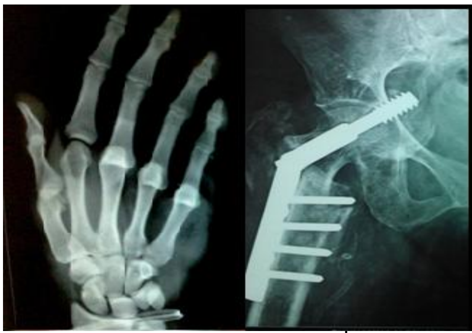


International Journal of Orthopaedics Sciences

ISSN: 2395-1958
IJOS 2017; 3(4): 626-629

www.orthopaper.com
Received: 28-08-2017
Accepted: 29-09-2017

Dr. Piyush Mittal
Associate Professor and HOU, CHA, BJ Medical College and Civil Hospital Ahmedabad, Gujarat, India

Dr. Amit Kumar
Department of Orthopaedic, BJ Medical College and Civil Hospital Ahmedabad, Gujarat, India

Dr. Ridham Baria
Department of Orthopaedic, BJ Medical College and Civil Hospital Ahmedabad, Gujarat, India

Correspondence
Dr. Piyush Mittal
Department of Orthopaedic, BJ Medical College and Civil Hospital Ahmedabad, Gujarat, India

Outcomes of kidney vs PEEK cages used in transforaminal lumbar interbody fusion (TLIF) for the treatment of degenerative lumbar spine

Dr. Piyush Mittal, Dr. Amit Kumar and Dr. Ridham Baria

DOI: https://doi.org/10.22271/ortho.2017.v3.i4i.88

Abstract

Purpose: Compared to titanium cage, polyethyletherketone (PEEK) cage with pedicle screw fixation has been increasingly used in transforaminal lumbar interbody fusion (TLIF). However, there is insufficient evidence supporting the superiority of PEEK cages over titanium cages as optimal TLIF spacers. The aim of this study was to compare the clinical and radiographic outcomes of patients at a 1-year follow-up after undergoing instrumented TLIF in which either a PEEK cage or a titanium cage was implanted for spacer [1, 2, 4].

Materials and Methods: We retrospectively analyzed prospectively collected 25 patients who underwent single-level TLIF in which the first 12 patients received a titanium cage and the 13 patients received a PEEK cage. Patient functional outcomes and radiographic imaging, fusion rates, subsidence failures were studied in follow up.

Results: Improvement of clinical outcomes was comparable between the two groups. Based on the criteria using repeated x rays with dynamic views, 83.33% in the Titanium group and 69.23% in the PEEK group showed fusion at 6 months. At 12 months, fusion rate in the Titanium group was increased to 100 %, while PEEK group showed 84 % of fusion rate. In the PEEK group, vertebral osteolysis was comparatively higher and 2 cases showed non-union.

Conclusion: Although there is no significant difference between peek cage and kidney cage for interbody fusion and clinical outcome but there is more chances of subsidence in kidney (titanium) group and hence segmental kyphosis than other group. Vertebral osteolysis in few cases of peek group might not provide a satisfactory fusion.

Keywords: Peek cage, kidney cage, lumbar fusion, TLIF, spondylolisthesis

Introduction

TLIF is widely accepted surgery for the treatment of degenerative lumbar diseases like isthmic spondylolyshesis, degenerative disc, lumbar stenosis and recurrent disc hurniations. It has been shown that it decreases potential complications as compared with anterior lumbar interbody fusion, shorter hospital stays and lower costs as compared with anterior combined with posterior approaches [4-6, 8]. In addition, TLIF theoretically offers a lower risk of segmental instability because of the preservation of posterior lamina arch and posterior longitudinal ligament complex.

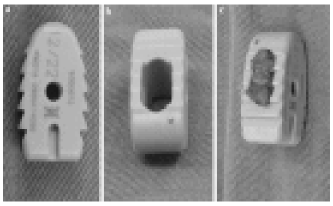
Titanium kidney cages and peek cages with local auto graft are used widely in this surgery now a days. Others materials for interbody fusion include auto-graft iliac crest, allograft bone, carbon fiber cages and. Auto-graft iliac crest has been considered the ‘‘gold standard’’ for fusion but there are some donor-site complications [1, 3, 6, 8, 9]. PEEK cages are radiolucent and have an elastic modulus similar to native bone. PEEK cages augmented by pedicle screws have been shown to promote lumbar interbody fusion and to provide excellent clinical outcomes

Materials and methods

Patients

The primary study subjects were patients who were diagnosed with degenerative or isthmus spondylolisthesis, degenerative disc disease, lumbar stenosis, lumbar disc herniation or recurrent lumbar disc herniation. We excluded patients with lumbar tuberculosis, tumor or infection or trauma or who lacked sufficient clinical data. The patients were retrospectively divided into two groups based on cage types.

Photos of titanium cages



Photos of PEEK cages

Surgical procedures

Before surgery,all patients underwent preoperative examinations for neurogenic claudication, low back pain, and radicular symptoms and investigated with anteroposterior and lateral flexion/extension radiographs of lumbar spine and MRI. During surgery, it was ensured that osteophytes surrounding the lateral recess and the ligamentum flavum were removed in every case to ensure that the dura mater was widely exposed and that the nerve root was released and end plates were well prepared.

All patients were instructed to wear a lumbar brace for a period of approximately 12 weeks and had 3-, 6- and 12-month follow up as a final follow-up. Static and lateral flexion/extension radiographs were used to assess the instruments, stability, lumbar curvature and disc-space height of the fused segments and bony fusion status. If doubtful fusion, CT scan was taken for further evaluations.

Outcome measurements

Clinical outcomes were assessed in a self-reported manner with the Oswestry disability index (ODI) and a 10-point visual analog scale (VAS) for low back pain (0–10, from “no pain” to “extreme pain”). The ODI and VAS were applied to evaluate the pain of low back and leg, as well as neurological status at preoperative, 3 month, 6-month, 12 month follow-up. At each follow up, we measured the intervertebral space height and segmental angle and interbody fusion status. The cage subsidence was defined as any loss of IH more than 3 mm.

Bony fusion was identified as the presence of trabeculation and bone bridging between cages and adjacent endplates, the absence of greater than 3 mm translational motion and more than 5° angular motion upon flexion/extension radiographs in the fused segments and the absence of a radiolucent gap between the cages and endplates. If fusion was uncertain, three-dimensional computed tomography scans were taken to verify the fusion status

The IH (intervertebral height) was improved both the group (from 7.22 ± 2.18 mm preoperative to 12.62 ± 1.58 mm)at 1-week postoperative in titanium cage and in the PEEK group from 7.62± 2.14 mm preoperative to 12.01 ± 1.68 mm at 1-week postoperative. There were no significant differences between the two groups for all of the above parameters at any time point observed (*P*>0.05). Regarding the SA (segmental angle) it also did not differ significantly (*P*>0.05)

IH(mm)

	Kidney	peek	p
Pre-O	7.22 ± 2.18	7.62 ± 2.14	0.490
1-w Post-O	12.62 ± 1.58	12.01 ± 1.68	0.536
3-m Post-O	11.95 ± 1.48	11.70 ± 1.47	0.114
6-m Post-O	11.55 ± 1.41	11.32 ± 1.36	0.141
1-y Post-O	11.27 ± 1.32	11.07 ± 1.39	0.177
Fin-foll-up	10.97 ± 1.26	10.86 ± 1.37	0.453
Correction	3.18 ± 1.73	3.23 ± 1.72	0.791

At the 6 month follow-up, 83.33 % showed fusion in titanium group and 69.2 % of patients in the PEEK group showed bony fusion and statistical significant difference was noted. At the final follow-up (12 months), the bony fusion rate was 100% in titanium and 84% in PEEK groups, respectively. At three month follow up, the cage subsidence was noted to be higher in titanium group as compared to peek but at 1 year follow up, there were no significant differences cage subsidence rates (*P*>0.05)

Fusion rate (%)	Kidney cage	peek cage	p
6 montPost-O	10/12 (83.33 %)	9/13 (69.2 %)	0.925
Fin-foll-up	12/12 (100 %)	11/13 (84 %)	0.766

Clinical Outcomes

The preoperative ODI and VAS scores did not differ between groups upon follow up, VAS scores had improved significantly for both groups, but no significant differences were found between the kidney and PEEK groups (*P*>0.05,). The ODI was also similar between the two types of cage groups during follow up (*P*>0.05).

VAS and ODI at pre-o and post-o (mean ± SD)

Parameters	kidney Cage	PEEK Cage	*P*
VAS(points)			
Pre-O	6.02 ± 1.20	6.17 ± 1.38	0.338
1-y Post-O	2.31 ± 0.85	2.25 ± 0.87	0.617
Fin-foll-up	1.56 ± 0.87	1.58 ± 0.89	0.853
ODI(%)			
Pre-O	50.56 ± 6.41	51.00 ± 6.47	0.583
1-y Post-O	26.37 ± 5.94	26.51 ± 5.88	0.851
Fin-foll-up	14.69 ± 4.13	14.61 ± 4.08	0.862

Discussion

The overall rate of cage subsidence was 17.4% in both of the groups. The loss of segmental correction in all of our patients at the last follow-up could be regarded as a consequence of cage subsidence. Both cage-types offer certain advantages in spine surgery. Titanium-implants likely provide a good osseointegration. Furthermore, their surface structure appears to be comparably resistent to microbial adhesion, although of course many factors affect the incidence of infection. The PEEK’s modulus of elasticity is close to that of cortical bone and its radiolucency allows for a more accurate assessment of osseous fusion on plain radiographs. It does not compromise MRI-examinations, which is of particular interest in follow up.

When comparing PEEK- with titanium cages the occurrence of titanium-cage subsidence is believed to be related to the higher modulus of elasticity. But this could be a random effect also depending on quality of individual bone, cage size, endplate preparation, distance of implant from the anterior rim, and overdistarction with subsequent increased stress of the endplates, quality of radiographs and measurement tools used.

The higher rate of bone formation in our Titanium group could be explained by more osteogenic and osteoconductive properties as coating (plasmaphore) of the Titanium-cages enlarges the surface area as compared to the PEEK-cage. Cage subsidence and subsequent exposure of cancellous bone inside the cage might promote fusion in certain case. Nonetheless, it must be considered that fusion is not mandatory for a clinical success, and a loss of disc height and a potential segmental kyphosis might result from a cage subsidence. As PEEK-cages are not entirely radiolucent to allow a certain assessment of bone within the cages, for these reasons only the presence of anterior or posterior bone formation was rated. So, the absence of segmental movement was our main criterion to rate a segment as a solid arthrodesis or pseudarthrosis. While in many studies bony union of the operated segment is regarded as the main criterion for a stable fusion, the study of functional flexion-extension radiographs and the position of the spinous processes can reveal no motion at the level and hence show a stable segmental status despite the lack of osseous trabeculation. The absence of bony fusion can occur with absence of motion even for a long-term period, which is therefore accepted as a successful criterion for fusion in lateral radiographs. A CT-scan would have allowed a more precise statement of bony ingrowth, but was not performed routinely in our study to avoid an unnecessary radiation exposure.

Conclusions

This retrospective study demonstrated that the use of both kidney and PEEK cages can promote effective clinical and radiographic outcomes in the treatment of lumbar degenerative diseases with an average 1 year follow-up.

References

1. Cutler AR, Siddiqui S, Mohan AL, Hillard VH, Cerabona F, Das K. Comparison of polyetheretherketone cages with femoral cortical bone allograft as a single-piece interbody spacer in transforaminal lumbar interbody fusion. J Neurosurg Spine. 2009; 5(6):534-539. 10.3171/spi.2006.5.6.534.
2. Chou YC, Chen DC, Hsieh WA, Chen WF, Yen PS, Harnod T *et al*. Efficacy of anterior cervical fusion: comparison of titanium cages, polyetheretherketone (PEEK) cages and autogenous bone grafts. J Clin Neurosci. 2008; 15(11):1240-1245. 10.1016/j.jocn.2007.05.016.V
3. Meier U, Kemmesies D. [Experiences with six different intervertebral disc spacers for spondylodesis of the cervical spine]. Orthopade. 2011; 33(11):1290-1299. 10.1007/s00132-004-0707-3.
4. Niu CC, Liao JC, Chen WJ, Chen LH. Outcomes of interbody fusion cages used in 1 and 2-levels anterior cervical discectomy and fusion: titanium cages versus polyetheretherketone (PEEK) cages. J Spinal Disord Tech. 2012; 23(5):310-316.
5. Matge G. Cervical cage fusion with 5 different implants: 250 cases. Acta Neurochir (Wien). 2002; 144(6):539-549. 10.1007/s00701-002-0939-0. discussion 550
6. Barsa P, Suchomel P. Factors affecting sagittal malalignment due to cage subsidence in standalone cage assisted anterior cervical fusion. Eur Spine J. 2007; 16(9):1395-1400. 10.1007/s00586-006-0284-8.
7. Chiang CJ, Kuo YJ, Chiang YF, Rau G, Tsuang YH. Anterior cervical fusion using a polyetheretherketone cage containing a bovine xenograftp: three to five-year follow-up. Spine (Phila Pa 1976). 2008; 33(23):2524-2428. 10.1097/BRS.0b013e318185289c.
8. Francke EI, Demetropoulos CK, Agabegi SS, Truumees E, Herkowitz HN. Distractive force relative to initial graft compression in an *in vivo* anterior cervical discectomy and fusion model. Spine (Phila Pa 1976). 2010; 35(5):526-530. 10.1097/BRS.0b013e3181bb0e6e.
9. Yang JJ, Yu CH, Chang BS, Yeom JS, Lee JH, Lee CK. Subsidence and nonunion after anterior cervical interbody fusion using a stand-alone polyetheretherketone (PEEK) cage. Clin Orthop Surg. 2011; 3(1):16-23. 10.4055/cios.2011.3.1.16.
10. Lemcke J, Al-Zain F, Meier U, Suess O. Polyetheretherketone (PEEK) Spacers for Anterior Cervical Fusion: A Retrospective Comparative Effectiveness Clinical Trial. Open Orthop J. 2011; 5:348-353. 10.2174/1874325001105010348.
11. Cabraja M, Klein M, Lehmann TN. Long-term results following titanium cranioplasty of large skull defects. Neurosurg Focus. 2009; 26(6):E10-10.3171/2009.3.FOCUS091.
12. Verran J, Whitehead K. Factors affecting microbial adhesion to stainless steel and other materials used in medical devices. Int J Artif Organs. 2005; 28(11):1138-1145.
13. Diedrich O, Perlick L, Schmitt O, Kraft CN. Radiographic characteristics on conventional radiographs after posterior lumbar interbody fusion: comparative study between radiotranslucent and radiopaque cages. J Spinal Disord. 2001; 14(6):522-532. 10.1097/00002517-200112000-00012.
14. Disch AC, Schaser KD, Melcher I, Feraboli F, Schmoelz W, Druschel C *et al*. Oncosurgical results of multilevel thoracolumbar en-bloc spondylectomy and reconstruction with a carbon composite vertebral body replacement system. Spine (Phila Pa 1976). 2011; 36(10):E647-E655.
15. Teo EC, Yang K, Fuss FK, Lee KK, Qiu TX, Ng HW. Effects of cervical cages on load distribution of cancellous core: a finite element analysis. J Spinal Disord Tech. 2004; 17(3):226-231. 10.1097/00024720-200406000-00010.
16. Wilke HJ, Kettler A, Goetz C, Claes L. Subsidence resulting from simulated postoperative neck movements: an in vitro investigation with a new cervical fusion cage. Spine (Phila Pa 1976). 2000; 25(21):2762-2770. 10.1097/00007632-200011010-00008.
17. Pechlivanis I, Thuring T, Brenke C, Seiz M, Thome C, Barth M *et al*. Non-fusion rates in anterior cervical discectomy and implantation of empty polyetheretherketone cages. Spine (Phila Pa 1976). 2011; 36(1):15-20.
18. Tureyen K. Disc height loss after anterior cervical microdiscectomy with titanium intervertebral cage fusion. Acta Neurochir (Wien). 2003; 145(7):565-569. 10.1007/s00701-003-0050-1. discussion 569–570
19. Cabraja M, Koeppen D, Lanksch WR, Maier-Hauff K, Kroppenstedt S. Polymethylmethacrylate-assisted ventral discectomy: rate of pseudarthrosis and clinical outcome with a minimum follow-up of 5 years. BMC Musculoskelet Disord. 2011; 12:140-10.1186/1471-2474-

12-140.
20. Andaluz N, Zuccarello M, Kuntz C. Long-term follow-up of cervical radiographic sagittal spinal alignment after 1- and 2-level cervical corpectomy for the treatment of spondylosis of the subaxial cervical spine causing radiculomyelopathy or myelopathy: a retrospective study. J Neurosurg Spine. 2012; 16(1):2-7. 10.3171/2011.9.SPINE10430.
21. Harrison DD, Janik TJ, Troyanovich SJ, Holland B. Comparisons of lordotic cervical spine curvatures to a theoretical ideal model of the static sagittal cervical spine. Spine (Phila Pa 1976). 1996; 21(6):667-675. 10.1097/00007632-199603150-00002.
22. Kulkarni AG, Hee HT, Wong HK. Solis cage (PEEK) for anterior cervical fusion: preliminary radiological results with emphasis on fusion and subsidence. Spine J. 2007; 7(2):205-209. 10.1016/j.spinee.2006.03.002.
23. Boker DK, Schultheiss R, Probst EM. Radiologic long-term results after cervical vertebral interbody fusion with polymethyl methacrylat (PMMA). Neurosurg Rev. 1989; 12(3):217-221. 10.1007/BF01743989.
24. Barlocher CB, Barth A, Krauss JK, Binggeli R, Seiler RW. Comparative evaluation of microdiscectomy only, autograft fusion, polymethylmethacrylate interposition, and threaded titanium cage fusion for treatment of single-level cervical disc disease: a prospective randomized study in 125 patients. Neurosurg Focus. 2002; 12(1):
25. van den Bent MJ, Oosting J, Wouda EJ, van Acker RE, Ansink BJ, Braakman R. Anterior cervical discectomy with or without fusion with acrylate. A randomized trial. Spine (Phila Pa 1976). 1996; 21(7):834-839. 10.1097/00007632-199604010-00011. discussion 840
26. Brown JA, Havel P, Ebraheim N, Greenblatt SH, Jackson WT. Cervical stabilization by plate and bone fusion. Spine (Phila Pa 1976). 1988; 13(3):236-240. 10.1097/00007632-198803000-00003.
27. Gassman J, Seligson D. The anterior cervical plate. Spine (Phila Pa 1976). 1983; 8(7):700-707. 10.1097/00007632-198310000-00004.
28. Kaiser MG, Haid RW, Subach BR, Barnes B, Rodts GE. Anterior cervical plating enhances arthrodesis after discectomy and fusion with cortical allograft. Neurosurgery. 2002; 50(2):229-236. discussion 236–228
29. Wang JC, McDonough PW, Endow KK, Delamarter RB. Increased fusion rates with cervical plating for two-level anterior cervical discectomy and fusion. Spine (Phila Pa 1976). 2000; 25(1):41-45. 10.1097/00007632-200001010-00009.
30. Samartzis D, Shen FH, Lyon C, Phillips M, Goldberg EJ, An HS. Does rigid instrumentation increase the fusion rate in one-level anterior cervical discectomy and fusion?. Spine J. 2004; 4(6):636-643. 10.1016/j.spinee.2004.04.010.
31. Jagannathan J, Shaffrey CI, Oskouian RJ, Dumont AS, Herrold C, Sansur CA *et al*. Radiographic and clinical outcomes following single-level anterior cervical discectomy and allograft fusion without plate placement or cervical collar. J Neurosurg Spine. 2008; 8(5):420-428. 10.3171/SPI/2008/8/5/420.