EFFECTS OF GAZE DIRECTION ON LOWER EXTREMITY DYNAMICS DURING A SINGLE-LEGGED DROP LANDING

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INTRODUCTION
The first process in the motor skills is to perceive surface condition primarily from eyes. The visual system provides information about the surrounding environment from a distance and plays important roles during locomotion in the maintenance of stability and route planning. Based on the fact that the field of view in human eyes in the sagittal plane is limited to approximately 100-150 degrees [1], landing surface is not always fully perceived during landing in many sports activities. Therefore, the purpose of this study was to compare the differences in kinematic and kinetic parameters of the lower extremity according to three gaze direction when performing a single-leg drop landing.

METHODS
Fifteen healthy male subjects (age: 21.2 ± 3.7yr, height: 178.7 ± 5.2cm, weight: 73.6 ± 6.6kg) participated in this study. Each participant performed single-leg drop landing from a 45cm-platform with three gaze directions. During landing performance, the movements of the lower extremity segments were tracked with a three-dimensional motion capture system (Vicon MX, Oxford Metrics Ltd., Oxford, UK). Eight cameras captured lower extremity motion at a frequency of 200 Hz. Participants landed on a force platform (AMTI, OR 6–7; Advanced Medical Technology, Inc, Watertown, MA), which was located in the middle of the capture volume and used to collect ground reaction force. Ground reaction force was sampled at 2000 Hz synchronously with the Vicon system for subsequent off-line analyses.

RESULTS AND DISCUSSION
The results showed that ankle plantarflexion and hip flexion angles were the greatest at 50 ms prior to foot contact when subjects looked at the floor (p < .05). Angle of the knee joint in the frontal plane is presented in Figure 1. Ankle joint inversion and knee joint valgus angles were the greatest when subjects looked at upper field (p < .05). Increased knee joint valgus angle of subjects looked at upper field in this study may affect the loading on the ACL. Frontal plane biomechanics of the lower extremity may significantly influence on the ACL loading in landing task [2]. In addition, the ankle joint power in the sagittal plane is presented in Figure 2. The negative ankle joint power in the sagittal plane was the greatest when subjects looked at the floor during single-leg drop landing from the 45 cm height (p < .05). This presence of an increased negative ankle joint power when landing with eyes looking at the floor indicated that eccentric work done on ankle plantarflexors dissipated impact energy more efficiently. However, there were no significant differences of the negative knee and hip joint power among three gaze directions during single-leg drop landing. Our results suggest that the impact dissipation strategy during landing was altered depending on the gaze direction.

CONCLUSIONS
Based on the results of this study, there were significant differences in the kinematics and kinetics of the lower extremity during the single-leg drop landing performance according to three gaze direction (floor, front and upward). Subjects looked at upper field demonstrated a more dangerous landing posture and the least energy absorption from the ankle dorsiflexors during a 45 cm single-leg drop landing.
Collectively, this study demonstrates that the change of view field changes landing strategy, implying that the limited visual information is an important factor altering the control dynamics of locomotion. These findings suggest that unaccustomed landing with limited visual information may increases chance of injury occurrence at the ankle and knee joint when drop landing.

REFERENCES