TACSM Abstract

Biomechanical Assessment of Footwear and Foot Landing Types in Collegiate Female Runners at Preferred Running Speed

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ABSTRACT

Barefoot and shod running with conditions at heel landing and forefoot landing has implications on running biomechanics. **PURPOSE**: To investigate the impact of two footwear and two foot landing type conditions on lower limb and lumbar acceleration and kinematics. **METHODS**: Six collegiate female runners (20.6 ± 1.5 yrs, 58.6 ± 4.7 kg, 1.63 ± 0.05 m) performed running trials on a motorized treadmill. Their averaging running volume was 49.6 ± 31.5 km/wk (range: 16.1 – 80.5 km/wk). Inertial measuring units (IMUs) (370 Hz), containing triaxial accelerometers (1g = 9.81 m/s/s) and gyroscopes (deg/s), were secured on the foot/shoe over the navicular bone, tibia, lateral thigh and lumbar region on the right side of the body. Runners performed steady-state runs at preferred speed during two shod conditions, barefoot (BF) and shod (SH), and two foot landing conditions, heel strike (HS) and forefoot (FF). A total of four conditions were assessed in this analysis. The average running speed was 10.3 ± 1.5 km/h (range: 8.9 – 12.9 km/h). Vertical acceleration data from the lumbar IMU was integrated to velocity, which was used to determine foot contact. Ten gait cycles per condition were determined. Data were resampled to 100 Hz and relative gait cycle (100%) was calculated. Variables of interest were: maximum acceleration at foot contact (FTA), timing of maximal foot acceleration (FTAt), maximum acceleration at the lumbar region (LA), timing of maximal acceleration at the lumbar region (LAt), greatest negative angular velocity of the lumbar region at foot landing (Lgy), and timing of the greatest negative angular velocity at foot landing (Lgyt). A 2 x 2 ANOVA was performed to assess the dependent variables. Alpha level was set at $p \leq 0.05$. **RESULTS**: A significant foot landing x shod condition interaction effect was present for FTA (FF: BF 5.03 ± 0.8g, SH 4.80 ± 0.6g; HS: BF 4.81 ± 0.4g, SH 5.08 ± 0.5g, $p < 0.05$). A significant main effect for shoe was present for FTAt (BF: 12.05 ± 2.6%, SH: 14.09 ± 3.1%, $p < 0.01$). No significant differences were reported LA or LAt, however the landing x shoe interaction effect approached significance ($p = 0.055$). A significant main effect for landing was present for the Lgy (FF: -103.3 ± 38.1 deg/s, HS: -89.7 ± 43.4 deg/s, $p < 0.03$). A significant landing x shoe interaction effect was present for the Lgyt (FF: BF 9.0 ± 1.5%, SH 6.63 ± 3.3%; HS: BF 6.17 ± 1.9%, SH 6.13 ± 2.0%, $p < 0.01$). **CONCLUSION**: The combination of foot landing style and SH/BF indicated modified shock attenuation at foot landing while running at preferred speed. The timing of the shock was dependent upon whether running in shoes or barefoot, where the shoe extends the timing of the shock. Although shock and timing of shock to the lumbar region were not significant, the type of landing and the shoe did influence the rate at which the trunk negatively accelerated and the timing of this acceleration, respectively. Future studies need to assess how modifying running speed influences these variables.