Grant Information Summary:

Knee Flexion-Pronation Synchrony During an Exhaustive Run

Practical Significance Statement

Running mechanics may not change despite the onset of fatigue. However, compensatory muscle activation may exist resulting in an increased potential for overuse injury.

Study Background

Due to the repetitive nature of running, dissipation of the encountered forces requires a proper coordination of the segments of the lower extremity. The lack of coordinated movement between knee flexion and pronation will result in a torsional force about the knee and ankle as tibial rotation occurs concomitantly with sagittal plane knee motion and frontal plane ankle motion

Objective

The purpose of this study was to determine if running-related fatigue disrupts knee flexion-pronation synchrony and results in decreased shock attenuation in healthy, competitive male and female distance runners.

Design And Setting

A within-subject, repeated measures design was utilized for this study. The single independent variable was condition (fatigue, no fatigue). The study took place in a university research laboratory.

Subjects

Twelve healthy, competitive male and female distance runners (age 24.5 ± 4.1 y, ht 1.74 ± .09, mass 65.15 ± 9.82 kg participated. Subjects were competitive distance runners (>1500 m) with no history of musculoskeletal injury within three months prior to testing.

Measurements

Subjects reported for two testing sessions. During session 1, subjects performed a maximal oxygen uptake test to determine anaerobic threshold and corresponding heart rate. For test session 2, subjects performed an exhaustive run at anaerobic threshold pace that was determined from the maximal oxygen uptake test (figure). During this test, knee flexion-pronation synchrony, maximum knee flexion angle, maximum pronation angle, time to maximum knee flexion, time to maximum pronation, shank acceleration, head acceleration, and shock attenuation measures were calculated before and after exhaustion.

Results

No significant differences were demonstrated in knee flexion-pronation synchrony (Pre: 13.8 ± 48.1 ms; Post: 18.9 ± 37.2 ms), maximum knee flexion (Pre: 49.3 ± 6.6°; Post: 49.2 ± 6.2°), maximum pronation (Pre: 9.2 ± 5.1°; Post: 9.7 ± 6.2°), time to maximum knee flexion (Pre: 106.1 ± 22.7 ms; Post: 117.7 ± 20.4 ms), time to maximum pronation (Pre: 92.2 ± 48.5 ms; Post: 98.7 ± 46.9 ms), shank acceleration (Pre: 7.5 ± 1.24 G; Post: 7.58 ± 1.28 G), head acceleration (Pre: 2.66 ± 0.35 G; Post: 2.73 ± 0.47 G), or shock attenuation (Pre: 0.63 ± 0.08; Post: 0.63 ± 0.09)

Conclusions

Despite subjective termination of the anaerobic threshold run due to exhaustion, the lack of differences between pre and post exhaustion measures may have resulted from compensatory muscle activation. This may allow subjects to continue running in a fatigued state without alterations in joint kinematics and shock attenuation strategies.

Figure. Experimental setup of subject performing the treadmill exhaustive run.

Principal Investigator:

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John Abt completed his Ph.D from the University of Pittsburgh. Currently, he is an Assistant Professor in Sports Medicine at the Neuromuscular Research Laboratory at the University of Pittsburgh where his main research interests involve studying the effects of core fatigue on lower extremity kinematics and neuromuscular control in cyclists.

Publication & Presentation List

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