Applied Biomechanics Laboratory

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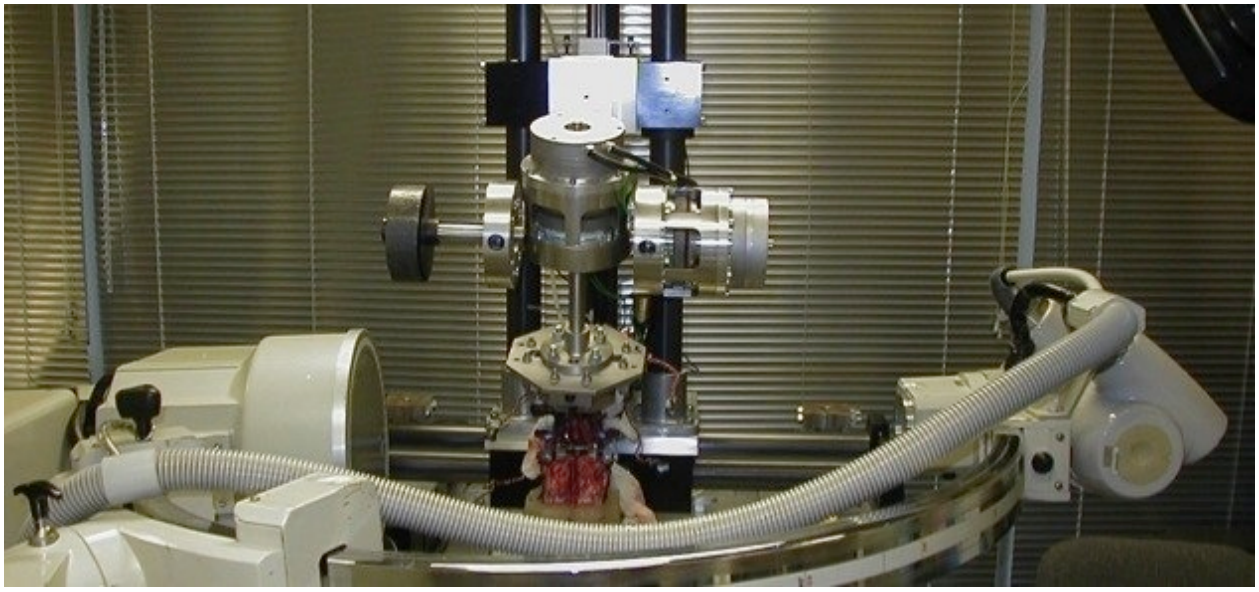
Multi-Axis Spine Simulator

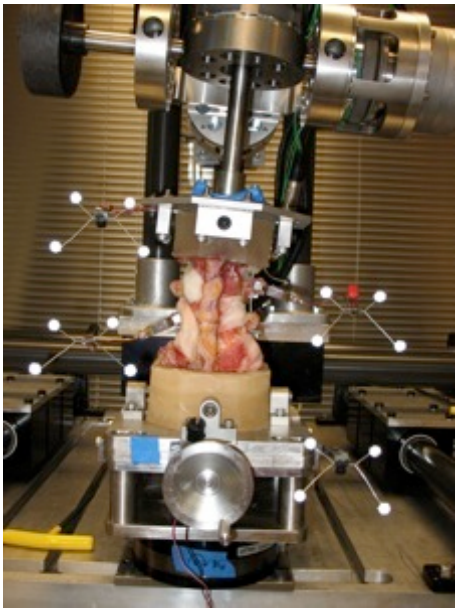


Features:

- ***Computer-Controlled Multi Axis Loading***
- ***Adjustable Follower Load***
- ***Kinematic Data Collection via Vicon Motion Capture***
- ***Intradiscal Pressure Measurement***

Computer-Controlled Multi-Axis Loading

The spine simulator enables the study of three-dimensional load-displacement characteristics of in vitro human cadaveric spines. This spine simulator is capable of transmitting pure bending about a single axis, or combined loading about multiple axes, at quasi-static to dynamic rates replicating typical to extreme physiologic loading of the spine. The cephalad end of a spine segment is mounted to a gimbal equipped with three brushless AC servomotors that impart pure bending moments along the spine about three orthogonal axes. The caudal end of the spine specimen is rigidly fixed to a 6-axis load cell to collect force and moment data transmitted through the specimen. In order to reduce any apparatus-induced artifacts, the gimbal/motor assembly floats on a series of air bearings riding on high-precision shafts allowing it to translate freely with the specimen while experiencing minimal friction. The mass of the gimbal is counterbalanced with three stiction-reducing glass-lined air cylinders. The simulator's loading profile is computer-controlled with feedback from electric encoders on the motors which can deliver a maximum torque to the spine of up to 64-Nm.

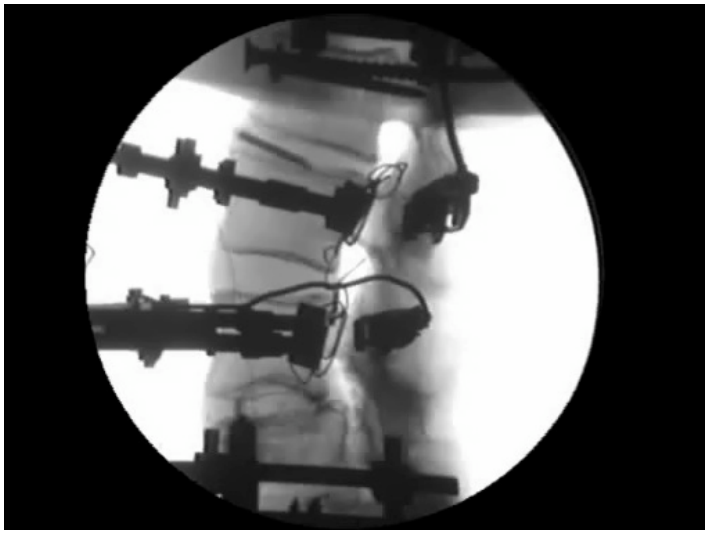


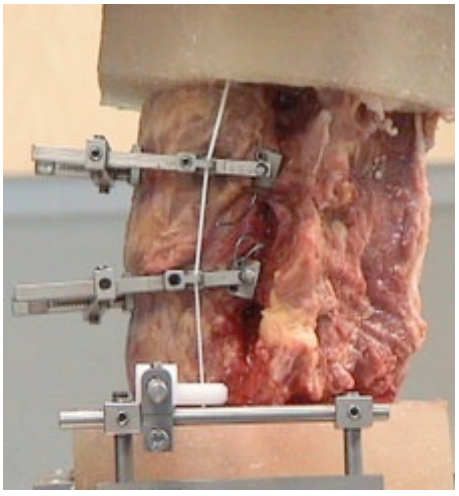
Kinematic Data Collection via Vicon Motion Capture System

Segmental kinematic data are collected with a Vicon MX13 motion capture system. The system includes four 1.3-million-pixel cameras positioned around the specimen such that they are able to track a set of reflective markers that are rigidly attached to each vertebral body. The system is capable of achieving a resolution of 0.05 mm/pixel within the capture volume of the spine simulator. Vicon Bodybuilder software is utilized to compute relative angles between the vertebrae and is capable of computing translations of each vertebral body as well.

Fluoroscopy

An OEC 9000 fluoroscope enables X-ray and cineradiography of the specimen and implant(s) before, during, and after each simulator test.





Adjustable Follower Load

A variable compressive follower load may be applied along the lateral aspects of the spine to replicate axial physiologic muscle loading. Spectra fiber cable is looped through brackets that are rigidly attached to each vertebral body and then fed through a pulley system under the specimen for even load distribution. The magnitude of the follower load is adjustable via a pneumatic cylinder that applies up to 1000N of tension to the cable. The placement of the load-bearing cable can be adjusted along the antero-posterior plane of the spine via the follower load brackets maintaining the unloaded neutral position of the spine without introducing any artificial rotation between vertebral bodies after the load is applied.