RELATIONSHIP BETWEEN THE KNEE VALGUS ANGLE AND EMG ACTIVITY OF THE LOWER EXTREMITY IN SINGLE- AND DOUBLE-LEG LANDING

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INTRODUCTION

A significant correlation between the muscle strength of the lower extremity and knee valgus motion was reported by Claiborne et al. [1]. Their report stated that the hip abductor plays a significant role in the control of the knee valgus motion. Since muscle strength was measured in the open kinetic chain position, it may not reflect the lower extremity movement. Additionally, as a mechanism of noncontact anterior cruciate ligament injury, single-leg landing is generally at a higher risk than double-leg landing [2]. However, differences between the biomechanical characteristics of the lower extremity during single- and double-leg landing remain inconclusive. The aim of this study is to determine the effect of two different drop landing tasks on knee biomechanics and muscle activities.

METHODS

Nine healthy males participated in this study. The mean age (SD) of the subjects was 20.4 (±0.3) years. All subjects signed the written informed consent.

The subjects performed two different drop landing tasks from a box (height, 30 cm), with the dominant leg and both legs. Two sets of infrared video cameras with a 3-D analyzer system (MA2000S; Anima Co., Japan) were used to obtain knee valgus and maximal flexion angles in the frontal and sagittal planes. In addition, an electromyography (EMG) system (TeleMyo 2400; Noraxon, USA) was used to record muscle activity during the drop landing task. Surface electrodes were placed on the gluteus medius, adductor magnus, vastus medialis, rectus femoris, biceps femoris, and semimembranosus of the dominant side. The EMG signals were recorded at a sampling frequency of 1,500 Hz. The maximum voluntary isometric contraction (MVC) of knee extension/flexion and hip adduction/abduction was measured using a dynamometer (system3; Biodex, USA).

The integrated EMG (IEMG) value of each muscle was computed from the period of ground contact to maximal knee flexion and was standardized in 100 ms. In addition, the IEMG of each muscle was normalized as a percentage of the MVC (%MVC). The kinematics and EMG data of 3 trials of each subject were averaged.

Paired t-tests were performed to compare the effects of the two different landing tasks on the knee valgus angle, knee flexion angle, and IEMG value. Pearson's correlation coefficient was used to determine the relationship between the knee valgus angles of single- and double-leg landing. The level of significance was set at $p < 0.05$.

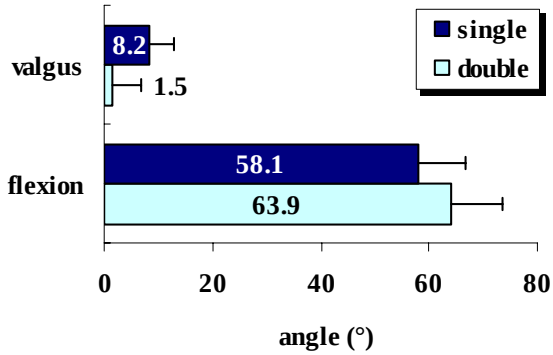

Figure 1: Mean knee valgus and maximal knee flexion angles during single- and double-leg landing.

RESULTS AND DISCUSSION

The average knee valgus angle during single-leg landing was significantly greater than that during double-lag landing ($p < 0.05$). In addition, the average maximal knee flexion angle during single-leg landing was significantly lower than that during double-leg landing ($p < 0.05$) (Figure 1). The knee valgus angles during the two different landing tasks were significantly correlated ($r = 0.767$, $p = 0.016$). The IEMG values in all muscles were higher during single-leg landing than during double-leg landing ($p < 0.05$) (Table 1).

In single-leg standing, the strong hip abductor muscles play a key role in maintaining body balance and neutral position of the knee joint. Our results showed that the EMG activities of the gluteus medius increased from 37% MVC during double-leg landing to 112% MVC during single-leg landing. This result indicates that the gluteus medius also plays an important role in single-leg landing.

CONCLUSIONS

This study demonstrated that single-leg landing increased the knee valgus angle, decreased the knee flexion angle, and increased the activity of the lower-extremity muscles as compared to double-leg landing. The gluteus medius was more active during single-leg landing. This result provides us important information for knee-injury prevention.

REFERENCES

1. Claiborne TL, et al. *J Appl Biomech* **22**, 41–50, 2006.
2. Olsen OE, et al. *AM J Sports Med* **32**, 1002–1012, 2004.

Table 1: Mean muscle activities (%MVC) during single- and double-leg landing.

%MVC	muscles					
	gluteus medius	adductor magnus	vastus medialis	rectus femoris	biceps femoris	semimembranosus
single	112.6 ± 35.1	70 ± 39.1	70.5 ± 38.3	85.2 ± 32.62	57.5 ± 26.5	37 ± 10.3
double	37.2 ± 9.6	40.2 ± 22	40.6 ± 15.6	52.1 ± 28.	31.7 ± 17.7	21.1 ± 7.2