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CONTRIBUTIONS TO OPTIMIZING THE FORCE CONVERSION TRAINING IN SPRINT EVENTS AT JUNIOR CATEGORY: 16 – 18 YEARS OLD

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Abstract

The capacity of manifesting the greatest force with maximal execution speed means mastering the physical quality of power which depends on the efficacy of the force training. Sprinting athletes cannot maximize their motor actuating potential, so as to raise performance, without converting the maximal force (non-refined, non-specific) in specific force, such as power (P= FxV), speed, agility and muscular resistance. Any rise of power must be the result of having improved either the force, or the speed, or a combination between the two.

The force distribution into periods is guided so that after the conversion period, the sportsmen might attain the performance peak in the main sports competitions. For the success of this process, there concur two decisive factors: the duration of the phase and the specific methods resorted to, in transforming, synthesizing the force pluses in force specific to the event.

Key words: force, power, speed, bio-motor actuating quality, explosive force, conversion

Introduction

During the conversion, the trainings aim at raising to a small extent the power, there being essential the transformation (conversion) of the energy in technique and tactics. Speed stands in its turn for one of the „beneficiaries".

Material and Method

The **purpose** of the conversion trainings is to recruit the greatest possible number of motor unities at the highest contracting level, in a very short while. The conversion synthesizes the power and muscular resistance pluses, makes them competitive and gives them specificity, turning into the *physiological basis of performance in the competing phase*.This phase has two important factors, which ensure its success: *duration* and *specific methods,* which determine the transformation of the specific force gains into speed. Through training the „ nervous system", there are brought about and along neural modifications, with effects upon the muscles.(A. Muraru, 2005).

- the specific methods for achieving the conversion are: isotonic method, plyometric method, dynamic method of force applying through throwing (ballistic), the method of contra-resistance. There must be considered the following methodical indications of application:

  - there is necessary a strict training specific for the rapid and explosive manifestations
  - the training will be conceived so as to strictly satisfy the requirements of the respective event, stimulating as faithfully as possible the prevailing skills. We have been arguing this way: the more the specific power effort focuses on the strictly involved muscles, the coordination is more efficient, the skills are more precise, have fluency, are more rapid.
  - the trainer will be using the energy during this period strictly for the technical and tactical training, and less for power.
  - there is recommended the lowest number of exercises, provided that they should be closely

connected to the envisaged skill (2-3 dynamic exercises in a few series, however with maximal efficiency).

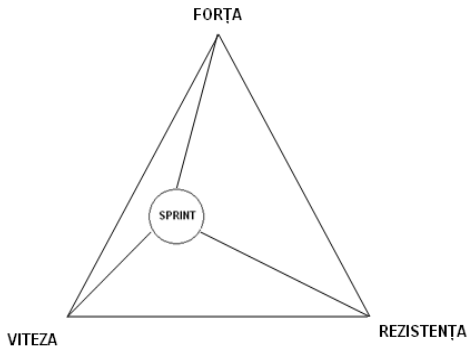
- the entire program will be carried through rapidly and explosively, so as to recruit a great number of motor units at the highest contraction frequency. We only nurture a single purpose: the explosive contraction of the muscle.

- the requirements are: the rise in rapidity, the explosive application of force; and the muscle preparation, so as to rapidly react within event-requested motions.

Force training, important component of the physical training for sprint; and the relation: force - power – speed (V. Tudor, I Crişan , 2007)

In the physical training of the sprint events, an important component is represented by the force training. The bio-motor actuating quality, ***force***, is envisaged as part of a system that includes speed, resistance, mobility and coordination.

The relation of this quality is the following:



The prevailing composition among the bio-motor actuating qualities for the sprint (T. Bompa, 2006)

We define force as a characteristic, as a feature, as a property of the locomotory apparatus, which, through the shift of its segments, following the muscular contraction brought along by the activity of the nervous system, overcomes external resistances, the weight and the inertia, within several parts of the body. This biological definition is being completed with the mechanical notion of force, which stands for the product between the weight and the acceleration F=m•a, the second Law of Mechanics according to Newton). This is, in essence, the cause of the modification in the motion state of a body or even in its shape, is the result of the acceleration variation, which, in its turn, is the speed variation within time unit. According to the second principle of mechanics, motion variation is directly proportional to the imparted force. Therefore, if we want this motion variation to be greater, in the sense of obtaining the maximal speed, we have to take into consideration: the weight of the body (centre of weight) the acceleration of the body, its inertia, the speed that the force manifests itself with, in time and space, other external forces.

As regards the classification of force, we mention the following types:

- general or special force (for certain muscular groups);
- explosive force (detent/explosion), which is the maximal force achieved in minimum of time through sudden contraction of the muscular groups;
- dynamic force (isotonic contraction) and static one (isometric);
- force in regime of speed or in regime of resistance.

Any motion of the human body is conditioned by a certain force. This force may have variegated forms of manifestation, which concretize in:

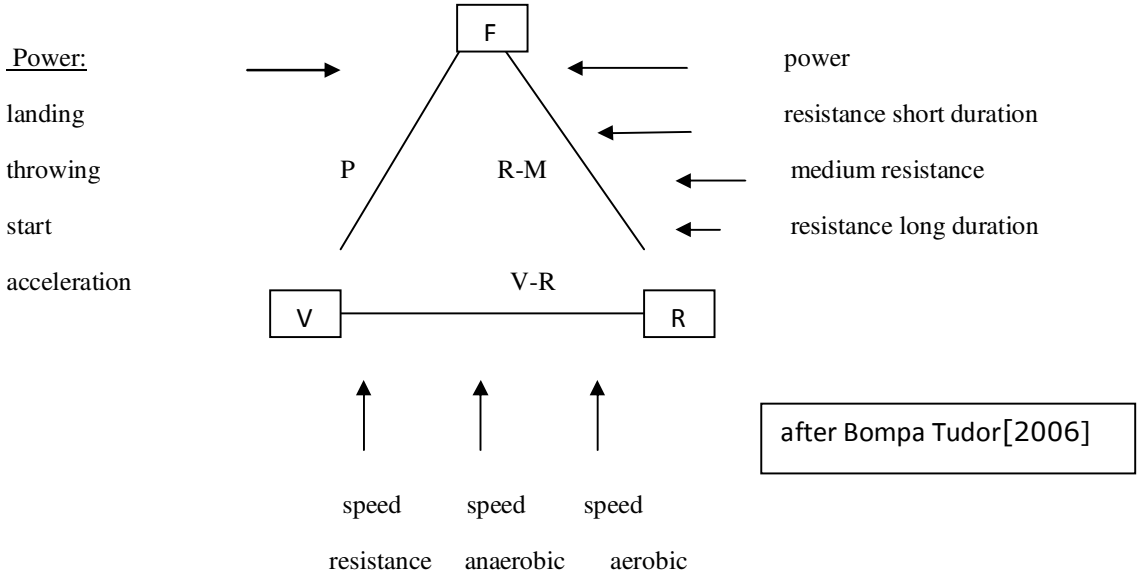
- **general force,** which reflects the overall capacity of the body to overcome various resistances based on the contraction of the main muscular groups (at the same time or successively). For instance lifting bar bells, body lifting in one's arms etc.;
- **specific force** standing for the capacity of overcoming some kind of resistance during frequent motions, especially based on involving some groups of muscles, which are of the utmost interest, in the sprint action. For instance, the pushing force in running, the detachment force in jumping etc.

From the physiological standpoint, the force of a muscle depends on:

- the number of muscular fibers participating in the contraction;
- the direction whereto fibers exercise their pressure;
- the surface of transversal section of the muscle. During the exercise of a force effort, there is

necessary the strain of a great number of muscular groups of the body. To this purpose, there are muscles which function in opposite reaction (antagonist). The muscular strains only have a positive effect when they involve and drive the agonist and synergic muscles, and the antagonist ones relax. During an intense physical effort, there is called for the contraction of an increased number of muscular fibers, therefore the percentage of active fibers rises to 40-70% and only during an effort of maximal intensity, the percentage of fibers within a muscle in simultaneous contraction, it rises to 75%. In this case, only 25% of the fibers relax, which leads to a great muscle strain, and fatigue occurs soon. However, a muscular effort is achieved not only by the muscles, but also by the nervous structures in the brain and in the spinal marrow.The starting force is a sub-category of the explosive force, the capacity of entailing and driving a maximal number of motor actuating units ever since the beginning of the contraction, determining a high initial force ((B. C Rață, 2008).The rapid force refers to the movements wherein manifold repetitions of accelerations occur and it characterizes the sprint and the jumps.

According to the stress is laid on the execution speed of the force, which is similar to power. To put it otherwise, it is the „dominant - speed in a force process" (T Bompa, 2006. „explosive force", which is the „capacity of achieving the greatest rise of force in the shortest time". It depends on the contraction speed A.F.T. (rapid fibers), on their number and on the contraction force of the fibers (T. Bompa, 2006)Our attention has been drawn by a theoretician in the field, whose opinion we have agreed upon, when we say that force is the clear expression of the speed, under conditions of maximal resistance and coordination.



Taking into consideration that "***power"*** is the main ingredient of all sports wherein the force-yielding level and especially the force, speed and agility-utilization level, being defined as: *force yielding level, product force multiplied with speed, volume of work carried through within the unit of time, rate whereto muscles may yield force.* "[1] in the field under research, we will discuss upon the situations specific to athletics and in particular to sprint (100m, 200m, 400m) wherein power must rise so that performance might improve and the sportsman might become more rapid and more agile. We will subsequently present a sharing out of the force in the annual thematic plan and in the stage plan in order to grasp the importance of this quality in the economy of the other components of sportive training:

- ***Start power*** – technically manifests through applying with strength and rapidity the force on the soil, being a limitative factor in sprint running, which is necessary when aiming at rapidly overcoming inertia and entering into maximal speed in the shortest possible time. We methodically work with:
  - one's own weight or supplementary loads

- exercises of rapid detachment and landing on one or both feet
- rise then progressive diminution of the load as we approach competition

- ***Acceleration power*** – limitative factor of speed; stands for that capacity pertaining to the sportsman of attaining maximal acceleration. They depend in their turn on the sprint speed (acceleration), on the power and rapidity of the muscular contraction, which determines the arms and the legs to achieve the greatest frequency of the stride, the shortest phase of contact with the soil and the greatest pushing in the soil towards the advancing position. Their capacity of acceleration depends on the force of the arms and of the legs.
- ***Power resistance*** – limitative factor; at every step, the sprinter bears twice his weight, during each contact with the soil. Therefore, there is called for the capacity to repeat at maximal level and with double load. There is also called for a strong will to overcome the fatigue rapidly installing and for maximal concentration during each execution.
- ***Reactive power*** – the capacity to control the landing and to still enjoy power so as to execute another movement, generating a force for jumping after the landing, "reactive". It depends on the jump height, on the sportsmen's body weight and on the power of his/her feet. The control and the absorption of the shock is given by the height of the detachment from the soil. A fall from 80-100 cm. induces within the ankles some loads six-eight times the body weight (at sprint, approximately two-three times). There must be involved and driven the muscles which best chamfer the shock and reduce the forces of impact with the soil, during the landing, knowing that landing entails an eccentric contraction. Unless we work specifically, there occur accidents, as there appear greater pressures than the number of active fibers, which causes the elastic tissue of the tendon to undergo very powerful stress. There are recommended eccentric contractions and plyometric exercises.

The conversion to power, obtaining maximal speed in the pre-competitive stage and the specific methods

Sportsmen cannot maximize their motor actuating potential so as to raise performance, without converting the maximal force (non-refined, non-specific) into specific force, such as power (P= FxV), speed, agility and muscular resistance. "Any rise of power must be the result of having improved either the force, or the speed; or a combination between the two." The force sharing out is guided so that after the *conversion stage,* the sportsman might reach the performance peak in the main competitions. For the success of this process, there intervene two determinant factors: duration of the phase and specific methods used in order to *transform, synthesize the pluses of maximal force in force specific to the event.*During the conversion, the trainings aim at raising to a small extent the power, there being essential the transformation (conversion) of the energy into technique and tactics. Speed is in its turn one of the „beneficiaries". The purpose of the conversion training is to recruit the greatest possible number of motor units at the highest level of contracting, in a very short while. The conversion synthesizes the pluses in power and muscular resistance, renders them competitive and provides them specificity, turning into the *physiological basis of competition in the competing phase.*This phase displays two important factors ensuring its success: *duration and specific methods* which determine the transformation of the specific force gains into speed. Through involving and driving the "nervous system", there are brought about neural modifications with effects upon the muscles. *The specific methods* for achieving the conversion are: *isotonic method, plyometric method, dynamic method of throwing instrumented applying force (ballistic), method of contra-resistance.* There must be considered the following *methodic indications for the application*:

- there is necessary a strict training specific for the rapid and explosive manifestations;

- the training will be designed so as to strictly meet the requirements of the respective event, stimulating as faithfully as possible the prevailing skills. We argue this way: the more the specifically power-targeted effort addresses the strictly involved muscles, the more the coordination is efficient and the skills are precise, fluent and rapid.

- the trainer will use during this period the energy strictly for the technical and tactic training; and less for power.

- there is recommended the smallest number of exercises, provided they are closely connected to the targeted skill (2-3 dynamic exercises, in a few series, however with maximal efficiency).

- the entire program will be gone through rapidly and explosively, so as to recruit a great number of motor units at the highest contraction frequency. We have a single purpose: the explosive contraction of the muscle.

- the requirements are: the rise of rapidity, the explosive application of force and the muscle training so as to rapidly react in event required movements.

Exercises for the reactive power (M. Pradet, 2000)

The specific of these exercises consists in keeping on, immediately after the initial jump, with another jump or plyometric movement; or with rapid running. We illustrate as follows:

Training 1: Plyometric (jumps on two feet forwards and laterally) 8 series over 9 fences lifted at 15 – 40 cm

Training 2: Plyometric: penta-jump 6x; jumps from/on boxes 10x3: 25 – 40 cm distance among them 60 cm

Exercises for the start powerThe essential quality which determines the initial phase of action – often dictating the final result – is the sportsman's capacity to recruit the highest possible number of rapid fibers at the beginning of an explosive movement. In the start position at the sprint, the elastic elements in the muscles store kinetic energy, which acts much like a spring when the pistol gives the start signal. We methodically work with:

- one's own weight or supplementary loads
- exercises of detachment and rapid landing on one or both feet, followed or not by acceleration 10 – 15m
- rise then progressive diminution of the load as we approach the competition 4-6 series, 8-16 repetitions, with 4-5 minutes pause

Exercises for the acceleration power (Rață B. C., 2008).Training has been advancing from free exercises with load (waistcoat, gauntlet, dumb bells) up to plyometrics and series of jumps on both feet or alternatively 6 -8 series with 2-3 minutes pause. There were carried out special trainings for running in swivel. The training was guided according to many of the principles submitted by the theoretician T. Bompa (2006) in his works referring to force development.

Results of the research and their interpretation

We wish to concretize these few theoretical aspects through a case study. The chosen subject is the sportswoman Zanfirescu Maria Ana, component of the national lot of juniors, Balkan junior vice-champion – II at relay race of 4x100m (Bar, Serbia 2008). On individual level, during the competing year 2008, she obtained the following results:

400mp – 59.00 – 3rd place C.N.J II – gymnasium

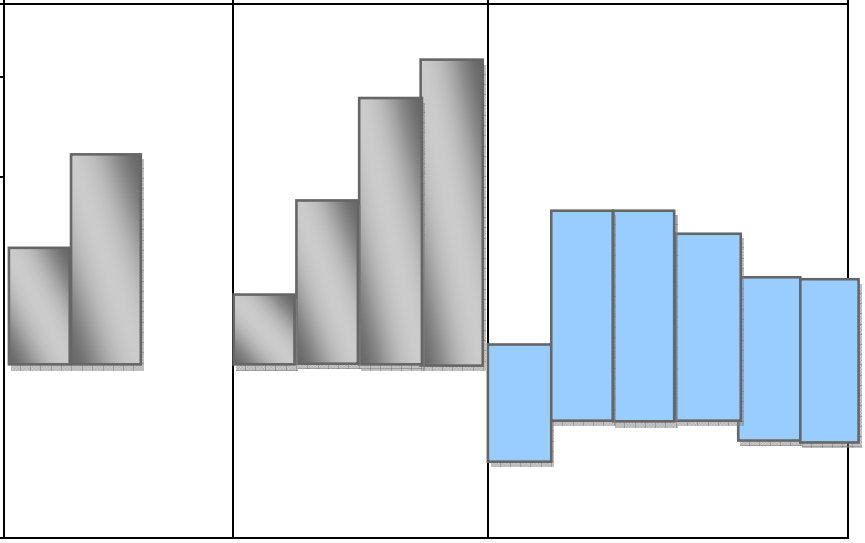
100 mp – 12.30 – 2nd place at C.N.J II-in the open

200 mp - 25.57 – International Championship

After a year of polyvalent athletic non-specific training, there came out several results, in a few running events, which suggested and proved that the sportswoman might successfully practice one of these events. There were also of significance the data collected from the National Competition of Sports Medicine from Bucharest, which helped at orienting her towards sprint and prolonged sprint.

Strictly referring to the force training, the trainer submitted his optics of approaching this bio-motor actuating quality, starting from a few genetic premises and from the motor actuating heritage already existing. Considering the 15-17 year-old-aged girls' morpho-functional characteristics, force training is interesting and challenging at the same time. The training was based on the study of the specialized theoretical materials and on the practical application of the processed data. There may be noted the approach of the force within the context of the system of qualities, never dissociated. There was taken into consideration the maturation level and the fact that we cannot apply tough, troublesome training on this level, because of the risk of over-strain and of bringing about the child's refusal to perform greater tasks. The conversion phenomenon, which is one of the determinant factors in the methodology of the physical training, on high performance level, has been carefully analyzed. We know that once with the age, the speed tends towards a maximum which stabilizes. The plus or the maintenance depend in a certain stage on the level of the progressive development of the other qualities, which are force, resistance, coordination, suppleness. *We consider that junior-ship period is very fertile, in order to*

*create the premises for progress, towards high performance. We refer strictly to the high speed - explosive power - training, specific to senior sprinters.*The sportswoman mentioned she had felt nervous strain and pressure during the training and that she was compelled to become aware of the greatest possible number of motions on the background of maximal strain and fatigue. Another aspect perceived and worked upon was the one of muscular coordination - "play between the antagonists and the agonists, and the capacity of possibly conscientiously straining and relaxing". These aspects helped both the trainer and the sportswoman to nurture a clear vision upon the disposition and the sharing out on yearly level of the means – inclusively of the force ones. Conversion to power, obtaining maximal speed in the pre-competitive – competitive II stage and guiding the training towards accomplishing the peak of sports shape and disposition.

No. of weeks		2(March)	4(Apr)	4 + 2(May - Jun)
Type of training force		AA	FMx	Conv. to P + Maintaining
Type of load	Great			
	Med.			
	Small			

The variations of the loading model in order to obtain the peak of sports shape and disposition for the sprint

Registering information – The notations used for describing the program are $\frac{\hat{i}nc\breve{a}rc\breve{a}tura}{nr.de.repet\breve{a}ri} serii$ (*loads / no. of repetitions*) (example: $\frac{80}{10}4$). The load will be calculated in percentages from 1RM, consequently the sportsmen have to be tested especially during the preparation phase, at the beginning of every macro-cycle.

Table 1 - Settling the tests

Circuit exercised at the beginning of the pre-competitive period (the last week of April).

Tests and Interpretation of the Results

There was considered to be edifying the power measurement of the standing detachment from the soil and the record of the maximal height during the fence clearing through jump with crouched landing. (exercise also used as training means) as it requires start power, coordination, concentration, determination, courage. There were recorded the following results:

CONTROL EVENT:	Standing long jump	20 double quick steps	Jump with standing detachment over a fence (landing in the sand or on the mattress)
TEST1:23.04.2008	2,25m	44,20m	85cm
TEST2:22.05.2008	2,45m	45,70m	100cm

During the pre-competitive and competitive period, when the athlete runs almost at maximal speed, there are used exercises which stimulate both the anaerobic capacity and the tolerance to lactate, resorting to repetitions of 60, 100, 150m. We may follow the manifestation of the motion speed, through calculating the difference between the running sequences on 30 – 60m. If the time on fractions (in the case of the repetitions on 150 – 200m) is close, we may consider to have achieved a satisfactory rise of speed under resistance regime, and if the time during the last fraction is higher (with ~0,25") it may be the result of a lack of adaptation, of an error in the effort distribution. The recorded rises prove the improvement of the dynamic force on the level of the inferior limbs and the achievement of the conversion in speed. We motivate the smaller progress in the event "20 double quick steps" through the complexity of the motion from the point of view of the effort structure and physiology, the neural-muscular resistance component being present in its turn to a small extent, the rate of progress in this event being positively correlated with the progress at 400m (3,27 – 3,28%). The greatest progress was achieved during the "fence clearing", a newly introduced exercise in the structure of the training. Learning the technique of the motion, together with the development of power, explains this progress (15%).Table 2. Results - RUNNING

EVENT	**100 m**	**200 m**	**400 m**	30 m	50 m	80 m	150 m	300 m	350 m
RATE OF PROGRESS	**2,4 %**	**1,9 3%**	**3,2 7%**	**4.3 4%**	**4.5 4%**	**4,0 8%**	**2,5 3%**	**3,6 9%**	**3,6 5%**

Analyzing the progress recorded in the running events, there may be confirmed the fact that one of the general performance objectives for the competitive year under study was creating the sportswoman's possibility to successfully cope, during the competitions, with a wide range of events (100; 200; 400mp and 400mg).

Conclusions and recommendations

1. Noticing the strictly ascending trajectory of the sportswoman's performance curve, whose case was studied above, we conclude that the *training, especially, the force targeted one, was correctly led.* 2. Force, specifically human bio-motor actuating quality, has grown into a dimension of human personality. This may be the reason for its being one of the most coveted qualities. There is called for passion so as to approach the development of this quality, so much longed for by teen-agers. 3. Without in-depth study and coherence during teaching, the training may reach the point of becoming harmful. 4. Force training may play a performance-stimulating and stirring up role, under normal conditions of the sportsman's state, even during moments of stagnation or falling-off.

Recommendations:

Proportional disposal of the training methods in the stage of conversion according to the formula below:

- force training: 6 – isotonic; 7 – plyometric
- speed and technique training: 20 The greatest part of the energy will be kept for the technical and tactic training, and a much smaller portion for the power training.
- The strict individualization of the load during the force training, the selection of the means according to the sportsmen's particularities.

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