INFLUENCE OF FLOOR MATERIAL CHANGE ON FALL RISK DURING LEVEL WALKING

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INTRODUCTION

Falls are the leading cause of unintentional injuries in the elderly in Taiwan and many industrial countries, and commonly occur at home [1]. To reduced fall-related socioeconomic cost, this study aims to identify suitable floor materials on which the elderly could have stable gait, i.e. less likely to fall. We will quantify biomechanical gait variables of young subjects and compare their movement and balance during walking on different floor materials, specially focusing on the movement walking from one floor material to another.

METHODS

Ten healthy young adults were recruited for this study. Four commonly-used floor materials in Taiwan – plane-wood (PW), rough-wood (RW), rough-ceramic tile (RC), and polyvinyl chloride (PVC), with coefficient of friction (COF) 0.865, 0.870, 0.878, and 0.770, respectively– were employed for examining gait stability. To study the change of gait stability while walking from one floor material to another, we used different combinations of the above-described floor materials to created *consistent* conditions (same floor materials on the whole walkway) and *transition* conditions (from one material to another) of walkway. The consistent condition was treated as a baseline condition for comparing the change of gait after transition.

Two force platforms (Bertec 4060, Bertec Corporation, Columbus, Ohio, USA) were placed underneath the middle of the walkway (right after the interface of two floor materials in the transition conditions). A six-camera motion capture system (BTS Bioengineering, Garbagnate Milaness, Italy) and the force platforms were used to obtain kinematics and kinetics of whole body while walking over different floor conditions. Twenty-two 15mm-diameter markers were placed on the bony landmarks of subjects [2].

During the experiment, subjects were asked to walk on a 6-m long and 0.8-m wide walkway with barefoot at their comfortable constant cadence (step/min).The test order of the floor conditions was randomized. Twenty trials were tested under each condition. The primary variables investigated here include foot angle at heel strike, peak required coefficient of friction (RCOF), pelvic motion, and whole-body center of mass (COM). T-tests were used to compare the means in different test conditions. $P<0.05$ was considered statistically significant unless otherwise stated.

RESULTS AND DISCUSSION

Compared with walking under the consistent condition of plane-wood, the foot angle at heel strike decreased when walking from higher-COF floor materials to a slightly lower-COF floor (e.g. from plane-wood to PVC). Moreover, peak required coefficient of friction were significant greater in the transition condition than in the consistent condition. The results also indicate that pelvic motion on saggital plane under a transition condition was significantly different – less anterior tilt during the second half of the gait cycle – from that in the consistent condition (Figure 1). Whole-body COM excursion is larger in transition conditions than in consistent conditions. However, we are conducting more experiment and analyses to confirm this.

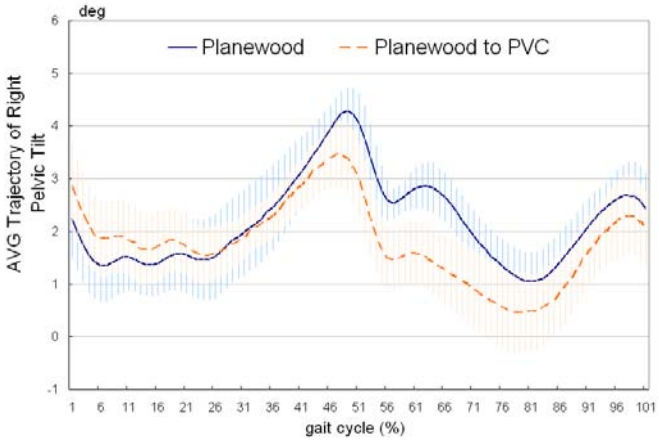

Figure 1: Average trajectory of right pelvic tilt.

Several studies have reported that people would adjust gait to reduce RCOF in order to lower the risk of falls on slippery floor [3, 4]. In this study we further show that walking from one material to another with slightly lower COF (e.g. from COF = 0.865 to COF = 0.770) could cause larger peak RCOF, and possibly less stable pelvic and whole-body COM motion than walking on a floor without material change, which might lead to higher risk of falls. Therefore, avoiding or using caution when walking over the interface between two different floor materials is suggested, especially for the living environment of the elderly. However, to better understand the age effects on the investigated movements, further studies targeting older adults are needed and in progress.

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