# Posterior lumbar interbody fusion using single polyetheretherketone transforaminal lumbar interbody fusion cage: a single-surgeon experience

Tarek El-Fiky, Yasser Allam

Department of Orthopedics and Traumatology, Spine Unit, El-Hadra University Hospital, Alexandria University, Alexandria, Egypt

Correspondence to Tarek El-Fiky, MD, Department of Orthopedics and Traumatology, Spine Unit, El-Hadra University Hospital, Alexandria University, Alexandria, Egypt.
Tel: +20 122 338 2958;
e-mail: tarekfiky@yahoo.com

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**Study design**
This is a prospective nonrandomized single-surgeon experience of posterior lumbar interbody fusion (PLIF) using a single polyetheretherketone (PEEK) transforaminal lumbar interbody fusion (TLIF) cage in degenerative lumbar disorders.
**Summary of background data**
The PLIF procedure has gained popularity, with different indications. TLIF PEEK cages can be used either singly or doubly. There are several practical problems encountered in the TLIF procedure with implantation of two cages.
**Objectives**
The aim of this work is to evaluate single-surgeon experience of early results of PLIF using a single PEEK TLIF cage in degenerative lumbar disorders.
**Patients and methods**
The study included 19 consecutive cases with degenerative lumbar disorders. There were 12 female and seven male patients. Their age ranged between 22 and 68 years. The follow-up period ranged between 6 and 16 months. All patients were diagnosed using MRI. Postoperative and follow-up radiography and multislice computed tomography were used to verify the screws and position of the cage, to exclude cage subsidence or migration, and to show the fusion status. The Visual Analog Scale (VAS) for back and leg pain was used.
**Results**
All the patients had good cage positioning and none had instrumentation failure or screw loosening. Postoperative intervertebral height in all the patients was better than the preoperative ones. Moreover, cage migration, retropulsion, subsidence, or pseudoarthrosis was not observed at the end of follow-up. VAS for leg pain showed a statistically significant improvement from 7.9 preoperatively to 2.8 at the end of follow-up. VAS for back pain also showed a statistically significant improvement from 6.8 preoperatively to 3.7 at the end of follow-up.
**Conclusion**
Early results of PLIF using a single PEEK TLIF cage in degenerative lumbar disorders are encouraging. However, longer follow-up is still necessary.

**Keywords:**
degenerative, lumbar, polyetheretherketone, posterior lumbar interbody fusion

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## Introduction

The posterior lumbar interbody fusion (PLIF) procedure has gained popularity, with indications including spinal stenosis, instability, degenerative disc disease (DDD), spondylolisthesis, and spondylolysis [1–3]. Interbody fusion techniques have been developed to provide solid fixation of spinal segments while maintaining load-bearing capacity and proper disc height [4]. The ability to reconstruct the anterior column after disc evacuation is important because 80% of the compressive, torsion, and shear forces are transmitted through the anterior column [5,6].

Several interbody spacers have been used such as titanium mesh, carbon fiber, and polyetheretherketone (PEEK) [7]. PEEK is a semicrystalline aromatic polymer that is used as a structural spacer to maintain the disc and foraminal height. Their use has led to increased and predictable rates of fusion. However, not many reports of the adverse effects of their use are available [8].

Transforaminal lumbar interbody fusion (TLIF) cages can be used either singly or doubly. There are several practical problems encountered in the TLIF procedure with implantation of two cages, such as difficulty in achieving symmetric positioning with two cages,



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loosening of the first cage after insertion of the second one, and higher costs to the patient [9].

The aim of this work is to evaluate single-surgeon early results of PLIF using single PEEK TLIF cage in degenerative lumbar disorders.

## Patients and methods

We started this study after approval from the institutional board review board. This is a prospective nonrandomized single-surgeon experience of PLIF using a single PEEK TLIF cage in degenerative lumbar disorders. The procedure was performed by the first author.

The study included 19 consecutive cases with degenerative lumbar disorders. There were 12 women and seven men. Their age ranged between 22 and 68 years (mean = 43.3 years). The follow-up period ranged between 6 and 16 months with a mean of 11.6 months.

The main symptoms were back and radicular pain. Spinal claudication was present in 16 cases because of lumbar canal stenosis. Three patients suffered from partial cauda equina syndrome due to acute lumbar disc prolapse.

All patients were subjected to conservative treatment for at least 3 months before operative planning, except for the three cases with parital cauda equina syndrome.

Cases with instability, with postlaminectomy syndrome, and with infection were excluded from this study.

As regards the levels, five patients had three levels of stenosis, seven cases had two levels, and in the remaining seven patients only one level was affected.

All patients were diagnosed using MRI. Conventional radiographies were done to rule out spine instability and to help leveling. Postoperative radiography and multislice computed tomography were used in every patient to verify the screws and position of the cage. Moreover, computed tomography was performed routinely after 6 months and 1 year to verify the position of the cage, to exclude cage subsidence or migration, and to show the fusion status.

The Visual Analog Scale (VAS) for back and leg pain was used to assess the patients preoperatively and postoperatively.

Statistical analysis was performed with the SPSS, version 11.5 statistical software (SPSS Inc., Chicago, Illinois, USA). Statistical significance was noted when *P* value is less than 0.05.

### Surgical considerations

In all cases, PLIF was performed in the standard manner [7]. After determination of the level of interest, top-loading pedicular instrumentation was performed. Thereafter, decompression and diskectomy was performed on the symptomatic side. If symptoms were bilateral, decompression was performed on the other side as necessary. After diskectomy, a local bone graft was inserted to fill the anterior one-third of the space. A single TLIF cage then filled with local bone graft was inserted. The widest cage was used. In all cases, additional posterolateral fusion (PLF) was added. The whole procedure was monitored with the C-arm.

## Results

The mean operative time was 195 min (range = 125–250 min), and the average blood loss was about 400–2500 ml/patient. The postoperative hospital stay ranged between 2 and 5 days. Cages were inserted at every level, with the exception of those with three levels, in which two-level PLIF was performed in addition to PLF and instrumentation.

VAS for leg pain showed a statistically significant improvement from 7.9 preoperatively to 2.8 at the end of follow-up. VAS for back pain also showed a statistically significant improvement from 6.8 preoperatively to 3.7 at the end of follow-up. Complete recovery of all cases with parial cauda equina occurred.

All the patients had good cage positioning and none had instrumentation failure or screw loosening. Postoperative intervertebral height in all the patients was better than the preoperative ones. Moreover, cage migration, retropulsion, subsidence, or pseudoarthrosis were not observed at the end of follow-up.

As regards the complication, we had two cases of dural tear, which was managed conservatively in one case. In the other one, surgical closure was necessary after 5 days because of continuous cerebrospinal fluid leak. This patient had transient weakness of the left ankle dorsiflextion (grade 3), and recovered after 3 weeks. Moreover, superficial infection occurred in one more case, and was managed conservatively (Figs. 1 and 2).

## Discussion

PLIF was first attempted by Cloward [10], and later revised by Lin [11]. The interbody fusion immediately produces a biomechanically stable postoperative spine, thus enhancing the opportunity for arthrodesis. A posterolateral graft is easily added to this procedure, further enhancing the stability and likelihood of fusion [1,3].

Interbody cages have become popular and are now composed of a wide range of materials, such as titanium mesh, carbon fiber, and PEEK. Not only have fusion rates improved with this evolution, but technological advances in these implants have also improved their safety and ease of application, further adding to the popularity of the PLIF procedure [12–16].

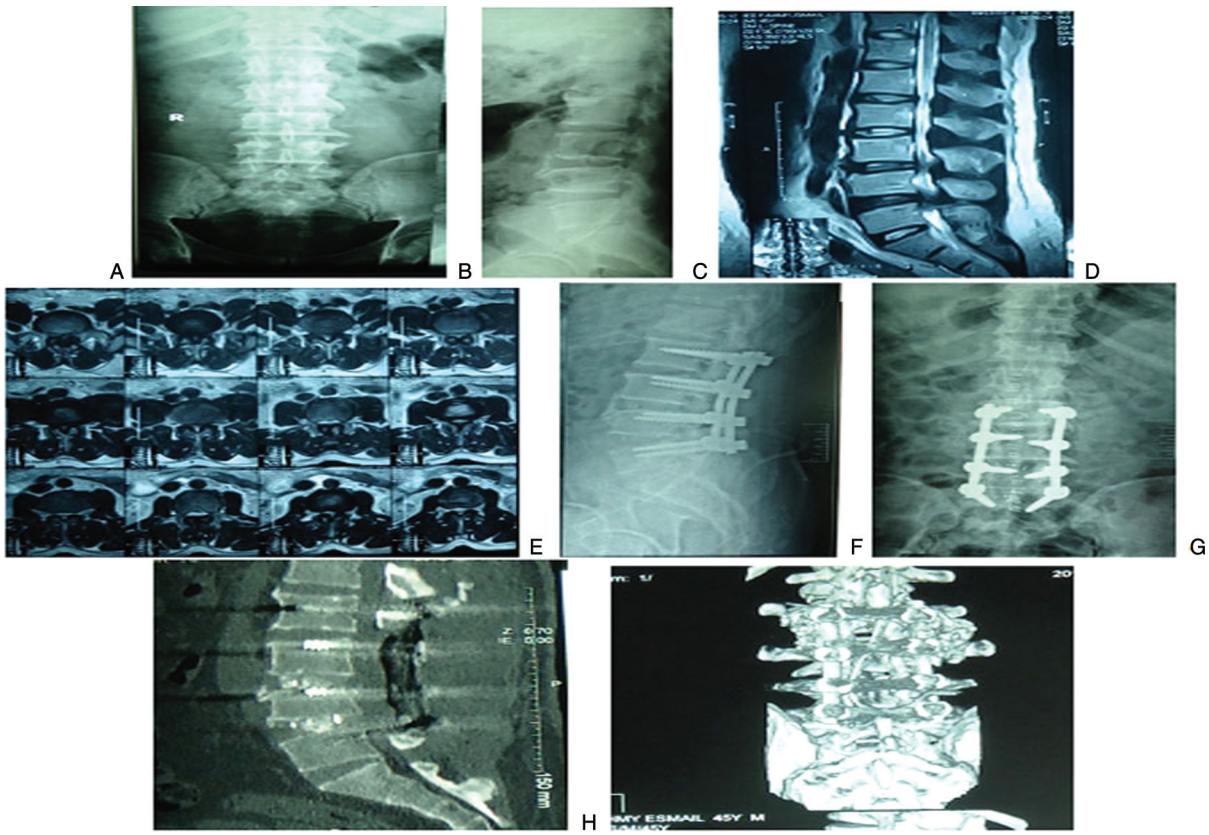
Although titanium alloy cages give good fusion rates, disadvantages are the subsidence of the cage in the adjacent vertebrae and problematic radiological evaluation of fusion. PEEK cages should overcome this [17].

It is well known that there is still no consensus on the management of degenerative lumbar disorders, namely stenosis, lumbar disc prolapse, and DDD, by fusion versus nonfusion strategy [18]. Typically, patients with a symptomatic herniated disc refractory to medical management undergo discectomy without fusion. However, our indication of fusion includes predominant back pain, a sizable herniation with significant disc degeneration, central disc herniation, and in manual workers to obtain strong back. For cases with stenosis necessitating excessive bone removal including facetectomy, or those with multiple levels, we would not hesitate to perform fusion.

We believe that a unilateral insertion of one cage is enough and can minimize operative trauma to the dura and nerve root. Moreover, it can reduce operative time and blood loss. In case of bilateral symptoms, or if the stenosis is on both sides, addition of decompression and foraminotomy is quite sufficient.

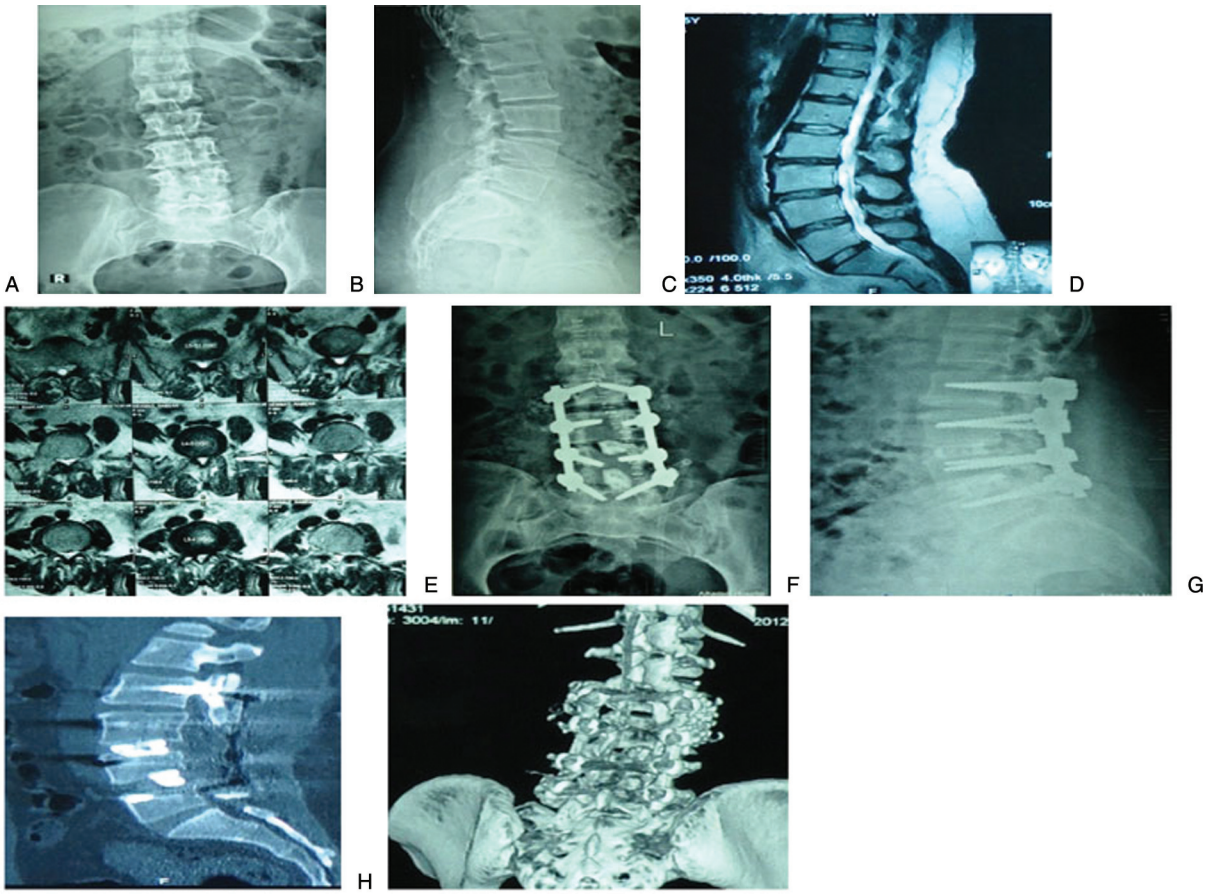
Improvement of the symptoms in our series was satisfactory, and it was comparable to those in the literature [7,13,17].

**Figure 1**




(a, b) Anteroposterior and lateral radiograph of a 45-year-old man with lumbar canal sternosis. (c, d) T2 MRI shows L2–L3, L3–L4, and L3–L4 stenosis. (e, f) Postoperative anteroposterior and lateral radiograph showing PLIF L3–L4 and L4–L5 with posterolateral fusion at L2–L3 level. (g, h) Sagittal and reconstruction multislice CT after 9 months shows good screws and cage positioning, and good interbody fusion. Note the posterolateral fusion at L2–L3. CT, computed tomography; PLIF, posterior lumbar interbody fusion.

**Figure 2**




(a, b) Anteroposterior and lateral radiograph of a 45-year-old man with lumbar canal sternosis. (c, d) T2 MRI shows L2–L3, L3–L4, and L3–L4 stenosis. (e, f) Postoperative anteroposterior and lateral radiograph showing PLIF L3–L4 and L4–L5 with posterolateral fusion at the L2–L3 level. (g, h) Sagittal and reconstruction multislice CT after 12 months shows maintained cage positioning, and good interbody fusion. In addition, the posterolateral fusion can be seen at L2–L3. CT, computed tomography; PLIF, posterior lumbar interbody fusion.

There are some potential complications for the PLIF procedure, including the risk of nerve root injury during retraction, which may cause endoneural fibrosis and chronic radiculopathy, pseudarthrosis, graft or cage retropulsion, cage subsidence, and juxtafusion degeneration [7]. Because of the previous inherent complications of PLIF in addition to the extensive surgery with subsequently increased blood loss, we did not perform more than two levels of PLIF. For those cases with three levels of decompression, PLF was added together with pedicular fixation at the uppermost level. Our complications were minimal (two cases of dual tear, and one superficial infection). Until the end of our follow-up, no further complications could be detected. The absence of cage subsidence in our series could be attributed to selection of the widest cage to fill the gap after making the trials. This finding was supported by Le *et al.*[19]. In addition, we were unable to see solid fusion in some cases with short follow-up. It was found by Lee and colleagues that the fusion rate of the PEEK cage used in PLIF assessed at 12 months was higher than that found at 6 months. Therefore, an assessment on the complete fusion of local bone at 12 months after surgery is more accurate. It should be noted, however, that we did not face any case of implant failure, screw loosening, or cage migration, which would occur if fusion problems happened [20]. Moreover, our follow-up may be not long enough to assess juxtafusion degeneration.

The strength of this article is that it studied a single-surgeon concept and experience of that technique. Patients' assessment and statistics were performed by the second author to exclude any bias. On the other hand, there are several limitations associated with this study. Besides the nonrandomized nature of the study, and the relatively small material, the follow-up period is short.

We believe that the issue of fusion versus nonfusion or motion-preserving strategy in DDD remains unsolved and should be verified with a well-randomized, prospective study.

## Conclusion

Early results of PLIF using single PEEK TLIF cage in degenerative lumbar disorders are encouraging. However, longer-term follow-up is still necessary.

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Nil.

**Conflicts of interest**

There are no conflicts of interest.

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