CHAPTER 1

INTRODUCTION

1.1 Problem Definition

Hip problem is getting more and more common nowadays. According to Cristofolini (1997), there are approximately 800,000 total hip replacements (THR) being performed around the world every year. In Malaysia, for past four years, there are at least 600 THR being reported (Norhan, 2005). The main reason of hip failure is due to osteoarthritis, where the cartilage of a person is broken down. Cartilage is the connective tissue that covers the head of the hip bones. When the cartilage is being worn away, the femoral head and the acetabulum will rub one another. This will cause wear on the bone. Consequently, one will feel pain due to the friction between the ball and socket of the hip. It happens even with small movements. Figure 1.1 and 1.2 show the normal working hip and the degenerated hip respectively.

Therefore, it is important to design an implant, which is called hip prosthesis, to replace the failed femur part. In this project, the analyses will be mainly concerning about how does the stress distributed when the hip prosthesis is implanted compared to the intact femur. Besides, the ability of the hip prostheses to withstand the loading will be determined, too. For cemented total hip replacements (THR), the sustainability of bone cement under loading will also be determined.

The main purpose in this project is to study the stresses carried by the femur before and after total hip replacement. Similarity in the stress is important to ensure the femur is still being properly stressed under loading and thus also enhance the

bone growth. If the femur is overstressed, there will be bone thickening, whereas if it is understressed, bone resoprtion will occur. Consequently, there is a high possibility for the implant to loose (Frost, 1964; Cowin and Hart, 1985; Harrigan et al., 1996; van Rietbergen et al., 1997).

Besides, the stresses carried by the hip prosthesis and bone cement are also studied. This is to make sure that stresses experienced by those two components do not exceed the yield strength of the materials.

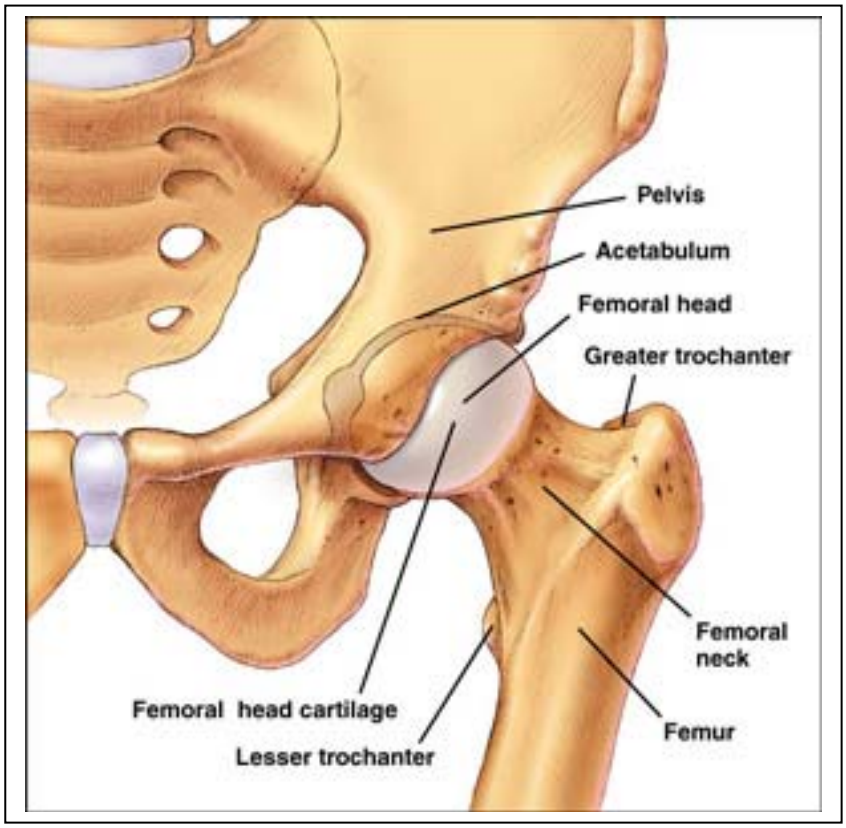

Figure 1.1 Normal working hip (Coordinated health, 2004)

Figure 1.2 Degenerated hip (Coordinated health, 2004)

1.2 Objectives

The objectives of this project are to

i. Develop finite element modeling procedure of current available hip prostheses, bone cement and femur.

ii. Perform static analysis to estimate the stress distribution within the hip prostheses, bone cement and femur.

iii. Study the difference between the stress distribution on the femur with cemented and cementless type of total hip replacement.

iv. Study the effects of different stem length on the stress distribution in the femur.

1.3 Scopes

The scopes of this project include

i. Intact femur.

ii. Charnley and Anatomic Medullary Locking (AML) hip prostheses.

iii. Linear elastic static analysis, where the major outputs of concern are maximum principal strains and von-Mises stresses.