DOES FOOTWEAR AFFECT LOWER EXTREMITY VARIABILITY IN HIGH AND LOW ARCHED RUNNERS?

Robert J. Butler[1], Irene McClay Davis[1,2], Joseph Hamill[3], & Chris Knight[4]
[1]Department of Physical Therapy, University of Delaware, Newark, DE, USA 19716 email: rbutler@udel.edu
[2]Drayer Physical Therapy Institute, Hummelstown, PA, USA
[3]Department of Exercise Science, University of Massachusetts, Amherst, MA, USA
[4]Department of Health and Exercise Science, University of Delaware, Newark, DE, USA

INTRODUCTION

High and low arches have been reported to be predisposing factors for an increased injury risk (Kaufman et al., 1999) Running shoes have been designed to decrease this injury risk. Motion control shoes help to reduce excessive motion in low arch (LA) feet and cushioning shoes assist in attenuating impacts in high arched (HA) rigid feet. Recent data suggest that running in the recommended running shoe for a given foot type reduces injury rates (Knapik et al., 2001). However, the biomechanical changes that occur when running in the recommended shoe have not been evaluated.

Coupling variability, as it relates to injury, has received recent attention in the literature (Hamill et al., 1999) although no inferences have been made to joint variability. Two studies have examined how footwear influences joint variability. Kurz et al., (2003, 2004) reported no difference in frontal and sagittal plane variability of the ankle joint when running in motion control and cushioning shoes. However, variability should also be examined amidst the fatigue that is typical of a prolonged run, when most overuse running injuries are thought to occur. It was reported that the variability of foot position placement on the treadmill increased when subjects became fatigued during a prolonged run (Verkerke et al., 1998). These changes in variability may be a function of arch type, and may be influenced by footwear.

Therefore, the purpose of this paper was to examine changes in lower extremity joint variability when low and high arched individuals run in motion control and cushioning shoes over the course of a prolonged run. It is possible that the shoes may have a greater effect on variability at the end of a prolonged run when the runner is in an exerted state. Since the motion control shoe is more rigid than the cushioning shoe, it was hypothesized that it will reduce variability compared to the cushioning shoe in low arched runners. It was expected the more flexible cushioning shoe will increase variability compared to the motion control shoe in high arched runners during the prolonged run.

METHODS

Subjects for the study included twelve LA and twelve HA recreational runners (>10mpw). These subjects were classified as LA or HA by being at least 1.5 sd below or above, respectively, a mean arch height index value of a reference population of 60 healthy individuals. The average arch height index was 0.273 for the LA runners and 0.390 for the HA runners. The motion control shoe used was the New Balance 1021 and the cushioning shoe was the New Balance 1022. Subjects were given a 5 minute warm-up jog before starting a prolonged run at their self-selected average training pace. Data were collected 5 min into the prolonged run and just prior to the termination of the run. The run was terminated when the subject exceeded a “hard physical activity intensity” as defined by the American College of Sports Medicine (>85% age specific HR max or the rate of perceived exertion >16).

The variables of interest were the average variability during stance for sagittal plane motion of the knee and ankle, tibial internal rotation and rearfoot eversion. Average variability was determined by calculating the point by point standard deviation of 5 trials for each subject and averaging across the trial. A two-way repeated measures (shoe, time) ANOVA for each arch type was used to analyze the data. Interactions and main effects were analyzed using a significance level of $p<0.05$.

RESULTS AND DISCUSSION

A significant interaction in the HA runners for tibial rotation variability was found (Fig. 1). A similar trend was observed for tibial rotation in LA runners. No other interactions or main effects were observed

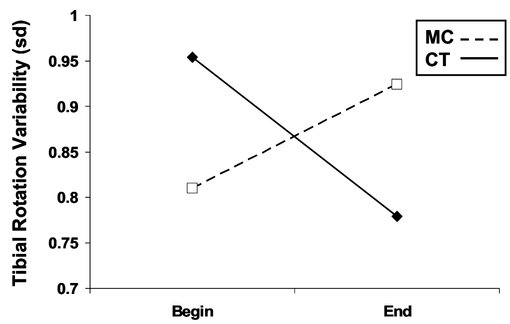

Figure 1. Interaction of footwear and time in High Arched runners (MC=motion control, CT=cushioning shoe)

The hypothesis that the cushioning shoe would increase variability in high arched runners and the motion control shoes would reduce variability in low arched runners over the course of the run was not supported. In fact, the single significant interaction was in the opposite direction of the expectation. Tibial internal rotation variability, while higher at the beginning of the run in the cushioning shoe, increased in the motion control shoe and decreased in the cushioning shoe oier the course of the run. A similar trend was observed in the LA runners although not significant (p=0.16). While we observed a shoe-related difference in variability, the benefits of this effect in injury prevention remain theoretical and require further study.

CONCLUSION

High arched runners increased tibial rotation variability in motion control shoes and decreased tibial rotation variability in cushioning shoes over a prolonged run.

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