Integrated Sensor Insole Systems for Application in Knee Osteoarthritis: FeetMe® versus Moticon®

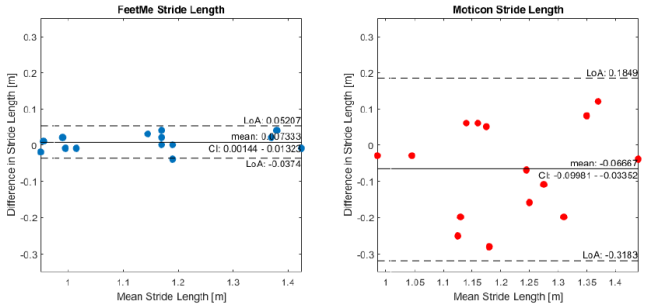

Figure 1: Bland Altman plots showing the difference in stride length of FeetMe and Moticon compared to the instrumented treadmill (Picture: T. Oshima).

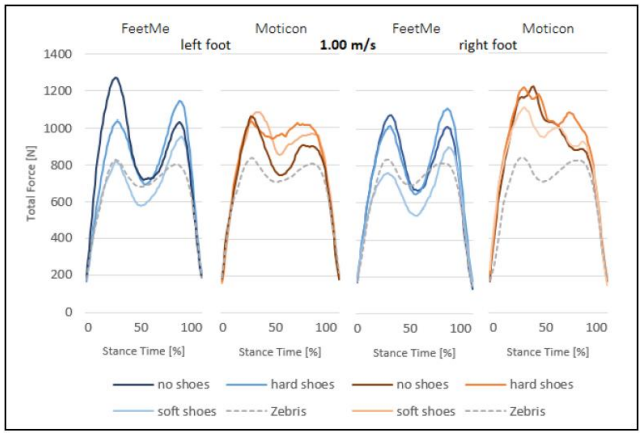

Figure 2: Vertical GRF for the individual insoles with different footwear (soft shoe, hard shoe, and without shoe where the insole was worn and fixed inside a sock) at medium gait speed. The reference curve from the instrumented treadmill represents the mean of all footwear measurements since the difference was negligible (Picture: T. Oshima).

Master's Thesis by Takanobu Oshima.

Wearable sensors become more and more advanced and offer a solution for gait analysis outside of the laboratory. Their recent advances determine a very important impact on the healthcare monitoring system and may overcome the limits of classical measurement systems [1]. With gait assessment being a potential exploratory for objectively measuring benefits of a drug in pain and function of knee osteoarthritis (OA), the purpose of the study was to compare the integrated sensor insole systems from FeetMe® and Moticon® with each other. System differences were shown with an overview in technical specifications, a usability review for clinical application, and a validation regarding spatiotemporal gait parameters and the vertical component of the ground reaction force (GRF) with an instrumented treadmill (Zebris) as reference.

The FeetMe® insole had advantages in technical specifications with a better resolution and a higher sampling frequency. For the usability aspect, FeetMe® showed benefits regarding data transfer and Moticon® regarding battery replacement. Only FeetMe® comes into question if a certified medical device is required.

Similar sensor performances were observed in gait cycle time and cadence. Superior results were acquired by FeetMe® for the spatial parameters stride length (figure 1) and walking speed. FeetMe® had a better accuracy in mean double support phase while Moticon® showed a systematic offset but with a higher precision.

The FeetMe® insole in combination with the soft running shoe showed the best results regarding vertical GRF calculation when compared to the reference system (figure 2).

In conclusion, this study allows for the selection of the appropriate insole system if its application is known and carefully planned. The results suggest the FeetMe® insole to have many advantages over Moticon®.

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[1] TarniŢă, D., *Wearable sensors used for human gait analysis.* Rom J Morphol Embryol, 2016. **57**(2): p. 373-82.