

# The Impact of CT-Based Subsidence Assessment on Radiographic and Clinical Outcomes after Transforaminal Lumbar Interbody Fusion

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**INTRODUCTION:** Subsidence represents a well-known complication after cervical and lumbar interbody fusion that has been previously associated with pseudoarthrosis, recurrence of preoperative symptoms, and higher reoperation rates. While interbody subsidence theoretically can lead to loss of segmental lordosis, there is currently incomplete evidence to characterize the effect of subsidence on postoperative local and global alignment and patient-reported outcomes measures (PROMs) after transforaminal lumbar interbody fusion (TLIF). Furthermore, prior TLIF subsidence studies were limited to indirect and imprecise measurement of subsidence on postoperative lateral x-rays. The present investigation utilized CT-based subsidence assessment to determine if subsidence predicted change in lumbar alignment, PROMs, and complications after TLIF for degenerative indications. Secondly, the impact of preoperative radiographic parameters on postoperative TLIF subsidence was determined.

**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. Interbody subsidence at the superior and inferior endplate of each TLIF level was directly measured on the endplate-facing surface of both coronal and sagittal CT scans obtained at six months- one year postoperatively. Patients were grouped based on the maximum subsidence at each operative level classified as mild, moderate, or severe based on previously documented  $\leq 2$ mm, 2-4mm, and  $\geq 4$ mm thresholds, respectively. 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. Univariate and multivariate analysis compared patient demographics, surgical factors, change in radiographic measures, change in PROMs, and complication rates across subsidence groups.

**RESULTS:** A total of 67 patients with 85 unique fusion levels met the inclusion/exclusion criteria (54 with moderate subsidence, 30 with severe subsidence). Moderate subsidence was not significantly associated patient demographics, medical comorbidities, or preoperative imaging analysis (all  $p > 0.05$ ). Whereas, severe subsidence was associated with lower Hounsfield units at the L3 vertebral body (Severe [S]:126.4, not severe [NS]:177.3,  $p = 0.046$ ), greater preoperative disc height at the TLIF level (S:9.2mm, NS:6.9mm,  $p = 0.013$ ), and greater superior (S:33.6mm, NS:29.8mm,  $p < 0.001$ ) and inferior (S:32.7mm, NS:28.5mm,  $p = 0.002$ ) vertebral body heights. Preoperative and postoperative PROMs and preoperative radiographic alignment did not differ significantly on the basis of moderate or severe subsidence (all  $p > 0.05$ ). Severe subsidence was associated with reduced regional lordosis (S:7.2 degrees, NS:8.8 degrees,  $p = 0.05$ ) at six months, reduced long-term preoperative to postoperative change in regional lordosis (S:0.0 degrees, NS:3.6 degrees,  $p = 0.007$ ), reduced fusion rate (S: 50.0%, NS:92.7%,  $p < 0.001$ ), decreased likelihood of fusing through the disc space (S:0.0%, NS:79.8%,  $p < 0.001$ ), and increased revision rate (S:23.3%, NS:5.5%,  $p = 0.029$ ).

**DISCUSSION AND CONCLUSION:** Severe subsidence, but not moderate subsidence, was identified as a significant risk factor for regional kyphosis, pseudoarthrosis, and need for revision surgery. However, subsidence was not significantly associated with PROMs.