

# **A COMPARISON OF ‘NEUTRAL’ RUNNING SHOES ON PLANTAR PRESSURE PATTERNS AND PERCEIVED COMFORT IN ATHLETES WITH A CAVUS FOOT TYPE: A CROSSOVER, RANDOMIZED CONTROLLED TRIAL**

Caleb Wegener<sup>1</sup>, Joshua Burns<sup>2</sup> and Stefania Penkala<sup>1</sup>

<sup>1</sup>Podiatry Program, The University of Western Sydney, Australia.

<sup>2</sup>Faculty of Medicine, The University of Sydney, Australia.

## **INTRODUCTION**

Athletes with a cavus foot structure have a higher rate of injury compared to athletes with other foot types (Cowan et al., 1993; Burns et al., 2005b). This increased risk of injury is thought to be associated with the elevated plantar pressure seen in people with a cavus foot (Burns et al., 2005a; Sneyers et al., 1995). Athletes with a cavus foot type are routinely recommended ‘neutral’ running shoes by their healthcare provider for the reduction of plantar pressure and to prevent and treat lower limb running injuries (Manoli and Graham, 2005). However, there is little empirical evidence to support the use of ‘neutral’ running shoes to reduce plantar pressures in this patient population. The purpose of this study was to investigate the effect of two commonly recommended ‘neutral’ running shoes on in-shoe plantar pressure distribution and footwear comfort during overground running.

## **METHODS**

A community sample of 22 runners [16 males & 6 females; mean age 30.6 years (SD, 11.1); body mass 70.8 kg (SD, 10.7); height 1.75m (SD, 0.1)] with a cavus foot type defined by the Foot Posture Index (FPI) (Redmond et al., 2006) volunteered to participate in this experimental, randomised, single-blind, cross-over trial. All participants were regular runners with a minimum average weekly running mileage of 20km [mean 55.4 km/wk (SD, 32.9)]. Two commonly recommended ‘neutral’ running shoes were selected for testing following a Delphi interview with a group of eight sports podiatrists. The footwear conditions evaluated were: Asics Nimbus VI (Asics Oceania Pty Ltd, Sydney, Australia), and Brooks Glycerin 3 (Texas Peak Pty Ltd, Melbourne, Australia) versus a control condition (Dunlop Volley, Pacific Dunlop Ltd, Melbourne, Australia). All footwear was purchased to avoid a conflict of interest. In-shoe plantar pressures (peak pressure and pressure-time integrals) were collected for the whole foot, rearfoot, midfoot and forefoot using the Novel Pedar-X<sup>®</sup> system (Novel gmbh, Munich, Germany) at 100Hz during over-ground running at a consistent self-selected velocity on a flat horizontal concrete surface. Running velocity during all tests was monitored and controlled to within 5% of the velocity of the initial test condition. Footwear comfort was assessed using a validated 150 mm visual analogue scale (Mundermann et al., 2002). The manufacturer and model of all footwear conditions was blinded to participants using an adhered surgical bootie. A one-way, repeated measures analysis of variance was used to test significance of all pressure and comfort variables between footwear conditions.

## **RESULTS**

Compared to the control footwear condition, the two ‘neutral’ running shoes significantly reduced peak pressure for all areas of the foot (Table 1). The Brooks Glycerin 3 was more effective at reducing peak pressure beneath the whole foot and forefoot while the Asics Nimbus VI most effectively reduced rearfoot peak pressure. Compared to the control, both ‘neutral’ running shoes significantly reduced the pressure-time integral for the whole foot and forefoot (Table 2). Only the Asics Nimbus VI reduced the rearfoot pressure-time integral compared to the control. The Brooks Glycerin 3 most effectively reduced pressure-time integral beneath the whole foot and forefoot. The Asics Nimbus VI was perceived as the

most comfortable footwear condition ( $P < 0.01$ ), although both neutral running shoes were significantly more comfortable than the control condition ( $P < 0.001$ ).

**Table 1:** Peak pressures (kPa) between shoe conditions.

Foot Region	Control (N = 22)	Asics Nimbus (N = 22)	Brooks Glycerin (N = 22)
Whole foot	513.4 (78.9)	399.4 (88.6)*	361.2 (82.2)* <sup>†</sup>
Rearfoot	358.1(173.8)	240.9 (91.9)* <sup>†</sup>	264.4 (90.5) *
Midfoot	168.6 (68.1)	126.3 (31.0)*	131.4 (34.4) *
Forefoot	464.2 (106.4)	386.1 (100.0)*	340.8 (89.4) * <sup>†</sup>

Values expressed as mean (standard deviation)

\* Indicates significant difference compared to Control ( $P < 0.05$ )

<sup>†</sup> Indicates significant difference between Asics Nimbus and Brooks Glycerin ( $P < 0.01$ )

**Table 2:** Pressure-time integrals (kPa. s) between shoes.

Foot Region	Control (N = 22)	Asics Nimbus (N = 22)	Brooks Glycerin (N = 22)
Whole foot	69.9 (12.4)	55.6 (12.2)*	51.7 (9.7)* <sup>†</sup>
Rearfoot	19.8 (10.9)	17.2 (6.9)*	18.81 (7.6)
Midfoot	15.3 (7.7)	14.4 (3.9)	14.8 (4.4)
Forefoot	63.9 (13.2)	50.3 (12.3)*	46.0 (9.6)* <sup>†</sup>

Values expressed as mean (standard deviation)

\* Indicates significant difference compared to Control ( $P < 0.05$ )

<sup>†</sup> Indicates significant difference between Asics Nimbus and Brooks Glycerin ( $P < 0.01$ )

## CONCLUSIONS

Both types of ‘neutral’ running shoes were effective at reducing plantar pressure variables compared to the control footwear condition. These results suggest ‘neutral’ running shoes are an effective strategy to reduce plantar pressures for athletic patients with a cavus foot type. However, due to regional differences in pressure reduction between the two types of ‘neutral’ running shoes, footwear recommendation should shift from being categorical in nature to be based on the location of pain or location of abnormally high plantar pressure. Further research is warranted to examine other ‘neutral’ running shoes and to investigate whether reductions in plantar pressures can reduce the high injury rates in athletes with a cavus foot structure.

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