FINITE ELEMENT METHOD PREDICTION OF HIP PROSTHESIS IN BONE RESORPTION ENVIRONMENT

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By
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Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

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May 2012

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Faculty: Engineering

Total hip replacement (THR) is normally done for the failure of hip joint caused by osteoarthritis. It is performed to relief pain and to improve functionality. Issues related to the study include method to reduce fixation failure, means to improve the longevity of the prosthesis, methods to reduce the factors contributing to probability of failure such as cement strength, implant interface strength, and loosening. The present work focused on failure related to stress related only. The main aim of this work is to study the inner failure stress for THR and to suggest recommended functional activities for patient whom undergoes THR. By knowing the stress for the inner bone, the failure mechanisms of THR for different dynamics loadings can be predicted more objectively. For this study, ANSYS Workbench version 11.0 was used for the Finite Element (FE) analysis. The values of stress and strain distributions in anterior (A), posterior (P), medial (M) and lateral (L) positions of the healthy femoral bone and THR were obtained. The stress and strain distributions of inner healthy femoral bone surface subjected to standing were studied. The effect of materials on the variations of stress and strain of the outer and inner surface of the
healthy bone were studied and determined. Hip prosthesis and hip prosthesis with bone resorption for different functional activities such as standing, walking, stair-climbing, single-legged stance, abductor, and adductor loads was studied. Failure mechanisms of hip implant were determined and THR life was predicted. The values of von Mises stresses and strains for inner surface of the femur and consideration of bone resorption are essential for the study of Total Hip Replacement (THR). The restricted types of activities for the patient who undergoes THR surgery were recommended. From this study it was found that the THR the patient should not do activities such as stair climbing and adduction. The data for inner stress can be used as a guide for future implant design and surgical procedure.
Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

RAMALAN ALAT GANTI TULANG PEHA DALAM PERSEKITARAN PENGECHATAN TULANG MENGGUNAKAN KAEDAH UNSUR TAK TERHILANG

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I certify that a Thesis Examination Committee has met on 22 May, 2012 to conduct the final examination of Mr. Solehuddin bin Shuib on his thesis entitled "Finite Element Method Prediction of Hip Prosthesis in Bone Resorption Environment" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Doctor of Philosophy.

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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, is not concurrently submitted for any other degree at Universiti Putra Malaysia or other institutions.

SOLEHUDDIN BIN SHUIB

Date: 22 May 2012
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