Creating biomechanically accurate bone models.

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White Paper

Creating biomechanically accurate bone models.

To create realistic synthetic musculoskeletal models for medical device development, physician training, surgical demonstration and procedural planning, synthetic bones must replicate the density properties and mechanical behavior of human bone.

The J750 Digital Anatomy™ printer gives clinicians and engineers the power to create the most lifelike anatomical models available. Combinations of unique materials that vary in softness, flexibility and density, and more than 100 clinically-validated preset anatomy options, help to mimic human bone like never before.

THE POWER TO CREATE

Accurate cortical and cancellous bones: Testing screw pull out force and driving torque

In 2020, researchers at the Computational Mechanics and Experimental Biomechanics Lab evaluated the characteristics of bone models 3D printed on the J750 Digital Anatomy printer and how accurately they replicate screw pull out force and driving torque.

Method

3D printed models of cortical and cancellous bone were created using Digital Anatomy printer software. Pilot holes were drilled into each model, and tapped with the appropriate tap. The most commonly-used cortical and cancellous screws were inserted to the ASTM standard depth for testing bone substitutes.

Pullout tests were performed until the screw was released from the bone model, and measured to compare force and displacement. Driving torque and pullout measurements were then compared to values found in literature and to ASTM standards.

Results

Screw pull out force during screw insertion corresponded to those found in literature for the cortex of a cadaver bone, demonstrating that the 3D printed model accurately replicates cortex thickness.

Conclusion

Orthopedic screws have a similar haptic response in human bone and 3D printed bone models.

The J750 Digital Anatomy printer allows clinicians and engineers to control density properties of bone models with physician-tested anatomical presets. 3D printed models accurately mimic bone density characteristics and behave like native bone when force is applied such as drilling, reaming, or sawing.

THE POWER TO CREATE

Accurate lumbar spine models: Testing mechanical performance

In 2020, researchers from the Technion Institute of Technology Materials Science and Engineering Laboratory performed mechanical lab tests to measure the mechanical accuracy of 3D printed synthetic spine models compared to cadaver spine.

Method

Using Digital Anatomy printer software, researchers constructed four lumbar spine models using 3D printed lumbar vertebrae (S1-L3), ligaments, sacrum, facet joints, and intervertebral discs. Each model was created using unique pre-set material combinations that varied in flexibility, stiffness and density to mimic a range of native musculoskeletal characteristics.

Mechanical tests were performed to simulate the natural axes of movement of the human spine as force is applied: disc compression, extension, flexion, lateral bending, and axial tension. Force values were then compared to those found in literature for human cadaver lumbar spines.

Results

Mechanical disc compression, displacement, and elasticity values for the 3D printed model corresponded to those found in literature for cadaver lumbar spines, demonstrating that the synthetic model accurately replicates biomechanical behavior of human bone.

Conclusion

3D printed L3-S1 models accurately represent the range of motion of human and cadaver spines.

Digital Anatomy printer technology uniquely allows clinicians and engineers to control the range of lumbar disc stiffness to accurately mimic the disease pathologies and anatomy variations of the human spine.

Unlock the power to mimic native bone structures.

- Highly-realistic, low-risk training
- High repeatability between samples
- Clinically-relevant benchtop testing
- Most consistent, accurate representation of bone
- Cost reduction of up to 70%

Learn more about the J750 Digital Anatomy printer, materials and software at **Stratasys.com**.

Questions? Contact us at **medical@stratasys.com**.

References

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