FORCE PROFILE COMPARISON OF ROWING ON A STATIONARY AND DYNAMIC ERGOMETER

[1]Aaron Benson and [2]Julianne Abendroth-Smith
[1]Ithaca College, Ithaca, NY; email: benson_aaron@hotmail.com
[2]Willamette University, Salem, OR; email: jabendro@willamette.edu

INTRODUCTION

Recently developed dynamic rowing ergometers enable part or all of the machine to move back and forth inversely with the rower, akin to the response of a boat. A common dynamic design incorporates a wheeled base beneath a normally stationary machine. Such a setup conserves mechanical energy and enables higher stroke rates, thus better simulating on-water rowing [3]. Comparisons of "fixed" and "floating" conditions using the RowPerfect (a truly dynamic ergometer) have found similar results, as well as decreased work per stroke in the dynamic condition [1,2].

Concept 2 has designed "Slides" to allow dynamic rowing, but research involving this popular equipment is minimal. This study compares the use of a Concept 2 ergometer alone and with Slides, through force profile evaluation.

METHODS

Varsity and novice rowers from the Ithaca College Crew volunteered; 21 women (ht. 1.71 ±0.08 m, mass 67.4 ±7.6 kg) and 16 men (ht. 1.82 ±0.08 m, mass 80 ±11.4 kg) participated. IRB approval and informed consent were obtained.

Subjects completed two 1000-meter trials on a Concept 2 Model C ergometer. The ergometer was alternately stationary or dynamic (counterbalanced). Subjects rowed at their self-selected race pace, maintaining a constant workload within and between trials. All subjects were allowed to warm-up, rest, and familiarize with equipment as needed.

A load cell (Bertec, 2200 N) mounted between the handle and chain provided stroke rate, peak force, mean impulse, and total integrated force (representing work) for the final 30 seconds of each trial. Differences by condition and sex were located with a 2×2 repeated measures ANOVA (α=0.05).

RESULTS AND DISCUSSION

Rowers displayed significantly higher stroke rate and total integrated force, and significantly lower peak force and mean impulse in the dynamic condition than in the stationary (Figure 1). Men exhibited significantly greater peak force, impulse, and integrated force than women. An interaction occurred whereby men decreased impulse on the dynamic ergometer more than women.

The statistical difference in integrated force implies that more work was performed on the dynamic ergometer. Although this is contrary to the literature [1], the small effect size (0.09) indicates minimal practical difference. Measurement over the entire bout could clarify this discrepancy.

These results support the suggestion that dynamic ergometers might reduce injury risk [1], given that the body is subjected to lower peak forces and load (impulse) during each stroke. It is likely that the reduced musculoskeletal stress is paired with greater cardiovascular stress, in the form of higher stroke rate.

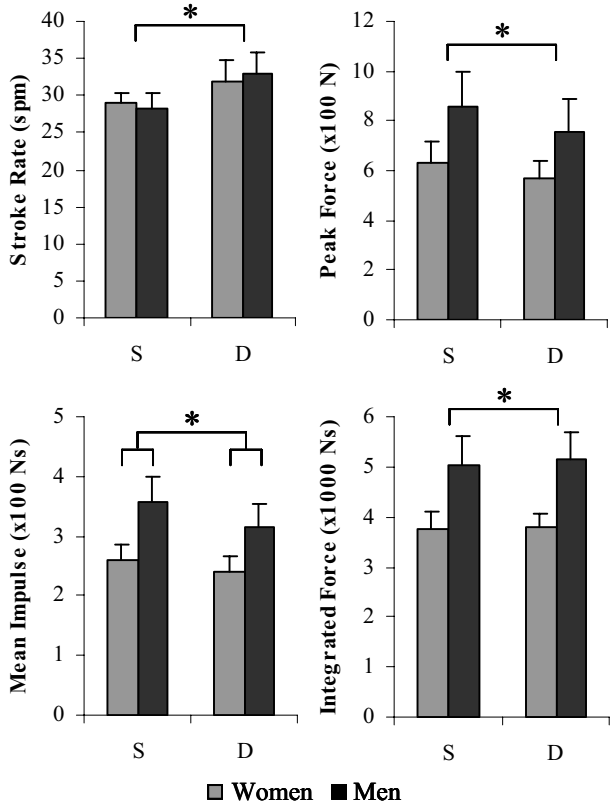

Figure 1: Mean (+SD) stroke rate, peak force, impulse per stroke, and total integrated force on the stationary (S) and dynamic (D) ergometer for women and men. An asterisk indicates a statistically significant difference by condition.

CONCLUSIONS

The dynamic ergometer appears to be more useful for training rowers during the sprinting season, when high stroke rates are desired. Training for strength and endurance might be more effective with the stationary ergometer, providing sufficient overload for muscle and connective tissue development.

REFERENCES

1. Bernstein IA, et al. *Br J Sp Med* **36**, 108-112, 2002.
2. Elliot B, et al. *Sp Biomech* **1**(2), 123-134, 2002.
3. Martindale WO and Robertson DGE. *Can J Appl Sp Sci* **9**(3), 153-163, 1984.

ACKNOWLEDGEMENTS

Thanks to Ken Halpin for his work processing data, as well as to Tom Swensen, Deborah King, and Becky Robinson.