REGIONAL FOOT PRESSURE DURING RUNNING, CUTTING, JUMPING AND LANDING

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INTRODUCTION

Foot pressure studies have generally focused on walking [1,2] and running [3,4] in a straight line to determine shoe-foot interactions at specific regions of the foot. However, it is likely that for several regions of the foot, straight line running and walking do not adequately quantify the complete range of plantar pressures. Ellis et al [5] has shown that during cutting movements peak pressures at the hallux increase by 40%, while the lateral forefoot undergoes a 54% decrease compared to running straight. The purpose of this study was to compare the peak pressures at seven regions of the foot during straight running, cutting, jump take-off and jump landing with two different shoe types.

METHODS

Subjects were ten healthy college athletes. All subjects signed an IRB-approved consent form. (Ht. 186.8 ± 5.3 cm; Wt. 102.3 ± 18.9 kg; Age. 20.5 ± 1.0 years). Each subject was asked to run at 75% maximum speed through a course of cones (figure 1), once wearing a wide turf shoe (Air Pro Turf Low; Nike, Beaverton, OR, USA) and once wearing a narrow cleat (Nike Speed TD) in random order. The surface was Fieldturf® (Montreal, Canada). Plantar pressures were measured using insoles (PEDAR Mobile; Novel GmbH, Munich, Germany). Only right insoles were sampled at 99 Hz. Each trial was filmed with a digital video camera (30 Hz); first and second trial times were within 5%. Each step from the foot pressure files processed from Emedlink (Novel) was matched to the corresponding step in the video to determine what maneuver was being performed. Two-way repeated measures ANOVAs were used to compare peak plantar pressure across seven regions (figure 2): great toe (T), medial forefoot (1), central forefoot (C), lateral forefoot (5), medial midfoot (MM), lateral midfoot (LM) and heel (H) during running straight, cutting right, cutting left, jump take-off and jump landing (2 shoe types by 5 maneuvers). Scheffe's tests were used for individual comparisons *post hoc*.

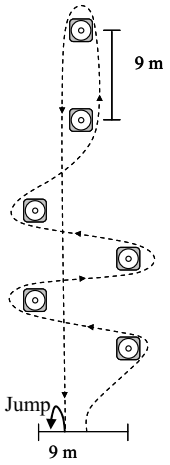

Figure 1: Running course

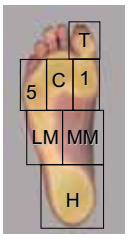

Figure 2: Mask regions

RESULTS AND DISCUSSION

The Speed TD had significantly higher peak pressures than the Pro Turf Low for all regions ($p < 0.0001$ to 0.03) except the LM ($p = 0.19$), meaning that the turf shoe had better overall cushioning. For the heel, straight running pressures were ⅓ that of cutting, jumping or landing activities ($p > 0.0001$). This suggests that hindfoot cushioning characteristics of sport shoes might be more robustly assessed by evaluating activities other than straight line running. For the great toe (T) similar high pressures were observed running straight, cutting left and jump landing, which were significantly lower than during cutting right and jump landing ($p < 0.03$). Comparing left and right cutting, the left cut produced higher pressures at the medial foot regions (T, 1 and MM; $p < 0.02$) whereas the right cut showed higher pressure at the lateral regions of the foot (5, LM) ($p < 0.0001$). The data suggest we run like we ski: by cutting our inside edges into the surface to carve the turn. All regions of the foot appears to have similar peak pressures for jump take-off and jump landing ($p > 0.12$), except T where jump take-off pressures were significantly higher than landing ($p < 0.0008$).

CONCLUSIONS

Assessing regional foot pressure over a range of movements may provide a more appropriate and sensitive evaluation of sport shoe performance.

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ACKNOWLEDGEMENTS

This work was funded by Dept. of Veterans Affairs Grant #A2661C.

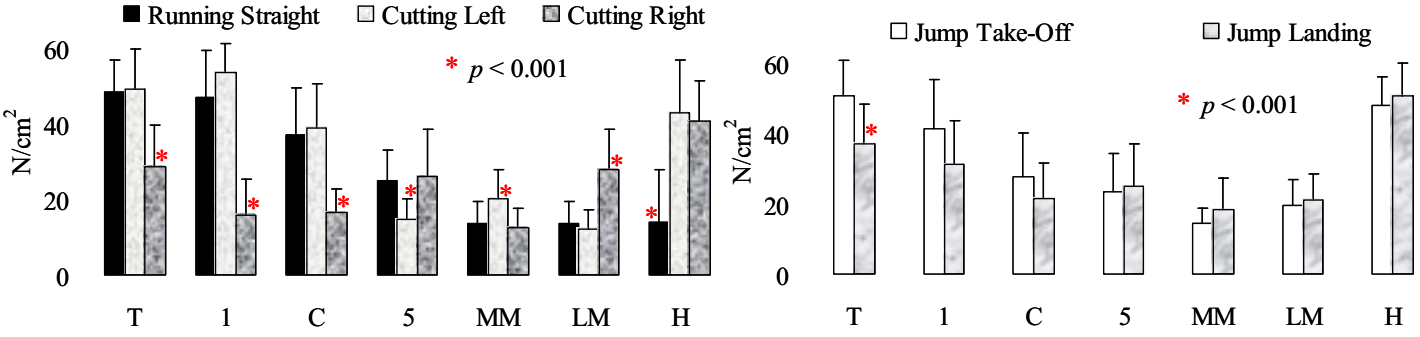

Figure 3: Peak plantar pressure over 7 regions of the right foot during running straight, cutting left, cutting right, jump take-off and jump landing. Significant differences between movements within each region are marked with *.