The Impact of Interbody Surface Roughness on Radiographic and Clinical Outcomes after Transforaminal Lumbar Interbody Fusion

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INTRODUCTION: The long-term success of interbody fusion relies on complete osseointegration between the implant surface and vertebral endplates. Modification to the surface characteristics of commonly utilized titanium (Ti) and polyetheretherketone (PEEK) interbody cages has been shown to maximize osseointegration and long-term stability. Specifically, in pre-clinical studies introduction of surface roughness and porosity has been shown to affect spinal interbody vascularization, osteoblast attachment, in-growth potential, and mechanics. The current study investigated the effect of rough relative to smooth interbody surfaces on radiographic alignment, fusion status, and patient-reported outcomes measures (PROMs) after transforaminal lumbar interbody fusion (TLIF) for degenerative indications.

METHODS: All adult patients who underwent one-two level TLIF for lumbar degenerative conditions at a multi-institutional academic center between 2013-2020 were retrospectively identified. Patients with a traumatic injury, infection, malignancy, previous fusion at the index level, combined anterior/posterior procedures, surgery with greater than two TLIF levels, or incomplete radiographic and clinical follow up were excluded. Ti and PEEK interbody roughness was defined by manufacturing techniques or postprocessing treatments that induced microscale morphologic surface variation, including porous surface layers. Preoperative and immediate (<3 months) and long-term (>6 months) postoperative radiographic outcomes (fusion status, local lumbar alignment, global alignment) and PROMs (VAS Back, Oswestry Disability Index, Short Form-12) were collected. Fusion status and subsidence (severe >4mm) was assessed on CT scans obtained at six months- and one year postoperatively. Univariate analysis compared patient demographics, surgical factors, change in radiographic measures, change in PROMs, and complication rates across rough versus smooth interbody groups.

RESULTS:

A total of 66 patients with 84 unique fusion levels met the inclusion/exclusion criteria (54 with smooth cage surfaces, 30 with rough cage surfaces). There were no significant differences in patient demographics, surgical factors, and preoperative bone quality between groups (all $p>0.05$). The use of interbodies with rough compared to smooth surfaces was associated with increased fusion rates (Rough [R]: 93.3%, Smooth [S]: 68.5%, $p=0.020$), increased pre-to long-term postoperative regional lordosis (R: 3.90, S: 0.60, $p=0.035$), greater pre- to short-term postoperative VAS Back pain reduction, (R: -3.82, S: -1.05, $p=0.005$), and decreased risk of severe subsidence (R: 16.7%, S: 46.3%, $p=0.013$). There were no significant differences in revision rate and long-term PROMs changes between cage surface groups (all $p>0.05$).

DISCUSSION AND CONCLUSION: Microscale morphologic roughness of spinal interbodies was found to be protective against pseudoarthrosis and subsidence and maximize long-term regional lordosis after TLIF.