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## Introduction

The concept of a leaf spring structured midsole shoe (LEAF) is based on shifting the foot anteriorly during the first part of stance phase in heel-toe running (Wunsch et al., under review). The aim of the current study is to analyze the effects of a LEAF (Fig. 1b) compared to a standard foam midsole shoe (FOAM; Fig.1a) on the foot kinematics in treadmill and overground running at two running speeds.

## Methods

### Data collection:

9 male heel strikers:  $33 \pm 6$  yrs,  $1.79 \pm 0.03$  m,  $74 \pm 6$  kg  
 Shoe conditions: LEAF versus FOAM  
 Running conditions: Treadmill and overground  
 Speed treadmill: 3 m/s and 4 m/s  
 Speed overground:  $3 \pm 0.2$  m/s and  $4 \pm 0.2$  m/s

### Data collection:

Kinematics: Vicon 200 Hz  
 Kinetics: AMTI 1000 Hz (overground only)

### Data analysis:

Anterior shift of the foot (calculated by the heel marker)  
 Foot-ground angle (FGA) at heel strike  
 Horiz. path of the center of pressure (COP) during stance

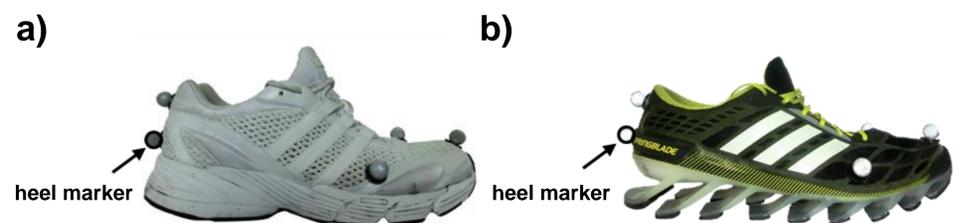


Fig. 1: a) FOAM (foam midsole) and b) LEAF (leaf spring structured) midsole shoe

## Results

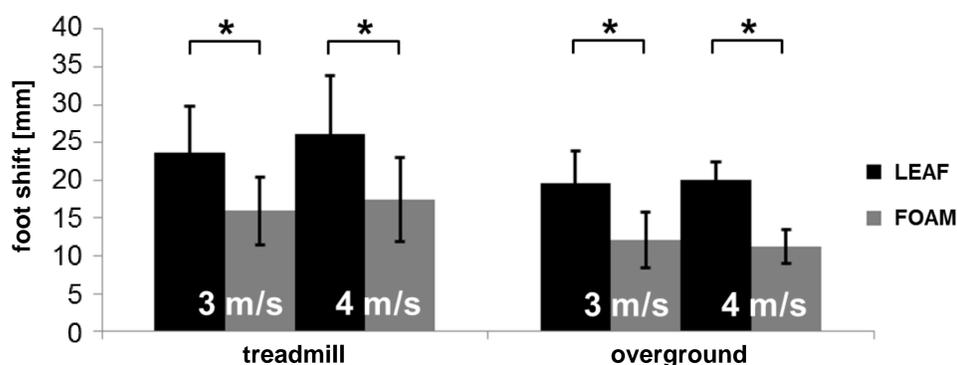


Fig. 2: Anterior foot shift

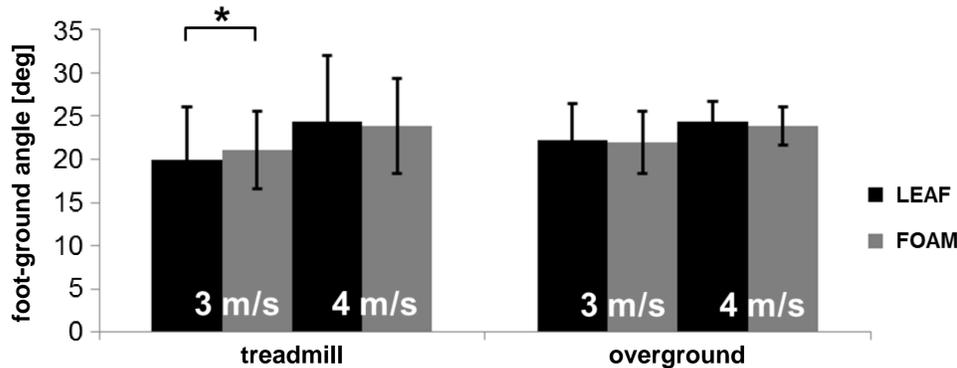


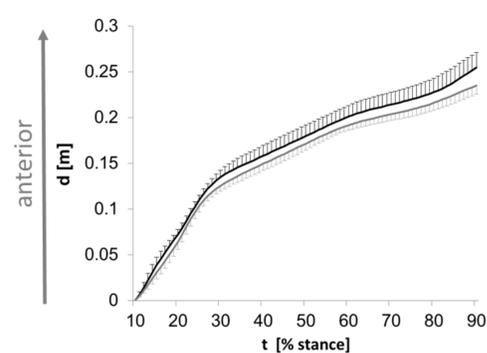
Fig. 3: Foot-ground angle at heel strike

The LEAF increases the anterior foot shift in treadmill and overground running at both running speeds compared to the FOAM (Fig. 2). No changes (except at 3 m/s on treadmill) were found for the individuals' FGA at heel strike (Fig. 3). The course of the COP during stance is presented in Fig. 4 showing an overall increased COP path

3 m/s diff(LEAF-FOAM):  $19 \pm 10$  mm,  $p = 0.000$

4 m/s diff(LEAF-FOAM):  $20 \pm 9$  mm,  $p = 0.000$

### a) COP – 3m/s



### b) COP – 4m/s

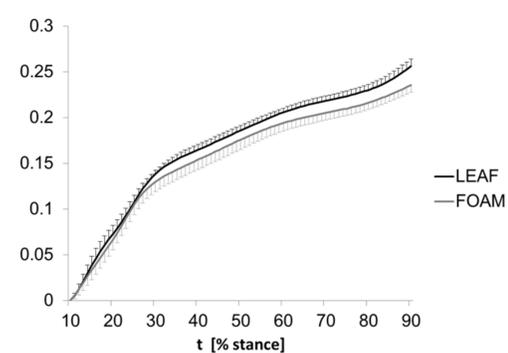


Fig. 4: Center of pressure (COP) during stance in overground running (mean  $\pm$  SD)

## Discussion and Conclusion

Running with the LEAF compared to the FOAM leads to an increased anterior foot shift of 8 – 9 mm independent of speed and surface. Furthermore, the anterior foot shift leads to an enlarged COP path (Fig. 4). According to previous research (LEAF vs. FOAM on treadmill 3m/s; Wunsch et al., under review) the anterior foot shift positively affects spatio-temporal variables and oxygen consumption. Therefore the findings of the current study indicate a general benefit of the structured midsole on running economy.

## References

Wunsch, T., Kröll, J., Strutzenberger, G., Schwameder, H., (under review). Biomechanical and metabolic effects of a leaf spring structured midsole in heel-toe running.

## Acknowledgements

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