SOME METHODOLOGICAL ASPECTS OF SPORTS TECHNIQUE EVALUATION

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INTRODUCTION

Together with the development of the biomechanical methods including computer simulation, the number of papers dealing with the technique of nonstandart and three-dimensional movements increases. The technique of team and other sports games, and combat sports contrary to, for example, take-off technique in jumping events can be considered as such nonconventional movement. It is possible to distinguish three main aims of the published papers on the sports technique of the above mentioned movements, however, such aims are not always explicitly expressed.

The first aim which is fulfilled by such biomechanical papers is to deliver basic, descriptive, more often kinematic than dynamic data about a sports discipline. The second and rather formulated aim, is to point out the amount of load and possible risk of injury by investigating the torque, overload on bones and other tissue and other practice-contusion related phenomena. As a result the new equipment, shoes, technique diminishing the risk of injury etc. are introduced. The third aim, more often claimed to have been solved is to improve sports achievement through investigation of sports technique.

In this report the author intends to assess to which extend the third aim is or can be fulfilled? What methodological conditions should be fulfilled to achieve such an aim? The number of papers have been reviewed and four selected examples will be described to point out the authors consideration and to support the final conclusion.

The possibility to increase the sports performance of an athlete by ivestigating his technique is achived only with a great limitation because of the rather commonly unconvenient methodological approach. The papers delivering kinematic and dynamic data characteristic for a given sport or event, or revealing the source of injury, contribute indirectly to the increase of sports achievement. In most cases such papers cannot tell the coach what and why he has to change in the practice program but only what the difference between the actual state of technique and the accepted model is.

2. THE NOTION AND PLACE OF SPORTS TECHNIQUE IN THE ATHLETE'S TRAINING

Before answering the questions formulated above the definition of the sports technique is indispensable. Among the number of definitions the one formulated hereafter seems to be adequate:

The sports technique is a set of movement tasks which serve the utilization of the potential torque, speed, power, endurance (so called motorial features), and somatic and psychological features in order to achieve the highest sports results. As this definition refers to sports results, it is understandable that the movement tasks have to fall into line with sports rules. The accomplishment of any movement tasks is the accomplishment of the program which was created during the learning process and fixed into central nervous system.

This means that sports technique has its base in the informative sphere, that is connected with neural processes. However, any performance of the motorial programme is always fulfilled at the cost of energy expenditure (energetic sphere). The relationship between neutral programme and the motorial features accumulated during training process and the final utilization of the physical potential during sports competition is shown in the following scheme:

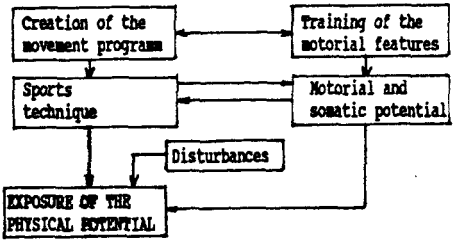

Figure 1: Relationship between sports technique and motorial features in the training process.

In this scheme psychological factor which influences the final motorial result is presented as disturbances which can either strengthen or weaken the relationship between the program and motorial features.

3. THE DIVISION OF SPORTS INTO GROUPS

The relationship between the program of movement finally shaped as sports technique and motorial and somatic potential is not the same in every sport and sports event. Taking into account the above statement and the previous suggestions (Donski, 1969, Diaczkow, 1972) sports can be divided into three groups.

Division of sports

	Groups of sports		
	A	B	C
Characteristics of movement structure	determined	determined	open
Aims	to reproduce program	to reproduce program with some plasticity and subordination with the main task: maximum exertion of the physical potential	to reproduce alternative programs (easy to choose) with great plasticity. The selection is subordinated to tactics
Additional characteristics	the program in unchangeable	the aim is unchangeable and program adaptable	the aim is adaptable to tactics and the program is adaptable to disturbances
Examples	gymnastics, figure skating, acrobatics, diving	field events such as jumping and throwing, rowing, weight lifting	team games, tennis and table tennis, judo, wrestling, downhill skiing

Consequently, the division of sports into groups according to their movement structure involves the different level of physical potential utilization that is the different role of sports technique.

The nature of sports of group A is to reproduce the program of movement task. In such case the utilization of physical potentional tends to optimum. In sports of group B the reproduction of program is characterized by some plasticity, that is the adaptability to relatively small disturbances, which should assure the maximum utilization of physical potential. The sports of group C are characterized by the ability to perform the alternative programs subortinated to tactics and the utilization of physical potential tends to optimal rather than maximum.

4.EXAMPLES

No. 1. High jump take-off.

During the first phase of the take-off there is maximum lowering of the center of gravity which can be expressed in percent of body height and by the dept of knee flexion. Dapena (1984) investigated the relationship between the lowest body position during take-off and run-up velocity. Taking into account two positions and two speeds the author has had four possibilities and recomended lower position and fast run-up as the best solution. He also commented that if the take-off leg buckles the jumper should go back to the old technique, that is to slow down or to diminish the knee flexion. In the other paper (Sung and Shin, 1989) the authors registered the maximum knee flexion between 138.8° and 158.2° which was less than 133° reported by Dapena (1980) and assessed this technique as a poor one. Meanwhile, the cause might lie in the muscles' torque potential and besides, the technique was adequate to this level.

A coach could easily come to such a conclusion but a researcher cannot reach the satisfactory interpretation unless the full spectrum of the problem technique plus physical potential at least is investigated.

No 2. Sprint start.

In 1976 BAUMANN published a paper on distribution of the load of body weight on hands and legs in "set" position in sprint start. The better athletes leant 73-82% of body weight on hands while the group of poor sprinters 52-67%. Obviously, the author didn't conclude that if poor sprinters would move the load more forward they would become the good ones. On the other hand untill we don't investigate the power of muscles involved in a take-off from the starting block we won't be able to tell the real cause of a given technique and consequently to advice the coach what should be practiced and improved in athletes.

No 3. Soccer kick.

TOO (1984) investigated the relationship between strength and coordination in the soccer kick. The author tested the torque knee extensors in the isokinetic mode at 120°/s and the ball angle of projection, transfer of momentum and lateral angle of deviation were assumed for coordination. The author investigated the correlation between horizontal ball displacement and among others the isokinetic peak torque of knee extensor and transfer of linear momentum (striking mass times tangential foot velocity before impact). In comparison to the examples No 1 and 2 there is, in addition to some data describing the technique, also physical potential in the form of muscle torque, which is an interesting approach. The results of this research show positive relationship between torque and transfer of momentum and the displacement of the ball. One may expect such results. The question is, how to organize the movement program in order to get the maximum momentum and to transfer it into the ball? What technique can utilize the torque of knee extensors the most? Knowing the number of degrees of freedom of the body, what variety of segments' movement, which still can assure the transfer of maximum momentum into ball, is admissible? The last question seems to be the most important because during the game the standard, comfortable conditions are unique.

No 4. Free throw shooting in basketball.

This problem was investigated by HUDSON (1982) who tested three groups of women players of different sport level. The percentage of accuracy was 78, 69 and 47 for high, moderate and low sports level respectively. Meanwhile, the mean angle of projection differs among groups 0.5°, and velocity of projection 0.18m/s and these differences were statistically nonsignificant. The question arises, why was there the difference in accuracy of scores among groups if the found parameters of ball release were so similar? (The only explanation of the difference in accuracy between groups seems to be lateral deviation.) The author found out some statistical

differences between groups in relative forward displacement of center of gravity and angular trunk inclination. But such movements didn't influence the final planar parameters of ball release! One may conclude that the secondary movements can have a certain variance and compensation movements within them still assure the stable and effective first rank movements. The utilization of admissible versatility of movements stands probably for efficient technique of the champion.

5. CONCLUSION

The biomechanical investigation of sports technique should attempt to answer the question: what and why the coach should train in athletes. Practical tests used by coaches are rather not sufficiently relevant to fulfill such task and are less reliable than biomechanical methods. In sports of group A, when the program movement is reproduced, to great extend the technique is the aim in itself and is not discussed in this paper.

To provide the coach with adequate and useful information in sports of group B it is necessary to investigate the parameters of movement pattern parallel to the level of strength (speed, endurance, power) of the given athletes. Such an approach enables to solve the dilemma: if the technique differs from the accepted model the reason lies in: a)poor technique of movement which makes it impossible to utilize the physical potential, b) lov level of physical potential to which the technique is quite adequate. In such events as jumping and throwing or weight lifting, the biomechanical investigation should point out the relationship between technique and level of physical potential and any model should not be considered separately, beyond these potentials. In sports of group C the model of technique has limited significance. That is because: firstly, it depends only to some extend on the level of physical potential and secondly, mostly the technical task is not performed at the standard condition at which it is elaborated. The description of the movement pattern serves only as the reference of the permissible scope of versatility. The scope of versatility within which it is still possible to score a point - that is what the coach is interested in. If the aim of the movement task is to kick a ball exactly within a limited time on the given distance, then the question is not about the mean but the range of running speed, body position, placement of the nonkicking foot and other secondary movements, which still make it possible to produce and transfer the momentum of the kicking leg (first rank movement executing the aim) into the ball. In other words, the dispersion of the secondary factors are of higher importance than the means. Such possible range of movement helps the coach to make the program of training. In sports of group C the biomechanical investigation of sports technique should point out the limit of variability within which the compensation movements make the first rank movement successful.

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