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Relationships between lower body strength characteristics and initial acceleration coordination in highly trained to world class sprinters

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INTRODUCTION:
Inter- and intra-limb coordination has recently been described in initial sprint acceleration [1]. From a dynamical systems perspective, coordination patterns emerge from interacting individual, task and environmental constraints [2]. Lower body strength is a key individual constraint in sprinting and influences sprint performance, but the interactions between strength characteristics and movement patterns are not yet known. This study aimed to assess the relationship between lower body strength and initial acceleration coordination in sprinters.
METHODS:
Twelve male sprinters (100 m PB: 9.95–11.17 s) performed 30 m sprints on an outdoor track during training. 3D kinematics for the first four steps were recorded using IMUs (250 Hz; Noraxon, USA). Participants then performed countermovement jump (CMJ), isometric squat (ISQ) and repeated hop tests using force plates (1000 Hz; Bertec, USA) and eccentric hamstring tests (NordBord, Vald, Australia). Thigh-thigh and shank-foot coordination were quantified for step 1 and steps 2-4 using a vector coding and binning approach [1]. Relationships between strength measures and the proportion of the step spent in each coordination bin in step 1 and steps 2-4 were assessed using Spearman's (rho) correlations.
RESULTS:
ISQ relative maximal force was negatively associated with the proportion of anti-phase leading (-) (rho=-0.67, p=0.02) and positively with anti-phase trailing (+) (rho=0.82, p<0.01) thigh-thigh coordination in step 1, as well as a negative association with in-phase trailing (-) in steps 2-4 (rho=-0.67, p=0.02). ISQ force was negatively associated with in-phase foot (+) (rho=-0.70, p=0.02) and positively with in-phase foot (-) (rho=0.62, p=0.03) shank-foot coordination in steps 2-4. CMJ height was negatively associated with in-phase shank (-) coordination in step 1 (rho=-0.81, p<0.01). Hop test RSI was negatively associated with in-phase leading (-) (rho=-0.58, p=0.05) thigh-thigh coordination and positively associated with anti-phase shank (+) (rho=0.60, p=0.04) and in-phase shank (-) (rho=-0.59, p=0.04) shank-foot coordination in step 1.
CONCLUSION:
These findings suggest sprinters with larger maximal strength capacities have more trail leg dominant limb interchange in step 1 and exhibit a pattern indicative of more synchronous "scissoring" of the thighs. Moreover, greater maximal strength was associated with shank-foot coordination patterns exhibiting less in-phase forward rotation in early flight and potentially greater reliance on "shin block" to orientate the shank before touchdown in steps 2-4. Finally, the current results suggest larger reactive strength capacities may be associated with coordination showing a sequential reversal of foot then shank rotation during "shin block" to prepare for touchdown, as well as reduced shank dominance during simultaneous forward rotation around dorsiflexion. These are novel findings for further understanding acceleration technique.

[1] Donaldson et al. (2022) [2] Glazier (2017)

Topic: **Biomechanics**

Presentation **Oral**