

THE AFFECT OF LUMBAR SPINE LORDOSIS ON STABILITY AND INJURY

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Background

Lumbar spine problems are a significant cause of disability in the U.S. population and abroad. It is estimated that 60-80% of the adult population have experienced low back pain, with 2-5% affected on a yearly basis. Low back pain impairments rank among the leading causes of time lost from work and permanent disability in North America (cost est. \$50-100 billion/yr). The purpose of the study is to investigate one of the factors that appear to be responsible for the high incidence of back pain and disability, inefficacious lumbar lordosis. This was achieved by measuring the torsional stability of the lumbar spine in the conditions of decreased lordosis (flexion) and increased lordosis (extension).

Methods

Complete, intact lumbar spines were harvested from 4 fresh cadaver specimens. Each spine was X-rayed to determine the natural amount of lordosis for that individual. The spines were sectioned into three anatomical groups based on vertebral body pairings, L23, L34, or L45. These sections consisted of intact adjacent vertebral bodies and the encapsulated intervertebral disc, with all ligamentous structures, processes, and facet joints intact. Only the facet joint capsules and the terminal aspects of the spinous process were excised. Each vertebral section was potted superiorly and inferiorly in polymethylmethacrylate (PMMA) to isolate the disc, effectively creating a bone-disc-bone construct. The potting construct allowed the spines to be manually oriented into either flexion or extension for the mechanical test. Each construct was X-rayed before testing to determine the total flexion/extension range of motion, and those values were replicated during the loading tests.

The potted spinal sections were mounted to an MTS 858 Mini Bionix (MTS Systems Corporation, Minneapolis, MN), and were either flexed or extended to their maximum range of motion without incurring damage to the soft tissues. After a 300N compressive preload, a cyclic rotation of 3 degrees was applied to the specimens at a rate of 1.0 degrees/second. Each test consisted of three complete cycles, the first two being conditioning cycles with data taken from the third cycle. The spines were then realigned in the testing machine in the other condition (flexion or extension) and tested again in the same manner. To determine lumbar stiffness, torque and angle values were recorded with the biaxial loadcell and data analysis was performed in Microsoft Excel 2000. **Figure 1** provides a detailed view of the loading apparatus and mechanical testing.

Results

In all cases, the higher degree of lordosis in the spine resulted in higher total stiffness. Thus, at maximum extension, the lumbar specimens were stiffer, generated higher torque values and generally absorbed more energy than the full flexion condition. Statistically, there was a significant increase in the average total stiffness between extension and flexion of 27.2 percent ($p=0.04595$).

Conclusion

Lumbar lordosis appears to correlate with increased stiffness in cadaveric specimens. It has been the observation of many back pain specialists that patients with back pain and disc problems have a decreased lumbar curvature; this has been presumed by some to be a result of muscle spasm, but by others as a cause of the primary malady.

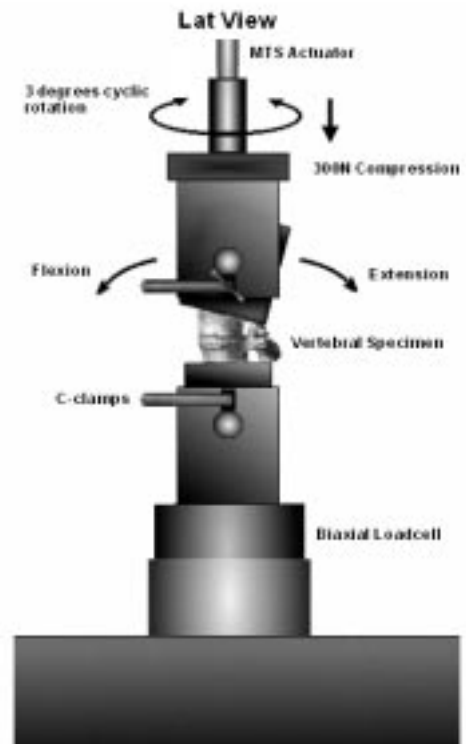


Figure 1. Mechanical testing setup for cyclic rotations in the lumbar spinal segments to measure differences between full flexion and full extension.