

Public Abstract

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Graduation Term:SS 2007

Department:Veterinary Medicine and Surgery

Degree:MS

Title:In vitro three dimensional biomechanical comparison of two internal fixation methods in equine adult radii

Radius fracture configurations conducive to internal fixation most often contain a spiral or oblique fracture of the distal diaphysis. The location and fracture configurations are biomechanically challenging because of the limited amount of bone available distally for screw purchase and the complex three dimensional (3D) loading and unconstrained motions that occur in the distal diaphysis of the radius.

Development of an in vitro loading-measurement system that mimics in vivo unconstrained 3D relative motion of long bones, applies uniform load components over the entire length of a test specimen, and measures 3D relative motion to directly determine construct stiffness was verified. Axial compression was applied through hardened steel sphere joints located axially in the base of each fixture. Torsion was applied by transmitting equal, but opposite forces to hardened steel shoulder bolts on the lateral and medial side of each fixture, while applying a constant axial bias load. A round steel pipe was bolted to each fixture base allowing a uniform four-point bending moment to be applied. An infrared optical tracking system was used to continuously measure the 3D relative motion between ends of a test segment in intact, osteotomized, and ostectomized radii. The applied load component was plotted as a function of the corresponding component of 3D relative motion between ends of the test segment. Stiffness was determined as the slope of a straight line fit to the data between selected load levels. Measured intact radii stiffness results were comparable in magnitude to those theoretically predicted, and were consistently higher than comparable results in the literature due to elimination of potting-fixture-test machine finite stiffness. Construct failure configurations were consistent with theoretical failure modes for brittle material (bone) and reproducible for both the torsion and bending load to failure tests.

Biomechanical properties of the dynamic condylar screw (DCS) implant system and the double broad dynamic compression plate (bDCP) construct used to repair distal oblique diaphyseal osteotomies and ostectomies in adult cadaveric radii were compared. The intact radius demonstrated greater stiffness than the corresponding osteotomized/ostectomized segment during axial compression, torsion, and four-point bending. No statistical difference was observed between the DCS implant system and the bDCP construct stiffness during axial compression, torsion, and four-point bending. Torsion and four-point bending failure loads were not statistically different for the DCS implant system when compared to the bDCP construct.