Orthopaedic Biomechanics and Surgical Fracture Fixation

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This work investigates plating mechanics in fracture fixation, focusing on the implications of plate-bone contact, working length, and screw types on construct stability and healing potential. Firstly, the interfragmentary displacements and stresses of finite element models of commercial bridge plates were analyzed, varying plate-bone distance, gap size, and working lengths. Secondly, these models were validated through physical experiments on synthetic bones. Once validated, these simulated models were used for parametric studies to observe the effect of implant-bone contact during loading. Finally, a comparative study on cadaveric bones assessed the mechanical effects of variable pitch locking screws versus standard locking screws, focusing on interfragmentary and plate-bone compression forces and their effects on construct stability during loading. The finite element analysis revealed that plate-bone contact and working length significantly influence construct stability. Experimental validation confirmed the correlation between working length and construct rigidity, with plate-to-bone contact at the gap site being a critical factor. Comparative analysis in cadaveric models showed that variable pitch screws enhance interfragmentary compression, while maintaining similar construct stability of standard screws. These findings underscore the importance of considering plate-bone interaction and working length in bridge plating design. The effects of these variables provide insights in surgical decision making regarding the biomechanics and achieving good healing.