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CORR Insights®: Poor Bone Quality, Multilevel Surgery, and Narrow and Tall Cages Are Associated with Intraoperative Endplate Injuries and Late-onset Cage Subsidence in Lateral Lumbar Interbody Fusion: A Systematic Review

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Where Are We Now?

Lateral lumbar interbody fusion (LLIF), a surgical procedure to treat disc problems in the lower back, provides a solid load-bearing fusion construct that improves sagittal alignment and can provide indirect decompression of the neural canal and foraminal spaces. The disc space opening is also critical to restoring sagittal alignment by lengthening the anterior column. Cage subsidence, a major complication of LLIF can result in nonunion, loss of alignment, and perhaps even recurrent compression of the neural elements.

In the current study, Wu et al. [7] systematically reviewed 183 abstracts, exploring patient, implant, and surgical techniques and the factors that can lead to cage subsidence following LLIF. The authors found late subsidence in 32% of standalone LLIFs and 18% of LLIFs with circumferential constructs.

The authors examined multiple risk factors for LLIF cage subsidence, including those related to patient characteristics (obesity, osteoporosis, number of levels) as well as factors related to the surgical technique. They find that aggressive disc height restoration and small-footprint cages more often resulted in intraoperative endplate failures and subsidence. They also found that patient-related factors such as obesity or osteoporosis as well as multilevel procedures contributed to increased rates of cage subsidence.

Where Do We Need To Go?

The study results suggest that careful patient selection can potentially reduce the risk of LLIF cage subsidence, particularly emphasizing body weight and bone health. Their results also suggest that meticulous surgical technique and prevention of intraoperative endplate fractures should be highlighted when choosing LLIF to provide indirect decompression and restoration of sagittal alignment. The surgical technique should include careful and progressive disc space expansion and precise implant placement that aligns with the vertebral endplates in the coronal, sagittal, and rotational orientation. Axially rotated cages can lead to point loading and endplate subsidence. Finally, the results also suggest that the endplate subsidence may decrease when the LLIF spacer is backed up with posterior instrumentation.

CT scans commonly used for diagnostics and preoperative planning can be used to estimate bone mineral density of the motion segments of interest [1, 5]. Early attempts at using low-dose radiation imaging devices to provide

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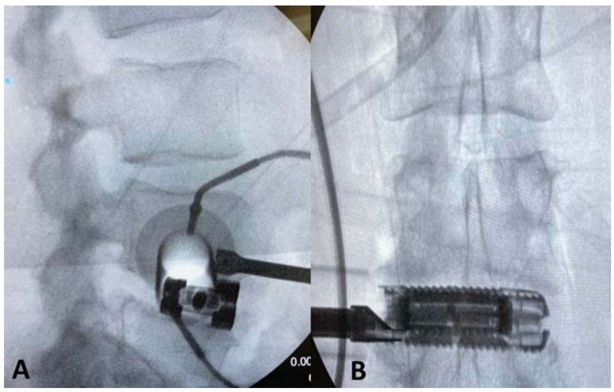

Fig. 1 A-B (A) The endplates are visualized on the lateral view, allowing for optimal orientation of the implant during insertion. (**B**) Dual-X® expandable LLIF with final 22-mm endplates placed through an 18-mm tubular retractor.

level-specific bone density have also been documented [4].

How Do We Get There?

The development of custom three-dimensionally printed implants adapted to individual endplate characteristics, disc space geometry, and bone quality would help us better serve our patients on an individual basis rather than in a one-size-fits-all capacity [3, 6]. As we think about designing those implants of the future, we should consider how geometry and materials interact in ways that support fusion, but also adapt (or at least vary) according to differences among our patients and the shapes and dimensions of their spines. As of now, we don't know whether these devices are superior to off-the-shelf devices, and given the costs and uncertainties of the new implants, future studies need to compare them in well-controlled trials. The role of expandable cage designs is also not clear, and although they may provide a limited degree of adaptability, there are no clear studies suggesting benefits in reducing endplate subsidence [2].

Finally, expandable implants (Fig. 1A-B) can provide the benefit of smaller insertion portals, facilitating the use of smaller retractors. This may be particularly relevant considering the need for better precision in the orientation of the interbody implants to avoid point-loading or intraoperative endplate fractures.

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