UNIVERSITI TEKNOLOGI MARA

DEVELOPMENT OF IN VIVO MEASUREMENT VIBRATION TECHNIQUE TO PREDICT BIOMECHANICAL PROPERTIES OF HUMAN TIBIA

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AUTHOR'S DECLARATION

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

I hereby acknowledge that I have been supplied with the academic rules and regulation of post graduate, University Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Health of human skeleton is a major concern issue attributed to its effect on the overall human health and performance. Human bone develops gradually and reaches to its optimum level during the second and third decades of human life. Monitoring and measuring of the bone states are necessary step to determine the bone health. Bone mineral density is the reference indicator to measure the bone health states. Several methods, in-vivo, are clinically available to measure bone mineral density such as dual x-ray absorption (DXA), quantitative computed tomography (QCT), ultrasonography, single-energy x-ray absorptiometry (SXA), and radiographic absorptiometry. DXA is the most accurate and widely available technique clinically. However, all the available techniques have major radiation activities side effects and are also limited in availability in certain clinics due to their total costs. In this study, an experimental vibration technique is developed to measure the vibration parameters and, consequently, to estimate the bone mineral density in-vivo for human tibia. A vibration spectrum analyzer is employed to measure the vibration parameters and a Vibration Response Function (FRF) technique is utilized to estimate the natural frequency and damping ratio. Moreover, DXA clinical measurements for BMD, T–score and Z–score are taken. Bio-statistical analysis has been performed to correlate the readings from both measurement techniques. All the parameters that would affect the analysis are also included such as volunteer's gender, skin thickness, age, Body Mass Index (BMI) and diameter where the readings occurred. Additional measurements of fundamental and in-vitro vibration and stiffness have been contacted to establish the necessary initial preparation for the in-vivo measurement. A Total of 12 healthy volunteer adults ages between 25 -58 had volunteer to perform the tests. For each volunteer ,an examination by orthopedic specialist is conducted before the DXA and the vibration test. The results from bio-statistical analysis have shown a great correlation between the proposed method and the standard clinical DXA method. Thus, the successful development of the in-vivo vibration testing technique for human tibia would be beneficial due to its free side effect, small size device and low cost .

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