The Effect of Body Weight on Interfragmentary Fracture Strain in Plate Fixation of Distal Femur Fractures: A Finite Element Analysis

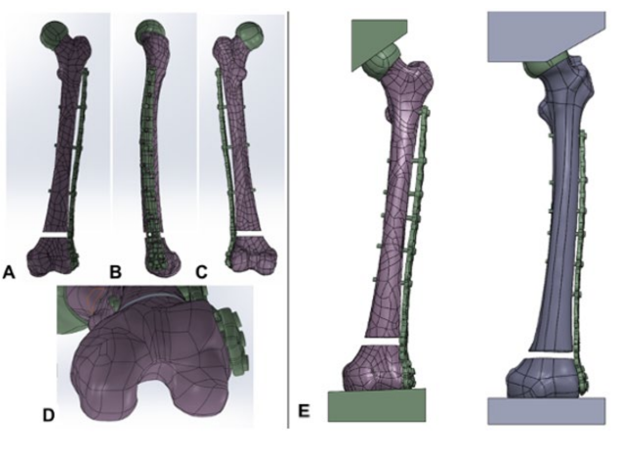
Ishan D. Shah, MD; *Adam M. Schlauch, MD; Lisa Phan, BA; Jiho Han, BA; Richard Raji, M. Eng; Brian Farrell, MD*

Purpose: Distal femur fractures are difficult to successfully treat due to high rates of nonunion. Obesity is an independent prognostic risk factor for nonunion. The purpose of this study is to determine the impact of body weight on fracture strain in a lateral locking plate construct for supracondylar femur fractures and whether additional construct rigidity is beneficial to optimize fracture strain in obese patients.

Methods: A 3D finite element analysis was performed on 2 separate femur models with a Zimmer Non-Contact Bridging 18-hole distal femoral plate and its associated screws using Ansys software. A supracondylar distal femur fracture was created in the femur models and a 10-mm fracture gap was created to simulate a region of comminution for an OTA/AO 33A distal femur fracture, starting 68 mm proximal to the most distal point of the femur. Axial forces were varied to represent 70-kg and 140-kg patients and recreate the effect of load from normal and obese body mass patients, respectively. Working length and screw density of the construct were varied for each condition and measurements of interfragmentary strain (IFS) and shear motion (SM) at the fracture site were compared.

Results: Doubling the patient body mass from 70 kg (control) to 140 kg (obese) in the baseline working length model increased the mean IFS from 1.91% ± 1.12% to 3.32% ± 1.82%. Shortening the working length to the short and intermediate trials reduced the IFS of the 140-kg model to 1.06% ± 0.27% and 2.19% ± 1.09%, respectively, which were comparable to the IFS of the 70-kg baseline working length model. A similar trend was found for SM. Increasing the screw density from 40% fill to 60% fill decreased the IFS in the control and obese models but did not decrease SM.

Conclusion: To our knowledge, this is the first study to investigate the relationship between obesity and varying locking plate fixation constructs for comminuted distal femoral fractures. The present study used a finite element model to demonstrate that increased axial load increases interfragmentary strain and shear motion in an AO/OTA 33A distal femur fracture fixed with a lateral distal femoral locking plate. Decreasing the working length of fixation constructs in the obese model normalized interfragmentary strain and shear motion.



PODIUM ABSTRACTS