

THE EFFECTS OF AN OVER-THE-COUNTER ORTHOTIC ON LOWER EXTREMITY KINEMATICS IN MALE AND FEMALE RECREATIONAL RUNNERS

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INTRODUCTION

Abnormal foot mechanics during the stance phase of running may affect the kinematics of the lower extremities and predispose an individual to injuries of the foot, ankle, and knee. Custom made foot orthotics are often prescribed to correct abnormal mechanics during running by restoring dynamic stability to the closed chain of the lower extremity. However, custom made orthotics are expensive and must be made by a specially trained professional. An alternative to custom made orthotics are several brands of over-the-counter orthotics. However, there has been no research to examine the efficacy of using an over-the-counter orthotic to correct abnormal gait mechanics. One of the purposes of this study was to examine the effects of an over-the-counter orthotic on ankle and knee joint kinematics during running in individuals identified as excessive pronators.

In addition, females are reported to demonstrate different lower extremity mechanics during running as compared to males. As a result, females are more likely to sustain injuries due to running than their male counterparts. The second purpose of this study was to determine if there are gender specific effects of orthotics on ankle and knee joint kinematics during running, as well as to determine if orthotics are more effective in reducing abnormal gait mechanics in female versus male runners.

METHODS

Twenty college-age recreational runners (10 males, 10 females) identified as being excessive pronators participated in this study. Excessive pronation was defined as those individual with a navicular drop of greater than or equal to 9 mm.

Subjects were required to perform two testing sessions in which they ran with and without orthotics. The orthotic used in this study is a commercially available over-the-counter orthotic (Flat Foot Products, Marathon Shoe Co.). In addition, all subjects used an identical pair of running shoes for both testing sessions (Air Max Moto II, Nike Inc.)

During both testing sessions, the subjects ran on a treadmill at a velocity of 3.35 m/s for 15 min. A three-dimensional motion capture system (Visualeyez VZ 3000, PhoeniX Technologies Inc.) was used to record the position of light emitting diodes placed on the foot, shank, and thigh segments at 100 Hz for 50 complete gait cycles during the last 5 min of each session.

Range of motion, peak angular velocity, and peak angular acceleration at the ankle and knee joints were calculated for the frontal, sagittal, and transverse planes of motion. A two-way ANOVA was used to assess the effects of the orthotic and gender on all kinematic variables.

RESULTS AND DISCUSSION

No differences between the orthotic and non-orthotic conditions across gender were found for ankle joint kinematics (range of motion, peak angular velocity, and peak angular acceleration) in the frontal, sagittal, and transverse planes of motion. One finding of note is that there was no difference in the amount of pronation between the orthotic condition ($4.1 \pm 2.7^\circ$) and the non-orthotic condition ($3.5 \pm 2.8^\circ$). This contradicts the common finding that soft orthotics reduce pronation (Eng and Pierrynowski, 1994; Smith et al., 1986).

In addition, no differences between the orthotic and non-orthotic conditions across gender were found for knee joint kinematics (range of motion, peak angular velocity, and peak angular acceleration) in the frontal and sagittal planes of motion. However, there was significantly greater ($p < 0.05$) transverse plane motion in the orthotic condition ($4.6 \pm 2.9^\circ$) as compared to the non-orthotic condition ($1.7 \pm 1.2^\circ$). Increased knee joint range of motion during running when using soft orthotics has also been documented by Eng and Pierrynowski (1994).

No significant differences in lower extremity kinematics between males and females were found; this contradicts the findings of Ferber et al. (2003). However, there was a strong trend for greater pronation in females than males ($7.2 \pm 1.5^\circ$ vs. $4.0 \pm 1.4^\circ$). Anatomical differences at the hip and knee between genders may predispose females to increased pronation.

Finally, it should be noted that there were no significant interaction effects between gender and orthotics on ankle and knee joint kinematics. Therefore, orthotics do not have a gender specific effect on lower extremity mechanics during running.

SUMMARY

The results show that the over-the-counter orthotic used in this study was not effective in altering the lower extremity kinematics in male and female recreational runners identified as excessive pronators. It can be concluded that over-the-counter orthotics provide mostly cushioning and little, if any, functional control. For individuals with gait pathomechanics, the use of a custom made rigid or semi-rigid orthotic may be necessary.

Also, while there are differences in lower extremity mechanics between male and female runners, there are no gender specific effects of orthotics on ankle and knee joint kinematics during running. Therefore, orthotics are no more effective in reducing abnormal gait mechanics in females versus males during running.

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ACKNOWLEDGEMENTS

This study was funded by a grant from the Mid-America Athletic Trainers Association. The orthotics used in this study were provided by Marathon Shoe Co. The authors would like to thank Dorian Amend and Matt Stensrud for assistance with data acquisition and analysis.