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Joint specific energy absorption and generation of elite female sprinters during the acceleration phase in comparison to maximum running speed

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During sprint running the muscle-tendon units of an athlete are alternately shortening and stretching to absorb and generate mechanical energy at the joints of the lower extremities resulting in a deceleration (braking) and acceleration (propulsion) of the sprinter's center of mass. In general, the aim of a sprinter is to generate as much net mechanical energy as possible and to maintain this energy as long as possible. However, it can be assumed that the applied sprint mechanics to reach this goal differs between the acceleration and the top-speed running phases. Therefore, the purpose of the study was to quantify and compare sprint mechanics of elite female sprinters (N=9; PB 11.4 ±0.2 s) during acceleration (1st, 2nd, 3rd step) and top-speed ('flying 30 m') running. Three dimensional kinetics and kinematics were measured on an IAAF indoor track armed with four force plates and 16 infrared cameras. The comparison between the 1st, 2nd and 3rd step and the 'flying 30m' (v_{ave}= 9.0 ±0.2 ms^{-1}) shows a joint specific progressive change in absorption and generation of mechanical power and work. Whilst the knee extensors were able to minimize energy absorption during the acceleration phase, the ankle extensors showed a stretch-shortening cycle behaviour and little energy absorption, starting with the first step. This loss of mechanical energy at the ankle joint does not necessarily lead to a decrease in sprint performance, but may offer the plantar flexors to work in an stretch-shortening cycle behaviour instead of a concentric only mode.

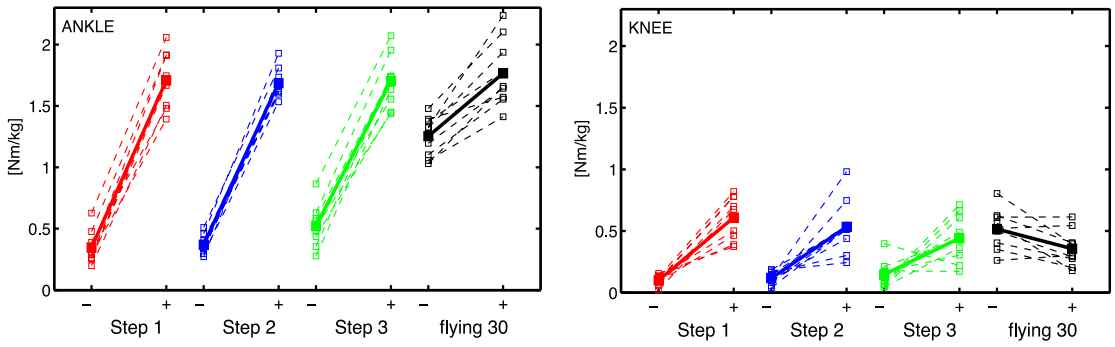

Fig 1: Absorption (-) and generation (+) of mechanical work at the ankle and knee during the acceleration phase (1st, 2nd, 3rd) vs. maximum speed running.