ANALYSIS OF HIP BIOMECHANICS IN PATIENTS WITH HIP REPLACEMENT SURGERY

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Introduction

Hip surgery is one of most routine surgeries for orthopaedic patients. Hip surgery has two types, total hip replacement (THR) and hip resurfacing (HR). The gait analysis for hip surgery is not routine in clinical practice. Although some studies detected the gait changes at the hip but little research was focused on the biomechanical changes that occur postoperatively at the joints. Therefore, the aim of this study was to investigate the postoperative 3D gait changes at the hip joint in patients with hip surgery.

Methods and Materials

The 126 patients with hip surgery (aged 30-87 and weighted 58-120 kg), and 45 healthy subjects (aged 20-62 and weighted 50-116) were collected in the study. Their gait was measured using Vicon motion capture system and force platforms. Of the 126 operated subjects 53.2% had unilateral HR operation while 46.8% had unilateral THR. The gait data from patients were obtained in following up between 1 to 6 years.

Two Kistler® force plates were used to collect the ground reaction force (GRF) while the subject was walking along the 20 m walk way. The Vicon® nexus motion capturing system with 8 MX cameras were used to capture data at 100Hz. A group of 14 mm retroreflective markers were placed on the appropriately anatomical landmarks for the subjects according to Vicon management system, and the biomechanical parameters were calculated using the Plug-in-Gait® model. For each participant, 5 good trials were selected for final statistical analysis.

The biomechanical variables from the gait data were spatial-temporal variables, joint kinematic and kinetic variables, e.g. angle, force and moment.

SPSS (v16) was employed to conduct statistical analysis. Significant level was set at 0.05. Data normality was checked using K-S test, and statistical methods used were independent t-test, general linear model, non-parametric test or ANOVA, depending data characteristics and distribution.

Results

The results were obtained and reported here as Figures 1-2 and Table 1.

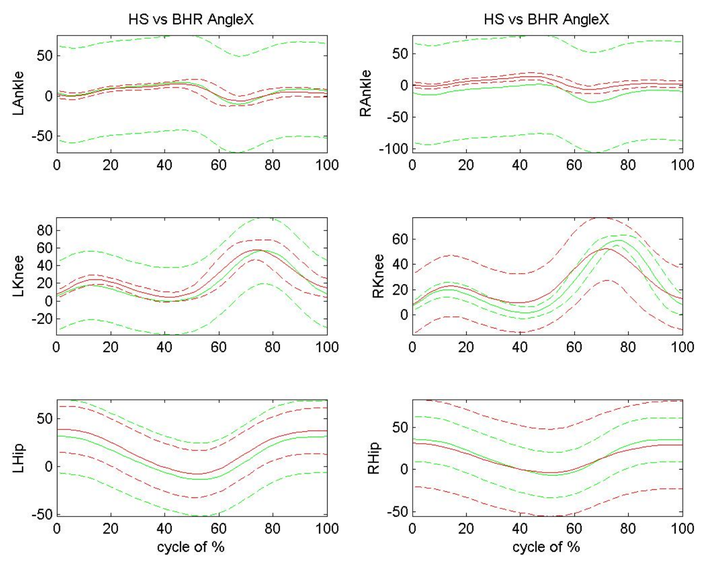

Figure 1: Comparison of the healthy people (HS) and patients in joint angles in sagittal plane

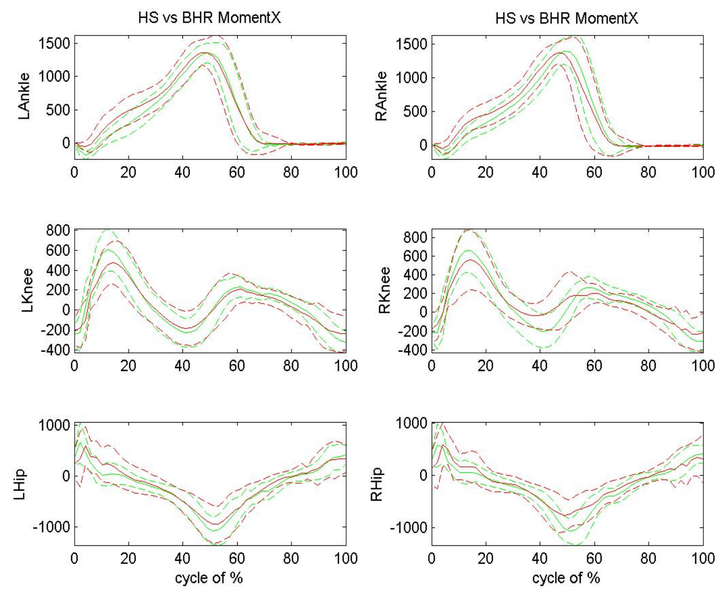

Figure 2. Comparison of the healthy people (HS) and patient in the joint moments in sagittal plane

Table 1: Comparison of the healthy people (HS) and patient operated sides in the hip joint angles (* p<0.05)

Movement		Dominant Limb HS	HR 1 to 3 year	THR 1 to 3 year
Flexion (Degree)	Mean	37.3	38.01	43
	Std.	5.75	5.38	6.45
	Mean Diff		0.71	5.70*
Extension (Degree)	Mean	-8.76	-2.46	2.71
	Std.	6.31	6.66	8.15
	Mean Diff.		6.29*	11.47*
Range (Degree)	Mean	46.3	40.51	40.27
	Std.	4.76	5.03	6.03
	Mean Diff.		-5.79*	-6.02*

Discussion

The results showed that the walking speed for the HR 1 to 3 year postoperative group was 1.22 m/s, and for THR 1 to 3 year was 1.15 m/s. All groups displayed significantly reduced walking speed when compared to the healthy normal group. In this study the patients with hip surgeries also showed significantly reduced stride length when compared to the healthy normal group. Table 1 reports the part of results in the hip joint angles. The results showed that THR significantly increased the hip flexion as approximate 6 deg, reduced the hip extension as approximate 11 deg, and as a result the range of motion in the hip decreased approximate 6 deg. Though both surgeries have the reduced range of motion as approximately 6 deg, the HR has a similar hip flexion to the healthy and reduced the hip extension. (Table 1).

In the hip forces, the results showed that THR and HR have reduced joint forces in the hip in compared with the healthy. In the joint moment, THR and HR shoed reduced values in compared with from the healthy. Obviously, these changes or unchanged are due to the surgeries in the hip.

Conclusions

The range of motion in the hip from THR and HR are reduced in compared with the healthy. Regarding to clinical practice, the hip kinematics and kinetics in HR and THR are acceptable. Though the patients after the surgery have their gait changed a little bit, the gait is fine for daily life.

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