The Kingetics Shoe Insole

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Introduction

- **Lower limb overuse injuries** are a common problem for military service members. In the U.S. army, 82% of all injuries are attributed to overuse which costs the U.S. an estimated $20 billion annually. [1]
- Custom designed **shoe insoles** are commonly recommended to prevent or impede the development of overuse injuries. [2]
- The Kingetics orthotic shoe insole (Fig. 1) utilizes energy storage and return through an embedded spring and lever system.

Figure 1: Images of Kingetics insole (right foot).

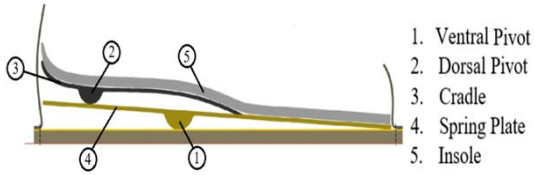

Figure 2: Schematic of the Kingetics insole [3].

Purpose

To determine if the Kingetics insole reduces vertical **ground reaction forces (GRFs)** during walking and heel strike running, and if it improves **metabolic efficiency** by decreasing **oxygen consumption rate**.

Methods

- To determine GRFs, subject walked (at 1 m/s) and then ran (at 2 m/s) using two styles—heel strike and midfoot strike—on force-sensing treadmill in regular athletic shoes, and then in shoes fit with the Kingetics orthotic insole.
- Force data was analyzed to find peak vertical GRFs.
- To determine metabolic cost, the subject repeated the previous trials (walking at 1.12 m/s and running at 3.13 m/s) on treadmill while metabolic cost measurements were made.
- Oxygen consumption rate at steady state was calculated and then averaged for each trial.
- For both measurements, unpaired t-tests were performed to determine if there were significant differences between the different shoes and running styles.

Results

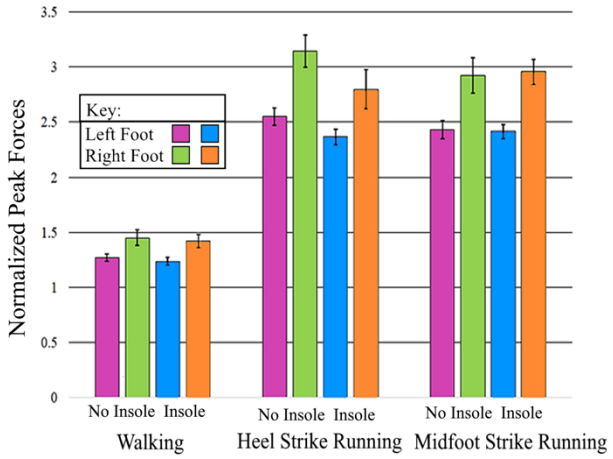

Figure 3: Average vertical, peak force experienced by each foot during trials. The Kingetics insole significantly reduced GRFs only during heel strike running.

Results (continued)

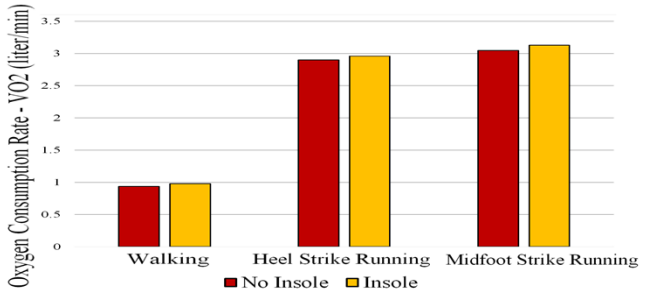

Figure 4: Average oxygen consumption rate subject experienced during trials. A difference of 150-200 liter/min or above indicates a considerable impact. No trial exhibited a difference of this amount.

Discussion and Conclusion

- Vertical GRFs on left and right feet showed significant differences and were analyzed individually.
- Heel strike running exhibited a decrease in vertical GRFs with the Kingetics insole while during walking they remained fairly constant.
- Contact forces with the ground during walking were most likely not large enough to store the amount of energy in the spring plate needed to decrease the vertical GRFs.
- During heel strike running, vertical GRFs decreased by 7.2% on the left foot and by 11.1% on the right due to Kingetics insole.
- Oxygen consumption rates did not change when using the insole.
- Optimizing the Kingetics pivots may improve its function.

References and Acknowledgements

[1] Malka I, et al. *Military Medicine* **183**, 196-197, 2018.
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[3] King S and Hewitt P. *U.S. Patent No. 8,353,968* **4**, 2013.

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