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EFFECTS OF THE PRONATION CONTROL RUNNING SHOES AT REARFOOT ANGLE DURING WALKING AND RUNNING

[1] Andreia Miana, [1,2]Maria Isabel Orseli and [1,2]Marcos Duarte
[1]Instituto Vita – SP Brazil, web: www.institutovita.com.br
[2]Universidade Federal do ABC, web: www.ufabc.edu.br

SUMMARY

The purpose of this study was to analyze the influence of the pronation control running shoes on rearfoot angle during walking and running. Eighteen recreational runners were studied during treadmill gait at 5 and 10Km/h in barefoot and shod condition and recorded with 6 high speed video cameras. The two-way ANOVA results showed that the motion control running shoes increased the pronation angle by 4.2 degrees, on average, independently of the task (walking or running). However, no statistical differences was found in the pronation angle of the same individual during walking or running, suggesting that speed does not affect the angle of the foot during motion, whether individuals are barefoot or shod.

INTRODUCTION

Excessive rearfoot pronation may lead to diverse injuries of the lower extremities, however, it is not clear if running injuries are directly or indirectly related to excessive pronation[1]. It is current consensus that excessive pronation per se may not be sufficient to cause injury, but that excessive pronation in combination with other anatomical or biomechanical factors, may lead to running injuries[2]. Thus, the choice of the proper running shoe can help to control excessive rearfoot movement in the loading response phase of gait and possibly reduce the chance of injury[3]. Consequently, footwear companies are increasingly interested in running biomechanics in order to understand the factors that predispose and lead to injury. Therefore, the purpose of this study was to analyze the influence of the pronation control running shoes on rearfoot angle during walking and running.

METHODS

Eighteen recreational runners (10 males and 8 females) were volunteers in this study. They ran at least two times per week and were able to run 10Km/h during at least 10 minutes. The runners were on average 30 ± 7.5 years, 66.0 ± 12.8 kg, and 1.68 ± 0.1 m tall. All runners were free of injuries at the time of the experiment.

The rearfoot angle was measured under two experimental conditions: shod and barefoot. A barefoot condition was incorporated to eliminate the effects that shoes may have on foot mechanics[1].

A static trial and a dynamic trial were recorded for both experimental conditions. During the static trial, runners were filmed standing stationary on the treadmill for 5 seconds. Twelve reflective markers were positioned on the runners' left lower extremity (Figure 1). For the dynamic trial, each subject walked and ran on a treadmill at two different speeds: 5 and 10 Km/h, for 5 minutes each. However, only the last minute was recorded.

A Vicon 3-D motion analysis system (Hardware Model, v-460; Software Model, Workstation 5.1, Ox- ford, UK) with 6 cameras (120Hz) was used to capture the lower extremity movements during the trials and for the 3D reconstruction of marker coordinates. In order to analyze the 3D motion capture data and calculate the rearfoot angle, a Visual 3D hardware was used. The data were smoothed with a zero-phase forward and reverse 8th order Butterworth digital filter with a 10 Hz cut-off frequency.

In order to achieve a more clinical/anatomical interpretation of the data, the three-dimensional joint rotation was calculated using Euler angles. However, only the Y-axis, which represents the pronation/supination movements, was analyzed.

The mean and the standard deviation of the rearfoot maximum angle of fifteen gait cycle, during running and walking, in both experimental condition, shod and barefoot, were calculated. Two-way analysis of variance was used to compare the mean rearfoot angle according to shod condition (barefoot and shod) and task (walking at 5Km/h and running at 10Km/h).

RESULTS AND DISCUSSION

The use of running shoes increased the pronation angle by 4.2 degrees, on average, independently of the task (walking or running) (Table 1). These results may be explained by the fact that the soles of most running shoes are made of pliable material to decrease impact of the foot on the ground. It follows that during walking or running, and when there is pronation of the rearfoot, this angle increases due to compression of the sole. Therefore, our results show that even running shoes made specifically for pronators, increase the pronation angle by an average of 4 degrees. These findings are similar to those reported by Morley et al.[1] who suggest that the decreased pronation angles during barefoot running is caused by a modified running technique used in such conditions. Another explanation is offered by the work published by Reinschmidt et al.[4] in which shows that the actual movement of the foot within the shoe is less than what the shoe would indicate.

With regards to tasks, there are no significant differences in the pronation angle of the same individual during walking or running, suggesting that speed does not affect the angle of the foot during motion, whether individuals are barefoot or shod. One explanation is that the net difference in speed between 5 and 10 Km/h may not be sufficient to cause significant alteration on the pronation angle, even in the transition from walking to running.

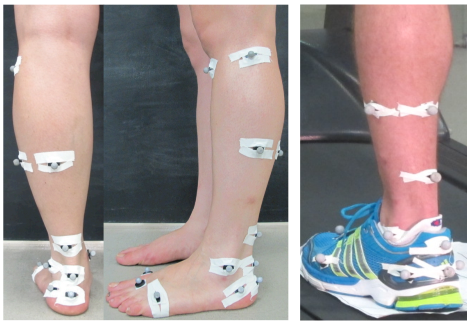

Figure 1: Marker placement.

CONCLUSIONS

We conclude that running shoes specifically made for pronators increase the pronation angles of the foot during walking and running when compared to barefoot measurements. Additionally, the pronation angle of the rearfoot remains similar during walking and running, in barefoot and shod conditions.

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REFERENCES

1. Morley, JB, et al. Effects of Varying Amounts of Pronation on the Medio Lateral Ground Reaction Forces During Barefoot Versus Shod Running, Journal of Applied Biomechanics, 2, 205-214, 2010.
2. Reinschmidt, C., et al. Current issues in the design of running and court shoes. Sportverletzung Sportschaden, 14, 71-81, 2000.
3. Roy, T. H., et al. Motion Control Shoe Delays Fatigue of Shank Muscles in Runners With Overpronating Feet Am J Sports Med 38, 486, 2010.
4. Reinschmidt, C., et al. Tibiocalcaneal motion during running, measured with external and bone markers. Clini- cal Biomechanics (Bristol, Avon), 12, 8-16, 1997.

Table 1: Mean values and statistical results of rearfoot angle according to shod condition and task.

Factors	Rearfoot Angle (Mean)	Difference between means	F	ρ
Shod Condition	S(-6.7)>B(-2.5)	4.2	12.40	0.00*
Task	W(-4.2) = R(-4.9)	---	4.19	0.06
Shod Condition x Task	BR(-2.8)=BW(-2.2) =SW(-6.3) =SR(-7.1)	---	0.09	0.07

* Significantly different ρ<0.05. S: Shod; B: barefoot; W: walking at 5Km/h; R: running at 10Km/h; BW:barefoot walking; BR: barefoot running; SW: shod walking; SR: shod running.