Pratik Nag

Thesis Title: "Biomechanical Design Prognosis and Preclinical Assessment of Bone Plates Used to Treat Extracapsular Femoral Fractures"

Abstract

The incidence of extracapsular femoral fracture is increasing with relatively high mortality, which requires immediate surgical interventions. The aim of surgical treatment is to provide initial fixation/rigidity such that the broken bones re-join through secondary bone healing. Such healing usually involves the need for fixation devices, e.g., bone plates, nails, external fixators etc. However, attaching such stiff, metallic fixation devices leads to excessive stress shielding causing impediment to healing. Osteoporosis and subsequent cortical thinning are the adverse outcome of stress shielding. Also, when a plate is in direct contact and pressed down to the bony surface, it can disturb blood flow to the underlying cortex. Thus, successful operative intervention depends on three crucial aspects, e.g., stability of fixation, bone fracture healing and post-operative cortical thinning. The concerned mechanical aspects and biological phenomena motivate to computationally predict the ideal implant for a particular patient. The thesis employs methods to biomechanically investigate the effect of different bone plates related to various fractures. Finite element (FE) models are used as tool to predict post-operative implant stability for different types of bone plates, fixated to proximal femoral fractures. The predicted results accorded well with various previous experimental observations. The present study vividly identified the different initial response in healing under different fixation stabilities. The investigation was able to forecast the regions of failure associated to implants under both physiological loading and extreme cases of fall and to highlight the probable reasons. Further, the study proposed a novel design of implant considering regional morphometry of Northeast India. The prognosis of cortical thinning due to implantation and simulation of bone fracture healing studied in the thesis, different treatment strategies can be predicted, and the optimal strategy can be chosen, which then can reduce the healing time and lighten the economic burden and pain for the patients.

Keywords: *proximal femoral fracture, finite element analysis, patient specific implant, bone remodelling, cortical thinning, tissue differentiation, fuzzy logic.*