THE RELATIONSHIP BETWEEN BONE MINERAL DENSITY AND FAILURE FORCE FOR A SIMULATED SCOLIOSIS DEROTATION SURGERY

NUCKLEY, D.J., ZUPAN, K.M., ZOLOTOV, Y.A., YARBROUGH, N.L., YANG, H., WONG, M.T.
UNIVERSITY OF MINNESOTA PHYSICAL THERAPY PROGRAM

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Abstract (Limited to 300 words):

Introduction: A patient with advanced idiopathic scoliosis may progress in spite of PT intervention. When referring these large curvature patients to surgeons there is a risk of pedicle fracture during surgery that is not well appreciated by PTs. These fractures can lead to deleterious outcomes and thus we wanted to identify this risk. The purpose of this study was to determine the maximally tolerated force that can be applied to pedicle screws during scoliosis de-rotation surgery given a certain bone mineral density (BMD).

Methods: This experimental bench top study evaluated the failure force in pedicle screws and its relationship with BMD. Nine dissected in vitro cadaveric thoracolumbar spine specimens (45.8 +/- 4.1 years, BMD 23-33.3g/cm³) were disarticulated into a total of 45 individual vertebrae. Each vertebra had two pedicle screws inserted by a board certified orthopedic surgeon and was then placed in an Instron materials tester and loaded to produce medial or lateral rotation of the vertebra to simulate scoliosis de-rotation. The direction and order of loading was randomized and the failure load recorded. Data analysis included correlation of failure loads with BMD in a loading direction dependent fashion.

Results: Our results identified distinct patterns between medial and lateral pedicle failures which were dependent on BMD. When pushing the screws in the medial direction the BMD was able to predict the failure force with a R² value of 0.857 (p<0.0001). When pushed laterally a similar correlation was identified between BMD and failure force with a R² value of 0.585 (p<0.0001). On average screws pushed medially had a higher failure force than screws pushed laterally.

Conclusion: Our results identified a predictable correlation between BMD and failure force. Surgeons can use this data to set force parameters during scoliosis de-rotation surgery to minimize the risk of injury and optimize results.