RELIABILITY OF DYNAMIC FOOT GEOMETRY ASSESSMENT USING A PEDOBAROGRAPHIC PLATFORM AND A TWO-STEP APPROACH

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BACKGROUND

Static measurements of foot structure have previously been used in both the clinical and research setting to describe and classify foot structure (Redmond, 2008). Attempts have been made to relate these different classifications to lower extremity injuries and to identify appropriate athletic footwear in an attempt to mitigate injury (Jenkins, 2007; Knapik, 2010). Such attempts, however, have yet to yield consistent results (Barnes, 2008; Burns, 2005). Since the foot is dynamically loaded during gait and sport activities, it may be more appropriate to classify foot structure based on dynamic geometric variables. Prior to this application, the reliability of these variables must be established. The purpose of this study was to determine the reliability of geometric variables obtained during gait at a self-selected speed.

METHODS

Ten healthy males (n=8) and females (n=2) participated in this study (age: 27.7 ± 4.1 years, mass: 77.6 ± 10.7 kg, height: 174.3 ± 7.0 cm). Data were collected on two different days using the EMED-X® system (Novel GmbH, Munich, Germany), with a sampling frequency of 100Hz. A two-step approach at a self-selected speed was utilized for all trials, which previously has been demonstrated to be reliable in gait analysis (McPoil, 1999). In order for a trial to be included the following criteria were met: only one foot contacted the platform, contact was made on the second step, subjects did not "target" the platform, and subjects appeared to walk with their normal gait and cadence. After familiarization of the task, subjects performed 5 right and 5 left trials.

Geometric variables were then obtained through the Novel software package. Intraclass correlation coefficients (ICC) were calculated using a two-way random effects model (ICC [2, k]) and means and standard errors were calculated for each foot for 21 geometric variables.

RESULTS

Means, standard errors of the measurement (SEMs), and ICCs for both the left and right feet are presented in Table 1. Excellent reliability (ICC>0.90) was demonstrated in 15 of the 21 geometric variables for the left foot and 16 of the 21 variables for the right foot. Good reliability (ICC>0.70) was demonstrated in 20 of the 21 variable for both the left and right feet.

	Mean ± SEM		ICC	
	Left	Right	Left	Right
Anterior plantar angle [°]	28.10 ± 0.79	28.46 ± 0.29	0.979	0.848
Posterior plantar angle [°]	28.03 ± 0.97	28.41 ± 0.32	0.975	0.775
Lateral tarsal angle [°]	154.02 ± 1.82	153.38 ± 1.62	0.708	0.629
Medial tarsal angle [°]	149.83 ± 1.49	149.76 ± 0.73	0.965	0.853
Lateral plantar angle [°]	7.32 ± 0.14	7.49 ± 0.08	0.991	0.971
Medial plantar angle [°]	7.32 ± 0.14	7.49 ± 0.08	0.991	0.971
Long plantar angle [°]	14.65 ± 0.28	14.98 ± 0.15	0.992	0.971
Transverse plantar angle [°]	16.61 ± 5.57	14.44 ± 5.00	0.785	0.733
Hallux angle [°]	4.42 ± 0.82	4.28 ± 0.75	0.986	0.983
Hallux angle (2) [°]	6.73 ± 1.46	5.80 ± 0.96	0.992	0.981
Forefoot angle [°]	113.94 ± 1.19	114.75 ± 2.17	0.736	0.921
Subarch angle [°]	114.73 ± 2.58	108.08 ± 2.73	0.972	0.975
Heel angle [°]	9.20 ± 1.15	10.06 ± 2.61	0.656	0.933
Foot progression angle [°]	7.46 ± 0.59	10.01 ± 0.54	0.990	0.988
Foot length [cm]	27.31 ± 0.15	27.43 ± 0.14	0.993	0.991
Forefoot width [cm]	9.75 ± 0.08	9.85 ± 0.13	0.970	0.989
Heel width [cm]	5.62 ± 0.05	5.63 ± 0.03	0.995	0.989
Coefficient of spreading	0.36 ± 0.00	0.36 ± 0.01	0.871	0.974
Arch index	0.24 ± 0.01	0.24 ± 0.01	0.965	0.985
Forefoot and heel coefficient	0.58 ± 0.01	0.57 ± 0.01	0.977	0.965
Forefoot coefficient	1.08 ± 0.01	1.09 ± 0.01	0.780	0.922

Table 1: Geometric variables: mean, SEM, and ICCs for left and right feet.

DISCUSSION

Reliable dynamic assessment of foot geometry can be obtained using the EMED-X pedobarography platform. These findings support the use of dynamic foot geometry assessment in future research to classify foot structure/type and to determine the relationship between foot geometry and lower extremity injuries.

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