

Static and Transient Stress Analysis of Human Lower Extremity Bone under Impact Loading

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Abstract—Finite element (FE) modeling based on medical imaging is considered a very promising technique for the assessment of *in vivo* femoral bone strength. A finite element model of bones with accurate geometry and material properties retrieved from CT scan data are being widely used to make realistic investigations on the mechanical behavior of bone structures. In our present study we have create a model of real proximal human femur and tibia bone for evaluating the finite element analysis (FEA). Here, behavior of femur and tibia bone is analyzed in ANSYS® 11 under physiological static and impact loading conditions. The stress analysis of femur was performed only with prime moving muscle via abductor, ilio-tibial tract, iliopectus. Hence the mechanical analysis with heterogeneous material property of bone is varying with different loading condition. For tibia the load is applied in the middle portion perpendicular to shinbone by constrained the upper and lower end. This is mainly a quantitative study of static and transient stress analysis of human lower extremity bone. The result of this analysis is helpful for orthopedic surgeons for clinical interest.

Keywords: transient analysis, computed tomography, finite element analysis, femur

INTRODUCTION

It is well-established that mechanical testing is of paramount importance, not only in aerospace, civil engineering and the automotive industry, but also in health care. The field of biomedical research raises specific problems due to the fact that today's research may prove extremely expensive and that the modeling and simulation step saves time and money for conducting the live experimental clinical trial.

Hip fractures, the most devastating and costly unintentional injuries in the elderly are mostly associated with impact directly on the hip in lateral falls. Fall-related injury can either be reduced by decreasing the number of falls or by decreasing the severity of fall-related impacts. Since the number of falls presumably cannot be reduced to zero, insight are needed to arrest a fall with the minimum risk of injury. Lotz and Hayes suggested that energy absorbed during impact in lateral fall might be the dominant factor in the biomechanics of hip fracture rather than bone strength.

In recent past, to obtain more sophisticated evaluation of femoral fracture load, investigators used finite element (FE) models developed from computed tomographic (CT) scan and applied a dynamic or quasi-static force on femoral head to predict fracture load and with the same linear FE models, they predicted femoral fracture location and established the effect of force direction on femoral fracture load.

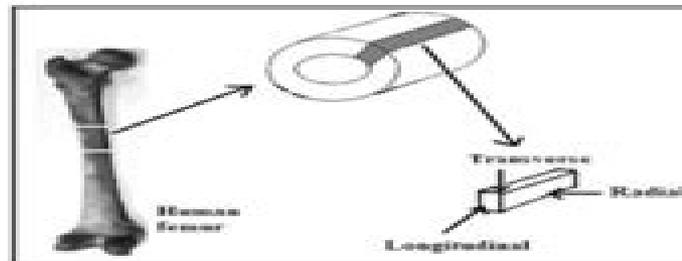


Fig. 1: Cross Sectional View of Femur Shaft

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