UNIVERSITI TEKNOLOGI MARA

DEVELOPMENT OF EPOXY-COATED BAMBOO COMPOSITE POLYMER REINFORCED PROSTHESIS FOR UNCEMENTED TOTAL HIP REPLACEMENT (THR)

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ABSTRACT

Hip arthritis often associated with total hip replacement (THR). It is estimated that by the year 2040, 78.4 million of adult aged 18 years and older in United State will suffering arthritis. As the population grows and ages increase; hence, the need of THR will increases. THR has become increasingly prevalent in relieving pain related to hip. Most of uncemented total hip replacement (THR) rely on press-fit for the initial stability and consequently lead to the secondary fixation namely biological fixation. The main key factor to a successful replacement is the implant stability. However, uncemented THR more prone to aseptic loosening as it the most reported cases in this surgery. Most of the patients will undergoes revision after 15 years utilizing the implant. Improper design and its material are among the aseptic loosening factors. The aim of this study is to propose a new material which having material properties closer to human cortical bone and develop a new hip prosthesis design to improve the fixation; hence, aseptic loosening can be minimized. In this present study, a new composite material which is Semantan (Gigantochloa Scortechinii) type of bamboo and glass fibre composite was introduced and subjected to a chemical treatment called epoxy coating prior to the fabrication of the composite as to increase the mechanical properties of the fibre. A three-dimensional model of hip prosthesis was then designed using CATIA V5 Software and analysed by using commercial Finite Element Software namely, ANSYS WORKBENCH V15 software to investigate the effect of using the new material properties and new chosen design of hip prosthesis in terms of mechanical stresses and deformation distribution. The new design of hip prosthesis has decreased the stress distribution and deformation occurred along the implanted femoral bone by 58% and 45% and the stiffness of new material of prosthesis was 88% closer to the femoral bone properties. Besides, the epoxy coating has increased the fibre-matrix adhesion. Therefore, the development of a new hip prosthesis design with Epoxy-coated/ treated EBEFEBE bamboo composite material was successfully reduced the mechanical stresses and deformation and consequently minimized the aseptic loosening.

Keywords: *Uncemented total hip replacement, finite element analysis, bamboo fiber, composite material.*

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TABLE OF CONTENTS

CHAPTER ONE
INTRODUCTION

1.1 Research Background

Healthy bone allow humans to move around freely without any obstacles especially for the lower extremity part. An intact hip bone allows human a wide range of motion (RoM) in order to permits them to do normal daily activities such as walking, stair climbing, and also jumping as well. In general, the RoM of a typical hip joint during human daily activities consisted of internal-external rotation, abduction-adduction and also flexion-extension [1].

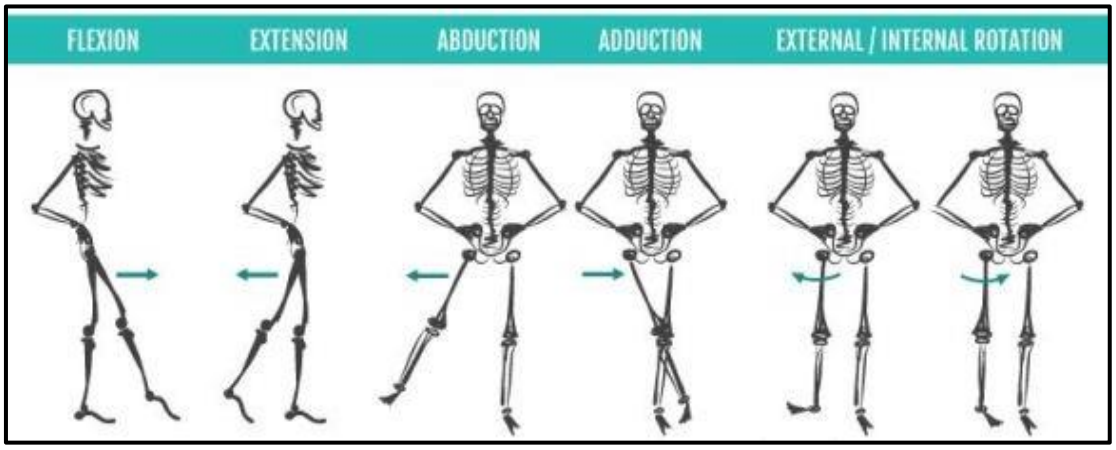

Figure 1.1 The Possible Hip Movement [2]

Activities like stair climbing and running may level up the transmission of forces to five times of the body weight (BW) while eight times for the condition of stumbling [3]. It is essential to have a healthy hip joint as it is the most crucial and important joint in anatomy of human. A normal human hip joint represented as ball and socket joint concept where the ball part is known as femoral head while the socket is the formation of the acetabulum. Besides, this hip joint is surrounded by a thin tissue which known as synovial membrane. This membrane will naturally lubricate the cartilage with a small amount fluid in a healthy hip joint; thus, it will knocked out almost all frictions that may present during its movement by decelerating the built-up heat on the surface of bearing and consequently avoid the area from damages [4][5].