Monitoring of Forefoot-Rearfoot Running Using a Piezoelectric Sock

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The way we run varies between us. One categorization of running is based on the way the foot strikes the ground, and based on this runners can be classified to be rearfoot strikers, midfoot strikers, or forefoot strikers. Among long-distance shod runners about 3 out of 4 are rearfoot strikers and the remaining are either the midfoot or forefoot type. It has been argued that forefoot running is more favorable as it is expected to produce a lower impact of ground reaction forces to mainly the knee joint at each step than rearfoot running, and that switching to forefoot running potentially can decrease running-related injuries (1).
The aim of this study was to see whether a newly developed piezoelectric textile fibre integrated in the forefoot and heel of a regular sock could be used to monitor the timing of forefoot and rearfoot contact to the ground. A specific aim was to test if such an instrumented sock interfacing to a regular smartphone can be used to monitor the footstrike timing during a long distance running race.
METHODS: Piezoelectric meltspun poly(vinylidene flouride) (PVDF) fibres were integrated in the forefoot and heel of a regular sock. The sock was connected to a custom-made signal-conditioning, analog-to-digital converting blue-tooth device placed at the ankle of the test person. An Android app was developed to record the signal from the blue-tooth device/piezoelectric fibres in the forefoot and heel and to store this information on the smartphone at a sampling frequency of 100 Hz. A first demonstration of the sock, blue-tooth device and data from the Android app was performed when a test person participated in a 10 km running race.
RESULTS: The data from the 10 km running race demonstrate that the custom-made sock and system can provide information on the foot strike in terms of rearfoot and forefoot timing to the ground in outdoor running using regular running shoes. The test person did not notice the sensors in the sock at any time. The amplitude of the signal from both the forefoot and rearfoot slowly decreased after about 15 minutes of running but the timing of the footstrike could still be discerned. A first guess is that the decreased signal amplitude is due to sweating but this needs to be further investigated.
CONCLUSION: This study shows that piezoelectric fibres integrated in a regular sock can be used to provide information on the footstrike timing in outdoor running. The developed system may also be a valuable tool in rehabilitation to inform about specific activities or activity patterns.

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