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THE EFFECTS OF DIFFERENT SURFACES ON THE ANTICIPATORY PERIOD OF GAIT INITIATION IN TYPICAL SUBJECTS

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SUMMARY
Gait initiation is the functional task used to describe the anticipatory postural adjustments to start a new gait cycle. Sensory information related to the texture characteristics of the support surface as well as the interface between the foot and the surface may play a role in this process. Thus this study aims to investigate whether different surfaces would change gait initiation anticipatory period. Twenty-five graduate students of both genders (24.4 ± 6.2 y, 69.4 ± 12.7 kg, 1.7 ± 0.1 m) participated in this study. Two AMTI force platforms were used and the instantaneous center of pressure (COP) and related variables were calculated. Anterior-posterior and medial-lateral COP displacements and average velocities were analyzed. With one foot over each platform the participants executed 4 trials in the following experimental conditions: soft surface, rouge surface, shod and barefoot. Significant differences were found in medial-lateral direction for displacement and velocity between barefoot and shod and between shod and foam surface. The COP path during gait initiation was not sensitive to the different surface materials tested, but responded to the foot-floor interface.

INTRODUCTION
Gait initiation is the functional task used to describe the anticipatory postural adjustments to start a new gait cycle. [1]. In gait initiation the center of pressure (COP) path during the transient period from standing still to the first walking step has to be managed by a motor program [2] in order to control the perturbation to posture induced by the voluntary movement.

Three gait initiation periods and landmarks can be defined [3]. The first period is the anticipatory postural adjustment period [4] that consists of a backward and lateral displacement of the COP which precedes the execution of the first step. Anticipatory postural adjustments preserve from balance disturbance that could result from the forthcoming movement and facilitate the set-up of the necessary condition of these forthcoming movement [5].

Thus, the initial backward movement of the COP is responsible for generating the forward momentum for progression [3]. As a result muscles are activated in a stereotyped manner and the body acts like an inverted pendulum. Somatosensory information related to the texture characteristics of the support surface as well as the interface between the foot and the surface may play a role in this process of momentum generation. Thus, the present study aims to investigate whether different surfaces would influence gait initiation anticipatory period.

METHODS
Twenty-five graduate students of both genders (24.4 ± 6.2 yrs, 69.4 ± 12.7 kg, 1.7 ± 0.1 m) participated in this study. All participants signed an informed consent form. Two synchronized AMTI force platforms were positioned in the center of a 10m walkway. The force platforms recorded the ground reaction forces and its respective moments at 100 Hz and the data were filtered by a zero-lag second order low-pass Butterworth filter at 30 Hz.

With one foot over each platform the participants executed 4 trials in the following experimental conditions: barefoot on soft foam surface (2.0 cm width), barefoot on rough surface (made by velcro), barefoot and shod directly on the platform. The average of the last three trials of each condition was used for analysis and the conditions were randomly assigned to each participant. A custom-written Matlab code was used to compute the instantaneous COP and related variables. Anterior-posterior and medial-lateral displacements and mean velocities were analyzed. Only the anticipatory postural adjustment [4] period was selected for analysis.

Statistical differences were tested with SPSS 10.0. Wilcoxon rank sum test was applied to verify statistical differences. The significance level was set to 5%.

RESULTS AND DISCUSSION
Significant differences were found in medial-lateral direction for displacements and velocities between barefoot and shod and between shod and foam surface (Table 1). No significant differences in the anterior-posterior direction were found among the conditions. Barefoot condition produced significantly greater medial-lateral COP

displacement and velocity than shod. On the other hand, foam condition produced significantly greater medial-lateral COP displacement and velocity than shod (Table 1).

These results may mean that sideward COP displacements toward the swing foot and its correspondent velocities are sensitive to the foot-floor interface, but not to the different surface materials used in the study. Therefore, the results might imply that the shoe limits intrinsic foot joint movements. These effects may be related to the attempt to stabilize the COP path and guarantee postural stability instead of generating a large forward momentum, similar to what was observed in Parkinson patients [4], a population prone to exhibit sequencing and locomotor problems.

CONCLUSIONS

The COP path during gait initiation was not sensitive to the different surface materials tested, but responded to the foot-floor interface.

However, despite the soft and the rough surfaces do not have influenced the COP path in the gait initiation, the use of shoes changed the motor response in the sideward maneuver. Therefore, the use of shoes must be considered in balance and gait initiation studies.

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Table 1: Medial-lateral (ML) and anterior-posterior (AP) displacements and velocities during gait initiation in all conditions

Gait initiation: anticipatory phase (n = 25)				
	barefoot	**shod**	**foam**	**velcro**
ML_displacement (m)	0.039* (±0.015)	0.034*† (±0.020)	0.037† (±0.011)	0.036 (±0.013)
AP_displacement (m)	-0.040 (±0.014)	-0.041 (±0.018)	-0.042 (±0.013)	-0.041 (±0.015)
ML_velocity (m/s)	0.162* (±0.077)	0.135*† (±0.065)	0.160† (±0.072)	0.152 (±0.066)
AP_velocity (m/s)	0.173 (±0.096)	0.174 (±0.072)	0.173 (±0.070)	0.171 (±0.059)

(* and † $p < 0.05$, minus sign indicates posterior direction**).**