Biomechanical Analysis of Direct Lateral Interbody Fusion (DLIF): Strategies for Adjacent Segment Degeneration in the Lumbar Spine

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Introduction

Safe and effective treatment of symptomatic adjacent segment disease (ASD) following lumbar fusion is imperative to the spine surgeon. The minimally invasive direct lateral interbody fusion (DLIF) may be particularly well suited for treatment of ASD with less morbidity than either transforaminal or anterior lumbar interbody approaches. To date, no study has analyzed the biomechanical effects of direct lateral interbody fixation constructs on levels adjacent to an existing fusion, as would be the case when treating symptomatic ASD.

Methods

12 human cadaveric lumbosacral spines (6M/6F, 58±9yo) were potted and non-destructively loaded in flexion, extension, lateral bending and torsion with intersegmental motion was recorded. Each specimen was tested intact and re-tested after instrumentation with a TLIF interbody device with bilateral pedicle screws from L3-L5. Afterward, 5 different DLIF-based strategies were implemented at the upper-adjacent (L2-L3) segment: DLIF alone DLIF+Spinous process plate, DLIF+lateral plate, DLIF+cortical screws (n=6), DLIF+pedicle screws (n=6) and re-tested. The final test was a standard 3-level TLIF for comparison.

Results

Sagittal plane range of motion (ROM) at the upper-instrumented level (L2-L3) was not significantly different between the TLIF and DLIF+Spinous process plate, DLIF+ pedicle, or DLIF+cortical screws, whereas DLIF alone and DLIF+lateral plate had significantly great motion ($p<0.05$). In the lateral bending and torsion, DLIF+pedicle screws provided the greatest stability, although ROM with DLIF+lateral plate and DLIF+cortical screws was comparable to the traditional 3-level TLIF.

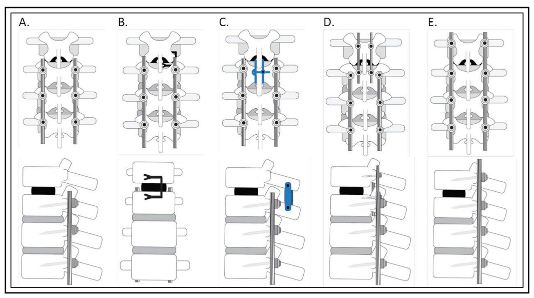
Conclusions

DLIF with limited supplemental instrumentation posteriorly or laterally may provide comparable stability without removal of the existing two-level rod. Other factors, such as reduced surgical time, blood loss, and quicker recovery, should be factored into clinical decisions as well and may provide additional reasons to choose alternative techniques.

Learning Objectives

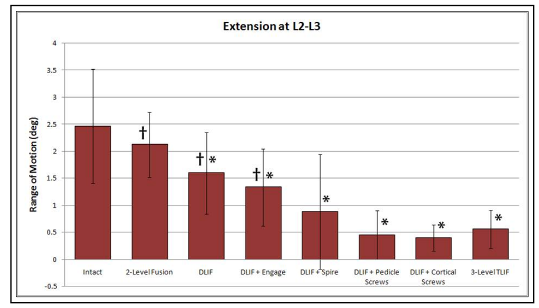
By the conclusion of this session, participants should be able to: 1) Describe the biomechanical properties of varying fixation constructs for treating adjacent segment disease, 2) Discuss, in small groups, the biomechanical and clinical factors that help decide surgical approach to adjacent segment disease, 3) Identify an effective treatment paradigm tailored to the individual needs of the patient with lumbar adjacent segment disease.

Figure 1



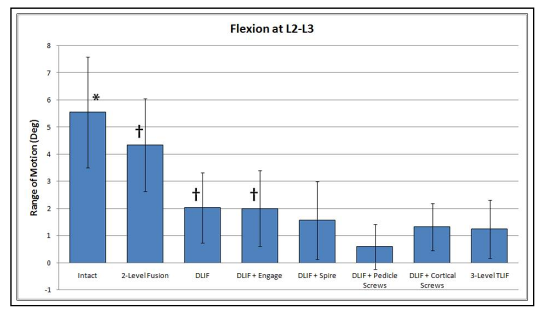
Schematics of the 5 DLIF constructs. Posterior view on top row and lateral view (A,C,D,E) or anterior view (B) on bottom row. A) DLIF alone, B) DLIF + engage plate, C) DLIF + Spinous Process Plate (Spire), D) DLIF + bilateral cortical screws, E) DLIF + bilateral pedicle screws.

Figure 2



Bar graph showing significant differences between DLIF constructs, intact, and TLIF in range of motion during extension testing at L2-L3. (*) Intact had significantly higher ROM than all DLIF and TLIF constructs. (†) The TLIF construct had significantly lower ROM than intact, 2-level fusion, DLIF alone, and DLIF + engage plate constructs.

Figure 3



Bar graph showing significant differences between DLIF constructs, intact, and TLIF in range of motion during flexion testing at L2-L3. (*) Intact had significantly higher ROM than all constructs. (†) TLIF had significantly lower ROM than 2-level fusion, DLIF alone, and DLIF + engage plate.