論　文　要　旨
Thesis Abstract

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主論文題名　Evaluation of Trans-femoral Prosthesis Function Using Finite Element Analysis

内容の要旨　（Abstract）

A transfemoral prosthesis is an artificial limb that replaces a leg missing above the knee. The transfemoral amputee must deal with increased energy consumption for ambulation, balance, and stability; a more complicated prosthetic device; difficulty rising from sitting to standing. Transfemoral amputees can have a very difficult time regaining normal movement. A transfemoral prosthesis includes the following components: a socket, knee part, shank, ankle foor and suspension mechanism. For the transfemoral amputee to achieve the best possible outcome, it is necessary for the prosthetist to understand the prosthetic components and how they work. In this study, the author refers to the understandings about features of transfemoral prosthesis, methods and engineerings used in evaluated and manufactured transfemoral prosthesis. After that, the author present a method for evaluation the functions of transfemoral prosthesis part by finite element method. The results of this study suggest that this method can used by the designer and prosthetist for design and choose the best comfortable prosthesis for the patient and reduce time for training before use the transfemoral prosthesis. This study includes seven chapter were structured as follows.

Chapter 1: Introduction

This chapter provides an outline of the whole work. In the first section, an overview of the amputation situation in over the world and some country are introduced. After that, the defination of amputation levels, prosthesis solution and its component, problem when use the prosthesis are summarized to high light the necessary of this study. Finally, the contributes and the abstract of all chapters provides a panoramic view of the entire of study.

Chapter 2: Technical Background and Literature Review
This chapter presents an overview of finite element analysis, multibody simulation and review the related studies. In the first section, the fundamental of finite element analysis and multibody simulation are briefly presented. This part provides the most important concepts and theory for the whole work. In the next section, the previous study are reviewed. Some prevailing results of studies are also introduced to clarify the novelty of the contributions in this work.

Chapter 3: Evaluation interface pressure on surface of residual limb in standing posture
In this chapter, a nonlinear finite element model was created and analyzed to determine the pressure distribution between a residual limb and the prosthesis socket of a transfemoral amputee. Besides that, the better approach for using the shape of socket and residual limb was considered. Three-dimensional models of the residual limb and socket were created using magnetic resonance imaging data; the models were composed of 21 layers, each separated by 10 mm. Two types of socket are MCCT (Manual Compression Casting Technique) socket and UCLA socket are used in this study for quantitative evaluation. The interface pressure distribution in the residual limb was observed. The experiment to measure the pressure at eight locations on the surface between socket and residual limb was conducted with the condition correspond with simulation.

Chapter 4: Transfemoral Gait Cycle Analysis and Evaluation Interface Pressure On Surface Of Residual Limb In Gait Cycle

This chapter present the analysis of kinematic transfemoral gait and the method for evaluation interface pressure on surface of residual limb in gait cycle. There are the different between the human normal gait and transfermoral gait. Even, there are very different of individual transfemoral patient. Understand the properties of gait pathology is very important in rehabiliation program. The multibody simulation method was used for analysis the gait cycle of transfemoral prosthesis. After that a method for computation the interface pressure between socket and residual limb during walking of patient with some of the limitation movement of residual limb and socket was presented. The shape of socket was assumed the same with the residual limb. The kinematics data of residual limb with prosthesis were observed by motion analysis system. The total model includes residual limb and all components of transfemoral socket were modeled in real size. The experiment was conducted to measure the value of pressure between socket and residual limb. The results of two methods were compared and disscused.

Chapter 5: Estimation of the ground reaction force and pressure beneath the foot prosthesis during the gait of transfemoral patients

In this chapter, the authors were implemented a finite element (FE) method for computing

the GRF, and the pressure beneath the foot prosthesis and its distribution. The finite element model of all components of transfemoral of the prosthesis was created. The ground reaction forces, beneath pressure of foot prosthesis and other parameters were disclosed after solving by explicit solver of LS-Dyna software. The results of the vertical ground reaction forces exhibit consistently similar data between the simulation and the measurement. A correlation coefficient of 0.91 between them denotes their correspondence. The reaction force at knee joint, distribution of beneath pressure of foot prosthesis were included in results and discussion. These results can be used for prosthesis design and optimization; they can assist the prosthetist in selecting a comfortable prosthesis for the patient and in improving the rehabilitation training.

Chapter 6: Conclusion and future work

This chapter conclusions the study about the transfemoral prosthesis. The achievements and the limitation of this research. Furether more, some solution to improve of this work was discussed.

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