STRESS ANALYSIS IN CEMENTLESS HIP PROSTHESIS

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ABSTRACT

In this changing global scenario, modification, transplantation, and replacement can be the eternal solution for most of the problems in the medical field. Hence replacement technique finds a very prominent place in medicine as a remedy having closely tied up with biomechanics. One of the most important joints in the human body is the hip joint, the big and complex joint. Many researches were conducted and many are in progress, but most of these works use simplified models with either 2D or 3D approaches. The hip joint is formed by four components like femoral head cortical bone, stem, and neck. In this system we can find orthotropic and isotropic materials working together. The main objective of this research is to develop a three –dimensional surface and solid finite element model of the hip joint to predict stresses in its individual components. This model is a geometric non-linear model, which helps us understand its structural mechanical behavior, seeming to suggest –with advanced research in the future –new hip joint prosthesis, as well as to prove the prosthesis –joint interaction before being implanted in the patient. This research explains a complete human hip joint model without cartilaginous tissue, using ANSYS 10.0 Multiphysics Analysis for nine different postures in hip joint using three different materials (CoCr, Ti6Al4V, and UHMWPE) to calculate fatigue life. The result obtained from the analysis of surface model and solid model serve to help in predicting the life cycle, surface characteristics, shear stress in XY plane, stress concentration and areas that are prone to failure. Von Mises stress on the surface of our model facilitates us to equip and design an optimized prosthesis device having unique materials composition , with a highly bio- compatible and durable alloy at a low cost could be produced. In this way, a first important step towards the structural characterization of human hip joint has been developed.

KEY WORDS: Hip joint; Total hip replacement; Force; Measurement; stress analysis; ANSYS