

SOME ASPECTS AND VIEWPOINTS OF STRENGTH DEVELOPMENT

By Ants Nurmekivi

Achieving the best event specific results from your weight training program can be a rather complicated task. In the following text the author from the University of Tartu, Estonia, looks briefly at some aspects and developments of strength training, including some interesting views from Bulgaria. The article is based on translated extracts from lecture notes. Re-printed with permission from Modern Athlete and Coach.

It is universally agreed today that strength is an extremely important component in track and field performances. While athletes in the 1940's devoted only 10% of their training to the development of movement strength, the distribution of strength and technique training was already equal in the 1940's. Since then the share of strength development has increased even further.

We are now in practical strength training faced with the development of maximal, relative, static, dynamic, explosive, explosive-reactive, ballistic, isometric, isotonic, plyometric, general, specific and specialized strength.

Without going into detailed definitions of the above listed strength categories, it can be said that the modern strength development methods have convincingly proven that strength should not be developed "ad ultimo". There are complicated correlations between the quality of strength and the quality of techniques in the different track and field events. This is decisive for the quantity of strength training in proportion to technique development.

Many training programs over-emphasize absolute or maximal strength, instead of planning to reach optimal strength. In order to determine optimal strength for different track and field events it is necessary to establish an athlete's:

- Biological age and physical development level;
- Technical preparation level;
- Training age and,
- The concrete requirements of the event involved.

The above indicates that the determination of maximal strength is associated with several individual characteristics. The same applies to the development of optimal strength and it is therefore useful to clarify the common principles that create the general base of strength training for track and field events. The first problem in the long-term (six months, a year) planning of strength training is to decide the sequence of the development of different kinds of strength capacities.

A common and rather simplified order is:

1. Strength endurance.
2. Maximal strength.
3. Explosive (speed) strength.

Strength endurance can from a general viewpoint be regarded as a preparation of muscles, tendons and joints for the subsequent phases of strength training. This is a particularly important component in the training programs of beginners and young athletes. Maximal strength represents the quality that influences the indicators of dynamic and static strength, as well as strength endurance, while explosive, or speed strength, represents the capacity of the muscles to overcome resistance in a rapid contraction.

One of the major problems in strength training is to find training means and methods to develop the strength and methods to develop the strength and speed components according to the competition demands. According to Verhoshansky we should differentiate here between three groups of training means:

1. Specific.
2. Specialized.
3. Non-specific (general).

Specific strength development exercises represent isolated versions of the fundamental performance with the aim to adapt the organism to the competition exercise. For example, by using varied weight implements in throwing events we develop the specialized movement capacity of the explosive-reactive-ballistic strength. Appropriate training means are here important, as too heavy or too light implements can change the rhythmical and biomechanical structure of the performance.

Specialized strength development exercises represent “analytical strength training” in so far as they take into consideration only one aspect of the demands of a particular event. An example here would be the employment of heavy implements to work on some muscle groups in simplified technique phases.

From this viewpoint specific strength bridges the gap between specialized and general (non-specific) strength.

According to Jimmy Pedemonte, specific strength development exercises in the throwing events should be executed according to the following basic rules:

- The exercises must be performed explosively.
- Specific strength training means using “strength drills” of the technical movements. The coach must pay attention to technical elements and a full range of movement in a correct sequence.
- The choice of implements must be strictly individual.
- It is not recommended to develop general and specific strength in the same training session. However, the development of specific strength and technique, with the aim to transfer the stimulus of specific strength to the competition movement, can take place.

It is interesting to note here the structure of strength training recommended by Ruth Fuchs to elite female javelin throwers. It is based on the following structure:

1. General strength training.
2. Maximal strength training.
3. Specialized strength training.
4. Specific strength training.

In this structure the first training phase includes 70% of general and 30% of specialized strength development. Specialized strength training takes place all year round but virtually no strength training is performed during the competition period.

Finland’s specialists, Hirvonen and Auras, have worked out a detailed structure of strength training in which the authors use the term “duration strength”, divided into muscular endurance (aerobic-anaerobic energy production dominates). They also divide maximal strength into basic strength and maximal strength, in which the first term refers above all to the enlargement of the cross section area of the muscle and the second to the quality and volume of the nervous innervation. Finally, the authors divide speed-strength into the speed and explosiveness categories.

Nearly all track and field events require from the neuro-muscular system momentary high intensity work (event specific speed) or the capacity to maintain sub-maximal strength (event specific endurance). For this reason it is necessary

to separate strength and speed-strength exercises, that are directed to the development of the neuromuscular (speed, intensity) side of the system, from strength endurance exercises, that are concerned with energy production (speed endurance, endurance). The event specific speed and event specific endurance system is presented in Fig. 1.

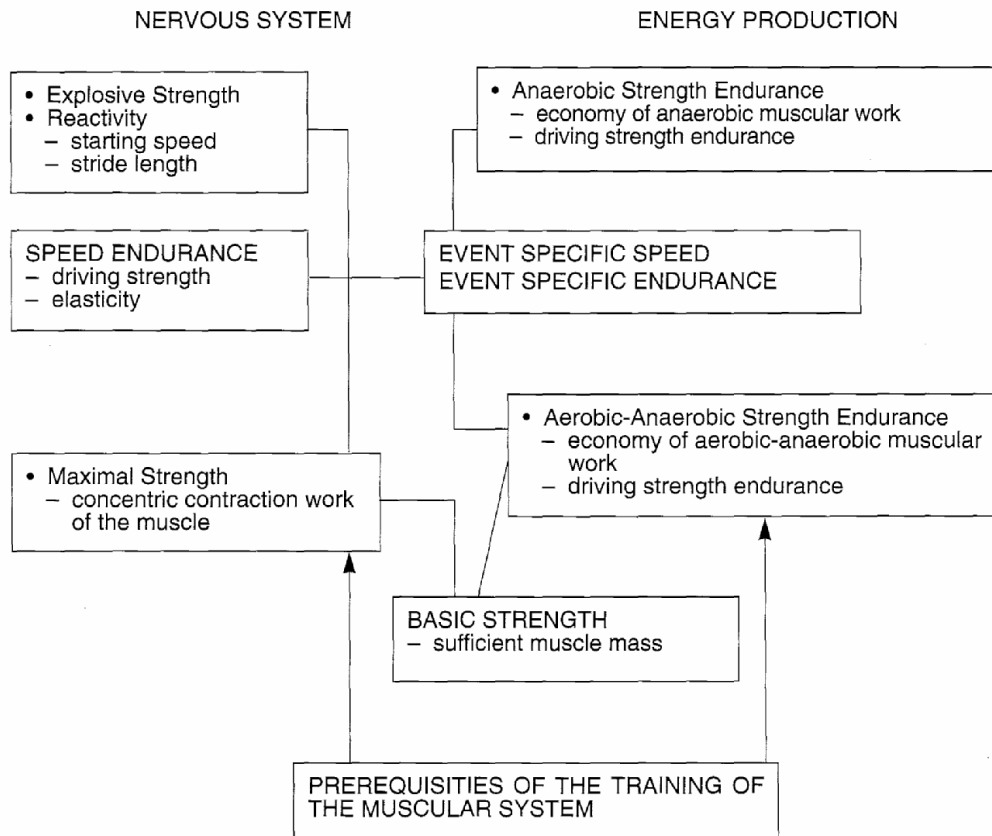


FIG. 1: The influence of the nervous system and energy production on the event specific speed and event specific endurance (Hirvonen, Aura, 1988)

As far as muscular endurance is concerned, the performance of an exercise has to be fast, but the blood lactate level should not exceed 4 mmol/l. On the other hand, strength endurance exercises that are performed at a low intensity have lactate levels between 6 to 8 mmol/l, while lactate reaches 8 to 12 mmol/l in the execution of high intensity exercises. It is important that a progressive upward direction is maintained in the performance of these exercises. This is achieved by:

- Increasing the resistance,
- Increasing the number of sets,
- Reducing the recoveries between the sets.

In the development of maximal strength it is generally recommended to use 2 to 4 exercises in 3 to 6 sets. The exercises are executed as fast as possible and the lifts of maximal weights (over 95%) should be restricted to 10 to 20 in any one training session. In order to avoid the development of excessive muscle mass the maximal strength training phases should last 3 to 5 weeks and are followed by speed strength training.

Bulgarian weight lifting expert, Spassov, stresses that maximal intensity secures best results in the development of maximal strength. Intensity should ideally be maintained at 80 to 85% level in training. It should not drop below 60 to 65% during the transition period in order to avoid a time consuming return to the optimal level. Spassov also stresses that the so called "Bulgarian system" is suitable for everybody who wishes to improve maximal strength.

The system is based on the following:

- Warm-up (10 lifts): 3 sets of 2 reps 50%, 22 reps. 60%, 1 rep. 80%.
- Development of maximal strength: 1 x 90%; 3 x 100%; 2-3 (3 x 85-90%); 1 x 90%; 3 x 100%; 2-3 (3 x 85-90%); 1 x 90%; 3 x 100%; 3 (3 x 85%).
- Recoveries: 1:30min. for 70%; 1:45-1:50min for 80%; 2:00-2:10mm for 90%; 2:30-4:00mm for 100%

Development of maximal strength:

$\frac{90\%}{1}$	$\frac{100\% \times 3}{1}$	$\frac{85-90\% \times 3}{2-3}$	$\frac{90\%}{1}$
$\frac{100\% \times 3}{1}$	$\frac{85-90\% \times 3}{2-3}$	$\frac{90\%}{1}$	$\frac{100\%}{3}$
$\frac{85\% \times 3}{3}$			

As far as track and field events are concerned, it is important to find means for the transfer of maximal strength into speed-strength or explosive strength. Bulgarian specialists recommend here the use of 25 to 28% loads, executed at maximal speed. The percentage is calculated from the athlete's current maximal strength level and is increased as the athlete improves. Four weeks is the longest time recommended for the use of the same resistance.

The development of speed-strength according to the Bulgarian system is based on a 4:1 ratio, in which four weeks of gradually increasing loads is followed by a recovery week. For example, the gradually increased load is made up from three sets in the first, four sets in the second, five sets in the third and six sets in the fourth week. In other words, we are dealing with a totally intensive approach.

The chosen training means in strength development must obviously be specific for a particular task. For this reason several authors claim that the so called pyramid system has justified itself as one of the best methods to develop maximal strength for track and field events. In the use of the pyramid system it is common to distinguish between “wide” and “narrow” pyramids. The wide pyramids are made up from 3 to 5 sets of 3 to 7 repetitions against 70%-80% resistances. The narrow pyramids from 3 to 8 sets of 1 to 4 repetitions against 85%-95%-100% resistances.

The development of speed-strength usually takes place by employing around 75% intensity from the maximum, while 30 to 50% from the maximum is applied to the development of explosive strength. Several authors recommend here the use of a complex method, where maximal strength development is combined with explosive strength improvement. Verkhoshanski, for example, considers the following two variations useful for the development of explosive strength:

- Variation 1: 2 (2-3x90%) + 3 (6-8x30%)
- Variation 2: 2 (3-4x50-75%) + 2-3 (6-8x30%)

Finally, another important strength training aspect, as far as track and field events are concerned, appears to be the need to differentiate between the exercises directed to the development of arm and leg strength. Studies by Ivanova indicated here that the use of heavy resistances with a small number of repetitions corresponded better to the energetics and coordinative characteristics of the arm muscles. On the other hand, moderate resistances with a large number of repetitions appeared to be better suited to the demands of the leg muscles. For example, the author found that the most effective combination in throwing events was 3 repetition maximum in the bench press plus 10 repetition maximum in the squat.