COMPARATIVE ANALYSIS OF PEDICLE SCREW FAILURE IN HUMAN CADAVER VERTEBRAE USING SIMULATED IN VIVO LOADING

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Objective: Compare a clinically applicable method of testing pedicle screw failure in human cadaver osteoporotic vertebrae to previously studied synthetic bone.

Background: Most studies in osteoporotic vertebrae lack a combined pullout and toggle evaluation of pedicle screw failure, which does not model failures as they are seen clinically. A prior study[1] performed with synthetic bone, where both equal pullout and toggle loading (transverse force with flexion-extension moment), produced similar failure results as is observed clinically. The translational nature of this line of investigation remains to be verified. The next logical step is the use of human cadaver bone to provide a better analysis of in vivo screw failure due to its continuous cortical shell, a feature not present in synthetic bone.

Design: Human cadaver osteoporotic vertebrae were scanned for bone mineral content (BMC) using DEXA and carefully cleaned prior to testing. Fixed-head pedicle screws were inserted into each vertebra, multi-component load was applied, and 3-D motion of the screw was measured.

Results: Maximum load-to-failure for the human cadaver vertebrae (396N, 939N) was higher than the previously tested synthetic bone (Max 60N). However, toggle failure that was seen in synthetic specimens was not observed during failure of the osteoporotic cadaver vertebrae.

Conclusion: Human cadaver osteoporotic bone has a higher maximum load-to-failure force than synthetic bone, a result of the continuous, dense cortical shell even in the presence of osteoporosis. However, the toggle failure was not seen in human specimens, suggesting that either the BMC was too dense, or there was a distinct difference between the architecture of synthetic and human bone. Further studies using multiple loading modalities will have to be performed to evaluate this observation.

Reference

1) Choma TJ, Frevert WF, Carson WL, Waters NP, Pfeiffer FM. Biomechanical Analysis of Pedicle Screws in Osteoporotic Bone with Bioactive Cement Augmentation Using Simulated In Vivo Multi-Component Loading. *SPINE. Manuscript Number 090865.*