DIFFERENCES IN GAIT DYNAMICS AMONG VARIOUS TYPES OF SHOE

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INTRODUCTION: The foot provides an important source of feedback for locomotion (Nurse et al., 2005). The healthy locomotor system integrates input from the neuronal system as well as feedback from visual, vestibular and proprioceptive sensors (Hausdorff, 2007). Shoe constructions can support altering gait mechanics and/or stability training (Nigg et al., 2006). Particularly, feedback from the feet may be influenced by changing the types of shoe. According to recent studies, gait variability, such as stride-to-stride fluctuation, may be a biomechanical marker for changes of gait mechanics (Hausdorff, 2007; Peng et al., 1995). The study of gait variability offers a complementary way of quantifying locomotion and its changes with aging and disease as well as a means of monitoring the effects of therapeutic interventions and rehabilitation (Hausdorff, 2007). Then, usually temporal (stride interval time, swing interval time, stance interval time, step interval time, double support time) and spatial (stride length, step length, step width) variables were used for variability analysis. Thus, analyses for gait variability were so-called "gait dynamics". And types of shoe may cause changes of gait performance during walking. In present study we would like to identify differences of gait dynamics (from variability point of views) between shoe types during treadmill walking.

METHOD: Five male university students (age: 25.2 years, height: 169.8 cm, weight: 66 kg) were participated in this experiment. All subjects were free of the muscular skeletal injuries on lower extremity. 3D motion analysis system (Motion Analysis Co., USA) was used to measure subject's kinematic data. 4 types of shoe (running shoes:RS, mountain climbing boots:MS, elevated forefoot walking shoes:ES, and modified negative heel rocker:NS) were used to evaluate changes of gait dynamics during treadmill walking on preferred walking speed and fixed speed (4 km/hr). Preferred walking conditions were performed on treadmill (RX9200S, TOBEONE Co. Inc., Korea) which moving speed can be adjusted automatically by subject's walking speed. This treadmill consisted of four load cells to measure shifting of subject's weight. Using this speed synchronized system, subjects kept their preferred walking speed. CV (coefficient of variance) and DFA (detrended fluctuation analysis) were used to compare effects of types of shoe on stride-to-stride fluctuation. CV is used to describe the amount of variability and DFA the structure of variability (Hausdorff, 2007; Peng et al., 1995).

RESULTS AND DISCUSSION: The results of this study were presented in Table 1. From these results at a speed of 4km/hr, in all shoe types, almost variables were similar. However, there were differences at the CV of swing time, double support time (DST) and step time of ES. It reveals that gait dynamics of normal subjects may be changed via shoe structures. It is necessary to compare when they perform a preferred walking. Differences in result of CV or DFA are expected among different types of shoe. It may reveal relationship between shoe stability and the value of CV or DFA.

CONCLUSION: The results of this study may provide insights into the future study of gait dynamics of various situations (elderly & young adults, normal & neuronal disease, with/without additional task, so on). It is necessary to clarify long term experiment, additionally.

Table 1 The results at a speed of 4km/hr

		Stride time	Stance time	Swing time	Step time	DST	Stride length	Step length	Step width
mean	RS	1.12	0.68	0.45	0.56	0.12	1.25	0.34	0.11
	MS	1.16	0.70	0.46	0.58	0.12	1.29	0.36	0.09
	NS	1.20	0.72	0.48	0.60	0.12	1.33	0.41	0.10
	ES	1.17	0.74	0.43	0.59	0.15	1.31	0.35	0.14
CV	RS	1.69	2.13	2.06	2.18	6.76	1.79	4.11	22.37
	MS	1.69	2.07	2.06	2.12	6.65	1.75	4.04	23.12
	NS	1.68	2.11	2.29	2.11	6.82	1.80	3.72	21.37
	ES	1.70	2.22	3.19	2.15	10.53	1.98	4.17	15.65
DFA	RS	0.85	0.76	0.77	0.80	0.63	0.79	0.76	0.67
	MS	0.86	0.78	0.80	0.74	0.59	0.85	0.81	0.69
	NS	0.92	0.82	0.79	0.80	0.60	0.86	0.74	0.66
	ES	0.89	0.76	0.76	0.78	0.67	0.81	0.71	0.68

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