

# In Vitro Disc Pressure Profiles Below Scoliosis Fusion Constructs

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## Abstract

### Study Design

Biomechanical human cadaveric study comparing straight and scoliotic spines with healthy and degenerated L4/5 discs.

### Objective

To describe the biomechanical environment of discs under various spinal alignments by measuring the coronal intradiscal pressure profiles.

### Summary of Background Data

Abnormal loading of the lumbar discs in the concavity of scoliotic curves may accelerate disc degeneration, which may be related to pain.

### Methods

Eight intact human cadaver spines (T1–S1; mean donor age 47 years old) underwent radiographs, DEXA, and MRI and were graded for disc degeneration. Each specimen was instrumented in a normal (straight coronal) spinal alignment from T4–L4. Intradiscal pressure profiles for the L4/5 disc and resultant moments were obtained under axial follower loads up to 1500 N. Testing was repeated for bilateral 3-cm decompensation. Posterior instrumentation was used to induce scoliosis (thoracic and lumbar curve average = 25°, fractional lumbosacral curve average = 5°), and testing was repeated for all load states.

### Results

MRI found 4 healthy (grade I and II) and 4 degenerated (grade III to V) L4/5 discs. Scoliosis and decompensation significantly increased coronal moments ( $P < 0.003$ ). Disc pressures increased linearly with greater applied loads for all specimens. Healthy L4/5 discs exhibited uniform pressure profiles with normal spinal alignment and minimal effect with simulated scoliosis or decompensation. For degenerated discs, there was a relative pressure profile depression in the nucleus relative to the anulus region; with spinal malalignment, either due to scoliotic curvature, decompensation, or both, there was disc pressure profile asymmetry. The ratio of maximum intradiscal pressure at the concavity relative to the convexity was 1.1 (range, 1.0–1.2) for healthy discs and 3.6 (range, 2.2–4.4) for degenerated discs in the scoliotic specimens ( $P = 0.008$ ).

### Conclusion

Disc pressure profilometry below long spinal constructs found asymmetric loading with the greatest loads at the concave inner anulus, especially in the presence of disc degeneration, scoliosis, and decompensation. For the degenerated cases, there was substantial disc pressure profile asymmetry despite only mildly severe scoliotic curvatures. These results suggest that scoliosis surgeons should minimize end-vertebra tilt, maximize lumbar curve, and balance correction at the time of surgical

intervention. These results combined with prior animal studies suggest a compounding effect of asymmetric loading and progression of disc degeneration.