BIOMECHANICAL CHARACTERISTICS OF GRINDING IN AMERICA'S CUP SAILING

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INTRODUCTION: Understanding the biomechanics of a sporting movement and what aspects of the movement technique most influence performance can facilitate more specific training, both in terms of strength and conditioning and technical improvements. This study was undertaken to describe the kinetic, kinematic, and muscular activation characteristics of the grinding movement in America's Cup sailing, a high intensity constrained cyclic movement (similar to bicycling) performed with the upper limbs.

METHODS: Ten male America's Cup sailors (33.6±5.7 years, 97.9±13.4 kg, 186.6±7.4 cm) who performed grinding regularly as part of their on-board role participated in this study.
Each sailor performed eight maximal grinding performance tests, of eight-second duration, on a custom-built grinding simulator (Dynapack, New Zealand). Performance tests were conducted under four conditions: forward and backward grinding at both moderate and heavy loads, with two tests completed for each condition (eight tests in total). In addition to power output from the grinding simulator, which was used as a performance measure, the following biomechanical data was also collected:

- Full body (nine segment) 2D sagittal plane kinematics, digitised using APAS (Ariel Dynamics, USA).
- Torque-angle analysis from the grinding handles using an adapted SRM (Schoberer Rad Messtechnik) Powermeter system with torque analysis module (SRM, Germany).
- EMG (Bortec AMT-8 system; Bortec, Canada) on seven upper body sites.

RESULTS: Analysis of all data has yet to be completed; however, findings from preliminary results are as follows:

- Peak torque application typically occurs through 60-200° for forward grinding and 300-40° for backward grinding (0° = crank handle vertically upwards).
- Shoulder angles (relative to the trunk, 0° = upper arm adjacent) at peak torque were similar for forward and backward grinding, at 83.5±10.3° and 83.0±7.1° respectively.
- Variation in torque application throughout the grinding cycle was negatively associated with forward grinding performance (r = -0.60; lower 90% CL = -0.88, upper 90% CL = -0.02) but positively associated with backward grinding performance (r = 0.48; CL = -0.15, 0.83).

DISCUSSION: Although results are not yet complete and currently inconclusive, preliminary results do indicate areas in which adaptations to aid performance enhancement may be implemented. One potential area is that the stimulus during strength training could be altered to more specifically target the key joint angles relating to torque production in grinding, in particular for backward grinding where it appears that the majority of work is performed through specific sectors of the cycle. In contrast, the negative association between variability of torque application and forward grinding performance could mean that technical adaptations to maintain consistent handle force through the cycle may be beneficial.