

# Long-Term Outcomes of Titanium vs. Polyetheretherketone Cages in Single Level Minimally Invasive Transforaminal Lumbar Interbody Fusion: A Matched Cohort Study

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**INTRODUCTION:** Minimally invasive transforaminal lumbar interbody fusion (MI-TLIF) has evolved as a treatment option for addressing various lumbar degenerative disorders. However, successful fusion may be limited by the properties inherent to the interbody devices utilized. Despite widespread application, concern over the use of polyetheretherketone (PEEK) cages has been raised due to their intrinsic hydrophobicity and lack of osteoconductivity. In contrast, superior rates of fusion and better clinical outcomes have been reported in patient cohorts treated with titanium (Ti) cages. However, it has been hypothesized that the increased stiffness of Ti cages may result in a higher risk of subsidence. There is a paucity of studies examining the differences between these materials in MI-TLIF. Therefore, we sought to compare the revision rates, rates of subsidence and fusion, and patient-reported functional outcomes of Ti and PEEK cages in single-level MI-TLIF with a minimum 2-year follow up. The purpose of this study was to compare clinical and radiographic outcomes of PEEK versus Ti cages in single-level MI-TLIF with at least 2 year follow up.

**METHODS:** A retrospective review was performed to identify all patients between 2012-2018 who underwent single-level MI-TLIF using a PEEK or Ti cage, with a minimum follow up of 2 years. Patients were successfully matched for age, sex, BMI, and levels of operation in each group. Revision rates, time to revision, graft subsidence, and fusion rates in each group were also compared. Graft subsidence was defined as cage migration into one vertebral endplate greater than 3mm on plain radiographic measurement. Clinically relevant pseudarthrosis was determined by evidence on computed tomography (CT) and presence of clinical symptoms. Functional outcomes were assessed with ODI, VAS-I, and VAS-b measurements at follow-up visits. All complications were reviewed. Standard binomial and categorical comparative analyses were performed.

**RESULTS:** A total of 216 consecutive patients were included (108 PEEK, 108 Ti). Mean follow up for the PEEK and Ti cohorts were 44.2 and 45.8 months, respectively ( $p= 0.234$ ). The overall revision rates were 12.9% for the PEEK cohort and 10.2% for the Ti cohort ( $p= 0.523$ ). The mean time to revision was  $35.8 \pm 11.2$  months and  $30.5 \pm 9.6$  months for the PEEK and Ti groups, respectively ( $p= <0.001$ ). The most common postoperative complication was pseudarthrosis in the PEEK group and adjacent segment disease (ASD) in the Ti group. The graft subsidence rates for the PEEK cohort at 3, 6, 12, and 24 months postoperatively were 1.9%, 3.7%, 6.5%, and 7.4%. Subsidence in the Ti group was 2.8%, 5.6%, 7.4%, and 10.2% at the same timepoints. Successful spinal fusion at 24 months was 92.6% and 95.4% for the PEEK and Ti groups, respectively ( $p= 0.391$ ). Both groups experienced significant improvement in their functional outcome scores after surgical treatment; however, although the Ti group had a greater score improvement, there were no significant differences in mean score change from baseline to final follow-up between groups ( $p= 0.070$  [VAS-I],  $p= 0.124$  [VAS-b],  $p= 0.122$  [ODI]).

## DISCUSSION AND CONCLUSION:

The Ti cohort in this study was found to have a higher rate of subsidence, a lower rate of revision, a higher rate of fusion, and greater improvement in functional outcome scores compared to the PEEK cohort; however, these differences were not statistically significant. Overall, superiority was not demonstrated in one group over another. Further studies should consist of randomized controlled trials with biomechanical analyses to definitively conclude the advantages of either device in single-level MI-TLIF.

Table 1. Patient Demographics

Demographic	PEEK	Titanium	p-value
# of patients	108	108	
Age (years)	55.2 (11.3)	56.1 (11.0)	0.554
Gender (M/F)	50/49	50/49	1.000
BMI	30.6 (5.5)	30.0 (5.2)	0.505
# of Smokers (%)	18 (16.7)	15 (13.9)	0.570
Follow-up (months)	44.2 (9.7)	45.8 (10.0)	0.234
Diagnosis (%)			
L4/5	35 (32.4)	28 (25.9)	0.205
L5/S1	54 (50.0)	59 (54.6)	0.496
L5/S2	19 (17.6)	21 (19.4)	0.726
Levels operated (%)			
L3-4	5 (4.6)	5 (4.6)	1.000
L4-5	61 (56.5)	61 (56.5)	1.000
L5-S1	42 (38.9)	42 (38.9)	1.000
Perioperative Data			
EBL (ml)	95.1 (24.8)	87.9 (22.2)	0.053
Operative Time (min)	150.3 (37.2)	144.2 (40.1)	0.248

Table 2. Complications

	PEEK	Titanium	p-value
Total Revisions (%)	14 (12.9)	11 (10.2)	0.523
ASD	4	6	0.516
Pseudarthrosis	8	5	0.390
Wound Infection	2	-	0.156

Table 3. Subsidence Rates

Parameters	PEEK	Titanium	p-value
Subsidence Rate (%)			
3-m Post-Op	2/108 (1.9)	3/108 (2.8)	0.651
6-m Post-Op	4/108 (3.7)	6/108 (5.6)	0.517
12-m Post-Op	7/108 (6.5)	8/108 (7.4)	0.789
24-m Post-Op	8/108 (7.4)	11/108 (10.2)	0.231

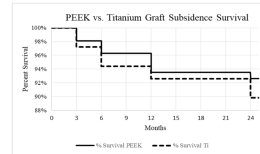


Table 4. Functional Outcomes

Parameters	PEEK	Titanium	p-value
VAS-I (Leg)			
Pre-Op	7.1 (1.4)	7.4 (1.5)	0.130
12-m Post-Op	3.6 (1.8)	3.2 (1.2)	0.056
24-m Post-Op	2.7 (0.7)	2.5 (1.0)	0.090
Score Change	4.4 (1.9)	4.9 (2.1)	0.070
VAS-b (Back)			
Pre-Op	6.5 (1.3)	6.3 (1.1)	0.224
12-m Post-Op	4.6 (1.1)	4.9 (1.3)	0.069
24-m Post-Op	4.1 (1.0)	3.7 (0.9)	0.112
Score Change	2.4 (0.9)	2.6 (0.9)	0.124
ODI Score			
Pre-Op	48.6 (7.1)	50.8 (7.6)	0.029
12-m Post-Op	26.7 (4.5)	27.9 (4.2)	0.065
24-m Post-Op	14.3 (3.2)	15.3 (3.8)	0.071
Score Change	34.3 (5.2)	35.5 (5.9)	0.122