Biomechanical Evaluation of a Novel Lateral Lumbar Interbody Fusion (LLIF) Device Possessing Zero-Profile, Intradiscal, Integrated Fixation

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Introduction

Use of supplemental lateral plating and/or integrated lateral screw fixation with lateral lumbar interbody fusion (LLIF) can be effective in diminishing the need for extensive/invasive posterior instrumentation. However, additional lateral fixation often requires wider exposure and prolonged retraction of the psoas. Accordingly, adjunctive lateral fixation achieved via a pure in-line lateral trajectory is clinically advantageous. The goal of this in-vitro biomechanics study was to assess stability of a novel LLIF device possessing zero-profile, intra-discal, integrated fixation deployed within the margins of the disc space (Fig.1).

Figure 1. Novel LLIF device possessing zero-profile, intra-discal, integrated fixation

Methods

Six ligamentous lumbar cadaveric spines (L1-S1) were tested. Specimens were screened radiographically to confirm integrity. The L1 and S1 vertebral bodies were potted for subsequent test apparatus attachment. Each spine was first tested in an intact state, followed by sequential iterative construct instrumentation (L4/5) and testing.

Testing Sequence:
1.Intact
2.LLIF+PS (PS=bilateral pedicle screw fixation)
3.LLIF+IPF (IPF=interspinous process fixation)
4.LLIF+IF+IPF (IF=integrated lateral plate fixation)
5.LLIF+IF+PS
6.LLIF+IF
7.LLIF+IF* (*superior plate removed)

Each specimen was tested in Flexion /Extension (8/6Nm) (‘FE’) without preload (0N), then with a 400N preload, and then in Lateral Bending (±6 Nm) (‘LB’) and Axial Rotation (±5 Nm) (‘AR’) without preload. Loading moments were applied to the specimen via arms fixed to the L1 vertebrae. Segmental range-of-motion (ROM) was tracked using a motion analysis system. Mean ROM reduction (% intact) was calculated. Comparisons between test iteration #2 and #3, 4, 6 were made using a repeated measures ANOVA with Bonferroni correction ($p<0.05$).

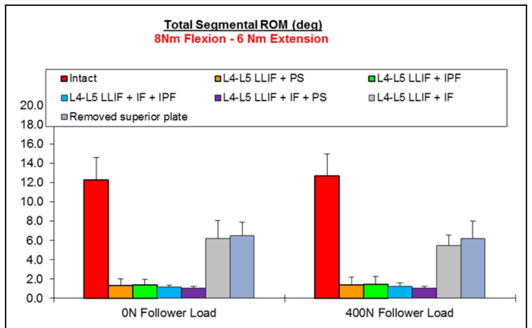

Figure 2. ROM results in FE. No significant differences observed between LLIF+PS as compared to LLIF+IPF and LLIF+IF+IPF (p=1.00; 0 & 400N); LLIF+PS was significantly more rigid than LLIF+IF (p=0.00; 0 & 400N)

Results

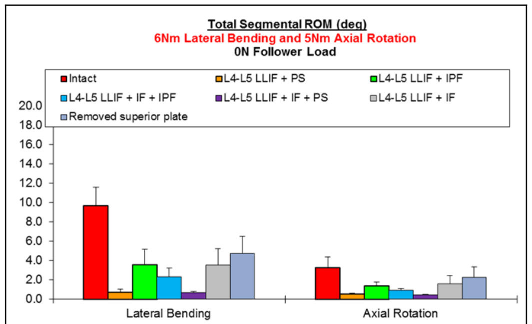

Figure 3. ROM results in LB and AR; LLIF+PSF was significantly more rigid than LLIF+IPF and LLIF+IF+IPF in both LB and AR (p0.016). LLIF+PSF was significantly more rigid than LLIF+IF in LB (p=0.021), but not significantly different in AR (p=0.053).

Conclusions

The LLIF+IF+IPF construct supported robust ROM reduction in all principle motions, performing well in comparison to traditional LLIF+PS. Given the minimally disruptive nature of IPF posteriorly, coupled with the zero-profile footprint of the integrated lateral device, the LLIF+IF+ISPF technique presents as a synergistic circumferential construct.

Learning Objectives

Following this session, participants should be able to:

1. Discuss whether the zero-profile, integrated lateral device supports added supplemental stability in comparison to traditional LLIF techniques

2. Discuss what clinical benefits may be associated with a zero-profile, integrated lateral device

3. Discuss potential patient demographics for which the novel LLIF+IF+ISPF technique may be suitable for