Kinematic comparisons between pre- and post-steady state running at various running speeds

Introduction Studies have shown that lower extremity kinematics is affected during running at exhaustion due to fatigue (1, 2). However, it is unknown whether running kinematics is altered over the course of running prior to exhaustion, in particular, the transition from the commencement of running to steady state. Subsequently, the purpose of this study was to compare lower extremity kinematics between running conditions prior to and following the obtainment of steady-state at various running speeds.

Methods Fourteen trained and moderately endurance trained runners (age 22.6 ± 3.5 years, height 1.8 ± 0.1m, weight 75.0 ± 8.0 kg) undertook a running economy (RE) test consisting of two 10-minute stages at an intensity of 70- and 90% of anaerobic threshold, respectively. There were two minutes rest between each stage. During the RE test, oxygen consumption was collected to ascertain whether the subjects reached steady-state. Lower extremity joint kinematics were recorded for 10 strides using 8 Vicon cameras (Oxford, UK, 100Hz) at 30 seconds (T30) and at 9 minutes 30 seconds (T9:30) of each stage. Borg's rating of perceived exertion (RPE) was collected immediately following motion capturing of each stage. Running gait parameters included hip range of motion (HROM), peak knee flexion during swing phase (KFS), peak knee flexion after foot strike (KFAS), and ankle range of motion (AROM). All variables were compared between T30 and T9:30 of each stage of the RE test using Paired-Sample T Tests.

Results All subjects reached steady-state within three minutes of each stage. At T9:30 of the second stage, RPE was less than 17, indicating the subjects did not reach exhaustion. When compared from T9:30 to T30, RPE and HROM were significantly greater during the first and second stages whereas KFS and AROM were significantly greater during the second stage ($p < 0.05$) with no significant differences for KFAS ($p > 0.05$).

Discussion and conclusion The increase in joint ROM may be the result of improved joint mobility due to an increase in the visco-elasticity of the musculo-tendinous unit. Unlike previous findings (1, 2), the changes in kinematics during the transition from the commencement of running to steady state appear to be the result of optimising running technique and not the impact of fatigue.

References 1. Dierks et al., J Biomech, 43: 2993-8, 2010. 2. Miller et al., Gait and Posture, 26: 407-12, 2007.