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Overall, regarding all types of loading scenarios except torsion, extrapedicular technique offered at least as much stiffness as intrapedicular technique did. This study identified increased thoracic spinal stability with the use of extrapedicular pedicle screws, in comparison to that of intrapedicular pedicle screws, in flexion, extension, lateral bending and axial compression.

#3 THE EFFECTS OF INSTRUMENTATION ON LUMBAR VERTEBRAL COMPRESSIVE STRENGTH: A BIOMECHANICAL ANALYSIS

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Although the stability and pull-out strength of spinal constructs have been studied, to our knowledge no studies have investigated the effect of implants on vertebral body compressive strength. Decreases in cross-sectional area and trabecular volume may significantly decrease vertebral body compressive strength and increase the risk of pathological fracture. This study quantitatively compares the compressive strength of lumbar vertebral bodies after insertion and then removal of pedicle screws and anterior body screws. Seven human cadaveric lumbar spines were harvested shortly after necropsy and stored at -20°C. Prior to testing, each spine was thawed and vertebrae were separated and dissected free from all soft tissue. Vertebrae exhibited no evidence of space-occupying lesions or trauma. Vertebral bodies were individually potted into liquid epoxy and then compressed to failure in a MTS (Eden Prairie, MN) materials testing device. Failure was defined as the first 10% decrease in load with increasing deformation. Each spine was tested as follows: (L1) intact control with no instrumentation, (L2) instrumented with pedicle screws, (L3) pedicle screws inserted and removed, (L4) instrumented with anterior vertebral body screws, (L5) anterior vertebral body screws inserted and removed. The compressive strength was normalized as ultimate load per unit volume and data were statistically analyzed. The average compressive strength of intact control lumbar vertebral bodies was 194 N/cc (approximately 5000 N). With pedicle screw insertion, the average compressive strength was 195 N/cc. The average compressive strength after pedicle screw removal was 168 N/cc, corresponding to a -13% decrease compared to intact controls and a -14% decrease compared to vertebral bodies instrumented with pedicle screws. The average compressive strength with anterior body screws was 181 N/cc, corresponding to a -7% decrease compared to intact controls. Following anterior body screw removal, the compressive strength was 165 N/cc, corresponding to a -15% decrease compared to intact controls and a -9% decrease compared to vertebral bodies instrumented with anterior body screws. Differences in compressive strength between all groups were statistically insignificant ($p > .05$). The average compressive strength for intact control lumbar vertebral bodies was in agreement with previous studies. Decreases in cross-sectional area and trabecular volume after spinal instrumentation decrease vertebral compressive strength and increase the likelihood of pathological fracture. With either insertion or removal of pedicle screws or anterior body screws, however, it does not appear that this effect is significant.

#4 THE INVERSE EFFECTS OF LOAD TRANSFER AND LOAD SHARING ON AXIAL COMPRESSIVE SPINAL STIFFNESS: A MECHANICAL MODEL

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The goal of spinal instrumentation is to stabilize involved motion segments until fusion occurs. As per Wolff's Law, axial load sharing is necessary for fusion to occur in situ. The purpose of this study is to utilize a well-accepted and highly comparatively mechanical model to create a mathematical relationship between stress shielding and load transfer in the spine. Forty-eight standard 62 mm diameter x 35 mm depth ultra high molecular weight polyethylene (UHMWPE) cylinders were used to represent the lumbar vertebral