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Analysis of the Influence of Species, Intervertebral Disc Height and Pfirrmann Classification on Failure Load of an Injured Disc Using a Novel Disc Herniation Model

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Abstract: The shape of the lumbar spine influences its function and dysfunction. Yet examining the influence of geometric differences associated with pathology or demographics on lumbar biomechanics is challenging in vivo where these effects cannot be isolated, and the use of simple anatomical measurements does not fully capture the complex three-dimensional geometry. The goal of this work was to develop and share morphable models of the lumbar spine that allow geometry to be varied according to pathology, demographics, or anatomical measurements. Partial least squares regression was used to generate statistical shape models that quantify geometric differences associated with pathology, demographics, and anatomical measurements from the lumbar spines of 87 patients. To determine if the morphable models detected meaningful geometric differences, the ability of the morphable models to classify spines was compared with models generated from random labels. The models for disc herniation ($p < 0.04$), spondylolisthesis ($p < 0.001$), and sex ($p < 0.01$) all performed significantly better than the random models. Age was predicted with a root mean square error of 14.1 years using the age-based model. The morphable models for anatomical measurements were able to produce instances with root mean square errors less than 0.8°, 0.3 cm2, and 0.7 mm between desired and resulting measurements. This method can be used to produce morphable models that enable further analysis of the relationship among shape, pathology, demographics, and function through computational simulations. The morphable models and code are available.

Keywords: Animal model; Annular repair; Bovine tail; Cadaver study; Calf spine; Disc failure; Disc herniation model; Disc repair; Failure load; Preclinical disc model.

Methods: We tested calf lumbar spines, bovine tail segments and human lumbar spines. We first divided individual lumbar or tail segments to include the vertebral bodies and disc. We then hydrated the specimens by placing them in a saline bath overnight. A magnetic resonance images were acquired from human specimens and a Pfirrmann classification was made. A stab incision measuring 25% of the diameter of the disc was then done to each specimen along the posterior intervertebral disc space. Each specimen was placed in custom test fixtures on a servo-hydraulic test frame (MTS, Eden Prarie, MN) such that the superior body was attached to a 10,000 lb load cell and the inferior body was supported on the piston. A compressive ramping load was placed on the specimen in load control at 4 MPa/sec stopping at 75% of the disc height. Load was recorded throughout the test and failure load calculated. Once the test was completed each specimen was sliced through the center of the disc and photos were taken of the cut surface.

Results: Fifteen each of calf, human, and bovine tail segments were tested. The failure load varied significantly between specimens ($p<.001$) with human specimens having the highest average failure load (8154±2049 N). Disc height was higher for lumbar/bovine tail segments as compared to calf specimens ($p<.001$) with bovine tails having the highest disc height (7.1±1.7 mm). Similarly, human lumbar discs had a cross sectional area that was greater than both bovine tail/calf lumbar spines ($p<.001$). There was no correlation between disc height and failure load within each individual species ($p>.05$). Cross sectional area and failure load did not correlate with failure load for human lumbar spine and bovine tails ($p>.05$) but did correlate with calf spine ($r=0.53$, $p=.04$). There was a statistically significant inverse correlation between disc height and Pfirrmann classification for human lumbar spines (r=-0.84, p<.001). There was also a statistically significant inverse relationship between Pfirrmann classification and failure load (r=-0.58, p=.02).

Conclusions: We have established a model for disc herniation and have shown how results of this model vary between species, disc morphology, and Pfirrmann classification. Both hypotheses were accepted: The force required for disc herniation was variable across species, and the force to herniation for human spines was inversely correlated with the degree of disc degeneration. We recommend that models using human intervertebral discs should include data on Pfirrmann classification, while biomechanical models using calf spines should report cross sectional area. Failure loads do not vary based on dimensions for bovine tails.

REFERENCES

1. Jumaeva A.A., Qodirov O.O`. HYGIENIC BASES OF THE ORGANIZATION OF CHILDREN'S NUTRITION. // CENTRAL ASIAN ACADEMIC JOURNAL OF SCIENTIFIC RESEARCH ISSN: 2181-2489 VOLUME 2 ǀ ISSUE 6 ǀ 2022. – P. 264-268
2. Uktamovich, K. O. CLINICAL AND THERAPEUTIC NUTRITION. *EUROPEAN JOURNAL OF MODERN MEDICINE AND PRACTICE*, *3*(3), . (2023). –P. 42–44.
3. Uktamovich, K. O. . (2023). Diets of Altered Consistency. *AMALIY VA TIBBIYOT FANLARI ILMIY JURNALI*, *2*(3), 81–84.
4. Nurov.A.S. Disruption of Natural Systems Affects Health.//- AMALIY VA TIBBIYOT FANLARI ILMIY JURNALI, (2022/11/15).-P. 258-260
5. Nurov.A.S. The Importance of Ecology for Children's Health and Well-Being.//- AMALIY VA TIBBIYOT FANLARI ILMIY JURNALI, (2022/11/15).-P. 238-240