

Biomechanical comparison of a locking compression plate combined with an intramedullary pin or a polyetheretherketone rod in a cadaveric canine tibia gap model.

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Abstract

OBJECTIVE:

To compare the biomechanical properties of a 10-hole 3.5 mm locking compression plate (LCP) with 2 proximal and 2 distal bicortical locked screws reinforced with either a Steinmann pin of 30-40% the medullary diameter or a poly-ether-ether-ketone (PEEK) rod of 75% the medullary diameter in a cadaveric tibia gap model.

STUDY DESIGN:

Ex vivo study.

SAMPLE POPULATION:

Cadaveric canine tibias (n = 8 pair).

METHODS:

Each construct had a 10-hole 3.5 mm LCP with 2 screws per fracture fragment using a comminuted tibia gap model. The Steinmann pin constructs had a 2.4 mm intramedullary pin whereas the PEEK-rod constructs had a 6 mm intramedullary PEEK rod placed. Biomechanical testing included non-destructive bi-planar 4 point bending, torsion testing, and destructive axial compression. Testing produced the responses of failure load (N) in axial compression, stiffness (N/mm or N/°) in axial compression, torsion, lateral-medial, and caudal-cranial 4 point bending. Screw position within the PEEK-rods was determined after explantation.

RESULTS:

The PEEK-rod constructs were significantly stiffer in axial compression ($P < .005$), lateral-medial 4 point bending ($P < .001$), and in torsional loading ($P < .031$) than the Steinman pin constructs. There was no significant difference between the constructs for stiffness in caudal-cranial 4 point bending ($P = .32$). The PEEK-rod constructs failed at a significantly higher load than the Steinmann pin constructs ($P < .001$). All constructs failed by yielding through plastic deformation. Each screw penetrated the PEEK rod in all constructs but the position of the screw varied.

CONCLUSION:

PEEK-rod constructs failed at significantly higher loads and were significantly stiffer in 4 point lateral-medial bending, axial compression, and torsion when compared with Steinmann pin constructs.

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