CAN A SANDAL ARCH SUPPORT REDUCE PLANTAR HALLUCIAL MICROCIRCULATION?

Jinsup Song, Howard Hillstrom, Nina Babu, and Yoko Miyazaki
Gait Study Center, Temple University School of Podiatric Medicine, email: jsong@temple.edu

INTRODUCTION

It was postulated that the three-dimensional footbed of the Birkenstock sandal could improve weight distribution and promote improved microcirculation to the feet. To test this concept, plantar hallucial cutaneous microcirculation was captured at baseline and following a 2-month wear period of the Birkenstock Arizona sandal while non-weightbearing. In addition, weight-bearing plantar hallucial microcirculation was measured in the barefoot and sandal conditions.

METHODS

Twenty healthy subjects with mild to moderate pes planus feet were evaluated at baseline and following a 2-month use of Arizona sandals. Using a technique described previously [1], cutaneous microcirculation was assessed at the plantar hallux for a 2-minute resting condition, a 2-minute challenge of skin heating to 42ºC, and following 5-minutes of occlusion. Mean flux (in arbitrary units) and skin temperature (°C) were measured using the DRT4 laser Doppler flowmeter (Moor Instruments, Willington, DE). Cutaneous microcirculation was also measured at the thumb (i.e. pollex) as a control. All subjects refrained from eating and drinking caffeinated beverages for greater than 1.5 hours prior to the assessment.

In addition, plantar hallucial microcirculation was measured while each subject stood in barefoot (BF), Arizonal sandal with a pronounced arch support (AP), and the Arizonal sandal with a soft foot bed (AS). For the barefoot condition, each subject stood on a 3/8" wooden platform, which had a 5mm diameter channel drilled for the DRT4 laser probe. Similarly, a 5mm diameter was also drilled through each sandal to allow for weight bearing plantar hallucial measurements. The DRT4 was placed leveled to the supporting surfaces. In each shoe condition, the laser Doppler flow meter was obtained during 2 minutes of sitting, 2 minutes of standing, and 2 additional minutes of sitting.

A repeated measures analysis of variance (ANOVA) model was utilized to ascertain group differences. Bonneferoni-Dunn post hoc analysis was conducted for significant ANOVA results for the weight-bearing assessment.

RESULTS AND DISCUSSION

As shown in Table 1, the ratio of reactive hyperemia (RH) during the first minute post occlusion and the 2 minute resting mean flux (RH1/Resting) was higher at 2 month follow up than at baseline (p value=0.0159). Mean flux during heating and peak flux during reactive hyperemia at the pollex also increased at 2-months. These changes were not accounted for by the room temperature.

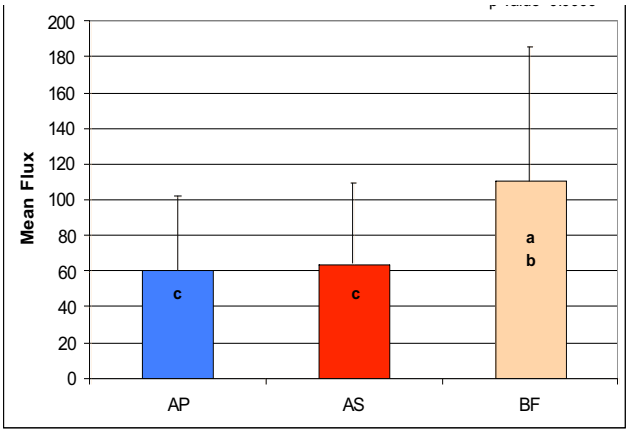

Figure 1: Mean flux (in a.u.f.) at the plantar hallux following 2-minutes of standing (reactive hyperemia) in 3 shoe conditions.

During quiet comfortable stance, mean flux during reactive hyperemia reduced significantly in the Birkenstock sandal conditions as compared to barefoot (see Figure 1). This implies that there was less oxygen deprivation in the sandal conditions thereby requiring a reduced hyperemic response.

CONCLUSIONS

These results suggest that the improved alignment as well as the increased contact area afforded by Birkenstock footbed technologies may help to minimize transient hypoxia in the plantar tissues while standing. It is also possible that wearing the Arizonal sandals for 2 months may influence endothealial-mediated valsodilation. Further studies are needed to confirm these findings.

REFERENCES

1. Song J, et al. *Submitted for publication, JAPMA*.

ACKNOWLEDGEMENTS

This study was funded by Birkenstock USA.

Table 1: Mean Hallucial and Pollex Flux (Pre/Post)

Mean flux in a.u.f. (Arbitrary Unit of Flux)	Plantar Hallux			Palmar Pollex		
	Pre	Post	P value	Pre	Post	P value
At 2-minute Resting	70.6 ± 75.0	90.6 ± 123.7	0.5523	195.8 ± 97.1	275.2 ± 187.7	0.0625
Localized skin heating to 42ºC	236.9 ± 157.4	277.8 ± 182.3	0.4405	274.4 ± 92.1	392.5 ± 174.9	0.0120
Reactive hyperemia (RH1)	114.1 ± 102.1	189.9 ± 168.7	0.1190	217.0 ± 81.4	309.8 ± 179.8	0.0396
RH1/Resting	2.3 ± 1.8	3.5± 2.0	0.0159	1.6 ± 1.7	1.5 ±1.3	0.4288
Room temperature (ºC)	23.8 ± 2.1	23.3 ± 1.0	0.5143	23.8 ± 2.1	23.3 ± 1.0	0.5143