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Quantification of Intradiscal Pressures below Thoracolumbar Spinal Fusion Constructs: Is There Evidence to Support “Saving a Level?”

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Summary: Using a validated in vitro cadaveric model, we demonstrate that with increasing length of instrumented spinal construct, unfused caudal lumbar discs experienced increased intradiscal pressures, most notably at the subjacent discs closest to the EIV. For each level saved in thoracolumbar/lumbar fusion constructs, the intradiscal pressures below may be reduced by an average of 4±7%, thereby reducing the relative risk for the development of subjacent disc degeneration and the need for revision surgery.

Introduction: “Saving levels” in spinal deformity surgery is a common goal. Constructs with end-instrumented vertebra (EIV) in the lumbar spine may alter the biomechanical environment of the remaining unfused lumbar intervertebral discs, leading to accelerated disc degeneration and back pain.

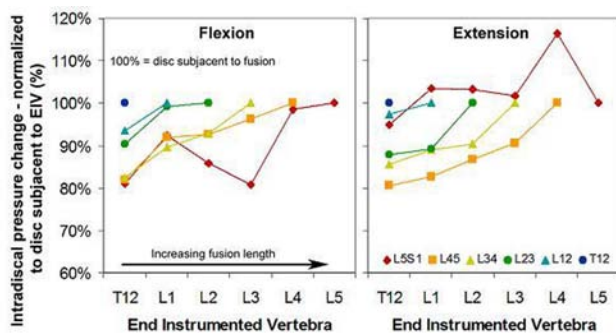
Purpose: The purpose of this study is to quantify the relative pressure changes that occur in the unfused caudal discs with progressively longer fusions into the lumbar spine.

Methods: We used a validated in vitro cadaveric model to assess intradiscal pressures (IDP) below simulated thoracolumbar fusions. Five fresh frozen T8-S1 specimens were instrumented with 4.35-6.0mm pedicle screws, and 6.35mm SS rods from T8-L5. A 400N axial load with a follower-type loading system and 7.5Nm moments were applied in flexion and extension. A needle mounted pressure transducer was drawn through the mid-sagittal plane each disc to obtain AP IDP profiles. After acquiring IDP measurements at a given construct length, the rod was cut one level higher until EIV=T12. IDP data from the middle 25% of each unfused disc were averaged and normalized to mean value of the disc immediately subjacent to the EIV.

Results: In both flexion and extension the mean normalized IDP of the unfused discs below the EIV increased with increasing fusion length (Fig). The IDP increases from the shortest to longest constructs were significant in the L2/3,L3/4 and L4/5 discs in either flexion or extension (p≤0.002-0.032). Each 1-level increase in construct length increased IDP by a mean 4±7% for each unfused disc. The discs closest in proximity to the EIV experienced the highest IDPs.

Conclusions: Under the loading conditions applied in this model, unfused caudal lumbar discs experienced increased IDPs with increasing length of instrumented spinal construct, most notably at the subjacent discs closest to EIV. For each level saved in long fusion constructs, the intradiscal pressures below may be reduced by approximately 4%, thereby reducing the relative risk for the development of subjacent disc degeneration and the need for revision surgery.

Significance: This is the first study to quantify the relative biomechanical protection resulting from “saving a level” in long spinal fusion constructs.



[Figure 1]