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Mechanical Constraints of Force Production during a Stationary Sprint-Start

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The ability to accelerate is a desirable attribute for competitive sprinters and can be affected largely by the amount of force produced through the initial push out of the blocks, or step-0. It is widely accepted in the literature that more force is always better for block performance. **PURPOSE**: To explore the limits of force production by the musculoskeletal system at a forward-oriented ground-reaction-force angle, like ones seen in sprint events, when not limited by friction, balance, and trajectory. **METHODS**: Four experienced adult male sprinters (height= 1.7 ± 0.1 m, mass= 82.9 ± 4.3 kg) volunteered and provided informed written consent. Horizontal and vertical ground-reaction-force data was collected at 1,000 Hz as subjects performed three variations of the sprint start using track blocks. Each subject performed three trials of a Normal Track Start (NS), Mat Dive (MD), and an In-line Mat Dive with a side-by-side block configuration (IMD). Resultant vector angles and magnitudes (normalized to body weight) were calculated for each trial and averaged for each condition, as well as block-clearance and post-block aerial times. **RESULTS**: The average vector magnitude for the three conditions were 1.46, 1.56, and 1.77 x body weight for the NS, MD, and IMD, respectively, while aerial times were 0.059, 0.055, 0.062 seconds for the same conditions. Vector angles for NS, MD, and IMD were 52.0, 47.5, and 43.3, respectively. **CONCLUSION**: Since subjects were able to increase their total force production without significantly increasing aerial time, we conclude that athletes produce force sub-maximally to perform a successful sprint start, resulting from the requirement for balance.

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