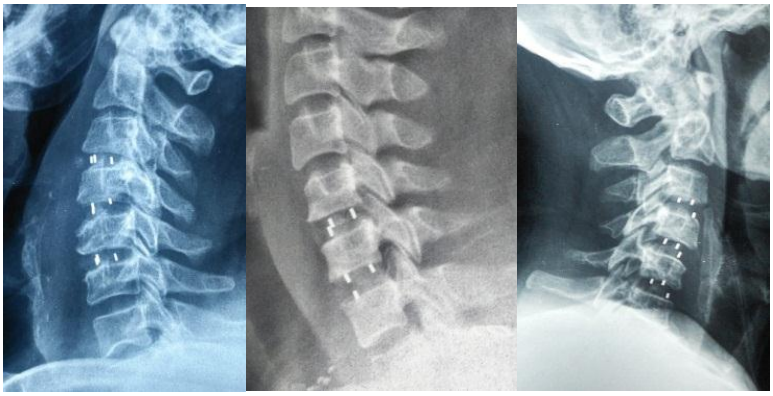

Figure (1): lateral cervical spine X ray of 3 patients with multilevel ACDF

Regarding the complications, one patient (3.3%) only developed subsidence, Figure 2. None of the patients developed cage protrusion, Table 2.

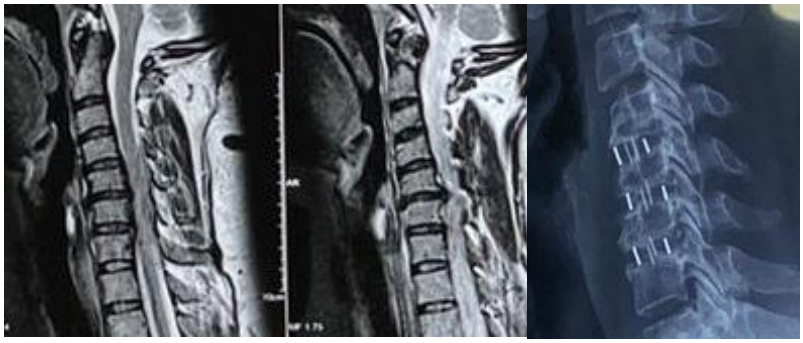

Figure (2): pre-operative MRI and Post-operative X ray of a patient with 3 level ACDF, this patient developed subsidence of 2 cages.

Table(2): Levels affected and complications.

	No.	(%) n = 30
No. of cages used		
2 cages	22	(73.3)
3 cages	8	(26.7)
Level of the lesion		
C2-C3	0	(0.0)
C3-C4	16	(53.3)
C4-C5	18	(60.0)
C5-C6	25	(83.3)
C6-C7	10	(33.3)
Cage protrusion	0	(0.0)
Subsidence	1	(3.3)

The median VAS of neck pain was 7 before the operation which decreased significantly after the operation to 2 ($p < 0.001$). The median VAS for radiculopathy also decreased significantly from 7 to 1.5 after the operation ($p < 0.001$), Table 3.

Table (3):VAS of neck pain and radiculopathy before and after the operation.

	VAS			
	Mean	(±SD)	Median	p-value*
Neck pain pre-operative	6.3	(±3.05)	7	< 0.001
Neck pain post-operative	2.1	(±1.39)	2	
Radiculopathy pre-operative	6.83	(±2.29)	7	< 0.001
Radiculopathy post-operative	1.97	(±1.37)	1.5	

***By Wilcoxon signed ranks test.**

Discussion

Anterior cervical discectomy and fusion is the mainstay of treating cervical disc prolapses and associated canal stenosis or root compression not relieved by nonsurgical measures. Many centers use an anterior plate with ACDF for more than one level to reinforce the construct to decrease incidence of non-union and pseudoarthrosis, hence the chance of cage migration and subsidence diminishes[11]. Despite its standardization and usefulness, there is no solid evidence for recommending the use of anterior plates in patients with more than one-disc disease[14].Cho DY et al[15], in their study compared complication rates of multilevel ACDF using PEEK cages without plating, with multilevel cervical surgery using bone graft and anterior plating. They preferred the first group as it had a much lower complication rate of 3% versus 16% in the second group where they used bone graft and plate. Liu et al[16] showed decreased VAS points of neck pain and arm pain preoperatively, 2 months after the operation and the final follow up from 8.2±1.23, 2.7±0.96, and 1.9±1.03, respectively. González et al reported good to excellent pain outcomes with reduction of VAS score from an average 8 points to 2 postoperatively. Demircan et al[17] evaluated 16 patients with multilevel ACDF using PEEK cages without plating. They concluded that the procedure is highly effective with no reports of cage failure. Sheban E et al[18], which had 138 patients with two and three-level ACDF using stand-alone empty PEEK cages, demonstrated excellent clinical outcomes. They had 36 patients with subsidence (26%); however, none of them warrants surgical intervention and they were clinically irrelevant. El Tantawy A[19] investigated the clinical and radiological outcome of multilevel ACDF in 28 patients (82 levels). He states that this procedure is very successful with maintained good clinical improvement. However, he had only seven levels of subsidence (8%). Kim et al, in their study, had a 43% subsidence rate in 68 patients with multilevel ACDF. However, they state that the finding was merely a radiological phenomenon with no significant clinical implications[20]. Zhou et al. presented three cases of subsidence (8.8%) as complications of intervention to three vertebral levels without anterior plate[21]. Kulkarni et al used Solis PEEK cages in 32 patients, they demonstrated subsidence in 3 segments (8.1%) at 8 weeks of follow up and it was not statistically significant and there was no decrease in total disc space height[10].In this study, we assessed the radiological and clinical outcome for 30 patients with a total of 69 segments, operated on for multilevel ACDF with PEEK cages and synthetic bone graft without using an anterior plate. Patients were put in a soft collar for 8-12 weeks post-operative. The overall vertebral alignment was preserved. The procedure has a very satisfactory clinical outcome. The pre- and post-operative pain was compared by visual analog score. The pain score dropped from 7 to 2 post-operatively for both neck pain and radiculopathy. Only one patient (3.3%)

developed subsidence of more than 3mm at 6 months follow up X-ray, which did not affect the patient clinically. We had no cage protrusion.

Conclusions

In conclusion, multilevel ACDF without plating provides good fusion rate, low subsidence, stability provided by the cage, excellent pain improvement and facilitation of radiological assessment are the result of the physical properties of the PEEK material as well as the design of the cage and most significantly the complication related to using plate is avoided.The pearls to decrease the risk of subsidence, one should respect the endplates of the adjacent vertebral bodies with meticulous curetting to avoid breaching it, avoiding over distraction, and using an appropriately sized cage with larger AP diameter.

Conflict of interests

There were no conflicts of interest.

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