ISBS2015 Geoffrey Dyson Abstract

Generating and applying knowledge in sports biomechanics: examples from rowing and running

Professor Richard Smith

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Abstract

Geoffrey Dyson was a pioneer in the translation of scientific knowledge to athletic performance and this is one of the foremost missions of the ISBS. This knowledge can be generated through sudden insights, long and hard meticulous data collection and analysis or by coincidence. Any of these pathways can lead to new insights into the mechanisms of performance which, in turn, lead to significant shifts in training effectiveness, technique improvement or injury minimisation. This presentation will illustrate this process by drawing on rowing and footwear biomechanics research.

Rowing takes place recreationally and competitively in boats and on ergometers. To maximise performance, it is helpful to understand the mechanisms of power production. Mechanical efficiency, a useful criterion for performance, is the ratio of the external energy output to the internal mechanical energy expenditure summed over the major joints. This ratio is calculated from the integral of the joints' power output. Examination of the pattern of joint power output reveals the relative magnitude and timing of the major muscle outputs, with implications for strength and conditioning and, with further modelling, insight into the causes of back pain and other injuries. Some surprising results arise out of a detailed study of this research.

Recent interest in running barefoot and in minimalist footwear has led to a greater focus on how these modes affect foot biomechanics. Is barefoot biomechanics the holy grail for maximal performance and injury minimisation? The traditional anatomical description of foot action shows a great over-simplification of the wide range of motion exhibited by foot segments during propulsion, and the fraction of power output rivalling that of the ankle joint. Our research has led to the design of a shoe that retains the

protective properties of a traditional running shoe while allowing movements that mimic barefoot running.

Professor Richard Smith's bio

Richard Smith is Professor of Biomechanics and leads the Biomechanics and Motor Behaviour team in the Discipline of Exercise and Sport Science at the University of Sydney, Australia. His two main areas of research, conducted with a team of staff and higher degree research students, are rowing performance and lower limb function with and without footwear. Both areas focus on maximising performance while minimising injury potential.

Richard's research on rowing performance and injury biomechanics is studied in depth and the knowledge outcomes used to design systems to facilitate the translation of that research into practice. Overcoming the technical challenges of obtaining data in the real environment, particularly during competition, communicating the information to coaches and athletes and evaluating its effect has thus been an ongoing focus of the rowing work with athletes of all levels of competition.

Richard analyses lower limb mechanics and the effect of footwear using models of sufficient complexity to realise practical performance and clinical outcomes. Foot motion is measured in-shoe and the effect of footwear on power output from the multi-segment lower limb joints computed. A new shoe design has been developed to facilitate barefoot biomechanics and, at the same time, retain the shock absorbing, protection and comfort properties of traditional running shoe designs. Its acute and long term performance during walking, running, sidestepping and jumping are being evaluated.

Richard has published over 200 papers and supervised 57 research students to thesis completion. He collaborates with the Australian Institute of Sport, Rowing Australia and the New South Wales Institute of Sport and universities internationally. His research is supported by industry partners, the Australian Research Council and the Australian Sports Commission. Richard has been a member of ISBS since 1985 and has held Director and Vice President positions for many years.