University of Massachusetts Medical School

eScholarship@UMMS

UMass Center for Clinical and Translational Science Research Retreat

2014 UMass Center for Clinical and Translational Science Research Retreat

May 20th, 12:30 PM

Displacement Across a Fracture Gap with Axial Loading of Far Cortical Locking Constructs

Peter J. Wagner
University of Massachusetts Memorial Medical Center

Et al.

Displacement Across a Fracture Gap with Axial Loading of Far Cortical Locking Constructs

Peter J. Wagner, MD MMS[1]; Dennis T. Murphy, BS[1]; Kristen Billiar, PhD[2]; Judith Siegel MD[1]; John J. Wixted, MD[1]
[1]UMass Memorial Medical Center, Worcester, MA
[2]Worcester Polytechnic Institute, Worcester, MA
Contact information: Peter Wagner, peter.john.wagner@gmail.com, 631-848-8789

Purpose: Far cortical locking has been proposed for reducing stiffness and promoting greater dynamic stability in locked plating constructs. Prior studies have shown reduced stiffness with axial loading of these constructs, leading to a theoretical increase in inter-fragmentary motion and secondary bone healing. The purpose of this study was to examine strain across a fracture gap using far cortical locking constructs in a biomechanical model of distal femoral fractures.

Methods: Fourth generation sawbones were cut transversely along the distal diaphysis and plated with distal femoral buttress plates and cortical locking screws. Far cortical locking (FCL) specimens were predrilled in the lateral cortex and control specimens were plated with a standard locked plating construct. The constructs were loaded sequentially with 100, 200, and 400 lbs of force on a mechanical test frame. Displacement across the fracture gap measured in pixels using an optical system.

Results: Strain across the fracture gap increased with progressive loading from zero to 400 lbs in both groups. Strain also decreased in a linear fashion from medial to lateral across the fracture gap in both constructs (Figure 1). Standard locking constructs exhibited an average 28% greater strain than the far cortical locking constructs at all loading forces. Control specimens exhibited greater lateral displacement of the distal segment relative to the plate (Figure 2), consistent with higher shear forces compared to FCL specimens.

Conclusions: In all specimens, there was considerable strain seen with loading that increased in characteristic fashion from lateral to medial. Overall, FCL constructs exhibited both lower strain, and importantly, lower shear, than measured in controls. This biomechanical model suggests that FCL changes loading across the femoral diaphysis in complex ways, and that assumptions about strain approaching zero on the lateral side of the distal femur with conventional locking or FCL may be incorrect.

Figure 1:

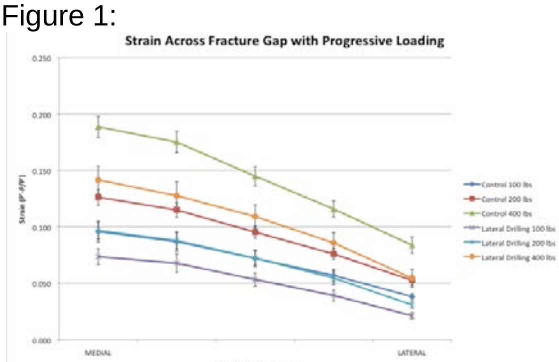

Figure 2: