

# Comparison of Titanium cage with PEEK cage in Anterior Cervical Discectomy and Fusion (ACDF) Surgery

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## ABSTRACT

**Aim:** To compare the Titanium cage with PEEK cage in patients who underwent anterior cervical discectomy and fusion (ACDF) surgery at neurosurgery department of DHQ teaching hospital, Gujranwala.

**Methods:** This was a retrospective analysis of the patients who underwent anterior cervical discectomy and fusion (ACDF) surgery from January 2015 to December 2018 at DHQ Teaching hospital, Gujranwala. The patients among which titanium cage was used were labelled as group A, while those in which PEEK cage was used, were labelled as group B. Informations composed from both cohorts included patient's age, gender, radiological fusion rate at 6 months, radiological fusion rate at 12 months and post-operative complications like cage subsidence, painful donor site, subluxation, limb pain, limb weakness, and limb numbness. Statistical analysis was done using SPSS version 25. Independent sample T test and Chi-square test for independence were used for quantitative and qualitative variables respectively to determine their significant correlation with the type of cage used.

**Results:** Out of 52 patients, 90.4% achieved fusion at 12 months of follow up and 13.5% faced post-operative cage subsidence. The mean age of titanium cage group patients was 56.22±15.93 years while that of PEEK cage group patients was 55.15±16.11 years (p=0.543). The radiological fusion rate at 6 months was 62.5% in Titanium cage group and 60% in PEEK cage group (p=0.543). Similarly, fusion rate at 12 months follow up was 90.6% in first group and 90% in second group (p=0.646). Among post-operative complications, cage subsidence rate was 18.8% with Titanium cage and 5% with PEEK cage (p=0.228). One patient of PEEK cage group suffered painful donor site, one patient of Titanium group suffered subluxation and limb weakness and one patient of Titanium group suffered limb pain and numbness.

**Conclusion:** The fusion rates with anterior cervical discectomy and fusion (ACDF) surgery are excellent and comparable using Titanium as well as PEEK cages with fewer post-operative complications. No one modality has superiority over other in our studied population. Titanium cages are cheaper, so may still be alternative to PEEK cages in our people where affordability is a big issue for general public

**Keywords:** Anterior cervical discectomy and fusion (ACDF) surgery, Titanium cage, PEEK cage

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## INTRODUCTION

Cervical spondylotic myelopathy (CSM)<sup>1</sup> is the consequence of cervical cord compression due to variety of spine disorders like spondylosis, trauma, neoplastic lesion, prolapsed disc and degenerative disc disease. Anterior cervical discectomy and fusion (ACDF)<sup>2</sup> is the procedure of choice for cervical spondylotic myelopathy and radiculopathy unresponsive to conservative care. This procedure was first reported in 1958 by Smith and Robinson.<sup>3</sup> Its mortality rate is about 0.1%, and morbidity rate after its adverse events is 19.3%.<sup>4,5</sup> The bony fusion rate after ACDF is excellent. In a meta-analysis of 146 articles having 10208 patients, fusion rate after one year of surgery was 90%.<sup>6</sup>

The complication rate associated with ACDF surgery varies from 0-4.3% for one level upto 56% for four level fusions<sup>7</sup>, and include cage subsidence,<sup>8</sup> dysphagia,<sup>9</sup> vocal cord dysfunction,<sup>10</sup> wound infection,<sup>11</sup> nerve root injury,<sup>12</sup> and CSF leak<sup>13</sup> etc.

In ACDF procedure, discectomy is combined with interbody fusion. Cancellous bone graft is usually taken from the iliac crest. Many types of cages are used in ACDF surgery for fusion in clinical practice. In our setup, titanium and polyetheretherketone (PEEK) cages<sup>14</sup> are commonly used. The national as well as international data suggest no significant difference in outcome between Titanium and PEEK cages with a variable associated post-operative adverse

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events. In our setup, no such comparative study has been carried out. Therefore, the objective of this study was to compare the Titanium cage with PEEK cage in patients who underwent anterior cervical discectomy and fusion (ACDF) surgery at neurosurgery department of DHQ teaching hospital, Gujranwala.

## MATERIAL AND METHODS

This was a retrospective analysis of the patients who underwent anterior cervical discectomy and fusion (ACDF) surgery from January 2015 to December 2018 at the Department of Neurosurgery, DHQ Teaching hospital, Gujranwala. The patients from both gender with more than two years follow up were included, while those with accompanying comorbidities like diabetes, end stage renal or lung disease, autoimmune disease, or underlying malignancy were excluded. The group of the patients among which titanium cage was used in ACDF surgery, were labelled as group A, while those in which PEEK cage was used, were labelled as group B. Informations composed from both cohorts included patient's age, gender, radiological fusion rate at 6 months, radiological fusion rate at 12 months and post-operative complications like cage subsidence, painful donor site, subluxation, limb pain, limb weakness, and limb numbness. Postoperative imaging were obtained at 1,6 and 12-months of follow-up for lucency around the work area and for issues with the cages like subsidence as well as post-operative complications. Cage

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subsidence<sup>8</sup> was defined as equal or more than 3 mm loss of height comparing the direct postoperative intervertebral height with the intervertebral height at the last follow-up time. Adequate lucency i.e. upto 70-80% seen around screws on radiographs defined the union / fusion. All findings were recorded in a structured performa. SPSS version 25 was used. Means with standard deviations were computed of quantitative variables, and frequencies-percentages for qualitative variables, and frequencies-percentages for qualitative variables respectively to determine their significant association with type of the cage used in ACDF surgery. The p values were taken statistically significant if < 0.05.

**RESULTS**

Out of 52 patients who underwent anterior cervical discectomy and fusion (ACDF) surgery, 90.4% achieved fusion at 12 months of follow up (Picture 1) and 13.5% faced host-operative cage subsidence (Picture 2). In 32 patients, Titanium cage while 20 patients PEEK cage was used in surgical protocol. Both cohorts had similar ages of the patients (mean age in group A 56.22±15.93 vs mean age of group B 55.15±16.11 years, p=0.543) (Table 1 & 2).

The radiological outcome in term of fusion and post-operative complications were comparable in both cage groups. The radiological fusion rate at 6 months was 62.5% in Titanium cage group and 60% in PEEK cage group (p=0.543). Similarly, fusion rate at 12 months follow up was 90.6% in first group and 90% in second group (p=0.646). Among post-operative complications, cage subsidence rate was 18.8% with Titanium cage and 5% with PEEK cage (p=0.228). One patients of PEEK cage group suffered painful donor site, one patient of Titanium group suffered subluxation and limb weakness and one patient of Titanium group suffered limb pain and numbness. Complications other than cage subsidence were also commutatively comparable in both cohorts (p=0.673) (Table 2).

Fig. 1: Fusion rate in patients who underwent ACDF surgery (n=52)

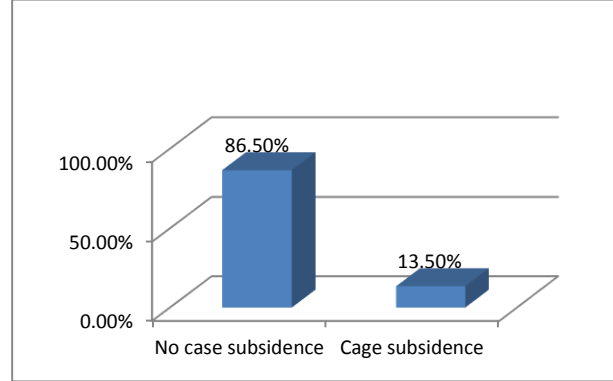


Fig. 2: Cage subsidence rate in patients who underwent ACDF surgery (n=52)

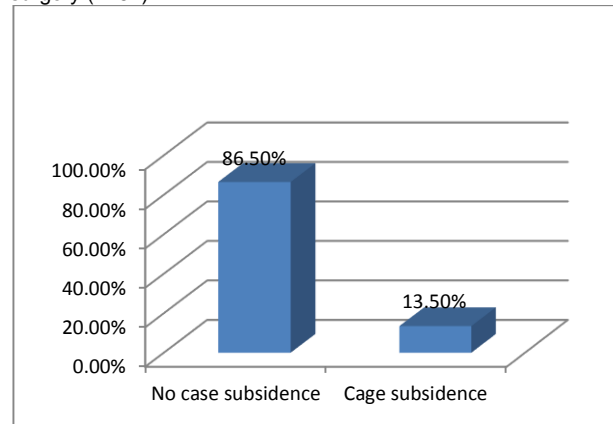


Table 1: Comparison of mean age with type of cage used in Anterior cervical discectomy & fusion (ACDF) surgery (n = 52) \*

Quantitative variables	Posterior pedicle screw fixation		Mean difference	p-value
	Titanium (mean + SD)	PEEK (mean + SD)		
Age of patients (years)	56.22±15.93	55.15±16.11	1.069	0.816

\*Independent sample T-test was used

Table 2: Comparison of various qualitative variables with type of cage used in Anterior cervical discectomy & fusion (ACDF) surgery (n = 52) \*

Predictors / Factors	Type of cage used in surgery		Total	p-value
	Titanium	PEEK		
Male	20 (62.5%)	12(60%)	32 (61.5%)	0.543
Female	12(37.5%)	8 (40%)	20 (38.5%)	
<b>Fusion at 6 months:</b>				0.543
Yes	20 (62.5%)	12 (60%)	32 (61.5%)	
No	12 (37.5%)	8 (40%)	20 (38.5%)	
<b>Fusion at 12 months:</b>				0.646
Yes	29 (90.6%)	18(90%)	47 (90.4%)	
No	3 (9.4%)	2 (10%)	5 (9.6%)	
<b>Cage subsidence:</b>				0.228
Yes	6 (18.8%)	1(5%)	7 (13.5%)	
No	26 (81.2%)	19 (95%)	45 (86.5%)	
<b>Other complications:</b>				0.673
Yes	2 (6.3%)	1 (5%)	3 (5.8%)	
No	30 (93.7%)	19 (95%)	49 (94.2%)	

\*Chi-square test for independence was used

## DISCUSSION

Anterior cervical discectomy and fusion (ACDF) surgery has outstanding radiological fusion rates in cervical cord disease patients. Kevin Phan et al<sup>18</sup> achieved a fusion rate of 96% after ACDF surgery where both titanium and PEEK cages were found equally effective. Yu-Cheng Chou<sup>16</sup> observed 46.51% and 100% fusion rates in titanium and PEEK cage groups respectively. Mario Cabraja<sup>19</sup> found a fusion rate 93.2% with titanium cage and 88% with PEEK cage. Similarly, in a meta-analysis by Zhi Jan-Li,<sup>17</sup> yield was comparable with both kinds of cages.

In our study, the radiological fusion rate at 12 months follow up was 90.4%, which was 90.6% in titanium cage group and 90% in PEEK cage group. Hence, choice of the cage keeping in view the fusion rates can be either of titanium or PEEK cage, as both are equally effective.

Iris Noodhock and colleagues<sup>8</sup> reviewed 71 studies including 4784 patients to determine cage subsidence rate among patients who underwent ACDF surgery. They found the mean incidence of subsidence of 21%. There was a little difference in subsidence rates depending on the material of the cage. In that study, subsidence rate with cage-screw combination was 15.1%, with PEEK cage 23.5%, titanium cage 24.9%, and with polymethyl methacrylate (PMMA) cage was 30.2%.

In our study, after ACDF surgery, cage subsidence rate was 13.5% only. The subsidence in titanium cage group of the patients was 18.8% while in PEEK cage group was 5%, however correlation was insignificant ( $p=0.228$ ). It means the choice of the cage is not affected by its subsidence rate in our patients. There are numerous complications associated with ACDF other than subsidence.

Tao Wang<sup>9</sup> studied the dysphagia after ACDF surgery and observed a dysphagia rate of 5.4% and 0.4% at 3 and 24 months post-operative respectively while Kenneth Kam Leung Yeung<sup>10</sup> studied 69 ACDF patients for post-procedural complications and found 2.9% hoarseness due to vocal cord dysfunction. Wound infection is a common complication for all surgical procedures, however in a 8887 studied patients after ACDF,<sup>11</sup> post-operative wound infection rate was only 0.07%.

The iatrogenic nerve root injury may also occur in ACDF procedure which may manifest with limb pain, limb numbness, or limb weakness. Jason Pui Yin Cheung et al<sup>12</sup> explained the risk of nerve injury of about 2% during ACDF surgery.

The pain at the donor site is commonly seen after ACDF surgery. Silber and colleagues<sup>20</sup> reported 26.1% pain rate at donor site after this surgery and 11.2% chronically use analgesics for pain. M. Skeppholm et al<sup>21</sup> observed that pain at donor site is a major issue only during first 4 weeks, after which it does not affect the quality of the life. In our study, only one patient suffered painful donor site, one faced subluxation and limb weakness and one suffered limb pain and numbness. In our study, cumulatively complications other than subsidence has a rate of only 5.8%, where titanium cage group has 6.3% and PEEK cage group has 5% rates with insignificant association between two groups ( $p=0.673$ ).

Hence, considering fusion rate and complication rate including cage subsidence, no significant difference was found between patients of titanium and PEEK cage groups in our studied population.

## CONCLUSION

The fusion rates with anterior cervical discectomy and fusion (ACDF) surgery are excellent and comparable using Titanium as well as PEEK cages with fewer post-operative complications. No one modality has superiority over other in our studied population. Titanium cages are cheaper, so may still be alternative to PEEK cages in our people where affordability is a big issue for general public.

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