EFFECTS OF ARCH HEIGHT AND ACCOMODATION ON POSTURAL STABILITY

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INTRODUCTION

The primary purpose of this study was to examine the effects of sandal arch height on postural stability. Secondarily the effects of a two-month wear period on posture were determined as well. Five models of sandals were tested: Santa Cruz (SC), Iceland (IC), Arizona (AS, soft footbed), Arizona (AP, pronounced footbed), and Fulda (FU). Note that each of the aforementioned models shared similar footbed technology yet had progressively larger arch heights.

METHODS

Data was collected on 20 healthy subjects with moderate pes planus feet. Each subject was tested in 5 different sandal conditions (Table 1). Center of pressure (COP) data was collected on each subject, in each shoe condition at 120 Hz using a Kistler™ (9261A) force plate. The subject was asked to stand upon the force plate in their comfortable angle and base of support. The subject's feet were then traced onto a white paper that was adhered to the force plate to ensure repeatability in each subject's foot position across all trials. Each subject stood for a total of 1 minute while only the last 40 seconds of data was analyzed to eliminate transient effects [1]. A total of 3 trials were collected for each shoe condition at the baseline visit. Data was also collected after 2 months in the Birkenstock® Arizona Sandal to examine the effects of accommodation. Best-fit elliptical and circular areas of COP excursion were calculated (Figure 1). Deviation from a postulated ideal COP position (i.e. the midpoint between the left and right feet at the posterior third of the foot length) was determined as well. A 2-way mixed effect ANOVA was performed for statistical analysis and all post-hoc analysis used the Bonferroni-Dunn test with significance at $P < 0.005$.

RESULTS AND DISCUSSION

Mean elliptical sway area increased as a function of sandal arch height. Mean elliptical area for SC (lowest arch height) was 166.22 mm^2, while mean elliptical sway area for FU (highest arch height) was 227.75 mm^2 (Table 1). Post-hoc's revealed that the SC and IC sandals were both statistically significantly smaller in sway area compared with FU. Following a 2-month accommodation period the mean elliptical sway area was reduced from 196.39 mm^2 to 172.28 mm^2 (Table 2) however this change was not significantly different.

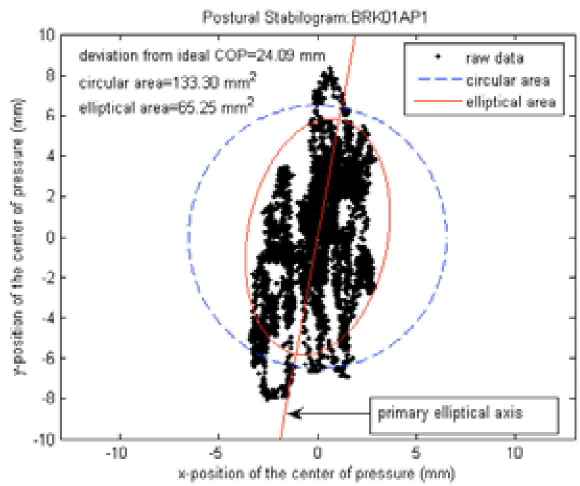

Figure 1: Sample postural stability analysis

CONCLUSIONS

Comparison of postural sway areas across the 5 different sandal models suggests that the mean circular and elliptical sway areas are the smallest in the IC and SC sandals while largest for FU. This result suggests that there may be an optimal arch height in sandals for minimum postural sway. With a 2-month accommodation of the AP sandal, there was a trend toward decreasing sway at follow-up. If postural sway can be minimized by appropriate selection of arch support then these findings may have important implications for those at risk of falling.

REFERENCES

1. Carroll, J.P., et al., *J Biomech*. **26**: 409-16, 1993.

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Table 1: Sandal Arch Height: Elliptical Sway Area

ID	Arch Height	Elliptical Sway Area			
		Mean (mm^2)	SD	p-value	Post-Hoc
SC (a)	4.0 cm	166.22	77.46	0.0477	e
IC (b)	4.2 cm	162.95	78.43		e
AS (c)	4.3 cm	180.50	77.46		
AP (d)	4.4 cm	196.39	79.38		
FU (e)	4.6 cm	227.75	79.38		a, b

Table2: 2-month Accomodation: Elliptical Sway Area

ID	Time	Elliptical Sway Area		
		Mean (mm^2)	SD	p-value
AP (a)	Baseline	196.39	65.74	0.1546
AP2 (b)	2-month Post	172.28	64.16	