VIEWPOINT

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WHAT BIOMECHANICS CAN DO FOR THE AVERAGE COACH AND ATHLETES

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In general, it is safe to say that most athletes are best left unaware of the exact nature of their complex movements and need only sufficient details to correct some performance errors, develop confidence and satisfy curiosity. On the other hand teachers and coaches must acquire all knowledge which can help their students and athletes to improve their performance. This is a responsibility which can not be overemphasized. In fact, every instructor has a moral obligation to be well versed in biomechanics, physiology and nutrition. Without a background in biomechanics in particular the advantage of high technology, which is available today, remains in the laboratories and on library shelves. Also, biomechanists have an equal obligation to conduct applied research and disseminate information to the practitioners in the language of the practitioner. That having been said, I can state that, with the proper approach, the performance benefits to the average coach and athletes from biomechanics can be extensive.

To elaborate on the question of "how can the average coach and athlete benefit from biomechanics...", we will first look at what is possible and available today, what is not possible, and then discuss means and methods of how to use the available resources for the benefit of the average coach and athlete.

State of the art – Performance Model

The more advanced biomechanists, with proper instrumentation and computer hardware and software, can analyse any athletic performance, at any skill level, and from the datum developed a computerized performance model for that athlete. This must be carried out with full consideration of individual differences in mass, skeletal structure, flexibility, strength and coordination. The computerized model performance, thus produced, comes closer to the optimum, with the athlete considered "as is". Later change in the athlete's mass, strength and flexbility will alter the computer model, and the analysis at such a time must be repeated and the computer model of the performance adjusted. The transfer of the model information to the athlete with language and symbols the athlete can grasp and carry out is another matter. In reality the athlete can handle only limited changes in the skill at any one time. The transfer of vital movement information from the computer model to the athlete is not by magic. It requires patience, time and hard work for both, coach and athlete. Nevertheless, with biomechanical assistance the end results may far exceed any performance the athlete could have performed without its help, making biomechanical analysis and modeling mandatory for all athletes who wish to do their best.

The point that needs to be emphasized is that each athlete is unique and therefore must be approached as an individual and not as part of some researcher's statistics. While statistics of performance may be interesting, they are of little or no pratical value to the athlete or practitioner trying to improve a performance. The athlete needs to know facts about his or her own performance. It matters very little what the average performance profile of a group of athletes looks like. The athlete needs to work toward mechanical perfection with his or her own body and idiosyncrasies, not that of a non-existing "mean" athlete.

Pratical problem

The uniqueness of each individual presents a practical problem when we consider the expertise, instrumentation and manpower necessary to make computer models of performances of a large population. With only limited resources available for biomechanics work we are forced to compromise between the ideal and practical. In countries with advanced technology and adequate resources, each athlete could be given the full biomechanics analysis and computer modeling treatment (at present this is done only on a few isolated cases). However, a great deal may be accomplished by using less sophisticated methods, with sound biomechanical principles. It would be beneficial if an organization like the IAAF could take a more active part in assisting less developed countries to acquire biomechanical resources.

Biomechanics film and video

As a visual starting point the average coach and athlete could benefit considerably by viewing film and video of performances which are mechanically sound. The sample performances should be biomechanically analysed and appropriate and precise commentary inserted within the film and video production. There should be frequent stops, commentary should cover and emphasize various parts of the movement, and there should be numerous repetitions of the whole movement, as with loop films, in slow motion and in real time. These should not be documentary films with statistics, but rather one or several performers analysed as individuals, with the peculiarity of each athlete emphasized, compared and discussed. This type of production would serve to show a mechanically sound performance and at the same time give a lesson on the biomechanics of that event. For added interest performances should be selected out of competitions at the Olympic Games the World Championships and similar high profile events, which should be acquired by biomechanists specialized in biomechanics cinematography. Above all, the films and video production should be precise and the commentary biomechanically accurate.

Basic biomechanical education

The teacher/coach and the athlete should clearly understand the objectives of the event from a biomechanical point of view and proceed with sound biomechanical principles as guides. Biomechanists should be called in to give short seminars on topics significant to the event. The teacher/coach should not hesitate to ask biomechanists numerous questions in order to become a more valuable asset to the athletes and the sports. The teacher/coach must keep in mind that more sophisticated technology makes the teachers/coach increasingly indispensable. When the proper biomechanics film and video become available, they should be viewed in conjunction with other forms of education.

Basic biomechanical analysis

With the basic biomechanical education in hand the practitioner can begin to carry out rough analysis from direct observation, from video or from film. This analysis can be of a qualitative nature, where the movement is observed without quantitative measurements. With a little more sophistication the practitioner can make some simple measurements, or quantitative analysis. Concurrently, in cooperation with a biomechanist, the practitioner can participate in the analysis of certain phases and movements of the event which raise questions. Eventually, the practitioner can and should carry out more sophisticated analysis on his/her own. This activity has three valuable aspects. It educates, gives confidence and improves the performance of the teacher/coach and athlete. It also gives the athlete a deeper involvement in the event thereby engaging more of the conscious and and subconscious brain with correct thoughts. In the long run this can produce amazing results.

Space does not permit to list all information available through biomechanical measurement, which can be made with one or a combination

of instruments. However, a few sample questions that can be answered for any one athletes follow: – What muscles or muscle groups to train more? What type of training to give to certain muscle groups? What type of sprint start is most productive? What type of shoe is most productive? What is the most economical pole carry? What vaulting pole is most suitable? What is the optimum angle of release for the shot? Or discus? Or javelin? Or hammer? Which javelin is most suited? What foot spacing is most productive in the sprint start? What is the most desired run curve in the high jump? What is the optimum run length for the long jump? How does increasing or decreasing the penultimate step influence the jump? What is the best foot-force distribution during the shot put? What is the optimum stride length in the 800 m? What stride length is least damaging to the knee? Is the sequence of motions and muscle involvment correct? What is the potential of the athlete? etc. etc.

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A long-jumper, a discus-thrower and two javelin-throwers. The jumper holds a pair of weights; these were swung forward on take-off to give added impetus, and then backward before landing to provide yet further thrust. Panathenaic amphora (jar presented to a victor in the games at the Panathenaic festival in Athens); made about 525 BC. Height 71.6 cm. BM Catalogue of Vases B 134.