

PLANTAR LOADING DIFFERENCES BETWEEN RACING FLATS AND TRAINING SHOES AT A SELF-SELECTED RUNNING SPEED.

Robin M. Queen PhD^{1,3}, Jordan C. Yoder^{1,2}, Johannes I. Wiegerinck^{1,4}, Jennifer Boyd, BS^{1,5},
Alicia N Abbey, BS, ATC^{1,3}, James A. Nunley MD³,

¹Michael W. Krzyzewski Human Performance Lab, ²Pratt School of Engineering, ³Orthopaedic Surgery Duke University Medical Center, Durham, NC, USA

⁴Academic Medical Center, University of Amsterdam, Netherlands

⁵College of Engineering, North Carolina State University, Raleigh, NC, USA

Contact: robin.queen@duke.edu, <http://klab.surgery.duke.edu>

INTRODUCTION

Recently racing flats have been gaining popularity as not only competitive racing shoes, but also as shoes used for daily training. This switch from standard training shoes to racing flats does not come without consequence. Racing flats have less cushioning and support as well as being a lighter weight shoe than training shoes. It has been suggested that a decrease in cushioning could lead to an increase in plantar pressure, which has been linked to an increased risk of lower leg injuries. (McKenzie, et al, 1985, Nigg, et al, 2003, Eils, et al, 2004) The purpose of this study was to determine the effect of two different types of running shoes on plantar pressure while running at a self-selected speed.

METHODS AND PROCEDURES

Using the Pedar-X in-shoe system, plantar pressure data was collected for 17 male and 20 female subjects who run at least 10 miles per week and ranged in age from 18-29. The subjects completed 7 acceptable trials at a self-selected pace while wearing both a training shoe (Nike Air Pegasus) as well as a racing flat (Nike Zoom Katana IV) (Figure 1). The peak pressure, maximum force, contact area, and contact time were calculated for each shoe type.



Figure 1: Running Shoes Used for Testing

The foot was divided into eight regions (rearfoot, medial midfoot, lateral midfoot, medial forefoot, middle forefoot, lateral forefoot, hallux, and lesser toes) in order to determine the difference in loading in each of these foot regions. Maximum force was normalized to body weight, while contact area was normalized to the size of the insole that was used during testing. The data was analyzed using a paired t-test after determining that no significant differences existed in the running speed between the two shoe conditions ($\alpha=0.05$).

RESULTS

Subjects had a mean height of 1.699 ± 0.068 m, mean weight of 63.0 ± 8.3 kg, were 22.9 ± 3.0 years old and ran an average of 29.7 ± 18.0 miles per week. Subjects demonstrated significantly greater total foot peak pressure ($p=0.019$) and total foot maximum force ($p=0.001$) while wearing the racing flats. Peak pressure was significantly increased

beneath the medial ($p=0.005$), middle ($p=0.008$), and lateral ($p<0.0001$) forefoot regions as well as beneath the lateral ($p=0.014$) midfoot and the hallux ($p=0.002$) in the racing flats when compared to the training shoes (Figure 2). Similarly, significant increases in maximum force were found in the lateral forefoot ($p<0.0001$), hallux ($p=0.001$), and lesser toes ($p<0.001$) in the racing flats. Contact area was significantly increased in the lateral forefoot ($p=0.029$) in the racing flats. However, contact area was significantly decreased in the medial forefoot ($p=0.048$). Total foot contact time was not significantly different between the two shoe types.

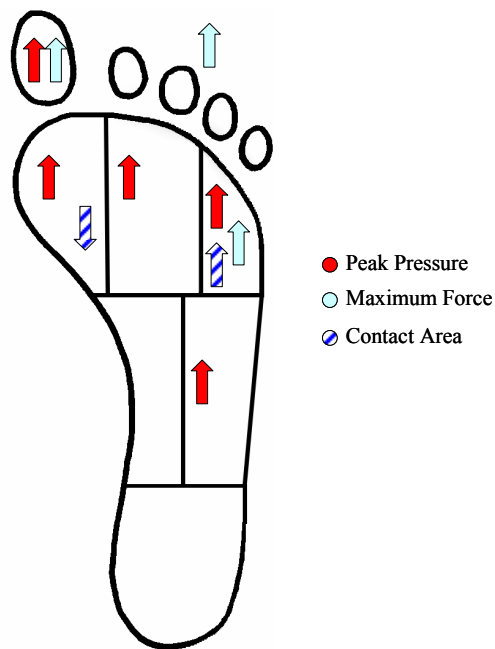


Figure 2: Plantar Loading Differences between the Racing Flats and Trainers.

DISCUSSION

Runners wearing racing flats experienced greater peak pressures and maximum forces in various regions of the foot. Based on the results of this study the

increase in pressure and force in the racing flats could indicate a potential increase in injury risk when running in a racing flat. These results indicate that racing flats should be reserved for competition as the distance and time in the shoe is much shorter, which could decrease the risk of injury. Future work should include an analysis of three-dimensional lower extremity kinematics and kinetics in order to understand any differences that might result from running in these different types of shoes.

SUMMARY

Increased plantar pressure and maximum force in the forefoot regions could be a potential risk factor for overuse injuries when running in racing flats. Therefore, the results of this study indicate the importance of not running long distances in a racing flat in order to avoid increased loads.

REFERENCES

- McKenzie DC, et al. (1985) *Sports Med.* 2(5):334-47.
 Nigg BM, et al. (2003) *J Biomech.* 36(4):569-75.
 Eils, E., et al. (2004) *AJSM* 33:140-145.

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