THE CHARACTERISTICS OF GAIT PATTERN ON THE SLIPPERY SURFACE

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INTRODUCTION

Icy and snowy surface roads near melting temperature are more slippery than normal one. There have been many fall accidents caused with slip on icy and snowy surfaces in cold regions and in the winter season in many parts of the world. The biomechanics researches on slip are an important component in the prevention of fall-related injuries. The purpose of present study was to compare the biomechanics of human gait from slippery floor surface to that from non-slippery floor surface in healthy subjects.

METHODS

Five male subjects volunteered to participate in the laboratory experiments. The mean values ± *SD* of their heights, weights, and ages were 1.72 ± 0.05 m, 65.2 ± 8.9 kg, 23.2 ± 7.8 yrs., respectively. They received an explanation of the experimental protocol and provided informed consent prior to testing. A slippery (coefficient of friction: 0.125-0.225μ) and non-slippery floor surface was placed on the walking track over the force plate (KYOWA, Japan). The subject was performed to walk with three different strides; preferred, long and short strides. The cadence of walking was fixed with 90 steps per a minute. The measurements of kinematic data during the walking were collected by using the VICON 460 motion analysis system (Oxford's Metrics, Oxford, UK) with six cameras at 120 Hz placed on the laboratory ceiling. The motion of the subjects' walking was recorded with this system and reflective markers. VICON Workstation software was used to calculate position of the subject's center of gravity (CG) and the relative angles between coordinate systems of each segment in the lower limb and the laboratory coordinate system. The electromyography (EMG) system (WEB-5000, Nihon Kohden, Japan) was used to collect muscle activity from the rectus abdominis, erector spinae, vastus lateralis, hamstrings, tibialis anterior and gastrocnemius. The EMG signals were amplified and recorded by a computer via an A/D converter. A Student's paired t-test was used to determination differences between the kinematic variables when walking either the slippery and non-slippery floor surface. Probability values of $p < 0.05$ were accepted as being statistically significant.

RESULTS AND DISCUSSION

Figure 1 shows the kinematic data of the CG when the subjects walked on slippery and non-slippery floor surface. The highest CG position during one cycle was significantly lower when walking on the slippery floor surface than on the non-slippery. Differences between the maximum and minimum value in the vertical CG position during one cycle of walking were 5.1 and 3.5 cm for non-slippery and slippery

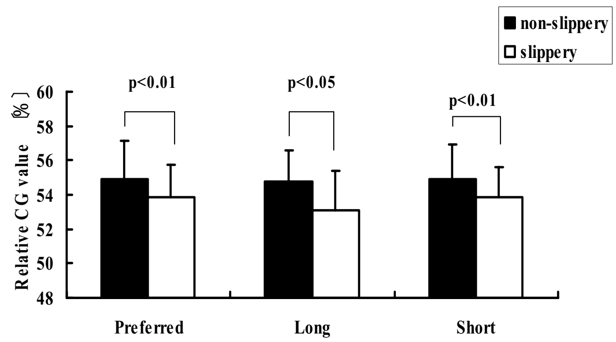

Figure 1: Comparisons of the highest value of the vertical CG position to relative body height during one cycle between slippery and non- slippery floor surface.

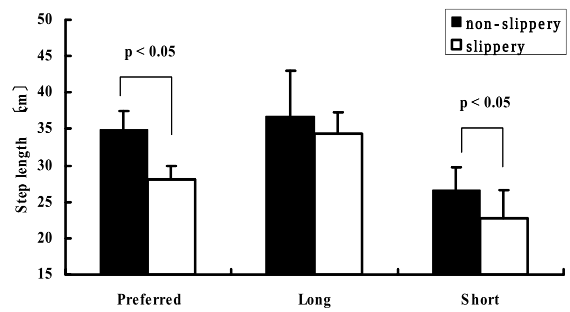

Figure 2: Comparisons of step length between slippery and non-slippery floor surface.

floor surface, respectively. This seemed to lower CG in order to stabilize the body in slippery floor surface. Figure 2 shows change of the step length when the subjects walked on slippery and non-slippery floor surface. The step length was significantly shorter slippery floor surface than non-slippery floor surface. Additionally, there was significant difference in walking speed between slippery and non-slippery floor surface. Pronounced EMG activity was found in rectus abdominis and tibialis anterior muscle during the walking on the slippery floor surface. These results indicated that the lower vertical position and smaller vertical variation of the CG during the walking on the slippery floor surface would be due to the shorter step length and larger ankle dorsiflexion and knee flexion compared to the non-slippery floor surface.

CONCLUSIONS

These findings suggest that the gait patterns were changed with depending on slippery or non-slippery floor surface. Especially, the transition of the CG on slippery was lower because of shorter step length and larger knee flexion. This changed gait pattern on slippery seems to avoid naturally for slip and fall.