TIME TO LIFT LEG DEPENDS ON INITIAL WEIGHT DISTRIBUTION

Masahiro Shinya, Yousuke Yamada, and Shingo Oda

Human and Environmental Studies, Kyoto University, Kyoto, Japan

KEY WORDS: postural control, weight distribution, choice reaction task.

INTRODUCTION: If you are a defensive player of football or basketball, you must have an experience that you were impotently left behind the offensive player while you certainly knew he/she cut back to left and you should have stepped to left. Why this happen? As a basic research to answer this question, we conducted the lift-one-leg task from quiet standing with and without visual feedback of weight distribution. We hypothesized that the time to lift leg depends on the initial weight distribution. The aim of the present study is to investigate if and how much the initial weight distribution during quiet standing influences the time to lift leg.

METHOD: Seven healthy male subjects (age 23.4 ± 1.3 years, height 171.3 ± 6.0 cm, body mass 65.9 ± 8.0 kg) participated in the present study. The participants stood barefoot and naturally on two force platforms (AMTI). The participants were instructed to lift their leg of the indicated side by go-signal LED as soon as possible and to keep standing on one leg until the LED turned off. Ground reaction forces and the voltages of LEDs were synchronously sampled at 1000Hz. Weight distribution (WD) was calculated as the following equation; WD = (FzR - FzL)/(FzR + FzL)×100, where FzR and FzL as vertical ground reaction forces on right and left feet. The experiment included two conditions. In the N condition, participants were instructed to load their weight evenly on both feet subjectively. In the F condition, participants were requested to adjust WD by using visual feedback at -20% (FL), 0% (FC), and 20% (FR), respectively. Participants performed 168 N trials and 84 FL, FC and FR conditions. We defined the reaction time (RT) as the latency between the stimulation of go-signal and the onset of movement, duration of anticipatory postural adjustment (APA) as the latency between the onset of movement and takeoff, and total reaction time (TRT) as the summation of RT and APA. Regression analysis was performed to quantify the effect of WD on APA.

RESULTS: In the N condition, actual weight distribution widely ranged even though subjects were instructed to stand center-weighted by fifty-fifty. Both inter-subjects and inter-trial variation of WD were larger in N condition than in FC condition. APA and TRT were significantly correlated with WD. The slope of the regression equation between APA and WD was identical among conditions (N: 2.81 ± 0.80; F: 2.67 ± 0.77, not significant).

DISCUSSION: Subjective sense of center-weightedness during normal standing condition might vary from person to person and from trial to trial. The observed result that APA depended on WD can be interpreted by postural control before the subsequent leg lifting. One had to shift his/her center of mass to the support limb before he/she lift the leg, or they would not keep standing on one leg and fall down. It is thought that WD is simple mechanical factor which determines the duration of APA.

CONCLUSION: The present study revealed that 1) postural component of the time to lift one leg was simple mechanical process which was determined by initial weight distribution over left and right legs and 2) weight distribution varies from trial to trial and from person to person when one keep natural stance subjectively and the range was wide enough to influence the time to lift leg.

Acknowledgement
This research was financially supported by Japan Society for the Promotion of Science (JSPS) Grants-in-Aid.