Introduction. Anterior cruciate ligament (ACL) provides passive stability of the knee and involves in the guidance of the joint motion. Injury of the ACL would lead to the degradation of stability and/or mobility of the joint. ACL-deficient (ACLD) patients tended to avoid or reduce quadriceps contraction during stance of walking to maintain stability of the knee [1]. It results in reduced flexion moments, which were found in ACLD patients during walking [2] and stair ascent [3]. However, the presence of this phenomenon was still considered controversial [4]. Stair locomotion, a common activity of daily living, is achieved through a complicated mechanical interaction among the lower limb joints, which may be affected following ACL injury. Previous studies of stair activities in ACLD focused on the changes at the knee joint. The present study aimed to provide a more complete account of the possible biomechanical changes at the three joints of the lower extremity.

Method. Ten ACLD (26.1±7.3 years) and ten normal controls (21.4±1.7 years) performed stair ascent and descent on a three-step stair in a gait laboratory. A seven-camera motion analysis system (VICON 370, Oxford Metrics, U.K.) was used to measure the movement trajectories of each segment of the lower extremity. The ground reaction forces (GRF) were measured with a force platform (AMTI, Mass., U.S.A.), which served as the second step of the three-step stairs (Fig 1). Peak joint angles, peak joint moments and angular impulses of the lower limb joints in three dimensions during the stance phase of the stair activities were calculated and compared between groups using t-test and between affected and unaffected limbs using paired t-test. A significance level of 0.05 was used.

Results. There were no significant mechanical differences between the affected knees and normal controls. But, at the affected hip larger flexion during both stair activities (Fig 2 and 3) and larger extensor impulses during stair ascent were found (Fig 3). For the unaffected limb, the ACLD group had larger hip flexion, knee internal rotation and abduction during stair ascent. During stair descent, larger peak hip flexion and extension, peak hip flexor moments, peak knee flexion as well as peak extensor moments and impulses were found (Fig 2 and 3).

Discussion and Conclusion. The ACLD group maintained a normal loading condition at the affected knee through biomechanical adaptations largely at the unaffected hip and knee and at the affected hip. This is different from walking where adaptations occurred mainly at the affected knee. Analysis of the forces transmitted at individual force-bearing structures may be needed to explain the differences.

Reference

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