FINITE ELEMENT METHOD SIMULATION ON EARLY HIP ARTHRITIS

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Introduction

The most common type of arthritis is osteoarthritis. It is characterised by progressive wearing away of the cartilage of the joint resulting bare bone being exposed within the joint [Chai et al., 2008]. Osteoarthritis can be caused by injury, excess weight or genetic diseases such as hip dysplasia. In acetabular dysplasia the acetabulum is too shallow or deformed and the femur head can either grow too narrow an angle to the shaft or the femur head is flat and irregular. The objective of the research is to provide a treatment guide to osteoarthritis for young patients.

The symptoms of osteoarthritis include pain with activities, limited range of motion, stiffness of the hip and walking with a limp. Treatment in early stages is pharmacological and physical therapy. In more severe cases total hip replacement or hip resurfacing are recommended. Those treatments have many disadvantages; in the first case the lifespan of total hip replacement is about 15 years which makes it unfitting for a young patient [Itoman et al., 2007] and in the second case, that of hip resurfacing there have been reported femoral neck fractures and metal wear among other things.

New Method of Treatment

The research is focused on a different approach, called hip reshaping, that is going to benefit younger patients. In hip reshaping no metal is added, each case is treated differently, it is possible to intervene in early stages of the disease and the simulation of the movement is software based. The goals of the research are to implement a 3-D model that best describes the contact behaviour of the femoral head and the acetabulum (socket) during the movement. Also it is important to simulate the movement and estimate the loads applied on the bones of both the healthy and the diseased hip joint. Finally tests have to be done to see how the set of real data fits the model to ultimately define how to reshape (cut) the bones in order for the movement of the hip joint to behave like the movement of the healthy one.

Research Methods and Initial Results

The research method of in the present study involves getting data from existing patients and transforming them into 3-D. The FEM software ABAQUS is then employed to simulate the movements, contact locations, pressures and deformations of the healthy and the diseased hips (fig.1). The initial results show local highly concentrated contact pressure for unhealthy hip and recommendations for reshaping the hip are then proposed to achieve more even and smooth hip contact.

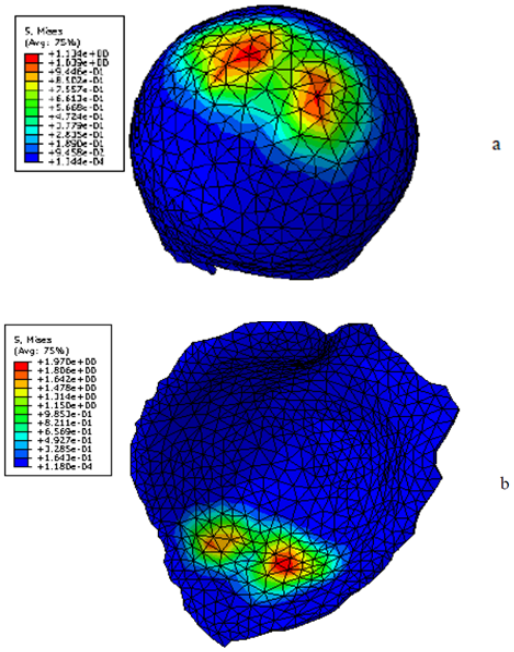

Figure 1: Von Mises stress of the (a) femoral cartilage (b) and acetabular cartilage.

References

Chai *et al*, SpringerLink, 165-179, 2008.
Itoman *et al*, SpringerLink, 163-180, 2007.