ACL DEFICIENT KNEE IS LIKELY TO AVOID PIVOT SHIFT PHENOMENON DURING HIGH DEMANDING ACTIVITY

INTRODUCTION

ACL injury is considered to lead to various compensatory movement such as 'quadriceps avoidance gait' [1], while dynamic knee motion pattern of the patients in coronal and axial planes have still not been clarified. Especially the motion pattern of the ACL deficient knee during high demanding activity is not well described.

The aim of this study was to evaluate three dimensional knee motion pattern during different levels of activities in ACL deficient knees using skin marker based motion analysis.

METHODS

The subjects were 22 knees in 22 patients, 11 women and 11 men, who were diagnosed as unilateral ACL injury by manual tests, MRI and arthroscopy. The mean age was 22.0 yrs, and the average time past injury was 19.6 months with a range of 2 – 120 months. After approval of IRB for this study and obtaining the informed consent, the measurements were performed using a six-camera system (Pro-reflex, Qualysis) and force plate (AM6110, Bertec), at synchronized frequency of 120 Hz and the three-dimensional knee kinematics were obtained by the Point Cluster Technique [2]. Each subject performed 4 different activities; level walking, walking to 90-degrees pivoting to the injured side, jogging, jogging to 90-degrees side cutting to the opposite side of the injury. Contralateral side of ACL deficient knees (healthy side), were also evaluated as control. Knee valgus angle and tibial rotation angle with respect to the femur were measured, and the data length was normalized by the time length of the stance phase for comparison. An analysis of variance (ANOVA) with a single factor was used to determine the difference in knee kinematics between ACL side and healthy side. Significance level was set at p<0.05.

RESULTS

1. Knee valgus angle

Overall, the ACL deficient knees had tendency to have less valgus angle compared to the healthy side. There was no difference during level walking, while in jogging, the ACL deficient side had approximately 3.5 degrees less valgus angle in average, and the significant difference was observed immediately after the heel strike. (Figure 1.) In the side cutting activity, the ACL deficient side had approximately 5 degrees less valgus angle in average. The difference was significant during most of the motion. (Figure 2.)

2. Tibial rotation angle

ACL deficient knees had tendency to have less internal tibial rotation in all the activities, however there was no significant difference except for the side cutting activity. During the side cutting, more external tibial rotation in ACL deficient side was observed immediately after heel strike and before toe off (maximum difference 6.3 deg.) (Figure 3.).

DISCUSSION

The ACL deficient knees had tendency to show less valgus and less tibial internal rotation compared to the healthy side during low demanding activity. And this motion pattern became more obvious during high demanding activity. These results suggest that the ACL deficient patients intend to maintain the injured knee in less abduction position, to avoid valgus torque during high demanding activity such as side cutting. The pivot shift phenomenon is known as anterior subluxation of the lateral tibial plateau (the tibia is internally rotated) under knee valgus torque [3]. The ACL deficient knee motion patterns, knee in less valgus and less internal tibial rotation, are supposed to be a compensation movement to avoid such dynamic instability caused by ACL deficiency. The dynamic compensation of the patients could be more clearly seen in high demanding activity since the effect of muscle weakness and apprehension due to the instability become larger during such movement.

REFERENCES