LOWER BODY KINEMATICS WHILE WALKING ACROSS A SLOPED SURFACE

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INTRODUCTION

Level surface walking has been well researched [1], with recent work investigating up and down slope walking [2,3]. Research has suggested Individuals are more likely to fall when walking on a sloped when compared to that of a level surface [4] Mechanisms for the increased likelihood of falling have been described as the proactive/reactive mechanisms of the balance control system [5] and the larger sheer forces due to an increasing angle of the surface [6]. The purpose of this study was to investigate if lower body kinematics will change as a function of slope and determine if a difference exists not only between conditions, but individual feet.

METHODS

Ten healthy male subjects (18-25 years) participated in the study. A roof segment 8.53m long and 2.44m wide with a 6\12 pitch (26.50^0 slope) was constructed. The roof segment was shingled with commonly used shingles and according to proper installation methods. Subjects completed two walking sessions on non-consecutive days. The initial session; subjects walked on a level surface which mimicked the length and width of the sloped surface. The second session; subjects walked along the sloped roof segment. Five to ten successful trials were incorporated in the analysis. Feet were analyzed separately and classified as the upslope or downslope foot. Ankle, knee and hip angles (Figures 1 & 2) were analyzed at two peaks in the gait cycle corresponding to weight acceptance (first 45% of stride) and propulsion second 45% of stride). Paired T-tests were used to calculate difference in conditions. Sloped data (upslope and downslope) were compared individually for changes. Alpha was set at 0.05.

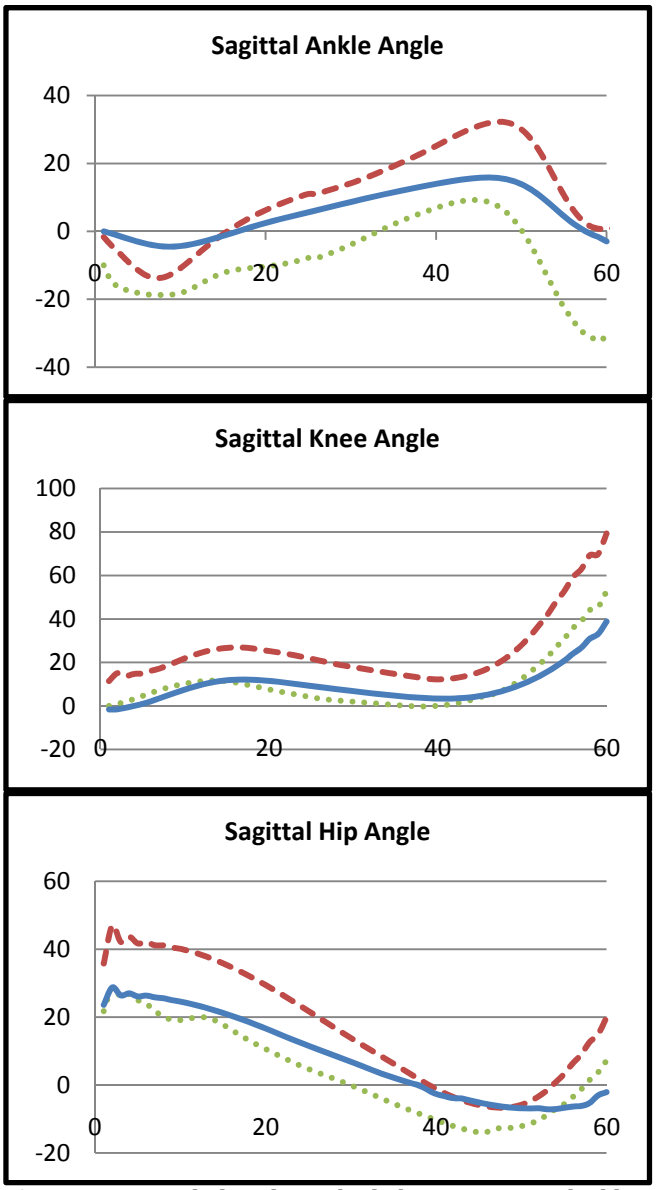

Figure 1: Sagittal plane lower body kinematics. Dashed line is upslope, solid is level and dotted line is downslope.

RESULTS AND DISCUSSION

The kinematic data from each subject was ensemble averaged and peaks were chosen using a custom excel program. Peaks angles about the ankle, knee and hip were compared for level and sloped walking.

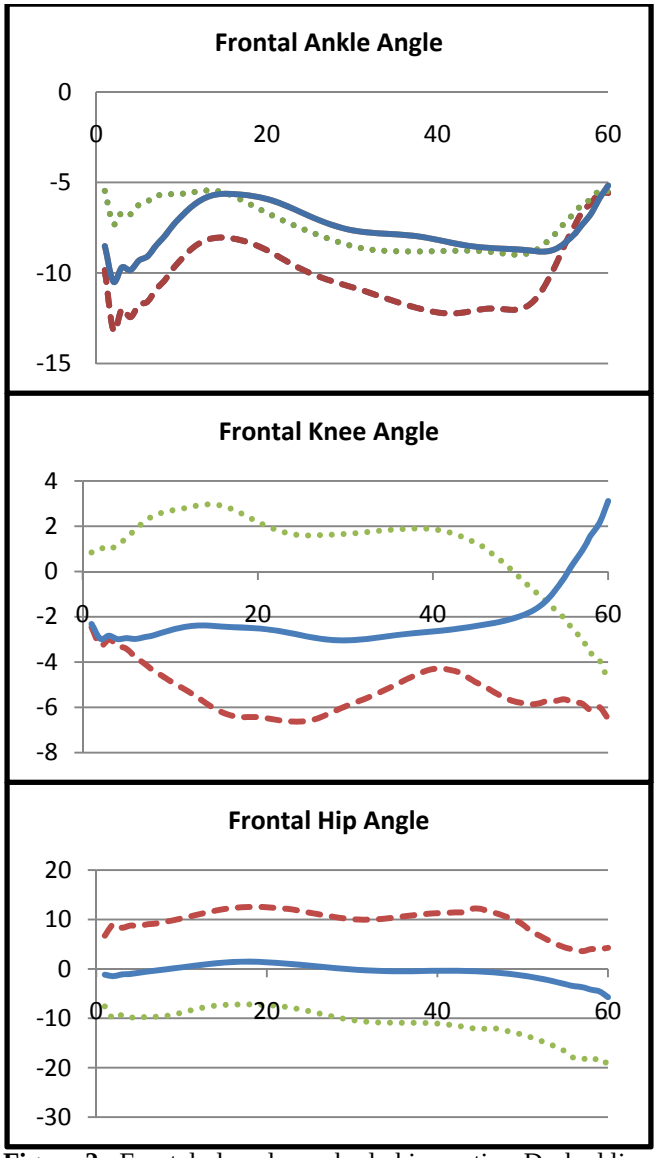

Figure 2: Frontal plane lower body kinematics. Dashed line is upslope, solid is level and dotted line is downslope.

Paired T-tests (alpha = .05) indicated a statistically significant change in several peak angles about the ankle, knee and hip in both the frontal and sagittal planes.

CONCLUSIONS

There is a serious need for research to prevent falls from roofs, both by improving the existing work practices, and by developing new approaches, methods and systems for fall preventions and protection.

A change in lower body kinematic variables during cross sloped walking might indicate an increased likelihood for falling while on a sloped surface and chronic injuries. By determining the changes in gait related performance during locomotion on a sloped surface (i.e. roof), safety measures and engineering controls could be developed and implemented to reduce the risk of falls on and from sloped surfaces.

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Joint Angle (deg)	Kinematic Peaks (Degrees)					
	Level HS	Level TO	UpSlope HS	UpSlope TO	DownSlope HS	DownSlope TO
Ankle Flexion/ Extension	-4.5 ± 1.8	15.8 ± 1.7	-13.7 ± 1.2*	32.2 ± 1.58*	-18.7 ± 0.8*	9.1 ± 1.1*
Knee Flexion/ Extension	12.14 ± 4.8	38.8 ± 4.6	26.8 ± 0.78*	79.3 ± 1.25*	11.6 ± 0.99	52.7 ± 1.8*
Hip Flexion/ Extension	28.7 ± 11.0	-7.1 ± 11.1	46.9 ± 0.51*	-6.6 ± 0.74	28.6 ± 1.0	-13.9 ± 1.8
Ankle Inversion/ Eversion	-10.4± 0.60	-8.8 ± 0.58	-13.2 ± 0.22*	-12.6 ± 0.57*	-7.7± 0.13*	-8.9 ± 0.27
Knee Abduction/ Adduction	-2.9 ± 4.1	3.1 ± 4.1	-6.6 ± 0.83	-6.5 ± 0.66	2.9 ± 0.42*	-4.8 ± 0.31
Hip Abduction/ Adduction	1.4 ± 12.2	-5.7 ± 12.4	12.5 ± 0.70*	12.1 ± 0.96*	-10.0 ± 0.49*	-19.3 ± 1.3*

Table 1: Peaks of lower body kinematics during level and sloped walking conditions. *Denotes significant change from level.