ABSTRACT
This study investigated the COM-COP inclination angles in patients undergoing total hip replacement (THR) while crossing obstacles. By using a 3D motion analysis system and force plates, we measured the parameters of: (1) peak anterior, posterior, medial COM-COP inclination angles, (2) the COM velocity at the peak angles. The results showed that there were phase effect in COM anterior velocity at the peak anterior inclination angle (p = 0.039), and COM upward velocity at the peak posterior inclination angle (p = 0.048). And another height effect in COM downward velocity at the peak anterior angle (p = 0.025), and COM anterior velocity at the peak posterior angle (p = 0.020). The results indicated that the patients demonstrate significant improvement of postural control in sagittal plane 3 months after surgery. Further study is needed to investigate whether post-operation rehabilitation could accelerate the recovery.

INTRODUCTION
Total hip replacement (THR) is a widely accepted strategy to resolve the pain and functional limitation caused by end stage of hip arthritis and/or hip joint necrosis. It can relief the hip pain, improve gait pattern and quality of life.

In previous studies, the changes of gait pattern were the most frequent investigated function of patients after THR surgery. However, the performance after surgery should be examined in depth because it is the requirement for efficient and safe performance of all daily functional activities. Furthermore, crossing obstacles (Fig. 1) is often not avoidable in our daily living situation and often is very challenging for patients after THR.

Many studies have used the whole body center of mass (COM) motion and its relative position to the center of pressure (COP) of the supporting foot to examine gait stability. Instantaneous orientation of the line connecting COP and COM can characterize whole body position with respect to the supporting foot during gait. When this line is referenced to the vertical line passing through the COP, an anteroposterior (AP) and mediolateral (ML) inclination angle can be defined in the sagittal and frontal planes, respectively (Fig. 2, 3).

RESULTS
Ten adults who underwent the 1st-time THR (males: females = 4:6; R: L operated leg=7:3; age: 64.58±6.50 y; height: 156.7±5.8 cm; weight: 58.27±7.02 kg) were recruited and were tested at one week before and three months after surgery. Each subjects was required to cross three different height obstacles (10, 20, 30cm) in the middle of a 10-meter walkway at a self-selected walking speed, using the operated leg as the leading leg (namely support leg, not the trailing or propel leg) for safety considerations. Eight-camera motion analysis system (Vicon 512, Oxford Metrics Group, UK) with 120Hz sampling rate, and two forceplates (AMT Inc., USA) with 960Hz sampling rate were used for data collection. The data was output and calculated by custom written program (Motion Processor, Chen & Ergonomic Team, CYUT, 2008). The parameters representing postural stability includes COM-COP anterior, posterior, medial angles, and COM velocity). Repeated measure ANOVA were used for statistical analysis.

DISCUSSION AND CONCLUSIONS
Patients with THR had some improvement in their postural stability as evidenced by the instantaneous COM velocity at peak COM-COP inclination angles (Tab. 1). Such improvement might indicate that the patients were more confidence and control better in the sagittal plane during obstacle crossing [2]. Although there were no significant difference in anterior and posterior angle, but there was a tendency that the angle decreased after the operation, it may be the result of better dynamic postural control and the patients can align the body smoothly in such a challenging movement activities and decreased the falling risk while crossing obstacle.

REFERENCE