UNIVERSITI TEKNOLOGI MARA

EFFECTS OF THE IMPLANT PLACEMENT TO THE RISK OF FEMORAL BONE FRACTURE IN RESURFACING HIP ARTHROPLASTY

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Resurfacing Hip Arthroplasty (RHA) is a hip replacement method that is widely known nowadays. This method usually applied to the hip disease patients who are in the late stage condition. RHA method is most recommended to the young and active patients since high successful rate was recorded to these group of candidates. However, the complication of femoral bone fracture often happens in this hip replacement method which associated with the implant positioning. The objective of this study is to quantify the effects of RHA implant placement towards the bone adaptation for prediction of femoral bone fracture risk by using finite element analysis. Finite element analysis was conducted to predict the damage formation of the bone model based on the computed tomography (CT) image of a patient. A 3D inhomogeneous bone model was developed from computed tomography (CT) image of a 47 years old patient with a hip osteoarthritis disease by using a biomechanical modelling software, Mechanical Finder. The material properties used for the RHA implant model was based on the properties of cobalt-chromium (CoCr). Straight implant placement was firstly developed by referring to the natural shaft-neck axis of the femoral bone, before generating several implant placement in varus and valgus. 13 implanted femur models with implant angle +3°, +6°, +9°, +12°, +15°, +18° in varus placement and -3°, -6°, -9°, -12°, -15°, -18° in valgus placement has been developed in this study. The study has simulated two loading & boundary conditions namely, normal walking condition and sideway fall condition. The effect of different RHA implant placements on the Drucker-Prager stress distribution and femoral bone strain was observed. The risk of femoral bone fracture associated with the implant placement was then predicted using element failure criterion. The results obtained show that the femoral bone models within the valgus implant placement were produced a high fracture strength as compared to the straight implant and varus implant placements. For the case of normal walking, the fracture strength of the femur bone was decreasing as the implant being oriented more towards varus placement with the lowest fracture strength obtained at the femur implanted with varus +18° placement. The fracture formation occurred at the neck area of the femur. For the case of sideway fall, femoral bone that implanted in varus placement category shows a higher risk towards bone fracture. The fracture formation is predicted to occur at the neck and trochanteric area of the femur. The findings in this study suggest that the RHA implant should be placed slightly in valgus placement or as much valgus as possible during the intra-operative session according to the patient's bone conditions.

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