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Wearable lower limb haptic feedback device for retraining Foot Progression Angle and Step Width

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Research Highlights

- Novel single haptic ankle device for retraining multiple gait parameters
- Ankle device effective in retraining foot progression angle and step width during walking
- One subject out of ten did not successfully modify gait parameters in one feedback scheme.
- No difference was found between the two feedback schemes experimented.

Abstract: Technological developments in the last decade have enabled the integration of sensors and actuators into wearable devices for gait interventions to slow the progression of knee osteoarthritis. Wearable haptic gait retraining is one area which has seen promising results for informing modifications of gait parameters for reducing knee adduction moments (KAM) during walking. Two gait parameters which can be easily adjusted to influence KAM include foot progression angle (FPA) and step width (SW). The purpose of this study was to: (1) determine whether a custom haptic ankle bracelet using binary vibrotactile and tactile apparent movement feedback, retrain ten healthy subjects to walk with a modified FPA and SW within a short training session with 80% accuracy; and (2) whether there was a difference between the number of steps required to complete the retraining task based on the two feedback schemes being tested. Retraining multiple gait parameters using a single device was a novel aspect of this work and we found that nine out of ten subjects were able to retrain their gait using the ankle bracelet in both feedback schemes to within 2° and 39mm of target FPA and SW respectively. We also found no difference in the number steps required for completion between the two schemes ($p > 0.05$). Future research will investigate the device performance with patients with knee osteoarthritis and the effective change in KAM by modifying a combination of FPA and SW.

Keywords: Gait retraining; Biofeedback; Haptic; Real-time feedback; Motion analysis

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