HIP FORCES IN HEALTHY AND BIRMINGHAM HIP REPLACEMENT SUBJECTS

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INTRODUCTION

Today approximately 533,000 total hip replacement surgeries are carried out per year in the US and Europe, and this number is set to rise [1]. There are several reasons for hip failures after surgery but aseptic loosening is one of the main areas researchers are looking to reduce. Aseptic loosening occurs in 12% [2] of primary hip replacements, giving around 60,000 hip failures. For revisions this figure rises to nearly 18% giving another 18,000 failures. A relatively new alternative is the Birmingham hip replacement. This is mainly used in patients that have a active daily lifestyle and have good bone quality. This study looked into any differences between healthy subjects and subjects after a Birmingham hip replacement during everyday activities.

One of the first steps is to find the forces from everyday activities that play a part in loosening the prosthesis. Musculo-skeletal modelling has been used previously to find forces during gait [3] and has been used in this study.

METHODS

Motion analysis was carried out using 6 inferred cameras and 15 markers placed on the subject using the Helen Hayes Marker Set. Markers were placed on the 2nd metatarsal of the foot, the heel, the ankle, the calf, the knee, the thigh and the iliac spine of both the left and the right legs. A marker was also placed on the lower back at the sacrum. Both male and female subjects were tested. Both subjects with and without a Birmingham hip replacement were assessed. The subjects were asked to carry out several everyday activities. These were, walking, sitting, standing, walking up steps and walking down steps. These movements were selected as it was found by Morlock [4] that sitting, standing and walking are the most common everyday activities, while Bergmann [5] found that stair climbing caused the greatest hip joint forces.

The data was recorded and processed using EVaRT 5.0 (Santa Rosa, CA, USA). The marker positions were then used as the motion input for models created in LifeMod (San Clemente, CA, USA), a musculo-skeletal modeling software. Values for stiffness and damping parameters were taken from previous similar work by Nazer et al [6], and Heller et al [7]. From these models results can be calculated for all hip and muscle forces. These forces are then used as dynamic loads in FE analysis to accurately predict forces at the hip joint.

RESULTS AND DISCUSSION

Everyday activities were carried out by both the healthy and the Birmingham hip subjects. The two sets of subjects showed good similarities in magnitude. For sitting down the average peak force in the healthy subjects was 2007N with the Birmingham hip subject's average peak force of 1866N. This is a difference of only 7%. Figure 1 shows the forces at the hip for a Birmingham hip patient while sitting down. The other actions carried out all showed similar differences in the average peak forces. The curves of all patients varied from patient to patient. A reason for this could be difference in gait between the subjects. However there were no major differences seen between the healthy and Birmingham hip subjects that would indicate any radical differences in gait.

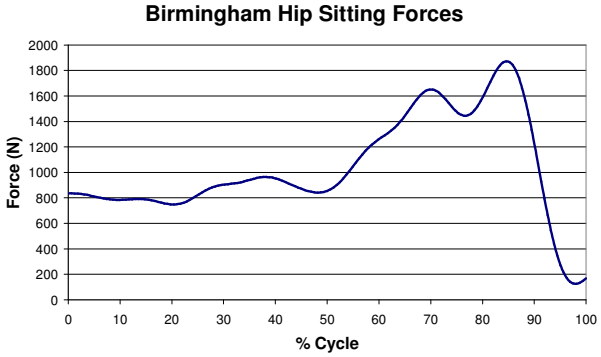

Figure 1: Forces at the hip in a Birmingham subject while sitting down

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