

ALTERING CADENCE OR VERTICAL OSCILLATION DURING RUNNING: EFFECTS ON RUNNING RELATED INJURY FACTORS

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ABSTRACT

Background: Wearable devices validly assess spatiotemporal running parameters (cadence, vertical oscillation and ground contact time), but the relationship between these parameters and lower limb loading parameters (loading rate, peak vertical ground reaction force [vGRF] and braking impulse) is unknown.

Purpose: To characterize changes in lower limb loading parameters in runners instructed to run with increased cadence or low vertical oscillation, and to determine whether the change in spatiotemporal parameters predicted the changes in lower limb loading parameters.

Study Design: Cross Sectional Cohort Study

Methods: Twenty healthy runners completed three running trials in three conditions: baseline, high cadence, and low vertical oscillation. Spatiotemporal parameters were measured with a wearable device and lower limb loading was measured using an instrumented treadmill. Spatiotemporal and loading parameters were analyzed between running conditions via a repeated measure ANOVA. A hierarchical regression model was used to determine if changes in spatiotemporal parameters predicted the change of loading parameters during conditions.

Results: High cadence and low oscillation conditions reduced average vertical loading rate ($p = 0.013$ and $p = 0.002$, respectively), instantaneous vertical loading rate ($p = 0.022$ and $p = 0.001$, respectively), and peak vGRF ($p = 0.025$ and $p < 0.001$, respectively). Braking impulse was significantly lower in the high cadence condition compared to baseline ($p < 0.001$), but not during the low oscillation ($p = 1.000$). The increase in cadence during the high cadence condition predicted the reduction of instantaneous vertical loading rate ($r^2 = 0.213$, $p = 0.041$) and braking impulse ($r^2 = 0.279$, $p = 0.017$). The reduction in vertical oscillation was more predictive of the change of peak vGRF in both running conditions (high cadence, $r^2 = 0.436$, $p = 0.009$; low oscillation $r^2 = 0.748$, $p < 0.001$).

Conclusion: While both higher cadence and lower vertical oscillation resulted in reduced loading rates during running, cueing to reduce vertical oscillation was more successful in reducing peak vGRF and only the higher cadence condition reduced braking impulse. These findings will inform clinicians who wish to use wearable devices for running gait modification to select injury-specific gait retraining cues.

Level of Evidence: Level 3

Key Words: running retraining, ground reaction forces, wearable devices

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Grant Support: N/A

Institutional Review Board approval: University of Delaware

Conflict of Interest: There are no financial disclosures or conflicts of interest for this manuscript submission.

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