ROWING APPLIED SESSION
IMPROVING ROWING PERFORMANCE AND MINIMISING INJURY

Richard Smith[1], Conny Draper[2], Leo Ng[3], Julien Lardy[4], Fabien Teissier[4], Floren Colloud[5], Vincent Fohanno[4], Antoine Nordez[4]

The University of Sydney, Sydney, Australia[1]
Sport Biomechanics Consultant, Australia/ Switzerland[2]
School of Physiotherapy and Exercise Science, Curtin University, Western Australia[3]
"Movement, Interactions, Performance" (EA4334), University of Nantes, Nantes, France[4]
Institut Pprime (UPR CNRS 3346), University of Poitiers, Poitiers, France[5]

KEY WORDS: sculling, instrumentation, rigging, technique, low back pain

INTRODUCTION: Competitive rowing has been practiced for millennia as evidenced by Egyptian wall paintings from 2500 BC. Boats from the First Egyptian Dynasty were 25 m long and 2 m wide had 30 rowers. Rowing races were conducted in Ancient Greece as part of festivals and games (Virgil, 19 – 30 BC) and in Rome regattas were organized for entertainment. The complexity of rowing boats probably reached their peak with the Greek Triremes which had 170 rowers in three banks. Today, in the modern day Olympics, there are 14 different events from the single scull to the sweep eight with coxswain. Further, ergometer rowing is an international sport in its own right. Both on-water and ergometer rowing are activities that are enjoyed recreationally and as a form of fitness training. Whatever the motivation for involvement in rowing, an understanding of the mechanisms of performance and injury can deepen appreciation of the sport.
Progress will be made towards optimizing performance and minimizing injury when the relevant determinants are known. They can be grouped by their association with the rower, boat, oar and environment.
The Rower: Rower variables can arise from anthropometry, biomechanics, physiology and psychosocial factors. Psychosocial factors were central to McLaren's study of cognitive techniques (McLaren, 2002) aimed to focus rowers' attention on relevant and productive thought processes during 2000 m maximal ergometer rowing. This strategy led to significant improvements in rowing performance after both technique and cognitive interventions. Greene, Sinclair, Dickson, Colloud, and Smith (2009) investigated the effect of the ratio of shank to thigh length on ergometer rowing performance and possible risk factors for low back pain and injury. The low shank to thigh ratio rowers were more flexed and produced more lumbar power at the catch than higher shank to thigh ratio rowers.
The oar: Coppel, Gardner, Caplan, and Hargreaves (2010) have made significant contribution to the understanding of oar blade hydrodynamic behaviour with their computational fluid dynamics modelling. Although some realistic drag and lift figures were obtained from the modelling, the angular motion of the blade and edge effects need further elaboration.
The boat: Hydrodynamics and rigging of the boat determine the effectiveness and amount of work that needs to be performed by the rower. Boat and blade properties have been combined by Formaggia, Mola, Parolini, and Pischiutta (2010) in a new model describing the dynamics of a rowing boat reducing the rower-oar-boat system to a set of ordinary differential equations.

The environment provides another set of challenges to expert performance from water, wind, wave, climate, sound and light. Filter (2000), cited in Kleshnev (2006) quantified the effects of water temperature, tail-, head- and cross-wind on boat speed.

Biomechanical measurement: Rowing is a sport that lends itself to biomechanical measurement and has the interaction between rower and boat as additional interest. The first force-angle curve for the oar was through a collaboration in 1895 between coach Gilbert C Bourne and E. Cuthbert Atkinson, both members of Oxford faculty (Atkinson, 1986). In recent times advances in technology and understanding of the determinants of rowing performance has resulted in a range of ergometer and on-water measurement systems that are comprehensive in the number pf variables measured.

The purpose of this session is to provide a forum for discussion of how rowing biomechanics can be applied in the real world setting for the improvement of rowing performance and the minimisation of injury. Four areas have been chosen to illustrate this application: 1) how biomechanical measurement techniques are being implemented internationally for the profiling of rowing athletes at different levels of competition; 2) a practical approach to the management of back pain in rowers; 3) a systematic approach to boat rigging to obtain desired oar catch and finish angles for a given rower anthropometry; 4) demonstration and discussion of rowing biomechanics measurement systems.

REFERENCES:

Atkinson, E. C. (1986). A rowing indicator. *Natural Science, 8*, 178-185.

Coppel, A., Gardner, T. N., Caplan, N., & Hargreaves, D. M. (2010). Simulating the fluid dynamic behaviour of oar blades in competition rowing. *Proceedings of the Institution of Mechanical Engineers Part P-Journal of Sports Engineering and Technology, 224*(P1), 25-35.

Formaggia, L., Mola, A., Parolini, N., & Pischiutta, M. (2010). A three-dimensional model for the dynamics and hydrodynamics of rowing boats. *Proceedings of the Institution of Mechanical Engineers Part P-Journal of Sports Engineering and Technology, 224*(P1), 51-61.

Greene, A. J., Sinclair, P. J., Dickson, M. H., Colloud, F., & Smith, R. M. (2009). Relative shank to thigh length is associated with different mechanisms of power production during elite male ergometer rowing. *Sports biomechanics, 8*(4), 302-317.

McLaren, T. (2002). *Cognitive strategies and elite rowing performance*. Paper presented at the Harvard University Rowing Center, Cambridge, Massachusetts.

Virgil (19 – 30 BC) The Aeniad.