Biomechanical Comparative Analyses Between the Anterolateral and Medial Distal Tibia Locking Plates in Treating Complex Distal Tibial Fracture: A Finite Element Study

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Abstract
Complex distal tibia fracture involving the articular surface poses a significant challenge to treat due to the need for stable fracture fixation that concurrently prevents articular displacement during motion. While several implant designs have been suggested to overcome this issue, the superiority of one design over the other has not been previously demonstrated. This study compared the stability provided by two commonly used implants (anterolateral plate (ATL) vs. medial distal tibia plate (MDT)) in treating these types of fracture. A three dimensional model of a six-part fracture fragment involving the distal tibia was reconstructed and simulated using computer aided software. Loading was applied to the model during swing phase gait. The model was fixed in all degree of freedom on bone fragment number 5 (central fragment). Simulated data from finite element analysis was used to determine the stresses in equivalent von Mises stress values (EVMS) whilst displacement of the fragments was measured in mm. The stresses subjected to the ATL and the MDT were 8.70 MPa and 5.62 MPa, respectively (p < 0.05). MDT caused less displacement of bone fragments as compared to ATL (0.22 +/- 0.001 vs. 2.05 +/- 0.019; p < 0.001). Fracture fixation using MDT provided superior stability and reduced fragment displacement than ATL during motion.

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