

In Vitro Analysis of Anterior and Posterior Fixation in an Experimental Unstable Burst Fracture Model

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Abstract

Study Design

A biomechanical comparison of fixation constructs in an experimental fracture model.

Objective

To determine the relative postoperative stability of anterior graft and plating with that of posterior or combined fixation constructs in an unstable thoracolumbar burst fracture model.

Summary of Background Data

Several treatment modalities have been proposed for unstable thoracolumbar burst fractures, but the optimal technique is unclear. Previous cadaveric biomechanical studies in unstable burst fracture models have not considered the commonly used posterior (interpedicular) and anterior (plate) constructs.

Methods

Nine human spine segments (T11-L3) were potted in epoxy and scanned using dual energy x-ray absorptiometry and computed tomography. Intact specimens had baseline flexibility testing. Unstable L1 burst fractures as verified by computed tomography were created using an impulse load and posterior surgical osteoligamentous destabilization (ie, transection of the lamina, interspinous ligaments, facet capsules, and ligamentum flavum). Specimens were instrumented posteriorly with pedicle screws and rods and tested to 6 Nm in flexion-extension, lateral bending, and torsion. Corpectomy and strut grafting were then performed, and testing was repeated in varying order with posterior fixation, anterior plating and circumferential fixation. Range of motion (ROM) and neutral zone was calculated for each test and fixation groups were compared using analysis of variance.

Results

All specimens had AO B1.2 (unstable burst) fractures. Mean ROM for posterior-only constructs was significantly less than that of the intact in lateral bending, flexion, and extension ($P<0.001$). Anterior-only constructs after corpectomy and strut grafting generally resulted in a smaller ROM versus intact in flexion (NS: $P=0.1$) and lateral bending ($P<0.001$). In contrast, all anterior-only and posterior constructs had greater ROM than intact in torsion (all at $P<0.05$). Circumferential fixation resulted in statistically smaller ROM compared with all other constructs ($P\leq 0.04$), and reached that of the intact specimen in torsion. Increased ROM was correlated with greater fracture comminution for posterior-only fixation ($P<0.05$), and was weakly correlated with lower dual energy x-ray absorptiometry score ($R^2=0.3$) for anterior-only fixation.

Conclusions

Circumferential instrumentation provided the most rigid fixation, followed by posterior fixation with anterior strut grafting, posterior fixation alone, and by anterior fixation with strut grafting. These results were dependent on bone quality and the comminution severity of the fracture. These results should aid surgical decision making in addition to other factors in the overall clinical situation.