

СПЕЦИАЛЬНАЯ СИЛОВАЯ
ТРЕНИРОВКА
ПРАКТИЧЕСКОЕ РУКОВОДСТВО ДЛЯ
ТРЕНЕРОВ

SPECIAL STRENGTH TRAINING
A Practical Manual for Coaches

Ю. В. ВЕРХОШАНСКИЙ
By Yuri V. Verkhoshansky

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ABOUT THE AUTHOR

Yuri V. Verkhoshansky, Dr. Professor

Professor Yuri Verkhoshansky is the Russian researcher who originally codified the benefits of plyometric training. He is a prominent figure in the field of explosive strength training and is known as one of the greatest experts of our times in the theory of sports training.

For many years he was a track and field coach and served as senior coach of the Moscow United Team in the jump events. At that time he was a professor at the State Central Institute for Physical Education and at the Elite Coaches' School. In addition, he served as head of the Scientific Research Laboratory in programming of training and physiology of sports work capacity.

Dr. Verkhoshansky was Vice President of the International Information Academy and served as head of the Methodological and Theoretical Problems of Sports Theories Center at the Russian Research Institute of Sport in Moscow.

He authored more than 500 scientific-methodological papers and more than 20 monographs. His works have been translated into 22 foreign languages and published in 29 countries.

For many years, Professor Verkhoshansky has lectured on the philosophy, physiology and methodology of sports training and programming of training in Russia and in many other countries including Austria, the USA, Spain, Yugoslavia, Greece, Israel, South Africa, Germany, Italy, France, Holland, Portugal, and Bulgaria. He has also been rewarded for his multi-year assistance in the preparation of Russian (Soviet) national sports teams for the Olympic Games and other international competitions.

Dr. Verkhoshansky is an associate editor of the NSCA Journal, Journal of Applied Sports Science Research, Fitness and Sports Review International (USA) and Leistungssport (Germany). He is a member of the International Sports Sciences Association in the USA. In 1992 he was elected President of the International Association on Theory and Methodology of Training in Elite Sports at the International Sports Scientific Congress in Israel.

Currently, Professor Verkhoshansky serves as scientific consultant to the National Olympic Committee of Italy and is Professor at the University of Rome.

ABOUT THE EDITOR/TRANSLATOR

Dr. Michael Yessis Professor Emeritus

Dr. Michael Yessis is President of Sports Training, Inc. (www.dryessis.com) a multi-faceted company specializing in biomechanical/kinesiological analyses and sports specific training. Dr. Yessis is Professor Emeritus at California State University, Fullerton. He taught on the university level for over 35 years in the areas of biomechanics (technique analysis), kinesiology (muscle and joint movements) and exercise science.

Dr. Yessis has been associated with Dr. Verkhoshansky for well over 20 years and Dr. Yessis has translated his material published in Soviet journals since the 1960's. He was the first to report on plyometric training (together with Fred Wilt who introduced the name plyometrics). While in Moscow, Dr. Yessis learned directly from Dr. Verkhoshansky the intricacies of the shock method and plyometric training and has expounded on this information for many years in his writings.

He was also the first to report on the block method of training also introduced by Dr. Verkhoshansky in the *Soviet Sports Review* also known as the *Fitness and Sports Review International* of which he was Editor-in-Chief for 29 years. Most recently they participated in the Specialized Strength Training conference held in Chicago, IL in 2005. Dr. Yessis has written well over 2000 articles in various publications covering most sports but mainly in Muscle and Fitness, the NSCA journal, and Running Times.

Dr. Yessis has developed many unique sports specific exercises and specialized training programs to improve technique, strength, flexibility, power, speed and quickness. His training program, now known as the Yessis system of improving performance, consists mainly of biomechanical analyses and the creation of specialized exercises that duplicate what the athlete must do in execution of his sports skills. He has been a training and technique consultant to several Olympic and professional sports teams, such as the L.A. Rams and the L.A. Raiders football clubs, U.S. Men's Volleyball Team and many athletes from youth to the professional level. He also conducts clinics and seminars especially in the areas of speed and quickness.

PREFACE

Dear reader,

I know your problems because I also was a coach for many years and I still am a coach in my mind and in my heart. In this book I tried to do my best for you.

This aim of this book is to be a tool that can help you not only to create the rational programs of the special strength training but also to organise efficiently the training process as whole with optimal expenditure of time and energy of athletes.

But if you want use directly the training programs presented in book, please pay attention to a volume of loads. Many of this programs are really hard, they where created for top level's athletes. Try to start with minimal level of loads indicated in this programs.

I am sure that success will come to you.

I appreciate if you will write me about it through the site of my friend Dr. Yessis "www.dryessis.com".

Dr. Yessis is one of the most important expert of the Russian methods of sport training.

I know him by long time, I read his articles about these issues and on the base of this I authorized him to translate my book.

This is the first time that my work is published in USA with my approval.

In 1986 and 1988, same of my works were translated and published by Chiarniga without my permission (I were not even advised about this). I discovered they were not very corresponding to original texts and this could create some misunderstanding about my ideas.

Dr. Yessis knows very well Russian language and I can always discuss directly with him about the translation of every part of this book.

Yuri Verkhoshansky

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ABBREVIATIONS AND DEFINITIONS USED IN THE TEXT

- Fmax:** The index of maximal force displayed in a specific movement.
- Fv:** The index of high-speed strength.
- GPP:** General physical preparation, conditioning exercises designed to enhance the athlete's general, non-specific work-capacity.
- J:** The index of explosive strength.
- MAP:** Maximal anaerobic power.
- MOC:** Maximum oxygen consumption; the athlete's maximum oxygen utilization during loading.
- o/sec:** The degrees per second (for angular speed of movements).
- Po:** The index of maximal (absolute)-strength.
- Q:** The index of starting-strength.
- R:** The index of reactive ability of nerve-muscular system
- Rep:** The number of repetitions of movements in one set.
- RM:** Repetition maximum. The maximum load that a muscle or muscle group can lift in a given number of repetitions before fatiguing. For example, an 8-RM load is the maximum load that can be lifted eight times.
- S:** Sports result.
- Set:** The number of repetitions performed consecutively without resting.
- SST:** Special strength training.
- V:** Speed of movements (locomotion).
- Series:** The number of repeats of a definite number of sets and reps of a cyclic movement can also mean the number of repetitions of a certain exercise. Usually the total skill.
- Depth Jump:** Used as synonyms are: drop-jump, drop-down, jump in depth.

INTRODUCTION

In many sports in many countries, bodybuilding is used to develop strength. This is a big mistake!

Bodybuilding was created entirely for other reasons, the main criterion being mastery of body harmony, elegance of pose and art, and control over the muscles. Bodybuilding is ideal for these purposes as it provides very fine detailed development and has scientific justification. The great success of the supermen and the magnificent superwomen is convincing confirmation of bodybuilding.

However, in sports where success is decided by split seconds and where victory hinges on speed of movement, power of muscular effort and one's endurance for intensive work, bodybuilding is not effective. In addition, the excess hypertrophy of the muscles and the specific mechanisms involved in the central neuro-control of the muscle contractile function and energy acquisition developed in bodybuilding, is very different from the requirements needed in sports. Bodybuilding can actually slow down progress of sports mastery.

Specialized strength training (SST) is based entirely on principles other than bodybuilding. These principles were developed in Russia at the end of the 1950's when the author was most actively involved in this work.* The main distinctive feature of special strength training is that it is not simply the development of muscle strength. Foremost is the intensification of the functional activity of the motor system and the physiological systems of the body which then ensure, or make it possible, for the athlete to participate in a specific work regimen or regimens in different sports.

*¹ See Y.U. Verkhoshansky, "How Soviet High Jumpers Train" *Modern Athletics*, 1961, V. 5. #10; Y.U. Verkhoshansky, "The Triple Jump," Moscow, *Fiskultura Sport*, 1961, 215 pp; and Y.U. Verkhoshansky, "Foundations of Special Strength Training in Sports," Moscow, *Fiskultura Sport*, 1970 263 pp.

Intensification of the functional activity of the motor and physiological systems of the body, that are specific to the morpho-functional characteristics of the skeletal muscles and body as a whole, takes place in specific ways. In this way they create the base for perfection of technical-tactical mastery of sports skill and speed of execution of the competitive exercise. As a result, the athlete makes progress in his sports mastery and personal performance.

SST is not simply a useful additive to participate in sports. Today it is an organic part of the system of sports training. It is one of the factors ensuring achievement of the highest levels of sports mastery. This is why the closer SST is connected with the training process and the more its contents correspond to the task of preparing the athlete, the more it determines his sports success and happiness.

It is important to emphasize that the expanded role of SST in the training system is connected not so much with searching out new training means, but with development of new

methodological principles of using conventional strength exercises, especially exercises with loads (weights).

Opinions about the negative influence of strength exercises on speed of movement still exist between coaches and in the literature. But it is unjustified. Studies in the last few years have shown that when effective methodology is used, exercises with resistance promote not only an increase in movement speed but also perfection of coordination, motor reaction, quickness and frequency of movements, the ability to relax muscles, development of local muscular endurance and an increase in maximal anaerobic capacity.

Another important aspect to consider is that the modern technique of using SST is characterized by the systematic use of specific means. Today it is not simply a collection of separate strength exercises to be occasionally included in training. Today it is an obligatory complex of special strength training means that are chosen for each sport on the basis of objective criteria in a definitive manner interconnected with and used in a timely manner.

This book is basically about SST for high level athletes. However, it will be of interest to many coaches working with young athletes who find the recommendations very useful. Besides this—and this is very important—coaches will see what is to be expected of the young athletes in the near future. They will then be able to prepare them beforehand in small increments.

Chapter 6 of this book contains specific SST programs for various sports (sprinting, middle distance running, rowing, basketball, volleyball, American football, tennis) and a universal program for development of explosive leg strength (jump force).

These programs have been worked out on an experimental base and have been used successfully in sports practice. On the basis of these proven programs (and being guided by the contents of the book) the coach can work out his own programs for any sport.

CHAPTER 1

METHODOLOGICAL FOUNDATIONS OF SPECIAL STRENGTH TRAINING

1.1 Role of SST in the Training Process

The main criterion of sports (athletic) mastery is the power produced by the body which determines the speed of movement (locomotion). Therefore, an increase in the speed of execution of the competitive exercise is the main criterion for progress in sports results (see Fig. 1).

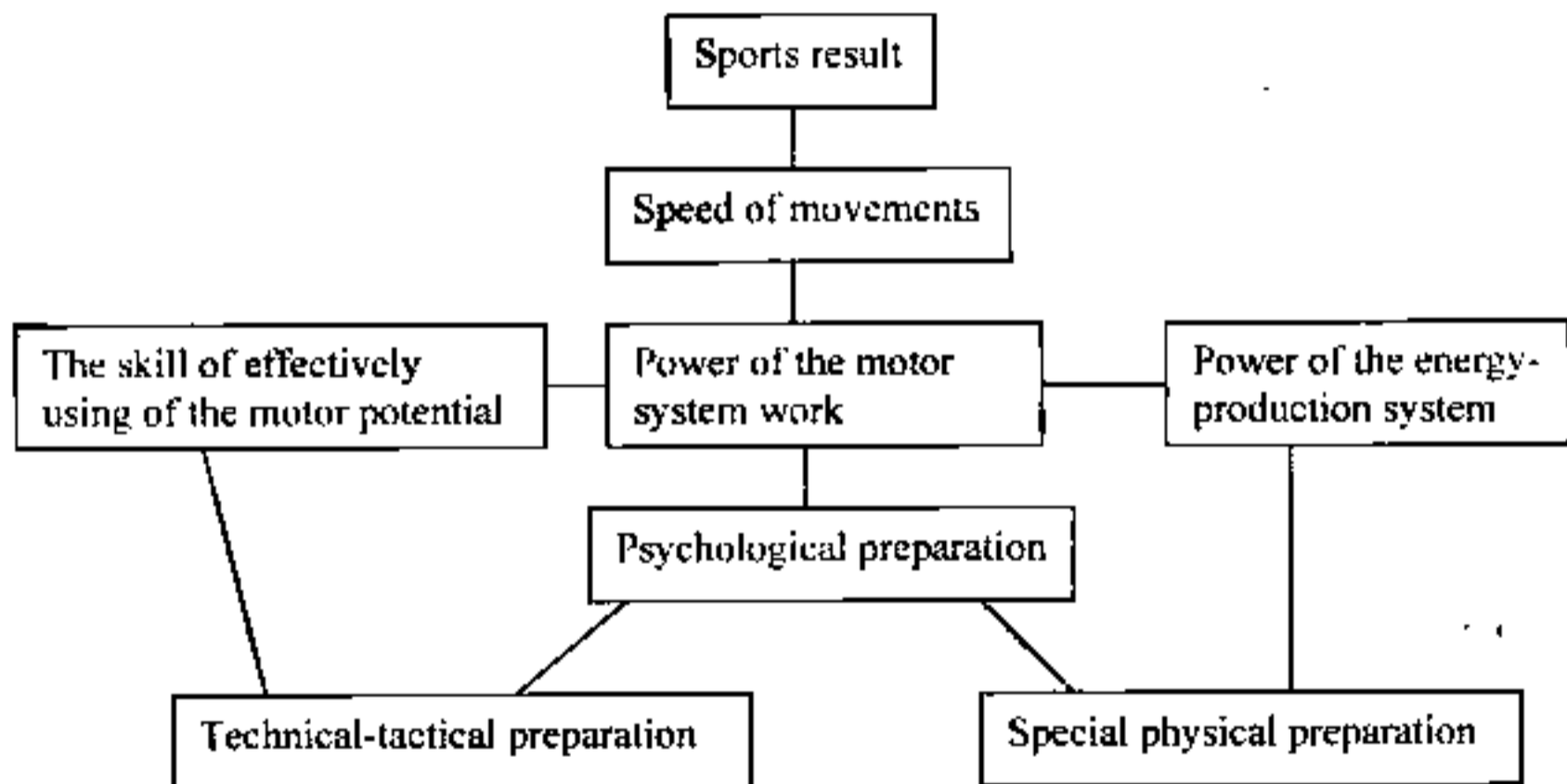


Fig 1: The factors mainly responsible for determining the sports result

The increase in speed (power production) is provided mainly by an increase in the athlete's motor system work capacity. This is done by:

- Increasing the capacity of the energy producing **systems** of the body; **and**
- Perfection of the athlete's skill to effectively realize his power-motor potential in competition.

In training these tasks are resolved by special physical (including strength) and technical-tactical training. In addition, it is necessary to pay attention to the fact that improvement in technical-tactical skill is also based on an increase in the motor potential of the athlete (see Fig. 1). On this basis we can assert (without negating the importance of other types and purposes of training) that the primary role in sports mastery progress belongs to SST.

1.2 The Main Emphasis of SST

In an athlete's movements strength is very specific:

First, strength as used in physics, is a vector which means it has a definite direction and value (F):

Second, strength is applied to a moving body (object) in a particular manner (S) to perform definite work (A) or simply $A = FS$; and

Third, this work is executed during a specific and as a rule, limited amount of time (t). Because of the anatomical features of the support-motor system (skeletal-muscular system) the application of force (the amplitude of movement) and consequently the time of its action, are limited. Because of this, the working effect of the sports movement is connected not so much with muscle strength, as it is with the power developed by the muscles, that is, with the work accomplished in a unit of time ($N = A/t$).

This means that in SST it is always necessary to take into account the conditions of executing the movements and the requirements for its energy acquisition. As a result, the main direction of SST should be seen not so much in the development of muscle strength as in increasing power of the athlete's muscular system work.

1.3 Purpose of SST in the Training Process

The purpose of SST in training is to intensify the work of the muscular system when training in a specific regime that is predominantly inherent in the sports activity. Such intensification provides for not only the utmost mobilization of the motor potential of skeletal muscles but also makes all of the physiological functions (including the energy-producing systems) more active to ensure their specific work capacity.

1.4 SST and Qualifications of the Athlete

The essence of long-term training in sport can be expressed by the schematic seen in Fig. 2. The progress of the sports result (S) is directly connected to the increase in the athlete's motor potential, that is, the level of special work capacity (A), and perfecting the athlete's skill to effectively use this potential in competition (B). In the process of improving sports mastery, the realization of the motor potential is increased (in Fig. 2, graph B comes closer to graph A).

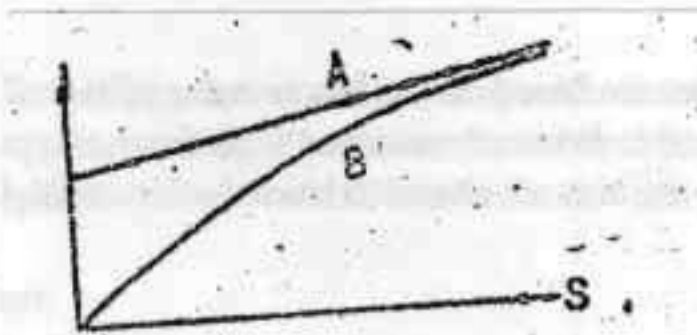


Figure 2: Dynamics of the athletes special physical (A) and technical (B) preparedness.

Thus, when there is high level mastery, when the athlete is capable of fully using his motor potential in his skill execution, further increases in the sports result (S) can be ensured mainly at the expense of increasing the athlete's motor potential (A). This is the main task of SST in training high level athletes.

An increase in the sports result (S) during long-term training is tied in with the increase in speed (V) of the athlete's movements (Fig. 3), which is ensured by the increase in the motor potential of the athlete. But, if maximum strength (P_0) is increased and there is some slowing down in speed (except perhaps in weightlifting and track and field throw events), work power (N) as a rule, increases in proportion to the square of velocity. Thus with an increase in the athlete's mastery, the SST should be more and more oriented toward increasing the athlete's muscular power while taking into consideration the specific character of the sports exercise or event.

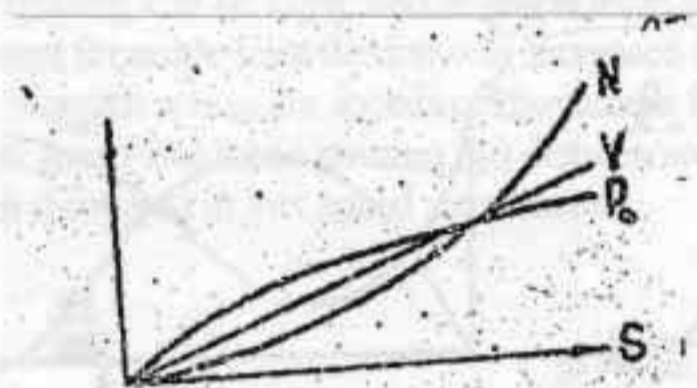


Figure 3: Dynamics of special work capacity of athletes relative to the sports result

1.5 SST and the Coach's Qualifications

To ensure the high effect of SST the coach should have good knowledge of biomechanics, physiology, and the bioenergetics of his sport. He should especially be good in determining:

- What kind of strength should be developed;
- The means necessary to develop this strength and how they must be selected;
- How to intensify the muscle work regime in the most expedient manner (why the regime is the best to use); and
- The methods and forms of SST that are most effective in his sport.

1.6 Strength Abilities of the Athlete

The athlete's strength abilities are based on the functional qualities of the body that ensure his ability to overcome considerable external resistance with the most speed possible. The following forms of strength abilities are characteristic of athletes (Y. U. Verkhoshansky 1963, 1970).

Maximal Strength (P_0)

Maximal strength characterizes the greatest magnitude of effort which the athlete can display when there is unlimited time (see Fig. 4, A). Maximum strength is most needed when the movement is executed with great external resistance. This determines how great the maximal working effort will be (F_{max}).

High-Speed Strength (F_v)

High-speed strength is displayed in high speed movements involving small external resistance.

Explosive Strength (J)

Explosive strength is characterized by the athlete's ability to display powerful effort (movement) in the shortest amount of time. Explosive strength is determined by the relation of F_{max}/t_{max} .

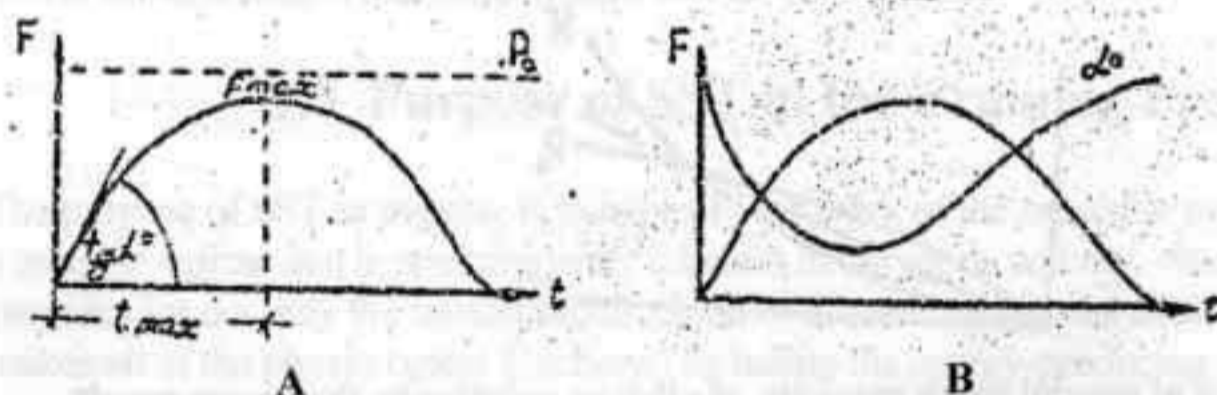


Figure 4: The biomechanical characteristics of the force-time curve of explosive effort.

Starting Strength (Q)

Starting strength characterizes the ability of the athlete to produce rapid increases in external force at the beginning of the muscle tension produced by the muscles. It is measured by the tangent (tg) to the curve $F(t)$.

Reactive Ability (R)

Reactive ability characterizes the specific quality of the nervous-muscular system to display a powerful explosive effort immediately after sharp mechanical stretching of the muscles by an external force. This regimen is characterized by the fast switching of the muscles from eccentric work to concentric producing a maximal dynamic load at this moment. See Fig. 4, B. An example of this would be the take-off in jumping.*

*The existence of starting force and reactive ability, as specific functional qualities of the nervous muscular system, was experimentally shown for the first time by the author in the early 1960's. Today these concepts are widely used in biomechanics and physiology of sport.

Local Muscular Endurance

Local muscular endurance is characterized by the ability of separate groups of muscles and physiological systems of the body to ensure motor activity while displaying the necessary level of effort for a long period of time and with no decrease in their working effect.

Maximum Anaerobic Power

Maximum anaerobic power is the ability of the body to effectively execute short-term (10 – 15 sec.) work at maximum capacity in cyclic or repeated regimens.

1.7 Specificity of Strength Abilities

During long systematic training, the strength abilities that are acquired have a highly specific character. This means that strength abilities can be effectively realized only in the specific regime in which the muscle is working and developing strength.

The specificity of strength training can be expressed in graph form as seen in Fig. 5. After isometric training the moment for ankle joint flexion was increased in the isometric regimen. At the same time dynamic strength at angular speeds of movement from 40 to 160 degrees per second was lower. The low speed isokinetic training (40 degrees/sec.) improved both isometric and dynamic strength when displayed in low speed movements.

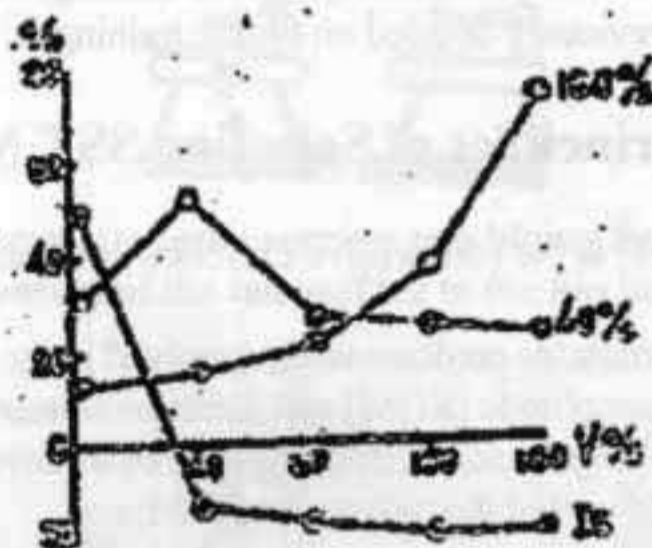


Figure 5: The relative changes in moment of force in the ankle joint developed at different speeds as a result of various methods of strength training

Training at high speed (160 degrees/sec.) resulted in an increase in strength displayed mainly at high speeds (120 and especially 160 degrees/sec.)

Thus, the greatest increase in the moment of force is observed in the training regime. As such, the isometric training has a negative influence on muscle tension in a dynamic regime. High speed training in the isokinetic regime does not produce an increase in isometric force.

1.8 The Means of SST

SST means are specialized strength exercises that:

----correspond to the competitive exercise in relation to the form of movement [skill], the dynamic mechanisms involved [forces, ROM, etc.] and the nervous-muscular system working regime [type of muscle contraction, etc].

----contain the proper training effect, capable of increasing the level of special work capacity which the athlete already has; and

----ensure the needed power generating base for improvement of technical-tactical skill and speed of the athlete's movement.

The SST means should:

----ensure the development of the specific (for the given sport) functional properties (contractile, oxidative, elastic) of the muscle groups primarily involved; and

----promote perfection of the dynamic structure of the sports exercise, i.e., effective organization of time and space regarding the working effect produced by separate muscle groups.

The SST means can be used to effectively resolve these tasks only when they:

----correspond to the competitive exercise in regard to the biomechanical and bioenergetic characteristics of the movements;

----are united in the particular system and organized precisely according to their timing; and

----are an organic part of the common system of training, i.e., are rationally combined with other loads and tasks previously decided on for the training.

1.9 Principles of Selecting SST Means

SST means should correspond to the competitive exercises in regard to the following criteria:

- a) to the groups of muscles predominantly involved in the work;
- b) according to the amplitude [ROM] and direction of movement;
- c) according to the magnitude of effort and time of its development;
- d) to the accentuated part of the movement ROM; and
- e) to the muscle work regime.

For example, in sprinting and the long jump, the movement of the swing leg (Fig. 6a) has a particular direction and amplitude (relative to the hip joint) and accentuated site (the portion shaded) on which the maximum rotary effort is developed. Therefore, the sprinter or jumper who wants to increase the power of the swing movement should execute the exercise shown in Fig. 6, (c). He should not do the conventional exercise with the barbell plate as shown in Fig. 6, (b).

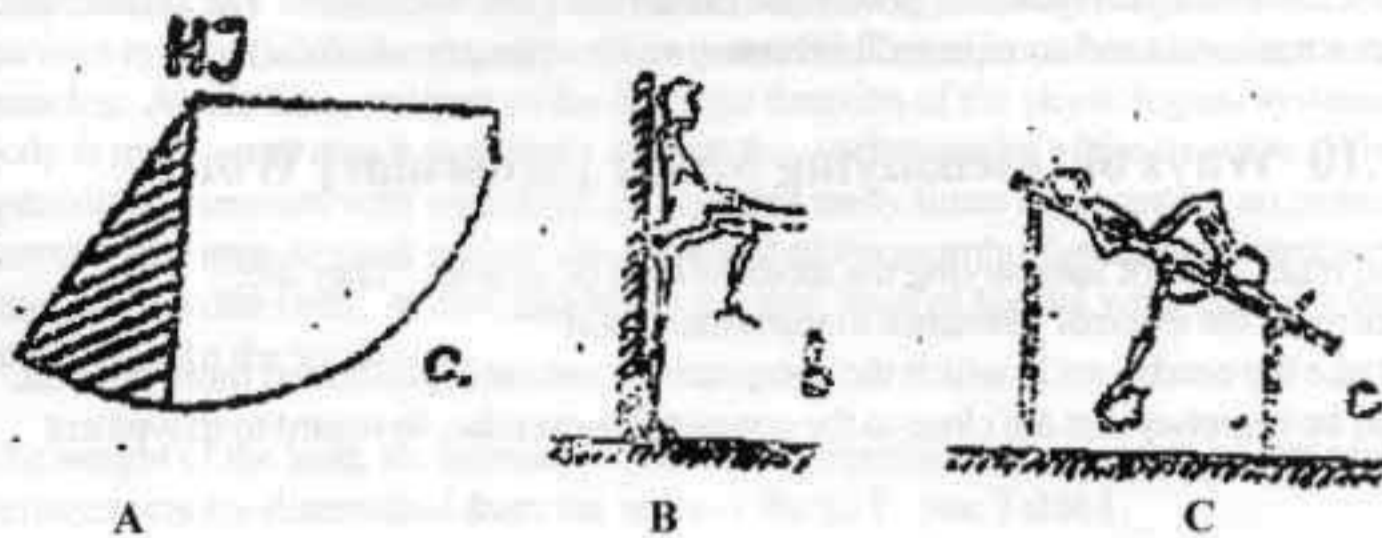


Figure 6: Illustration of the selection of means of the special strength training

When the swing leg movement is done in a specific way, combined with the work of the takeoff leg, the exercise imitates the coordination of efforts developed at this moment. In this regard, Figs. 7 and 8 are extremely useful. In all of these exercises, muscular effort is accentuated at the beginning of the movement.

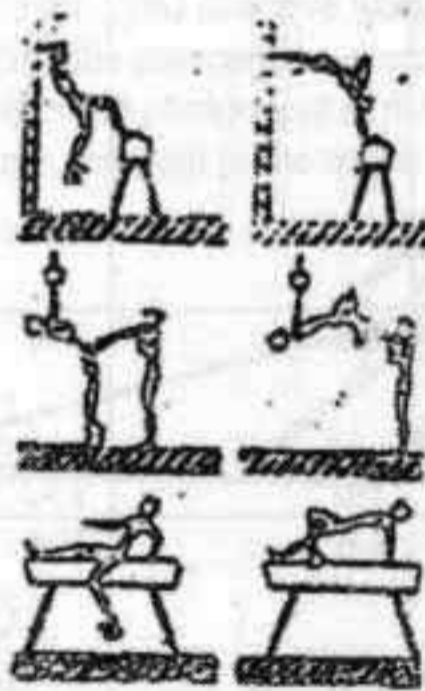


Figure 7: Examples of special strength exercises combining flexion of the swing leg with extension of the take-off leg in the hip joint.



Figure 8: Another example of special strength exercises

These exercises are useful for middle distance runners, football players, and athletes in other sports. But each athlete should use a regime of muscle work (or method of exercise) which corresponds to the specific character of his movements. For example, the jumper and football

player should execute single repetition, powerful efforts with great resistance. The sprinter and middle distance runner should do repeated movements with optimal resistance.

1.10 Ways of Intensifying Motor [Muscular] Work

There are two main ways of intensifying the motor system of athletes. They are:

- increase the external resistance to movement; and
- make the conditions in which the competitive exercise is performed more difficult.

Also used can be exercises that are close to the competitive exercise, in regard to movement structure.

Table 1
The primary emphasis of the training effect by using resistance exercises in different ways.

Weight in % from maximal	Number of repetitions	Number of sets	Rest between sets	Primary emphasis of the training effect
70-100	1-6	4-8	3'-4'	Maximal strength; explosive strength with large external resistance
80-90	5-10	4-8	3'-4'	Explosive strength with moderate external resistance
70-80	8-12	3-6	1'-2'	Maximum strength with an increase in muscle mass; speed of movement and explosive strength with small external resistance
50-70	10-15	4-6	3'-4'	
50-70	20-40	2-4	45"-90"	Local muscular endurance with large external resistance
30-60	30-50	2-4	45"-90"	Local muscular endurance with small external resistance
20-30	15-20	3-5	3'-4'	Quickness and frequency of non-loaded movements

Resistance (Load)

The resistance or load creates the external resistance to movement and mobilizes the central nervous system (CNS) to generate a more powerful flow of impulses to excite the working muscles. At this time, because of the load, the function of the physiological systems of the body is made more active in order to support the work capacity of the muscles. When the specialized exercises with resistance are repeated many times it guarantees an increase in the power of the muscle work and the development of the morpho-functional restructuring that takes place in the body. It then stabilizes on a new level of special work capacity that has been achieved from the workouts.

The weight of the load, the number of movement repetitions, the number of sets and rest pauses between sets are determined from the tasks of the SST. See Table 1.

The following pieces of equipment or devices can be used for creation of external resistance: resistance of a partner, rubber tubing, spring and hydraulic training devices.

Making the competitive exercise conditions more difficult resolves the same task as doing exercises with loads [external resistance]. In this case, neither the local influence on the separate muscle groups nor their functional unification is attained. Without exception, all the physiological systems of the body are involved in active work. Thus the basic reasoning behind using such a method (of making the competitive exercise more difficult to perform) consists in the intensification of the strength component in the entire movement structure (Figs. 9-12), and in the specific motor regime, inherent in the sports activity.

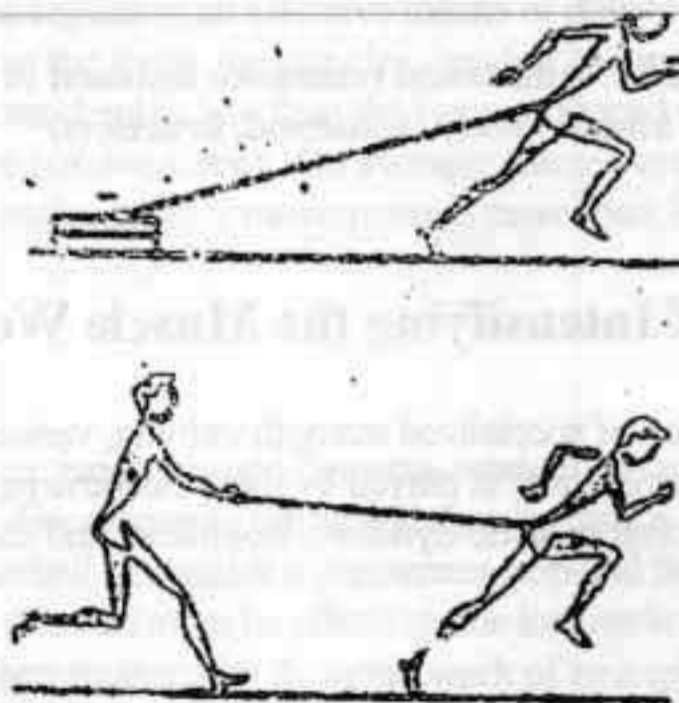


Figure 9: Running in more difficult conditions (top) towing an automobile wheel, (bottom) with resistance of a partner



Figure 10: Swimming while towing the float (brake)

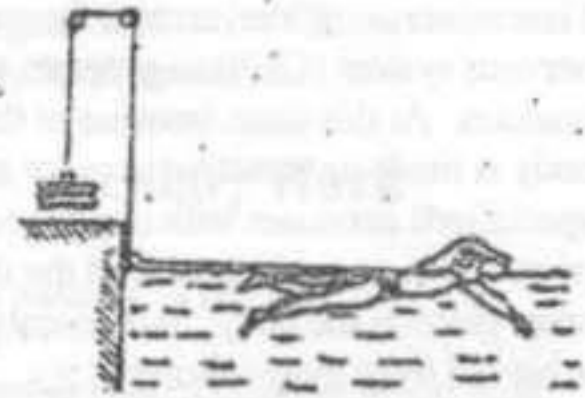


Figure 11: Swimming with pulley device



Figure 12: Additional resistance fastened to the athletes body (waistcoat, bracelets)

1.11 Ways of Intensifying the Muscle Work Regime

To intensify the motor function of specialized strength training, various muscle work regimes are used in SST. The predominant role is played by the concentric regime which is added and combined with isometric, eccentric, static-dynamic, isokinetic, and shock regimes.

Isometric regime

In the isometric regime effort is developed without muscle shortening, i.e., when the muscles are under active tension but there is no visible movement. There are two types of isometric regimes. In one of them the contraction of the muscles is increased smoothly and the duration of maintaining muscle tension depends upon the amount of effort (Fig. 13). This regime promotes development of maximum strength or static endurance.

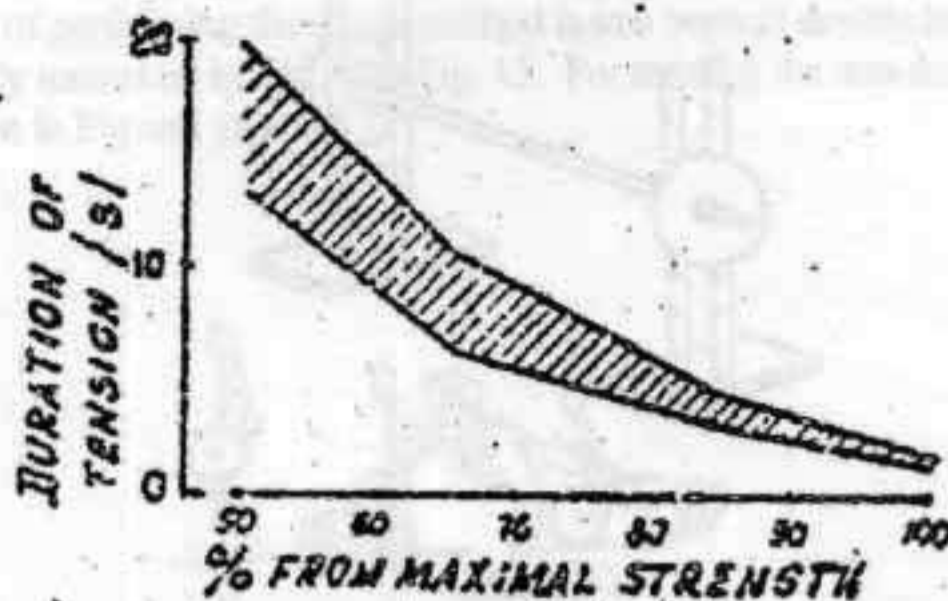


Figure 13: Duration of isometric muscle tension depending on the amount of the developing effort

In the other isometric regime the contraction is executed with emphasis on speed of tension development up to 80-90% of maximum. This ensures development of the ability to display explosive efforts and starting strength of the muscles which includes dynamic work conditions.

Eccentric (plyometric) regime

The eccentric or plyometric regime is an effective means of developing maximal strength. It is known (A. Bethe, 1929) that the force the muscles develop in a maximal contraction (the active force) as a rule, is considerably less than the force produced in a contracted muscle in the forced stretching phase (the passive force). On average, the resistive force generated in the stretching of contracted muscles in slow movements is more than 1.2-1.6 times the force seen in muscle shortening.

Static-dynamic regime

In the static-dynamic regime, isometric and dynamic work of the muscles is sequentially combined in one exercise. For example, lifting and then holding a considerable weight for a period of time. Or, lift a barbell up against a permanent stop and then push with an isometric contraction (Fig. 14). For this variant to be effective, the isometric tension should be held for two to three seconds and then replaced by dynamic work of an explosive nature using a relatively low weight. For this it is necessary to have some special simple equipment.

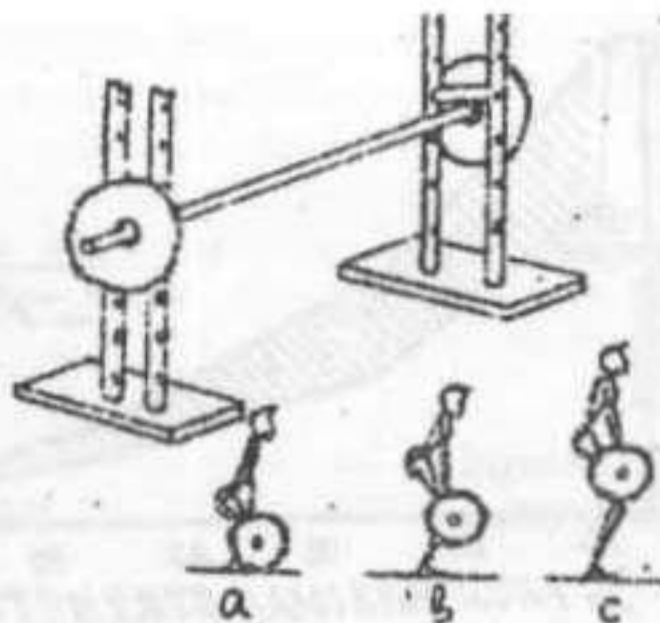


Figure 14: Exercise in the static-dynamic regime of muscle work. A, B, and C the poses in which isometric tension is developed

Isokinetic regime

The isokinetic regime is realized through the use of special devices that enable the external resistance to change automatically during the movement. When the speed of movement is increased, the resistance is also increased so that it ensures a maximum load on the muscles at all working amplitudes. In this case, it is not the amount of resistance that is important as in exercises with loads, but the speed of movement. In other words, the external resistance to movement is a function of applied force. Insofar as the muscle effort and work capacity of the athlete are changed with repeated execution of the movements, the resistance is automatically adapted to the ability of the muscles at each point in the range of motion (amplitude). As a result, a constant sub-maximal load on the muscles is ensured on each repetition of the exercise.

The shock regime

The shock method was thoroughly investigated in my research in the 1960's. The idea behind this method is in the use of the kinetic energy of the body or other object, to stimulate neuromuscular tension rather than using resistance and a slowing down of the movement. The neuromuscular tension is provided at contact after dropping from a specific measured height. The deceleration of the body drop (or of an object) creates a relatively short phase of amortization (shock) that causes a sharp stretching of the muscles. This stimulates the intensity of the central impulsion of motor neurons and creates an elastic potential of muscle tension. In the whole action (the amortization-push off cycle) fast subsequent contraction of the muscles with fast switching from an eccentric to a concentric regime is promoted.*

* In the USA the shock method is attributed to plyometric training. This is not entirely correct. But according to the main feature of the shock method and by the principal training factor involved in this method it is not simply the stretching of the muscles but fast switching from sharp shock stretching to vigorous contraction. For more detail about the shock method read my book "All About the Shock Method" which is published in Brazil and Italy.

The simplest form of performing the shock method is in a vertical double leg jump after a drop down from a strictly measured height. See Fig. 15. For training the arm muscles you can use the exercises shown in Figures 16 and 17.

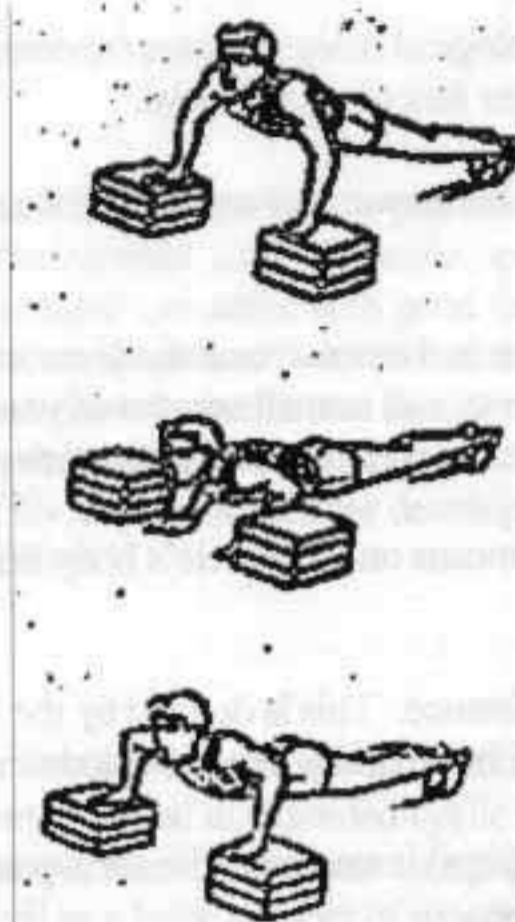


Figure 16: Push up Depth Jumps. An example of a shock regime exercise for training the arm extensor muscles

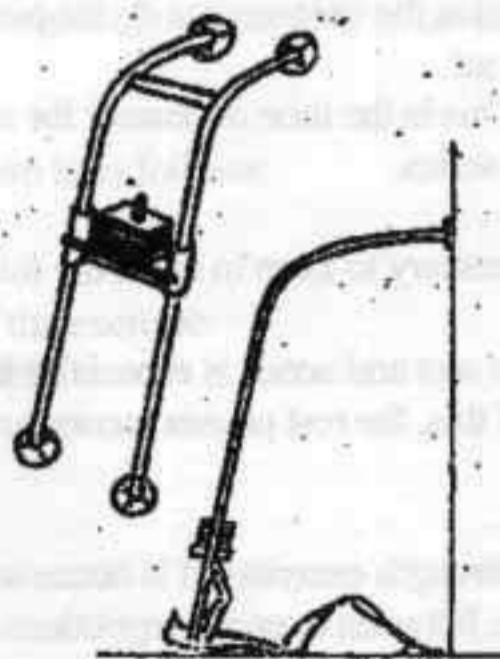


Figure 17: An elementary device for training the arm extensors by the shock method

1.12 The Main Features of The SST Methodology

The SST means should ensure the accomplishment of three specific tasks.

1. Improve the ability of the central nervous system to generate a more powerful flow of impulses to the peripheral muscles.
2. To ensure specific morphological reorganization (restructuring) in the muscles, which is necessary to increase their functional potential.
3. To promote an increase in the power and capacity of the energy transformation of the working muscles.

To resolve these tasks, the intensive and extensive methods are used. The intensive methods are characterized by maximum power and a small amount of work. Extensive methods are characterized by moderate (sub-maximal) power and optimal amounts of work.

The training influence of the SST means on the athlete's body is adjusted according to the following load parameters:

----Size of the external resistance. This is defined by the weight as for example, the weight of a barbell at 90% of maximum, or any other method of making the movement more difficult.

----Number of repetitions (reps) in one set. The set is continuous without pause or rest during the execution of one exercise.

----Number of sets. The total quantity (number) of repetitions in the continuous execution of one exercise.

----Training series. This is the association of several sets of one exercise. There can be several series in a training session. [Editor's Note: In this case "x" number of repetitions for one or more sets is considered one series. After completion of a series and a rest period, repetition of "x" number of reps and sets is then repeated for the second series.]

----Rest between sets. This is the time necessary for recovery of the body's ability to effectively perform the following set.

----Rest between series. This is the time necessary for recovery of the body's ability to effectively perform the following series.

When organizing the SST it is necessary to keep in mind the following:

1. The rest pause between sets and series is especially important for attaining the effect produced by the SST. Because of this, the rest pauses recommended in the following chapters should be strictly observed.

2. When performing the strength exercises it is necessary to relax the muscles wherever possible, as for example, between exercise repetitions.

3. It is necessary to execute exercises for relaxation and stretching of the muscles in between sets and series.

1.13 Ways of Performing Strength Exercises

In specialized strength training the following ways (methods) of performing the exercises are used:

Repeat Method

The repeat method makes it possible for the athlete to perform the exercise on a high level with one or another characteristic of movement, as for example, speed or power. The common quality of each repetition is repeatable execution with good form. The repetitions cease at the moment there an appreciable decrease in these characteristics which is tied in with the development of fatigue. The rest pause between sets should be of sufficient duration for restoration of the body to the optimal condition which makes it possible to have a quality performance of the exercise. This method is used for development of maximum explosive, starting strength and reactive ability.

Interval Method

The interval method is used for development of strength endurance and increasing the capacity of the energy acquisition sources involved in extended cyclic work that requires the display of significant muscle effort. In comparison to the repeat method, this method is characterized by sub-maximal work power as well as a large number of repetitions with a short rest pause between sets.

Serial Method

The serial method provides for execution of several series of exercises, each of which includes the same number of sets. Between the series it is necessary to maintain rest pauses that are sufficient for restoration of the body until it is capable of having a qualitative performance in the following series.

The serial method in formula form is as follows:

$$\frac{n \times X}{t_1} \times \frac{m}{t_2}$$

X-- the number of repetitions of the exercise

n -- number of sets (it is one series).

m -- number of series

t1 -- the rest between sets

t2 -- the rest between series

For example: $\frac{4 \times 6}{4 \text{ min.}} \times \frac{3}{8 \text{ min.}}$

This means that there are four sets of six repetitions with a rest period of four minutes in between. This constitutes one series. There are three series with a rest of 8 minutes in between.

In training, there are two forms of the serial method: repeat-serial and interval-serial.

Repeat-Serial Method

This method is characterized by sub-maximal work intensity and volume loads. The exercise is executed for the same number of sets, and with optimal rest pauses. This constitutes one series. Each series is repeated the same number of times. Between series the rest pauses are longer. The number of reps in the series, the number of series and the duration of rest pauses between them is determined by the current condition and level of preparation of the athlete, the tasks of the training, and the regime of exercise execution. This method is used predominantly for activation of morphological rebuilding in the body. It is also used to increase the amount of power generating substances available and the development of adaptive reactions to stabilize the body on a new functional level.

Interval-Serial Method

This method uses repeated work with sub-maximal intensity with limited (shorter) rest pauses than used in the repeat-serial method. Using this method provides for an increase in power and capacity of the energy acquisition mechanisms for muscle activity. It is used predominantly for the development of local muscular endurance or strength endurance.

The “Work to Failure” (Refusal) Method

This method is used mainly for the development of strength endurance. The amount of resistance, which makes it possible to execute a specific number of repetitions, as for example only 10, not more, not less. It is the key factor in this method. It is performed the same way, as for example, with 4 to 6 sets with the rest between them varying from 2 minutes to 30 seconds. If the “work to failure” method is executed with more sets, as for example 6 to 8, the amount of resistance must be reduced so that in each set only 10 repetitions are executed.

1.14 Special Methods of SST

In SST a complex of special methods is used. This includes circuit, alternative, coupling and complex methods.

Circuit Training

Circuit training is a variant of the interval method. The difference between them is that circuit training has a more versatile influence on the muscular system by using exercises having various training effects and less intensity of muscle work (Fig. 18). This method helps mainly to increase the capacity of the energy acquisition sources, perfection of the functional capabilities of various muscle groups and activation of morphological reorganization (restructuring) in the body.

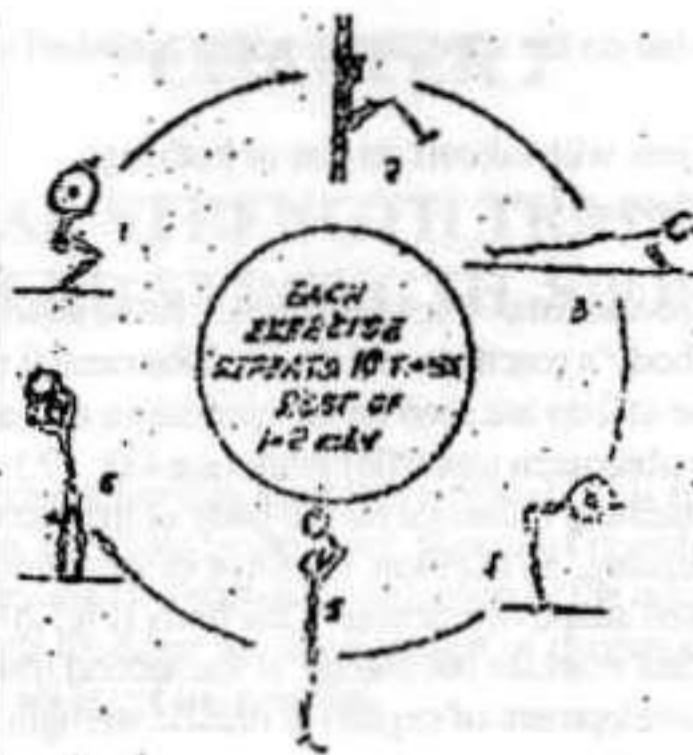


Figure 18: Examples of organizing the strength exercises using the circuit method. Each exercise is repeated 10 times. The rest between repeats is 1-2min.

Alternative (Contrast) Method

This method is used mainly for development of high-speed (fast) strength. The idea behind it is to create a contrast of muscle sensations when performing a movement in various alternated conditions such as facilitated, normal, and slightly impeded. By doing this, the degree of adaptation of the sensory system to the same (monotonous) work is diminished. The power of the central impulses to the muscular system is supported on a higher level that provides for an increase in the speed of movements. At the same time, a subjective sensation of lightness (of speed) of the movements is created in the athlete. As a result, he is then ready to reproduce this sensation when performing the exercise in normal conditions. This method also improves the ability to control and have objective evaluation of the movements.

Coupling (Conjugate) Method

This method is used to express the unity and interrelationships between the tasks of special physical and technical training of the athlete. It is realized by selecting such means and methods of execution that ensure simultaneous development of the needed motor abilities and perfection of sports technique elements. (See section 1.9).

Complex Method

The complex method provides for simultaneous (in one training session) combining and using SST means that have one primary emphasis but with various characteristics and intensities of their training influence.. For example, the following means for development of "jump force" may be used:

- Barbell squat.
- Squat jumps with a bar on the shoulders or with a kettlebell in the hands.
- “Short jumps”.
- Various jump exercises with takeoff on one or both legs.
- Drop jumps (jump downs).

The complex method has two variants. The idea behind one of them consists in using the positive after-effects of the body's reactions and those of the central nervous system. After performing tonic work, these effects are seen on the qualitative and quantitative characteristics of the training effect of the subsequent (specific) work (see Fig. 19.)

In this case the force of the training influence on the body of the second (subsequent) specific exercise is increased considerably. In addition, the force of the training influence is seen in the integrated and more expressed adaptive reaction of the body (Fig. 20). This includes the functional attributes of the first exercise but mainly of the second training effect. This method is used predominantly for development of explosive muscle strength.

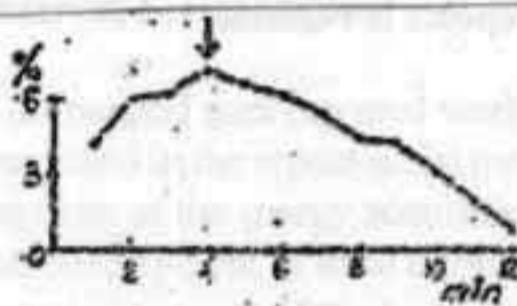


Figure 19: The dynamics of the increased ability to display explosive effort after squatting with a heavy bar. The arrow indicates the most favorable moment for execution of the second exercise



Figure 20: Increase in power in the vertical jump in place after 6 weeks of training with various weights: 1) 50% of maximum. 2) 90% of maximum and 3) combination of 90% and 50% of maximum.

The second variant of the complex method is used for development of local muscular endurance. In the first workout of the day the athlete uses specific work of low muscle tension and insignificant oxygen consumption for extended periods. This is needed to deplete the reserves of glycogen of the slow twitch muscle fibers. Then in the second workout of the day, the athlete uses the same muscle groups and executes the same specific work but with higher intensity. As a result, because of the exhaustion of the glycogen depots, the contractile properties of the slow twitch muscle fibers are considerably reduced. The work now involves predominantly fast twitch muscle fibers that promotes improvement of their oxidative properties and an increase in the aerobic capacity of the body. The rest pause between the workouts is 1.5 to 2 hours.

CHAPTER 2

SPECIAL STRENGTH TRAINING IN SPEED-STRENGTH SPORTS

For SST in speed-strength sports, various exercises are used. This includes exercises with weights, isometric exercises, exercises in the shock regime of muscle work, jump exercises, and complex methods. They are all directed to perfection of the athlete's ability to display powerful concentrated efforts based on the development of maximum, explosive and high-speed strength and reactive ability of the muscles.

2.1 Development of Maximal Strength

Exercises with weights and isometric exercises are mainly used for development of maximal strength.

2.1.1 Exercises With Loads

The repeat and repeat-serial methods are predominantly used.

The repeat method

This includes exercises with large (maximal, sub-maximal, and super maximal) loads. The training effect of this method is directed mainly to the improvement of the central nervous system to:

- (a) generate a powerful flow of motor impulses to the muscles;
- (b) include a greater number of muscle fibers in the work effort; and
- (c) Increase the power of the energy acquisition mechanisms for the muscle contraction.

This method is characterized by a limited number of repetitions in one set and in the numbers of sets. For example:

1. Execute 2-3 repetitions with the weight at 90-95% of maximum.

In the session execute 2-4 sets with a rest pause of 4 to 6 minutes in between. Two regimes of muscle work can be used here. In one of them the movements are executed without relaxation of the muscles between repetitions, as for example in squats with the weighted barbell held on the shoulders for the entire set. In the other regime, after each squat the bar is placed on the racks for a few seconds in order to instantly relax ("shake up") the muscles. Both regimes are effective for development of maximum strength, but the second one is better for improving the ability to display explosive strength and to relax the muscles.

2. Five sets are executed.

- 1) with the weight at 90% of maximum -- 3 repetitions;
- 2) with the weight at 95% of maximum -- 1 rep.
- 3) with a weight of 97% -- 1 rep;
- 4) with the weight at 100% of max -- 1 rep; and
- 5) with the weight at 100% of maximum plus an added weight of 1-2 kgs.

The last set is not done if the athlete has a feeling that he will not be successful. The rest between sets is 3-4 minutes. The five sets are repeated 2-3 times [2-3 series] with a rest of 6-8 minutes in between the series.

3. Work is executed in an eccentric regime with the weight 120-130% of maximum for the given exercise. Four to five repetitions are done for 3 sets with the rest between sets, 3-4 minutes. The load is raised to the initial position with the help of partners.

4. The combination of eccentric and concentric regimes of muscle work in the barbell squat with the use of separate suspensions are now being made (Fig. 21). For example, the squat descent is executed with a weight of 120-140% of maximal. The athlete then rises up from a low squat after the suspensions (hook apparatus) touch the floor and are separated from the ends of the barbell.

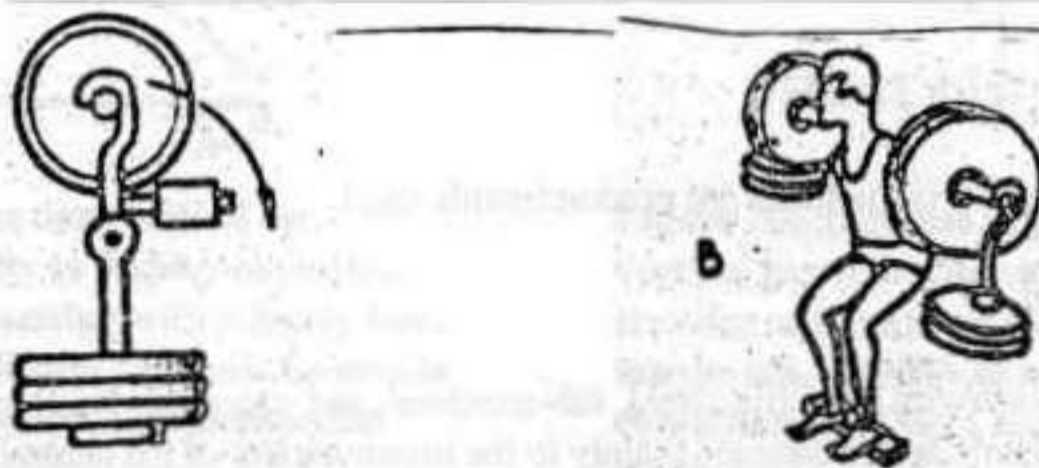


Figure 21: Special suspension device for using additional loads in the squat

When starting the bar is on the shoulders taken from special pillars adjusted to the needed height. After the suspended weights are removed the remaining weight, which is about 70-80% of maximal, is used for coming up from the squat very quickly. The bar is then once again put on the pillars and the athlete shakes the leg muscles. The partners at this time once again suspend the additional weights on the bar.

Two to three repetitions with compulsory relaxation and shaking of the muscles are executed for one set. In one series there are three sets with 4-6 minutes rest in between sets. There are a total of two to three series with a rest of 8-10 minutes in between series.

In the examples mentioned above (and in the future) the optimum dosage of exercises for use in practice is indicated. The dosage depends on the number of muscle groups involved in the work. In conditions of total body work, as for example when doing the barbell squat, the

dosage of exercises in regard to the number of sets should be less and the rest between them longer than when there is local work as for example, when doing the bench press.

The repeat-serial method

This method is different from the previous one according to the following factors. In this method the main training factor is not the amount of weight load but the duration of work (muscle tension) with sub-maximal weight. The training effect of this method is directed predominantly to activating the processes connected with functional adaptation and working hypertrophy (morphological specialization) of the muscles. This method is characterized by an increased volume of work at the expense of increased repetitions and sets. The movements are executed slowly and some of the sets are united in series, which are repeated for some time.

Two variants of the repeat—serial method, distinguished according to their primary emphasis on the training effect, are recommended. They include a moderate and considerable increase in muscle mass.

Variant 1

For development of maximal strength and a moderate increase in muscle mass, the resistance used is 70-90% of maximal. In this, it is necessary to be guided by the following rules:

- 1) The work should be very intense so that as much as possible, the optimal working condition of the athlete's body will be maintained for an extended period of time;
- 2) The strength work should not be executed as an addition to some other work as for example, perfection of sports technique, speed, or endurance. It should be an independent training session or a part of the main training;
- 3) It is necessary to maintain the rest pauses between sets and series very strictly. This is needed for sufficient restoration of the specific work capacity of the athlete; and
- 4) The rest between training workouts for development of maximum strength with large loads should be 2-3 days.

Examples:

- 1) The weight is 85-95% of maximum and there are 5-6 reps in one set. There are 2-3 sets in one series with a rest of 4-6 minutes in between each set. There are 2-3 series with a rest of 6-8 minutes in between.
- 2) A series with 3 sets is executed as follows:
 - (a) with a weight of 80% of maximum—10 reps;
 - (b) with a weight of 90% of maximum—5 reps; and
 - (c) with a weight of 93-95% of maximum—2 reps.

The rest pause between sets is 4-5 minutes. In one training session there are 2-3 series with a rest of 6-8 minutes between series.

- 3) Four sets with a rest of 5-6 minutes between sets:
 - (a) in the first set the weight is 70% of maximum for 12 repetitions.
 - (b) in the second set the weight is 80% of maximum for 10 reps.

(c) in the third set the weight is 85% of maximum for 7 reps.

(d) In the fourth set the weight is 90% of maximum for 5 reps.

There are two series done with a rest of 8-10 minutes in between.

- 4) Slow movements in the eccentric regime with the load at 75-80% of maximum are executed. The very lowest position is maintained for 2-3 seconds and then, with the greatest speed possible, the concentric move is executed. The exercise is repeated 2-3 times in 2-3 sets with rest pauses of 4-5 minutes in between sets. Two series with a rest of 6-8 minutes in between are performed.
- 5) In the static-dynamic regime of muscle work, the load is 70-80% of maximal. At the beginning, there is a gradual, 2-4 seconds of isometric tension build-up within the limits of 80-90% of the weight being used. After the hold, there is fast movement in a concentric regime. In one set there are 4-6 reps. In one training session there are 2-4 sets with a rest pause of 4-6 minutes in between. In all, there are two series with a rest of 6-8 minutes in between series.

Variant 2

This variant of the repeat-serial method produces a considerable increase in muscle mass. This method is based on the intensification of the body's metabolic processes. This variant involves an intense regime of muscle work based primarily on the glycolytic mechanism of energy production. When this mechanism is strongly involved, protein break down is especially strong. Their synthesis begins at rest and is expressed more strongly, the greater the quantity of protein broken down. The greater the quantity the stronger the synthesis. It is necessary to keep in mind that the activation of protein synthesis is developed very slowly and proceeds for about 48 to 72 hours after heavy work.

The main features of this method are expressed in the following:

1. The resistance is not the greatest, but is sufficient for the stimulation of significant muscle tension;
2. The work is executed for a long period of time and to total fatigue;
3. The rest pauses between sets are shortened to 1-2 minutes;
4. Muscle relaxation is not required between the repetitions in one set;
5. The work executed is local in character and involves one group of muscles for 2-3 sets. In one training session 2-3 muscle groups are involved.
6. The load on the muscle groups is alternated from session to session so that they receive at least 72 hours of rest.

This variant of the repeat—serial method is good for promoting the development of maximal strength in slow movement conditions. However, it has little effectiveness in development of explosive strength and speed of movement. This is why it is best used with low volume at the beginning of a yearly cycle.

In order to increase the training effect of this method it is necessary to follow these rules:

1. Increase only one variable of the training load—weight or the number of repetitions;
2. Increase the number of reps and sets before increasing the weight;
3. Reduce the number of repetitions in accordance with increases in resistance or number of sets;
4. Reduce the rest pause between sets by small amounts.

Examples of this method include:

1. With the resistance at 75-85% of maximum, the movements are executed slowly to obvious fatigue. Do 10-12 reps for 2-3 sets with a rest of 2 minutes between sets.
2. With the resistance at 80% of max. do 3-5 sets of 8-10 reps with a rest of 2-3 minutes in between sets. If the fatigue is significant, the time of rest between sets is increased to 5 minutes.
3. With the weight between 84-95% of maximum, do 3-8 sets of 3-8 reps with the rest pauses between sets, 3-5 minutes. If the last repetition in the set cannot be executed because of fatigue, a partner assists in overcoming the resistance.
4. With the resistance between 85-90% of maximum the number of repetitions is optimal (to fatigue) and then two additional movements are done with the help of a partner. When the weight is lowered the partner does not assist. Two sets are executed with the rest pause depending upon the individual.
5. The same number of repetitions is executed in each set but with less resistance in each set. For example, 65 x 10, 60 x 10, 55 x 10, 50 x 10. The rest pause between sets is 1-2 minutes. This variant is useful for targeting the small muscle groups which fatigue quickly or when the rest pauses between sets are reduced.

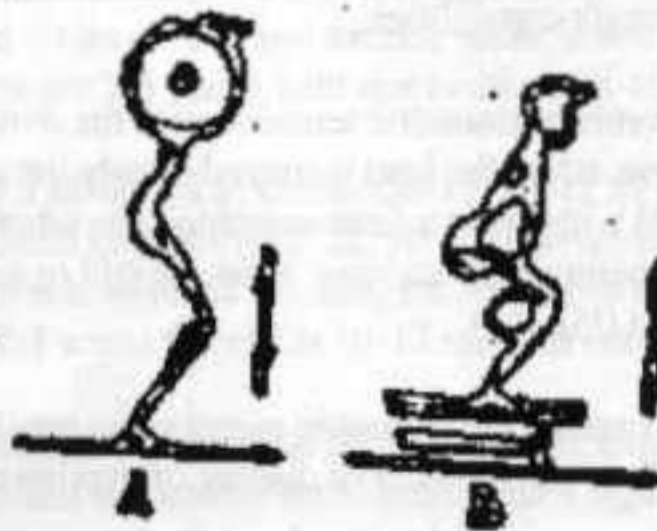


Figure 22: Squat jump with the bar on the shoulders (A) and with kettlebell in hands standing on 2 parallel exercise benches (B)

6. Squat jumps on two parallel benches or on the floor with kettlebells, (24-36 kgs.) held in the hands (Fig. 22.B). In one set there are 8-10 jumps with sub-maximal effort. In one series with two sets, the rest between sets is 2 minutes. In 2-3 series the rest between series is 3-5 minutes.

2.1.2 Isometric Exercises

In isometric exercises the muscle tension is increased smoothly to the maximum and maintained for 6-8 seconds. In the 2-3 sets that are done, each set involves 3-5 tensions with the rest between each not less than 1 minute. Between sets the rest pause is 4-6 minutes and between 2 series the rest is 6-8 minutes.

Guidelines for isometric training:

1. Isometric training is especially effective when the competitive exercise requires the display of a high level of strength. However, if it is necessary for the athlete to execute high-speed movements with relatively small external resistance, the isometric training is less effective and can even create a negative influence on speed of muscle contraction (see Fig. 5).
2. Isometric exercises effectively develop maximal strength of muscles. However, long application of isometric loads leads to significant expansion of the connective tissue. As of result, the strength (the biomechanical rigidity) of the muscles is increased. When this occurs, elasticity is reduced. Because of this, for sports that involve fine coordination and speed in cyclic muscle work, the application of high volume and extended duration isometric loads is not desirable.
3. The essence of isometric training is in the development of maximal strength when there is a slow increase in the amount of muscle tension for relatively extended holding periods of 6-8 seconds. It requires expenditure of significant force that stimulates adaptive reorganization in the nervous-muscular system which determines its strength capabilities.
4. It is effective to combine isometric tensions with the dynamic regime of muscle work. For example, when the load is moved slowly through a large amplitude of movement [ROM] with intermediate stopping. Or, when the isometric tension is developed after a preliminary increase in the weight or resistance against a stop or immovable object (Fig. 14).
5. It is necessary to execute the isometric exercises in specific positions (postures) that are appropriate to the moment of display of maximum effort in the competitive exercise.
6. It is necessary to perform relaxation exercises before each isometric tension as well as dynamic exercise. Exercises which involve stretching of the muscles should be

done between sets. At the end of isometric training it is necessary to do relaxation and dynamic exercises of moderate intensity.

2.2 Development of Explosive Strength and Reactive Ability

The development of explosive strength and reactive ability uses loaded exercises, isometric exercises with a fast display of muscle tension, jump exercises, shock and complex methods.

2.2.1 Exercises with Loads (Weights)

The repeat-serial method is used here mainly in the following areas:

1. The load used is in the range of 60-80% of maximum. The greater the external resistance which must be overcome in competition, the greater the weight. There are 5-6 reps in a set performed at maximum effort with compulsory relaxation of the muscles between movements. The rate of executing the repetitions is not high. In one series of 2-4 sets, the rest pauses are 4-6 minutes between sets. In a training session of 2-4 series the breaks between series are 6-8 minutes.
2. The weight is 60-80% of maximum. The weight at the beginning of the lifts is at approximately 1/3 of the working range of motion. The weight is lowered with instant switching to the concentric regime and quickly moved in the opposite direction. In one set there are 5-6 repetitions with relaxation of the muscles when the weight is put back on support pillars. There are 2-3 reps in one set with a pause of 4-6 minutes in between sets. In a training session of 2-3 series the breaks between series are 8-10 minutes. In these variants, the work should not be of a steady rate nature. It is necessary to be mobilized for each repetition and to concentrate effort at the beginning of the movement.
3. Barbell squat jumps (Fig. 22, A) The weight of the bar is selected according to the athlete's abilities within the limits of 30-60% of maximum. In one set there are 4-6 squat jumps. In one series of 2-3 sets the rest pause is 4-6 minutes between sets. In a training session there are 2-3 series with rest breaks of 8-10 minutes.
4. In squat jumps with a kettlebell in the hands (16, 24, or 32 kgs, selected individually), standing on two parallel benches (Fig. 22, B). In one set there are 5-8 jumps at maximum effort. In one series of 2-3 sets, the rest is 6-8 minutes between sets. In one training session of 2-3 series the rest is 10-12 minutes between series.

The repeat method should also be used for the development of explosive muscle strength (Section 2.1.1.) especially when the athlete has to overcome a significant external resistance in competition. In this it is important to remember that it is necessary to relax the muscles whenever possible.

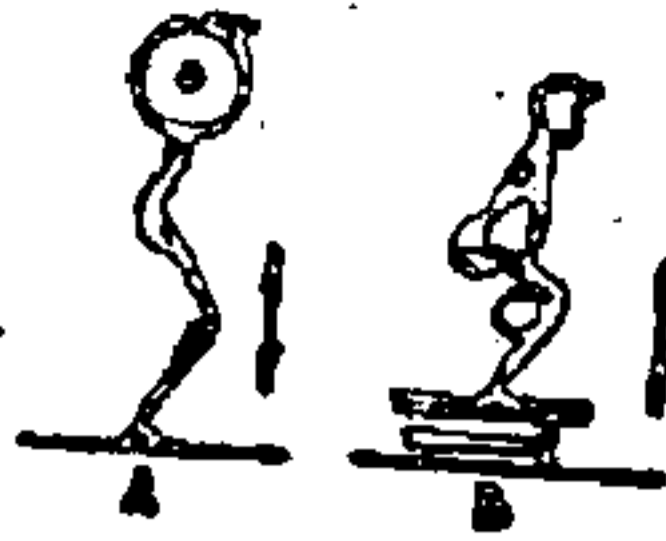


Figure 22: Squat jump with the bar on the shoulders (A) and with kettlebell in hands standing on 2 parallel exercise benches (B)

2.2.2 Isometric Exercises

Isometric exercises are executed with the appropriate joint angles that correspond to the position seen when the muscle activity is accentuated in the working effort used in the competitive exercise. The isometric exercises are executed with fast (explosive) development of muscle tension up to 60-80% of maximum. In one set there are 5-6 explosive efforts with an arbitrary rest pause. In a training session with 2-4 sets the rest between sets is 4-6 minutes. Relaxation of the muscles is necessary before each effort. Stretching exercises are executed between sets.

2.2.3 Shock Method

The shock method is used for development of explosive strength of various muscle groups. The most widely used method is the vertical jump upward after a drop down from a height of .07-.08 meters [depth jump]. This method is very effective for development of so-called "jump force" (Fig. 15). The optimum dosage of such an exercise is 4 sets of 10 jumps for well-qualified athletes and 2-3 sets of 6-8 jumps for less prepared athletes. The rest between sets is filled with easy running and relaxation exercises for 6-8 minutes. The depth jumps should be executed 1-2 times per week and for qualified athletes, 3 times a week at the end of the SST stage. It is also necessary to vary the take-off after the drop down (Fig. 23).

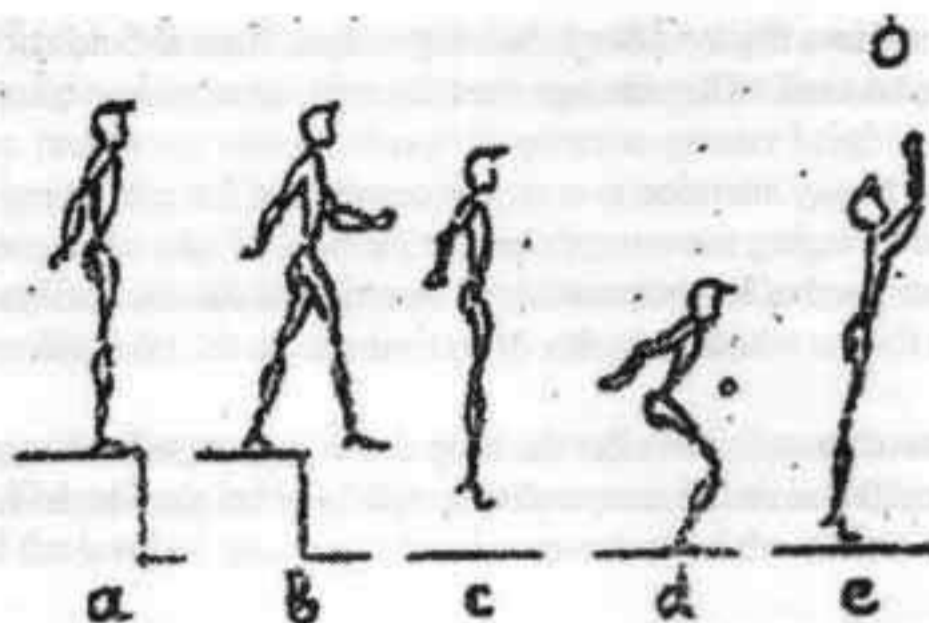


Figure 15: The take-off after the drop down in a depth jump.

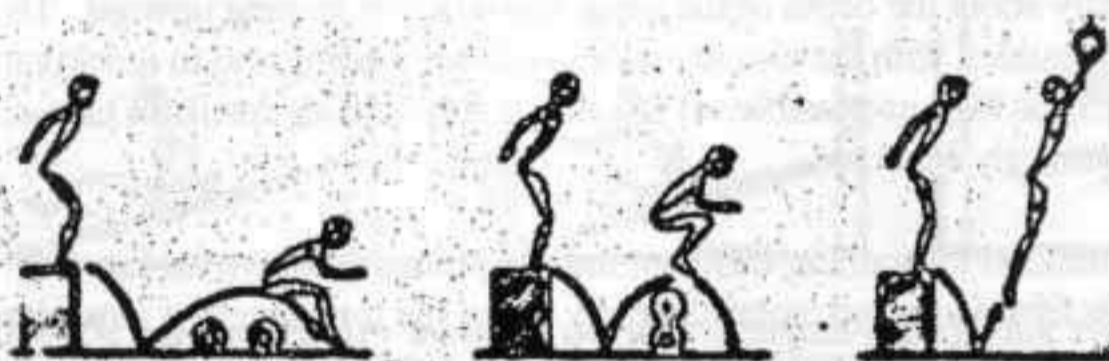


Figure 23: Variants of the take-off after the drop jump [depth jump].

The following should be taken into consideration when executing the push-off (take-off) after the drop down in the depth jump:

1. For development of explosive strength and reactive ability of the leg extensor muscles, it is important to use a height of 0.7 to 0.8 meters for the depth jump. Any further increase in height of the depth jump changes the dynamic characteristics of the push-off considerably. Take-off time increases quickly and mainly at the expense of an increase in the time of switching the muscles from eccentric work to concentric work. As a result, the primary effect of depth jump training effect is greatly changed.
2. Any increases in depth jump height should be limited to about 1.0 to 1.1 m. This jump variant renders enough of an effective influence on the development of explosive and maximal strength. But its training effect on perfection of the reactive ability of the muscles is decreased.
3. Depth jumps with additional loads or with high heights (2-3 m.), is not recommended in the literature. It is a mockery, above all to the muscles, ligaments, tendons, and joints. I do not recommend such tricks even to the triple jumpers.
4. In execution of the drop down, it is necessary to pay attention to an elastic banding and unity of movements at the push off. In training, the depth jump should be executed

with shoes that have thick rubber soles. Gymnastic mats should not be used when executing the take off. They change the nature of the muscle work.

5. It is necessary to pay attention to correct execution of the arm swing movements at take-off. The swinging movements are the element of take-off technique. They determine the speed of leg extension, the direction of the take-off and provide coordination for the whole complex of movements in the take-off.
6. For activation of the take-off after the drop down, it is expedient to use a target, as for example, a small ball or flag suspended at a definite height which should be touched by the hand.
7. In the landing it is necessary to have a very elastic landing on the forward part of the foot. The legs should be bent slightly in the knee joints. It is not necessary to think specifically about the depth of the jump down before leaping upward. The athlete should be guided with the aim to make a resilient landing and to quickly take off in order to fly as high as possible. If this aim is fulfilled, all details of take-off technique will be correctly executed.

Using the shock method for training different muscle groups is shown on Fig. 24. The weight at the beginning is freely lowered; approximately 2/3 of the total range of movement. Then there is sharp movement downwards—upwards—with fast twitching of the muscles from eccentric to concentric work, executed to produce vigorous acceleration of the load. In order to avoid injury it is necessary to provide limiting devices to block movement of the weight from going further than necessary.



Figure 24: Examples of exercises in the shock regime of developing effort.

When the exercises are executed the following should be taken into consideration:

1. The starting position is selected after taking into consideration the position of the body at which the maximum working effort in the competitive exercise is developed. The initial pathway should be minimal but sufficient to create the shock tension in the muscles.

2. The size of the shock effect is determined by the weight and the height from which it falls. The optimal combination of these and other factors is empirically selected. However, preference should always be given to greater height rather than greater weight.
3. The exercises in the shock regime should be executed only after an intense warm up of the muscles.
4. The dosage for shock exercises should not exceed 5-8 movements (repetitions) in one set. The volume and number of series are determined with an eye on the weight used and the level of special physical preparation of the athlete.

On Fig. 25 are some elementary training devices that use the shock regime. The principle behind these is quite obvious.



Figure 25: An elementary training devices to achieve the shock regime of muscle work.

It is very important to emphasize that one should not relate to the shock method in a frivolous manner. In recent times, in many publications (mainly in the USA), the authors offer various variants of shock methods. However, they neglect the basic rules which were experimentally developed and verified even back in the 1960's. Relative to this it is important to pay attention to the following:

1. The shock method has an extraordinarily strongly expressed training effect on the nervous-muscular system. It is considerably stronger than any other method of natural stimulation of the contractile activity of the muscles. Because of this, it is inadmissible to exceed its optimum dosage and duration of use, as well as the recommended height of the drop down.
2. Because of the shock method's strong training effect on the nervous-muscular system, ligaments and joints it is necessary to:
 - (a) prepare the athlete in advance by doing jumping and resistance exercises.
 - (b) study the technique of executing exercises in the shock regime especially when the muscles are working in the push-off (take-off) after the drop down. This is not as simple as it may seem at first glance.
 - (c) increase the height of the depth jump and the power of the take-off.
3. It is incorrect to overestimate the possibilities of the shock method. It is only one of many ways of intensifying the work of the nervous-muscular system, which by itself, cannot replace all the others. The shock method should be applied in a complex with

other means and methods. It should have a definite place in the system of SST and be used on a specific stage of the training process.

4. The shock method is only for high-level athletes. The shock method should never be applied in great volume in the training of low-level athletes. For these athletes there are many diverse and sufficiently effective means of SST. One should never execute exercises in the shock regime of muscle work when in a fatigue state, with muscle soreness or in the final treatment of injuries.

2.2.4 Jump Exercises

Jump exercises are used for development of explosive leg strength, i.e., so-called "jump force." They are executed as single repetitions or repeated take-offs on one or both legs. The single repetition jump exercises are executed from place or with an upward jump on both legs (Fig. 26).

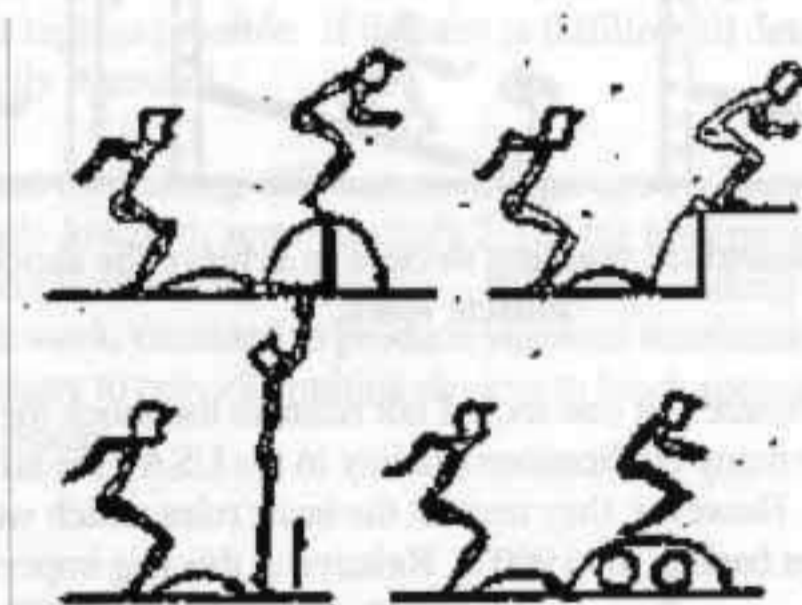


Figure 26: Examples of jumping exercises with single take-offs.

The repeat-serial method of exercise is used in the following dosage: 8-10 take-offs with an arbitrary rest pause in one set. There are 2-3 sets with a rest of 2-3 minutes between sets in one series. There are 2-4 series with a rest break of 4-6 minutes between each series in a training session.

Multi-repetition jump exercises include 3-8 take offs from place on one or both legs. For example: a three-fold jump on one leg, from leg to leg, or on both legs; a quintuple jump on one leg or from leg to leg; an eight-fold jump from leg to leg or alternating two take-offs one after the other, by one leg and then by the other. The repeat-serial method is used in one set of three to four repetitions. In one series there are two to three sets with a rest pause of 4-6 minutes between sets. In a training session of 2-3 series, the rest breaks are 6-8 minutes between series.

When using jump exercises it is necessary to remember the following:

1. The take-off should consist of a powerful concentrated effort with active work of the driving leg and vigorous movement of the swing leg. The swinging movements of the arms should also be vigorous and synchronized with the swing leg movements. Especially strong should be the arm swing movements in jumps with a double leg take-off.
2. When doing exercises with one leg or from leg to leg, the push-off should be directed forward and upwards and so that the flight phase trajectory is high.
3. The jump exercises have a specific technique of execution which is well developed in track and field. It is necessary to study this technique. If not, the efficiency of training using jump exercises will be low.
4. To make the take-off as active as possible, it is necessary to execute the exercises for result, i.e., to try and jump higher or further as much as it possible.

2.2.5 Complex Method











The complex method is very effective for the development of explosive strength. The following examples can be used as the basis for working out other combinations of exercises that take into consideration the specific characteristics of the movements executed in the particular sport.

First executed are two sets of 2-3 slow movements with the weight at 90-95% of maximum. This is followed by 3 sets of 6-8 movements with the weight at 30% of maximum, executed with maximum speed and compulsory relaxation of the muscles between movements. The rest between sets is 3-4 minutes and before changing the resistance it is 4-5 minutes. In one training session there are 2-3 series with a rest pause of 8-10 minutes between series.

1. Start by gradually increasing isometric tension to the maximum and hold for 6 seconds in the position in which maximum effort is displayed in competitive conditions. This exercise is repeated 2-3 times with a break of 2 minutes for compulsory relaxation of the muscles between the next repetitions. After this, execute the movements with the resistance at 40-60% of maximum with maximum intensity for 4-6 reps. Do 2 sets with a rest of 3-4 minutes in between. The whole complex is executed 2 times with a break of 4-6 minutes between.

For development of the so-called "jump force," combinations of exercises listed in Table 2 are effective. Only one of these combinations is used in a training session. In subsequent training sessions different combinations of exercises should be used.

TABLE 2
Complex Method for Development of Explosive Muscle Strength

First exercise	Rest between exercises	Second exercise	Number of reps of complex	Rest between reps of complex
 90% 2x2-3 rest 3-4'	4-6'	 30% 3x6-8 rest 3-4'	2-3	8-10'
 16-24-32 kg 2x6-8 rest 3-4'	3-4'	 6-8 jumps 2x5-6 rest 3-4'	2-3	6-8'
 80-85% 2x2-3 rest 3-4'	3-5'	 16-24-32kg 2-3x4-6 rest 3-4'	2-3	6-8'
 70-80% 2x5-6 rest 2-4'	4-6'	 3 jumps 2-3x6-8 rest 4-6'	2-3	6-8'
 90-95% 2x2 rest 2-4'	4-6'	 h=0.75m 2x6-9 rest 4-6'	2-3	8-10'

The complex method renders a very strong training effect on the body, especially the muscular-skeletal system. Because of this it requires very close attention to how it is used in training. More specifically:

- (a) To apply the complex method it is necessary to prepare the leg muscles with barbell and jump exercises;
- (b) The training effect of the complex method is reduced considerably if it is done in a fatigue state or after training work as for example, for perfection of sports technique, development of speed or endurance;

- (c) Because the complex method requires a large expenditure of energy, it should not be used before work that involves fine coordination of effort, high movement speed, display of explosive strength or endurance;
- (d) It is best to use the complex method program in a separate training session.

To summarize, it is necessary to pay attention to some of the basic features of the methods used in development of explosive strength and reactive ability of the muscles.

1. The working effort, regardless of the external conditions displayed (isometric regime, large or moderate resistance), should be concentrated (development of significant muscle tension in a short period of time),
2. The work effort should always be concentrated in the initial part of the working amplitude of movement {ROM}.
3. The movement should include fast switching of the muscles from eccentric to concentric work.
4. The greater the external resistance that must be overcome in a competitive exercise, the greater the resistance one must use in the SST program.
5. Always recall the necessity to relax the muscles and to do this at each convenient opportunity.
6. It is important to observe the recommended rest pauses between sets and series. If the exercise is repeated when the muscles are not fully restored it changes the training effect toward development of strength endurance.
7. The SST program should be performed as a separate training session and only with "fresh" forces, when the energy potential of the body is not spent on other work
8. Between series, it is necessary to execute free wide amplitude swinging movements by the muscle groups which were loaded. Also include imitations of the competitive exercise or its elements.
9. If the SST program is executed for development of "jump force," it is necessary to perform 2-3 non-intensive accelerations in combination with easy jump exercises in between series. In addition, swinging movements by the legs and exercises for relaxation (shaking up) of the muscles are done.

2.3 Development of High-Speed Strength

For loaded (resistance) exercises and jump exercises the complex method is used. Training devices are also widely used.

2.3.1 Exercises with Loads

Resistance exercises are executed using the repeat-serial method. For example:

1. The load resistance is selected in the range between 50-70% of maximum in relation to the size of the external resistance which must be overcome in competitive conditions. In other words, the stronger the external resistance the greater the weight. The exercise is executed 6-8 times at maximum speed but at a low rate. In one series of 2-4 sets the rest period is 3-4 minutes between sets. In a training session of 2-3 series the rest between series is 6-8 minutes.
2. For developing primarily starting muscle strength, a weight of 60-65% of maximum is used. The exercise is performed with short concentrated explosive efforts to only move the weight but not accelerate it through the maximum range possible. The regime and dosage of work is the same as in the previous variant.

In all variants of this method, relaxation of the muscles between each set is obligatory. Between series, active rest is needed. This involves using exercises for relaxation, "shaking up" of the muscles and swinging movements with a wide range of motion.

2.3.2 Alternative (Contrast) Method

For development of high-speed strength the alternative (contrast) method is effective (see Section 1.14). The idea behind this method lies in alternation of movement executed with maximal speed using the resistance of variable weights, as for example:

- a) The optimum weight is when it is possible to imitate the high-speed regime of the muscle work that is characteristic of the competitive exercise;
- b) A heavier weight is used for a greater than optimum load; and
- c) A facilitated load, which is easier and lighter than the optimum one.

The facilitated weight is used for experiencing the sensation of high movement speed and for the psychological transfer of this sensation to the movement with optimal weight. The heavier weight is used for activating the muscle effort needed and to transfer it to the appropriate motor act with optimum weight.

For example, the following combinations of weights are executed:

Variant 1

- (a) Heavy weight, 3-4 reps
- (b) Optimum weight, 5-7 reps
- (c) Facilitated weight, 3-4 reps
- (d) Optimum weight, 5-7 reps

Variant 2

- (a) Facilitated weight, 3-4 reps
- (b) Optimum weight, 5-7 reps

Variant 3

- (a) Optimum weight, 5-7 reps
- (b) Heavy weight, 3-4 reps
- (c) Optimum weight, 5-7 reps

Variant 4

- (a) Facilitated weight, 3-4 reps
- (b) Optimum weight, 5-7 reps
- (b) Heavy weight, 3-4 reps
- (c) Optimum weight, 5-7 reps

Variant 5

- (a) Heavy weight, 3-4 reps
- (b) Optimum weight, 5-7 reps

In each set the movement rate is not high. Between movements with different weights the rest pause is minimal. Relaxation of the muscles is obligatory. Variants 1, 3 and 4 are executed 2-3 times and Variants 2 and 5 are executed 3-4 times, with a rest of 2-4 minutes between sets for all variants.

2.3.3 Jump Exercises

Unlike the development of explosive strength, any variant of jump exercises should be executed without a display of great power. Emphasis should be on fast take-offs.

1. A ten-fold jump from leg to leg or two jumps on the right and two jumps on the left leg. In one series of 4-6 sets the rest pause is 4-6 minutes between sets. In one training session of 2-3 series, the rest pause is 8-10 minutes between series.
2. The jumps from leg to leg are done for a distance of 50 m and the time is recorded. The athlete starts by pushing off from both legs as in the standing long jump, and then lands on one and then alternates the legs consecutively. In one series there are 3-5 sets with a rest of 4-6 minutes between sets. In all, there are 2-4 series with a rest break of 8-10 minutes between series. This is a very good means for developing the power of starting acceleration.

2.3.4 The Complex Method

To get the effect of the complex method, as in the above variants of exercises with loads (2.3.1), the exercises are executed on the positive background of the previous (tonic) work with great (90-95% of maximum) resistance. Two series are executed and each of them includes two sets of 2-3 reps.

The main features of the SST program for the development of high-speed strength are as follows:

(a) aim for performing fast movements giving attention to relaxation of the muscles before and immediately after sets and in between repetitions of movements wherever possible;

(b) carry out the SST program only when in a non-fatigue state;

(c) select means of SST that are very close to the coordinated structure of movements and the development of muscle effort in the competitive exercise (skill).

CHAPTER 3

SPECIAL STRENGTH TRAINING IN CYCLIC SPORTS

The task of SST in cyclic sports is to develop specific forms of strength endurance, i.e., the ability of the athlete to repeatedly display the needed effort (power) over the distance. Perfection of this ability is tied in with an increase in the strength potential of the athlete as well as the ability of the body to execute maximally long periods of muscle work that use the aerobic pathways for energy acquisition.

In view of these requirements, SST should ensure the main task of training—an increase in speed of locomotion over the distance. This is done by the establishment of an effective ratio between the power of the working effort that determines stride length and the rate of movement (stride frequency).*

*Stride length is the distance overcome in one moving cycle as for example, in running, swimming, cycling, rowing and other sports.

In other words, the main task in training in cyclic types of sport is to increase the distance speed by increasing stride length at an optimum stride frequency. For SST in cyclic sports, resistance exercises, isometric and jump exercises, and execution of competitive exercises in more difficult conditions are used. The main task of these exercises is to develop maximum explosive and high-speed strength, reactive ability of the muscles, local muscular endurance, and maximum anaerobic power of the athlete.

3.1 Development of Maximum Strength

Exercises with mainly large loads are used with the repeat-serial method. The work is executed in two directions. One is oriented to the development of maximum strength. The other, to the development of the ability to repeatedly display lesser amounts of effort.

3.1.1 Exercises With Weights

In cyclic sports, to develop maximum strength it is necessary to execute resistance exercises in the repeat and repeat-serial methods (See Section 2.1.1).

To develop the ability to repeatedly display smaller amounts of effort, the following variants of the repeat-serial method are effective.

1. With the resistance at 70-80% of maximum, 10-15 movements are executed at a slow rate. There are 3 sets with a rest pause of 4-6 minutes between sets. In a training session there are 3-4 series with a rest of 8-10 minutes between series.
2. Two series with different weights are executed.
 - (a) With the weight at 70-80% of maximum, 10-15 movements are executed at a slow rate.
 - (b) With the weight at 50-60% of maximum, 15-20 movements at a faster rate are executed.

The rest between sets is 6-8 minutes. There are 2-3 series with a rest of 8-10 minutes between series performed in each training session.

3. In one series, three different weights are used:
 - (a) 70-80% of maximum, 10-15 repetitions at a slow rate;
 - (b) 60-70% of maximum, 15-20 movements at a faster rate;
 - (c) 50-60% of maximum, 10-15 movements at a low rate but with utmost effort to display the greatest amount of effort.

The rest pause between sets is 4-6 minutes. Two series, with a rest period of 8-10 minutes between series, are executed.

The training methods related to the first and second aims of training should not be used in the same training session. It is necessary to alternate these methods in different sessions or in a week. At the beginning, the main focus should be on the first aim, i.e., development of maximum effort, then on the methods aimed at the second purpose, i.e., development of the ability to repeatedly display significant effort. At the beginning, the correlation between these is 1:3. Then, in accordance with increased maximum strength, 3:1.

Some examples of using different resistance exercises for development of maximum strength in various sports follow:

In the training of rowers, to duplicate the pull of the bar in a racing scull, a front lying position, face down on a horizontal surface is assumed (Fig. 27).

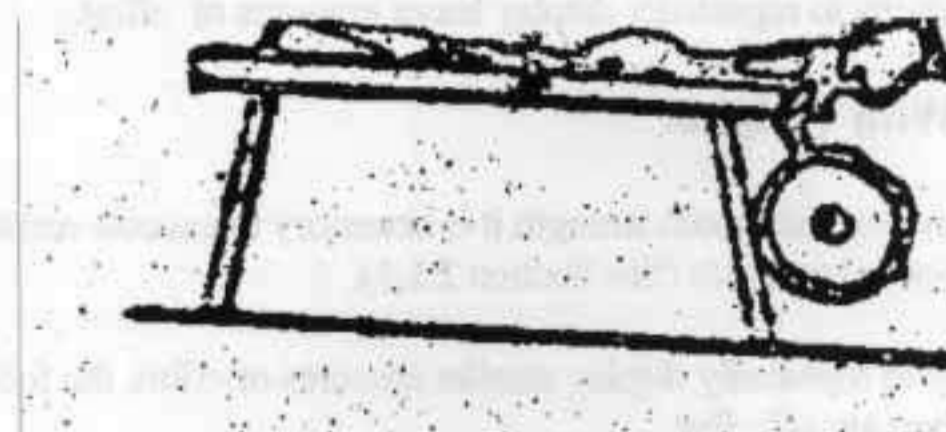


Figure 27: Special exercise for rowers

The following variants are used:

(a) with the weight at 90-95% of maximum, 2-3 movements, 4-6 sets with a rest of 4-6 minutes between;

(b) with the weight at 85-90% of maximum, 5-6 movements per set in a series of 4-6 sets. The rest pause is 5-6 minutes. The rest is 8-10 minutes between series in one training session of 2-3 series;

(c) there are three sets in one series:

---With the weight at 80% of maximum—10 reps;

---With the weight at 90% of maximum—5 reps;

---With the weight at 95% of maximum—3 reps.

Rest is 4-6 minutes between sets. When there are 2-3 series, rest is 8-10 minutes between series, all executed in one training session.

(d) with the weight at 75% of maximum, there are 10-12 repetitions per set. With 3-4 sets the rest period is 2 minutes between sets.

In cyclic sports the following exercises are used:

(a) The clean (bringing the barbell up from the ground to the shoulders). Weight should be 95% of maximum. Do 3 sets of 1-3 reps;

(b) Barbell squats and half squats with the bar on the shoulder. The weight is 80-85% of maximum. There are 3-5 sets executed for 5-7 reps. With the weight at 90% of maximum, 2-4 sets of 1-3 reps are done;

(c) The deadlift. Pull of the bar with 80-90% of maximum weight using trunk and leg extension. There are 5-6 sets of 3-5 reps;

(d) Standing barbell calf raises with heavy weights on the shoulders. There are 3-4 sets of 10-15 repetitions;

(e) Lying leg press with the weight at 85-90% of maximum. There are 3-5 sets of 5-6 reps each.

Athletes commonly use the barbell squat for development of maximum strength. However, it is necessary to understand that:

--First, it creates large and inadequate loads for many cyclic sports, as for example, running, skating and cycling. The load on the spine, and especially the small of the back, carries the danger of injury;

--Second, it forms a non-specific mechanism between intra-and inter-muscle coordination for improving the ability to maintain a position with non great static effort.

In such cases, it is best to use training devices on which it is possible to execute strength work by the legs without loading the muscles of the back. It is also possible to execute the squat but without the bar on the shoulders. Instead, use barbell plates fastened by a strong cable to a wide belt around the waist and special devices having simple construction (Fig. 28).



Figure 28: An exercise for development of leg strength

3.1.2. Isometric Exercises

For maximal force development a small volume of isometric exercises can be used. They should be executed in poses [positions] that are appropriate to the beginning of the working movement and to the moment of maximum force in the execution of the competitive exercise. Tension should be developed slowly up to the maximum and held for no more than 6 seconds. This is followed with fast relaxation of the muscles.

There are 6-8 tensions [contractions] executed in one set and the rest between is arbitrary. In a training session there are 2-3 sets with a rest of 6-8 minutes between sets during which dynamic, relaxing and stretching exercises are used.

It is most useful to use the local isometric tensions for the muscle groups that perform **the main** load in the competitive exercises, as well as for muscles that need strengthening.

Maximum strength development is needed in each cyclic type of sport **but its** particular significance for the sport can vary, as for example, where the effort is great as in rowing, cycling and skating. When maximal strength determines the magnitude of the working effort, **then** more attention should be given to the development of maximum strength. The level of maximum strength in unitary (single repetition) isometric efforts that are displayed without any restriction of time, should be 20-30% greater than the maximum amount of working effort in the competitive exercise.

3.2 Development of Explosive and High-Speed Strength

Exercises with weights and jump exercises are mostly used for explosive and high-speed strength. The predominant method is the repeat-serial. As with the development of maximum strength, there are two main directions of work distinguished here. In one, the work is done at a moderate rate with emphasis on an explosive beginning effort. In the other, there is a gradual increase in the speed and rate of movement while still maintaining the explosive beginning effort.

3.2.1 Exercises with Weights

The following variants of the repeat-serial method are effective:

1. The weight is at 30-70% of maximum. The greater the external resistance that must be overcome in the competitive situation, the greater the weight, within the limits of this range. One set of 8-10 reps is executed at maximum speed with compulsory relaxation of the muscles between movements. The rate of executing the repetitions is not high. In one series there are 4-6 sets with a rest of 4-6 minutes between sets. In a training session of 2-4 series, the rest breaks are 6-8 minutes between series.

2. Jump out of a squat with the bar on the shoulders with maximum effort. The weight of the bar remains within the limits of 30-60% of maximum. In one set there are 10-12 jumps. In one series of 2-3 sets, the rest pauses are 4-6 minutes between sets. In a training session of 2-3 series the rest breaks are 8-10 minutes between series.

3. Squat jumps while standing on two parallel benches, holding a kettlebell in the hands. Weight of the kettlebell is either 16, 24, or 32 kgs, selected individually. In one set there are 8-12 squat jumps at maximum effort. In one series there are 2-3 sets and the rest is 6-8 minutes between sets. In a training session of 2-3 series, the rest break is 10 minutes between series.

4. With a weight of 50-60% of maximum, execute one series of two sets of 30-40 repetitions with a rest break of 4-6 minutes between sets. In a training session there are 2-3 series with the rest break 8-10 minutes between series.

5. Barbell squat for speed of movement. The weight is 50-60% of maximum, and the athlete executes 4 sets of 5 reps with a rest of 4-6 minutes between sets. The time for each of the 5 squat sets is recorded. The difference between the first and fourth sets characterize the speed-strength endurance of the athlete. The key in training is to reduce this difference.

3.2.2 Jump Exercises

Jump exercises are divided into "short" jumps consisting of 4-6 maximum full force takeoffs and "long" ones for a distance of 40 to 100 m. that are executed with sub maximal take-offs at a moderate rate striving to advance ahead as fast as possible.

The "short" exercises are executed with a double leg landing in a jump pit or on gymnastic mats. For example

1. A six-fold jump from leg to leg with active swing movements by the free leg. It is executed 6-8 times [set] with an arbitrary rest period between. In all there are 3-4 series with a rest period of 8-10 minutes in between.

2. A four to six-fold jump from place with alternation of the legs (two take offs on the right leg, two on the left leg). In all, 4-6 sets are executed and there are 2 series with a rest of 8-10 minutes in between.

The "long" jump exercises are executed on soft, resilient ground. For example:

1. Forward jumping from leg to leg with sub-maximal takeoffs. Begin with 50-60 m, gradually increasing to 100-120 m. In the rest interval of 30-60 seconds, do easy running. At the beginning use 3-5 sets and then gradually increase to 10 sets. In a two-series training session the rest is 10-15 minutes between series. During the rest, begin with 4-5 minutes of easy running, then 50 m. of easy jumping from leg to leg, repeated 2-3 times and quiet walking.

2. In jumping from leg to leg (or two takeoffs on the right leg and two take-offs on the left) advance forward moderate distances with emphasis on the pushoff. Begin with 100 m. and then increase it to 200 m. The rest interval is 4-6 minutes between repeats. Begin with 3-4 repetitions, then increase to 6-8 reps.

3. Jumping from leg to leg (or two takeoffs on the right leg and two takeoffs on the left leg) with a moderate push-off. The distance is 200 m. Execute 2 times with a rest of 8-10 minutes between them.

4. Jumping from leg to leg from place for 50 m as fast as possible. Use an arbitrary rest period of 4-6 minutes between repeats. The jumping for 50 m. is timed. In all, there are 2-3 series with a rest of 8-10 minutes between.

In training sprinters, it is best to use a combination of the "short" and "long" jump exercises in different training sessions. The first (short) jump exercises promote an increase in starting acceleration speed and the second (long), speed of the run over the distance.

3.3 Development of Reactive Ability

Reactive ability of the leg muscles is successfully developed with jump exercises. For greater perfection, as for example in sports such as track running and competitive rowing, exercises using the shock regime of force development should be used. The repeat or repeat-serial methods are used in such exercises. For example:

1. Jumps over 8-10 boxes with push-off on both legs (Fig. 29). The movements are executed at a moderate rate. In one series of 3-4 sets the rest is arbitrary. In all, there are 3-4 series with the rest interval 4-6 minutes between series. It is also possible to execute the jumps over low hurdles in the same dosage.

2. Jumps onto boxes of different heights with a two-legged takeoff. Three series are performed:

- (a) With the height of the box at 60-70 cm, 3 sets of 10 jumps;
- (b) With the height of the box at 70-80 cm, 2-3 sets of 10 jumps each;
- (c) With the height of the box at 80-90 cm, 8-10 jumps for 1 set.

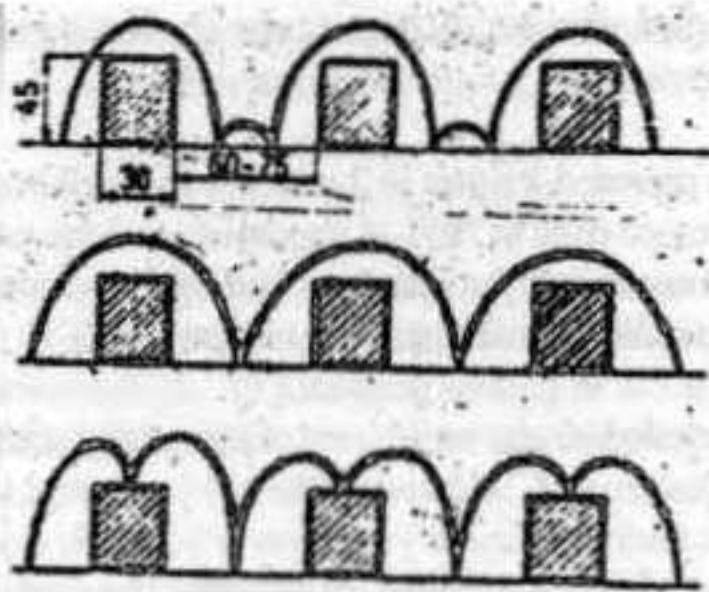


Figure 29: Exercise variants with a shock regime of muscle work.

In one set, the jumps are executed without any stopping. The rest pause between sets is 2-3 minutes and between series 3-4 minutes. All of this work is possible in one training session (3 series) and can be repeated 2 times. For high level, well-prepared athletes it can be 3 times with a rest pause of 8-10 minutes between.

For rowers, jumps on to a box with the height at 25-30 cm is used for men and 20-25 cm for women. They are effective using the following variants:

- a) The interval-serial method. In one series there are 5-6 sets of 40-50 reps, executed at a moderate rate. The rest between sets at the beginning is 3-4 minutes and then is gradually reduced to 2 minutes. The rate of jumping on to the box should be gradually increased and then maintained in each set. In all there are 2-3 series with the rest period at 10-15 minutes between series.
- b) The repeat method. At the beginning, jumps are executed at a moderate rate (4 minutes for men and 3 minutes for women). Gradually increase the duration of the exercise to 6 and 5 minutes respectively. Then increase the movement rate. In all there are 2-3 series with a rest of 12-15 minutes between.

3.4 Development of Local Muscular Endurance

For development of local muscular endurance the following methods are used:

- 1) Exercises with resistance;
- 2) Training devices;
- 3) Jump exercises;
- 4) Hill running;
- 5) Executing the competitive exercise in more difficult conditions.

3.4.1 Exercises with Resistance (Weights)

Resistance exercises for various muscle groups use the repeat, repeat-serial, interval-serial, complex and alternative (contrast) methods.

Training devices with a constant amount of resistance at all working amplitudes [ranges] of movement are effective following work with the repeat method.

1. The work load is repeated 8 times in 2 minutes for each bout. The rest interval is 30 seconds between. The resistance used is 70% of maximum and the rate of work in the first minute is moderate (45-50 movements per minute). During every subsequent 30 seconds the rate is increased and in the last 30 seconds rate is up to maximum.

2. Three sets are included in one series; one of them for 2 minutes and the next 2 for 1 minute. The rest interval between sets 30-60 seconds.

In the first set the resistance is about 40-45% of maximum. The duration of work is 2 minutes. The rate of movement at the beginning is moderate and then in the last 30 seconds built up to maximum.

In the second set the resistance is increased by 1.5 to 2 kgs. The duration is 1 minute. The movement rate is average (in the range of 40-60 movements per minute).

In the third set an additional 1.5 to 2 kgs. are added for more resistance. The duration of work is 1 minute. In this work it is necessary to preserve or even increase the rate of movement in comparison to the first set.

When using these series it is necessary to adhere to the following rules:

- a) The resistance used and the interval of rest between sets are determined by the number of muscles involved in the work. The more muscle groups that are working, the greater the resistance and duration of work (within the limits of the ranges indicated for them);
- b) If the athlete, in executing the set, successfully manages the load and maintains the given rate, further increases in load should be given only if the optimal rate is still maintained (about 45 movements per minute).
- c) Between sets it is necessary to execute exercises for relaxation and stretching of the muscles.

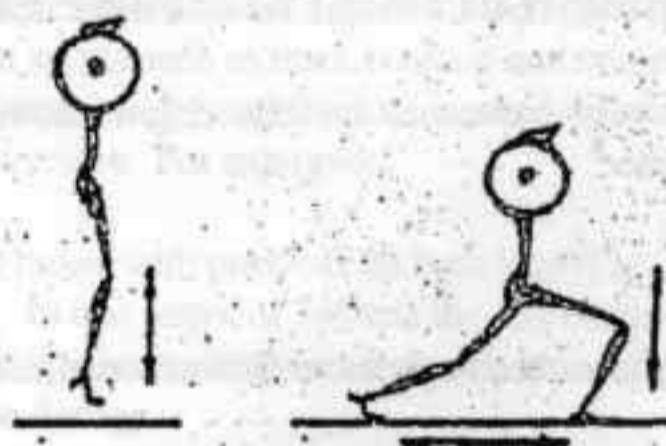


Figure 30: Exercises for development of local muscular endurance of the leg muscles.

For development of local endurance of the legs, squat jumps or lunge [split squat] jumps are effective. The resistance should be in the form of a bar on the shoulders and in the squat the

feet should be shoulder width apart or in the lunge position (Fig. 30). The interval-serial method is used.

Examples are as follows:

1. In one set, short-term maximum intensity work of about 10-12 seconds at the rate of one movement per second (8-10 movements per set). In one series there are 6-12 sets with rest intervals of 10 seconds between them. In a training session of 2-3 series, the rest period is 8-10 minutes between series. To begin work in this variant it is first necessary to do 5-6 sets in one series with the rest interval between them at 60 seconds. Then in accordance with improvement in the athlete's ability, it is necessary to increase the number of sets to 10-12 and to reduce the rest intervals between sets, first to 30 seconds and then to 10 seconds.

2. In one set, the athlete works for 30 seconds at sub-maximal intensity at the rate of one movement in 1.5 to 2 seconds. The number of sets range from 4-5 to 10 with a rest interval of 30 seconds between. In a training session there are 2-3 series with a rest of 10-12 minutes between. Work in this variant should begin with 4-6 sets with the intervals of rest between them at 30 seconds. Then, in accord with an increase in the preparedness of the athlete, the number of sets increases to 10 and the interval of rest between sets is reduced to 30 seconds.

The first variant favors the predominant development of power. The second one, the development of the capacity of the anaerobic alactate sources of energy acquisition with moderate use of the glycolytic mechanism of energy production. At a point in time, both variants effectively favor an increase in the power and capacity of the body's aerobic energy production. In addition, there is an increase in the speed of development of the aerobic function at the beginning of work, and the role of the aerobic mechanism in the after-work recovery process for some time. During the training it is necessary to gradually increase the intensity of work in both variants in two different ways:

- a) By increasing the weight while maintaining the rate of movement; or
- b) By raising the rate of movement using the same resistance.

The amount of resistance in these variants is individually selected and its amount (about 40% of maximum) depends upon the athlete's preparedness. In variant 1 the weight selected in each particular case is empirical so that the rate of work, one movement in 1-1.5 seconds, can be executed for 10-12 repetitions with no appreciable decrease in their speed. In variant 2 the athlete executes 15-20 repetitions.

For development of local endurance of the hip flexor muscles, an elementary pulley device, the schematic of which is shown in Fig. 31, can be used.

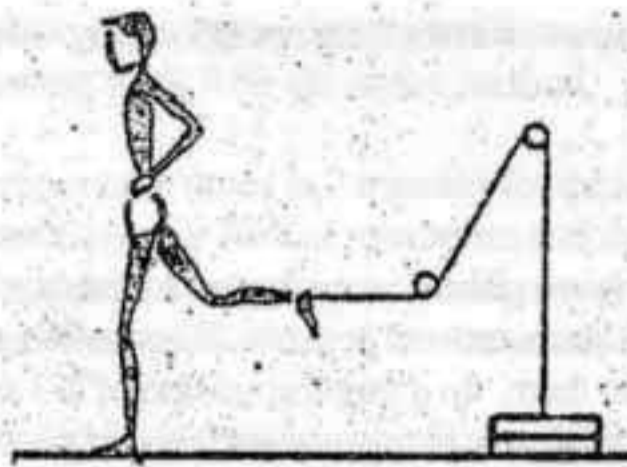


Figure 31: Exercise for development of local muscular endurance of the hip flexor muscles.

The thigh movement is executed in a forward movement with the effort emphasized at the initial site of the working range (see Section 1.9). The load is selected individually. The rate of movement is 6-8 repetitions in 10 seconds. There are 10 movements by one leg, then the other. In one series there are 5-6 sets on each leg. In a training session there are 2-3 series with a rest of 8-10 minutes between them. Between sets the weight should be supported, to get instant relaxation of the muscles. The exercise is executed in all variants by the interval-serial method as described above. The rate of movement should be gradually increased.

Also effective are the following variants of resistance work executed in the "to refusal" method. (See Section 1.13). For example:

1. Work "to refusal" with a weight of 40% of maximum. Four sets are performed with increasing rest intervals between sets (10, 15, 20 minutes).
2. Work "to refusal" with the weight at 40% of maximum with the rest between sets, 1 minute. Two series of 5-6 sets are executed. The rest between series is 5-6 minutes.
3. Working with a weight that can be raised only 10 times (i.e. "to refusal"). The work consists of 6-8 sets and the order of work is as follows: After each two sets the resistance decreases by approximately 3%. Between two sets using the same weight, the rest pause is 1.5 minutes. When there is a change in weight, the rest pause is 2 minutes. The last two sets are executed with assistance from a partner who helps slightly in overcoming the weight.

Last, for development of local endurance two variants of the complex method can be used. (See Section 1.14).

Variant 1

1st series. The weight of the load or the resistance on the training device, is 65-75% of maximum. One of the following variants of work is executed.

- a) Three sets of 5 minutes each; or
- b) Five sets of 3 minutes each; or
- c) Ten sets of 2 minutes each.

The rate of work is moderate--35-45 movements per minute and the rest between sets is 30-60 seconds.

2nd series. The weight is 80-85% of maximum. The work is performed for 5-8 sets consisting of 3-6 slow movements in each and with a rest period of 2-3 minutes in between sets. The rest pause between the series is 6-8 minutes.

Variant 2

1st series. The same work as in series one of the previous variant.

2nd series. Speed work with the weight at 75-85% of maximum. There are 10 repetitions within the limits of 30 seconds, followed by rest for 1.5 to 2 minutes. Another 10 repetitions are done within a 20 second limit. This series is repeated 2-3 times with a rest pause of 6-8 minutes between series.

3.4.2 Jump Exercises

Jump exercises are applied in two variants of the interval-serial method.

The first of them is directed predominantly to an increase in the power of the anaerobic alactate mechanism of energy production. "Short" jumps are used for this and are executed with sub-maximal power as for example:

1. A ten-fold jump from place with alternation of legs (2 on the right leg, 2 on the left one); or
2. An eight-fold jump from place from leg to leg; or
3. Six-fold jumps (hops) on one leg (right and left).

In a series, one of these jumps is repeated 4-8 times with an interval of 15-20 seconds between them. In 2-3 series, the rest period is 8-10 minutes in between.

The second variant is directed predominantly to increasing the capacity of the anaerobic alactate mechanism of energy production. For this, any form of jump exercises is executed at a moderate intensity for 25-30 seconds. In one series there are 4-6 sets with a rest of one minute in between. In the training session there are 2-3 series with a rest of 10-12 minutes in between.

3.4.3 Uphill Running

The uphill run is not such a simple exercise as it may appear on the surface. In sports practice, uphill running is frequently executed differently from what is needed. The fact is that in moving the mass of the body vertically, much energy is expended, which in turn quickly results in local fatigue of the leg muscles. This is why, if the athlete does not have the necessary

motivation and does not aim for the correct method of execution, he involuntarily goes to short steps (like jogging), steps that create a subjective sensation of work being accomplished.

However, as a matter of fact, the athlete only increases the expenditure of energy for locomotion and instead of using the aerobic source in this manner of running, he predominantly uses the glycolytic mechanism of energy acquisition for the work. As a consequence, primary emphasis of the training effect of the uphill run is changed. In the exhausting work, the run is transformed to one of very low efficiency and a waste of energy.

In uphill running it is necessary to use a direct path with different steepnesses of the hill. The higher the speed and the shorter the distance of the run, the more abrupt [steeper] should be the inclination of the pathway. On the contrary, the lower the speed and the longer the distance of the run, the less should be the hill (pathway) incline.

In all variants of uphill running it is necessary to be guided by the following methodological rule: The main task is not the speed of locomotion but the accentuated take-off by the foot together with a vigorous upward and forward movement by the thigh of the swing leg.

Short, (40-60) meter portions of the uphill run promote an increase in maximum anaerobic power, capacity of the respiratory muscles and explosive strength of the leg muscles. Average sections (150-300 m) are used for an increase in alactate and lactate power. The long runs (more than 400 m.) provide for an increase in the aerobic ability and efficiency of the cardiovascular and respiratory systems.

Using a 10 x 150 m uphill running workout is recommended for middle-distance runners, while for long-distance runners, 10 x 400 m with the speed at 55-60% of the speed in competition.

In addition, for improvement of the elastic quality of the middle-distance runner's muscles, light jumps from leg to leg with active take-offs by the foot and active swing movements of the thigh are used. They are done on an incline, the length of which is 200-800 m, selected individually. After this, light running (like jogging) is executed. After returning to the initial starting place on level ground the athlete runs at less than full power 2-3 times for a distance of 100-400 m. This work is repeated up to five times.

3.4.4 Execution of the Competitive Exercise in More Difficult Conditions

The competitive exercise is executed at a low rate of execution when there is an increased strength component to the movements. The repeat-serial, interval and alternative (contrast) methods are used.

For example, swimmers use a pulley device (Fig. 11). By using loads of different weights the coach sets the force of traction which the athlete must overcome in his swim so that he remains in place. A series with coordination of total body movements or with only work of the arms or only with the legs is then executed.*

* In this part the material supplied by the coach of the United Team of the USSR in swimming (B. Zenov) are used.

Work for Development of Special Strength Endurance:

- a) Swimming with coordination of total body movements executed in 2 minutes, repeated for 4-6 series. The weight used is 8-10 kgs and the rest interval between series is 60 seconds.
- b) Swimming with only the arms for 2 seconds, repeated for 3-5 series. Rest interval is 60 seconds in between. Weight is 5-8 kgs.
- c) Swimming with only the legs 3-5 times, 2 minutes each, or 5-8 times for one minute each. The rest interval is 40 seconds. The weight used is 5-7 kgs.

Work for an Increase in Pulling Power.

- a) Swimming with coordination of total body movements, 6-8 times for 2 minutes each time. The rest interval is 90 seconds between each repeat.* The weight used is 2 kgs more than the maximum pulling force.

* The maximum pulling force is measured in water using a load gauge (dynamometer) that is fastened on the training device (Fig. 11) when "swimming on a leash".

- b) Swimming with the arms only 4-5 times with each repeat executed for one minute. Rest interval is 90 seconds between each repeat. The weight is 1-2 kilograms less than the maximum pulling force.
- c) Swimming with the legs only, 3-4 times. Each bout is one minute. Rest interval is 90 seconds in between each repeat. The weight used is 1 kg less than the maximum pulling force.

Increasing Pull Capacity and Special Endurance:

- a) Swimming 6-8 times, 35-40 seconds each. Add 0.5 to 1 kg on each repeat as long as the athlete is capable of remaining in place. The rest interval between repetitions is 30 sec.
- b) Continuous swimming for 4-6 minutes without stopping. Resistance increases by 0.2-0.5 kgs every 30 seconds as long as the athlete is capable of remaining in place.
- c) The alternative (contrast) method (See Section 1.14) is effective when the competitive exercise is executed well in more difficult conditions.

For example, the swimmers use two "brakes" (large and small floats).

Variant 1—done once:

1. 2 x 25 m at maximum speed for 1-2 minutes.
2. 4 x 25 m at maximum speed with a large brake, paying attention to the power of the pull and not trying to achieve maximum rate.
3. 4 x 12-15 m at a maximum rate of execution with a large brake.
4. 2 x 25 m at maximum speed without a brake for 1-2 minutes.
5. 4 x 25 m at a maximum rate of execution with a small brake.
6. 4 x 12-15 m. at a maximum rate with small brake.
7. 1 x 25 m at maximum speed without a brake.

Variation 2—repeated 4 times.

1. 1 x 25 m with maximum speed without a brake.
2. 1 x 25 m on pulling power with a large brake.
3. 1 x 12-15 at a maximum rate with a large brake.
4. 1 x 25 m at maximum speed without a brake.
5. 1 x 25 m on pulling power with a small brake.
6. 1 x 12-15 m at a maximum rate of execution with a small brake.
7. 1 x 25 m with maximum speed without a brake.

The rest interval between each bout is 1-2 minutes, between series 2-3 minutes.

In rowing the following three series can be used:

- a) Rowing with the tow of a cutter (motor boat);
- b) Normal rowing at a moderate rate of execution;
- c) Rowing with the pull of a tug boat (motor boat). The speed is 120-128% of maximum for a distance of 250 m, executed at a high rate for time.

In the first two series the duration of work is about 5-6 minutes. The rest between series is 4 minutes. The length of the tow line should be limited to 35-60 m. and the tow line should include an elastic element for damping of any sharp changes, such as slack in the line.

And last, a running series for different sports, executed using the alternative (contrast) method:

- a) Run uphill, steepness not greater than 6%;
- b) Running in the usual conditions;
- c) Running in facilitated conditions (using a small down slope) with the speed 105-110% greater than maximum speed.

Distance is 60-80 m or 100-150 m. The rest intervals are 3-5 minutes. All series are repeated 2-3 times with a rest of 4-6 minutes in between.

3.5 Development of Maximum Anaerobic Power

Maximum anaerobic power determines the speed of starting acceleration (acceleration from rest). Maximum anaerobic power plays an especially important role the shorter the competitive distance. For increasing maximum anaerobic power it is expedient to use the above-mentioned methods of SST with primary emphasis on development of maximum strength, explosive strength and reactive ability. In addition, specific methods are used as for example:

1. Jumps from leg to leg on stadium steps with a powerful take-off covering 2-4 steps. The duration of work is about 8-10 seconds. This is followed by an easy run (jogging) around the stadium (Fig. 32). The athlete comes down on another staircase while "shaking up" the leg muscles. He returns to the initial starting position with quiet walking. The repeat-serial method is used. In one series there are 4-6 repetitions of 4-6 minutes each. In all there are 3-4 series with a rest of 8-12 minutes in between each.

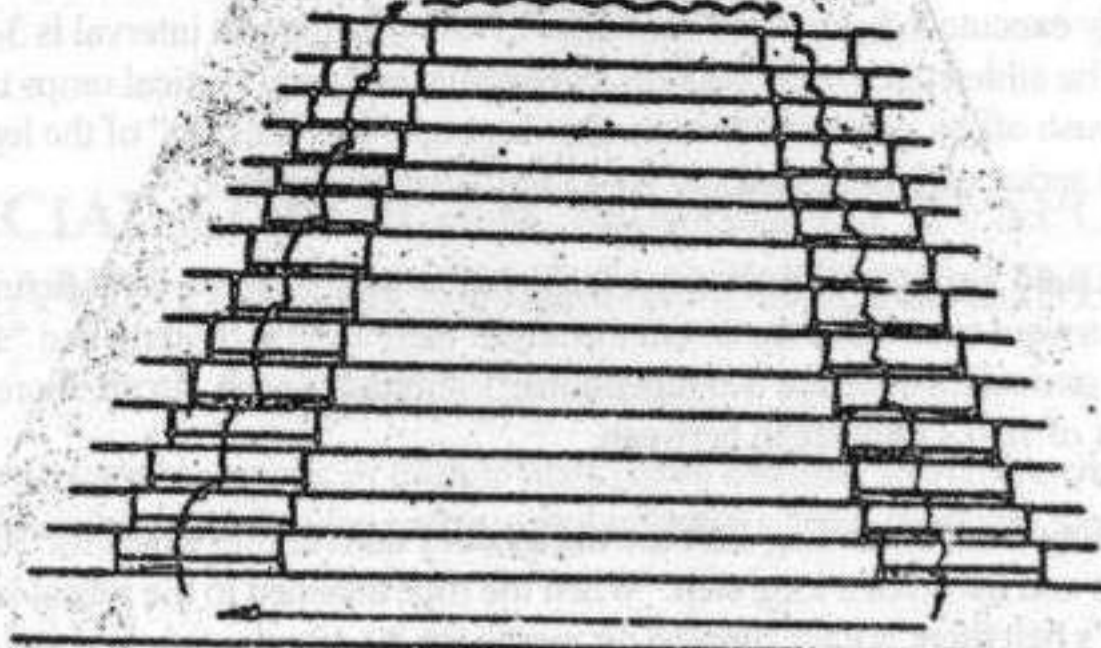


Figure 32: Drawing of the jump exercises on the stadium stairs.

2. Running from a crouch start position with a powerful long take-off using active movement of the swing leg. A partner resists forward movement by placing his hands on the shoulders of the athletes to create active resistance against forward advancement (Fig. 33). This exercise is executed for 8-10 seconds and then the partner steps to the side and the running athlete continues the free run for 25-30 m. After stopping he comes back with easy running. In one series there are 3-5 repetitions executed in 3-4 minutes each. In all there are 3-5 series with a rest of 8-10 minutes in between.



Figure 33: Exercise for improving speed of starting acceleration

3. Powerful jumps out of a squat holding a kettlebell in the hands. Weight of the kettlebell is 16, 24, or 32 kgs and is selected individually by the athlete. The jumps are executed on two parallel benches. One set consists of 5-6 repetitions followed by acceleration at half effort and light running. In one series of 4-6 sets the rest is 3-5 minutes in between. There are a total of 2-4 series with a rest of 10-12 minutes between each.

4. Three-five half-squats with a barbell on the shoulders using a weight of 75-85% of maximum. Emphasis is on fast lifting and jumping out of the squat. After the squats there are 1-2 accelerations for 40-50 m. and then quiet walking. There are 4-5 sets, 4-6 minutes each, in one series. In total, there are 2-4 series with a rest break of 10-12 minutes in between.

5. Squat jumps with a bar on the shoulders. The weight selected is one that makes it possible to freely execute 4-5 jump. In one series of 4-5 sets, the rest interval is 3-5 minutes between sets. The athlete then executes one acceleration and easy vertical jumps in place, alternating the push off by one and then the other leg and then "shaking" of the leg muscles. In all, there are 2-4 series with rest breaks of 10-12 minutes in between.

6. A six-fold jump is executed from leg to leg starting from place. Maximum force with an active forward take-off is used. On the return there is light running and "shaking" of the muscles. In one series there are 4-6 repetitions, 3-4 minutes each. In all, there are 2-4 series with a rest break of 10-12 minutes in between.

7. Running from a standing start towing a heavy automobile wheel for 10-15 m. The take-off is active and involves a long step. When the rope attached to the wheel is unhooked from the athlete's belt there is easy running on inertia for 20-40 minutes executed with free-striding and jogging on the return. In one series, there are 6-8 repeats with the rest 3-4 minutes in between each bout. In all, there are 2-3 series with the rest 10-12 minutes between each series.

8. For cyclists, overcoming a steep 60-80 m hill with maximum intensity on a large gear with a flying start is recommended. This exercise bout is executed 4-6 times with a rest of 4-6 minutes in between each bout. In all, there are 2-4 series with a rest of 10-12 minutes between each series.

9. For rowers, starting acceleration at the usual rate with a hydro-brake (or towing of a motor boat) for 10-15 seconds is recommended. The movement then continues on inertia (without resistance) followed by light rowing for 2-4 minutes at the normal rate. In all, there are 4-6 bouts repeated after which there is rest for 8-10 minutes. The series is repeated 2-3 times.

10. For skaters, jump exercises on a hill are recommended. In one set, 4 different exercises are executed at full strength for 8-12 seconds each. The rest period is 4 minutes in between each exercise. In all, there are 6-8 sets with a rest of 5-6 minutes in between each or 2 series of 5 sets each with a rest of 4-6 minutes in between each set. The rest between series is 8-10 minutes.

11. For sprinters, running up a steep hill with a short run-up and active forward take-offs for 15-20 m is used. On the return there is light running. Four-six sets are done in a series and each one lasts 3-4 minutes. In all, there are 2-4 series with a rest of 8-10 minutes in between.

CHAPTER 4

SPECIAL STRENGTH TRAINING IN SPORTS HAVING VARIABLE MOTOR REGIMES

Sports that have a variable regime of muscle work (team and dual sports) are characterized by extended motor activity with sudden and frequent transitions from moderate to short-term intense work.

Such regimes require the preservation of the athletes' high level specific work capacity during sharp changes in the internal environment of the body. This relates to stability of technical-tactical mastery, high speed and precision components of the actions executed on a background of growing fatigue and high mental stress.

The specific work capacity in these conditions is ensured by high level development of anaerobic alactate power. It should be combined with high aerobic opportunities and efficiency of the recovery processes that are connected with elimination of the by-products of the anaerobic exchange.

The task of SST in this case is to increase the strength component, as well as the power and the capacity of the energy acquisition systems for the work needed by the athlete. In addition, the SST means should improve the athlete's ability to effectively use his strength potential and to preserve the necessary level of work capacity in competitive conditions.

One of the more distinguishing features of the level of preparation in sports with the variable motor regime, is the need to pay great attention to technical-tactical mastery (literally every day).

Athletes must have great quantities of the technical elements and actions with perfection of the skills to effectively use them, as a rule, in unexpectedly arising and quickly changing situations. In team sports, the improvement of collective tactical interactions is necessary. As a result it is not always possible to devote the SST to a separate special stage as is done in speed, strength and cyclic sports.

In such cases, it is best to use the coupling (conjugate) method (See Section 1.14), to simultaneously resolve the tasks of the technical-tactical and the special strength preparation. It can be done as for example, by executing the specific work with additional resistance, such as fastening additional weight to the athlete's body (Fig. 12).

In sports that use the variable motor regime, it is possible to successfully use the means and methods of SST recommended in acyclic (speed-strength) and cyclic kinds of sport (See Chapters 2 and 3). These methods are intended for development of maximum explosive

strength, reactive ability, local muscular endurance and maximum anaerobic power. It is necessary to select the means and methods, taking into account the character of the motor activity specific to the particular sport.

Naturally, the foremost place in the training system for sports with the variable motor regime, is assumed by the specific methods of the SST. Most particularly this includes strength-aerobic, jumping, circuit and coupling (conjugate) methods.

4.1 Strength-Aerobic Method

The main characteristic of the strength-aerobic method is in the development of strength of the fast as well as the slow muscle fibers, while primarily using the aerobic source of energy acquisition for the work. For example:

1. Executing work by the same muscle groups in the following order:
 - a) With the weight at 80-90%, of maximum 3 sets of 3 reps at maximum effort. The rest pause between sets is 2-4 minutes.
 - b) With the weight at 40-50% of maximum, the movements are executed slowly with one of the following variants of work:
 - 4 sets of 15 reps with a rest of 2-3 minutes in between; or
 - work for 15-20 seconds, with 5 or 6 reps. Rest is 20-30 seconds in between at which time exercises for muscle relaxation are also done.

Each of these variants is executed 2-4 times with a rest period of 4-5 minutes in between. Work intensity is checked according to pulse, which should have a frequency between 120-140 beats per minutes.

2. Eight to ten exercises involving various muscle groups are executed. The weight used for each exercise should allow work to be done at a low rate for 30-60 seconds without obvious fatigue. The rest between exercises is 1 minute, which includes relaxation of the muscles. The pulse should not exceed 120-140 beats per minute. When the complex of exercises is selected it is necessary to be guided by the following rules:

First, the muscle groups that carry the main load in the competitive sports activity should be loaded (stressed).

Second, three consecutive exercises should not be executed by the same muscle groups.

For example, the following complex of 10 exercises can be effective for wrestlers (Fig. 34):

1. Barbell squat.
2. Bench press.
3. Trunk raises [sit-ups] from a supine lying position, with the legs fixed in place.
4. Bent arm flys. (Raising dumbbells sideways in a back lying position.)
5. Straight leg dead lift. (Pulling with the trunk keeping the legs straight.
6. Side bends with the bar on the shoulders.
7. Bent arm pullover in a lying position.

8. Barbell curl using a supinated grip.
9. Bent over barbell row pulling the bar to the chest. Legs remain straight.
10. Overhead press (military press from the chest).

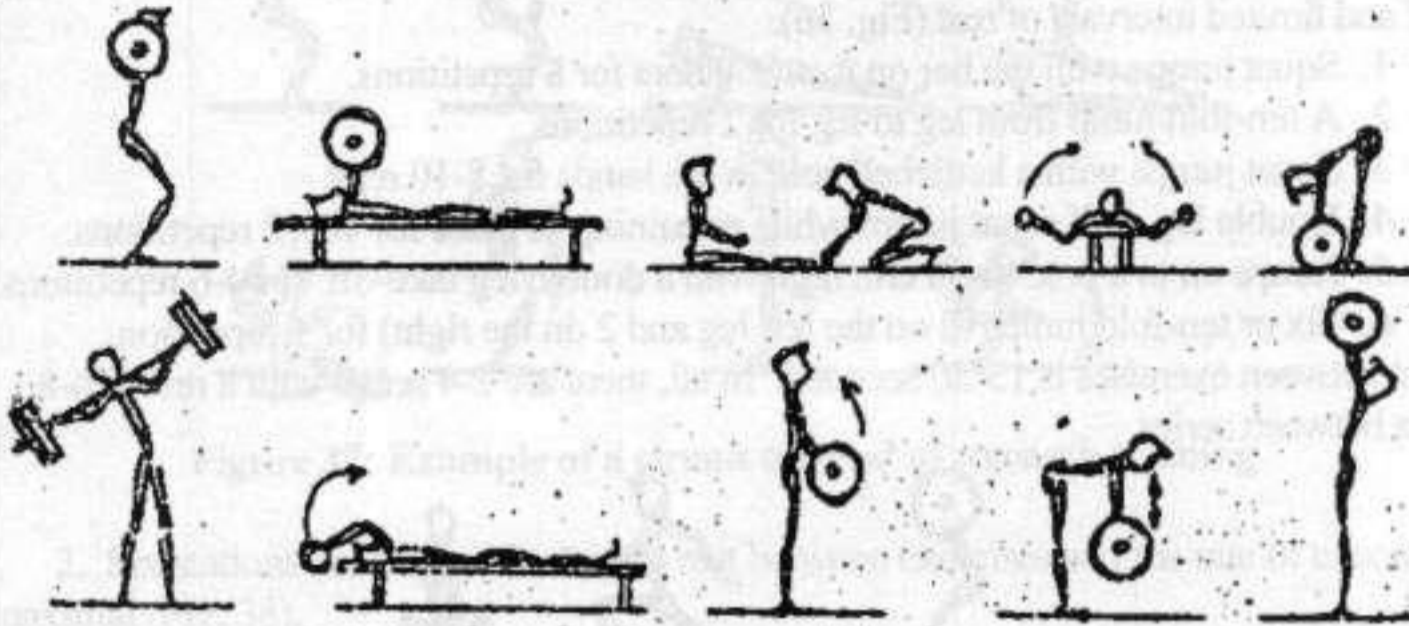


Figure 34: Complex of strength exercises for wrestlers.

The whole complex is executed in 20 minutes. It effectively promotes development of maximum strength as well as strength endurance.

4.2 The Jump Method

For development of local muscular endurance good results are produced by doing complexes of five jumping exercises in place. Two such complexes are shown in Fig. 35.

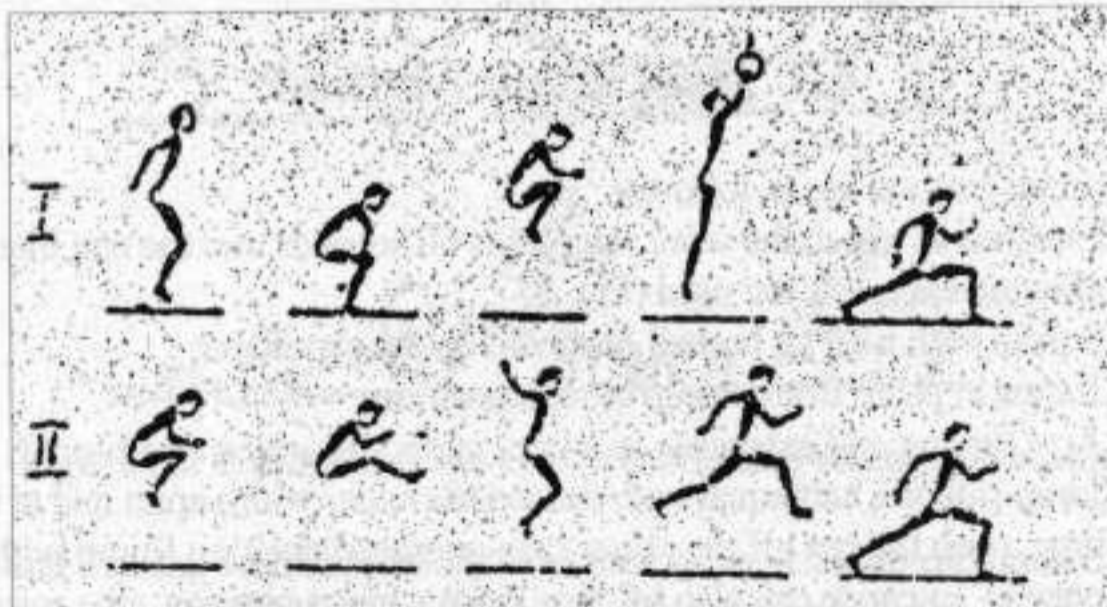


Figure 35: Two complexes of jump exercises in place.

Each exercise is repeated 10 times with the rest in between exercises about 1.5 minutes. Rest includes light running. The whole complex takes 10 minutes. The integrity of the jump exercises in place lies in the fact, that they promote development of strength coordination and

strengthening of the trunk muscles. In training, the composition of exercises in the complexes should vary.

Another variant of the jump complex is with high loads; six exercises with maximum effort at takeoff and limited intervals of rest (Fig. 36).

1. Squat jumps with the bar on the shoulders for 8 repetitions.
2. A ten-fold jump from leg to leg for 2 repetitions.
3. Squat jumps with a kettlebell held in the hands for 8-10 reps.
4. Double leg half squat jumps while remaining in place for 10-12 repetitions.
5. Jumps on to a box 40-50 cm. high with a double leg take-off for 4-6 repetitions.
6. Six or ten-fold jumps (2 on the left leg and 2 on the right) for 1 repetition.

The rest between exercises is 15-20 seconds. In all, there are 2-4 series with a rest of 6-8 minutes between series.

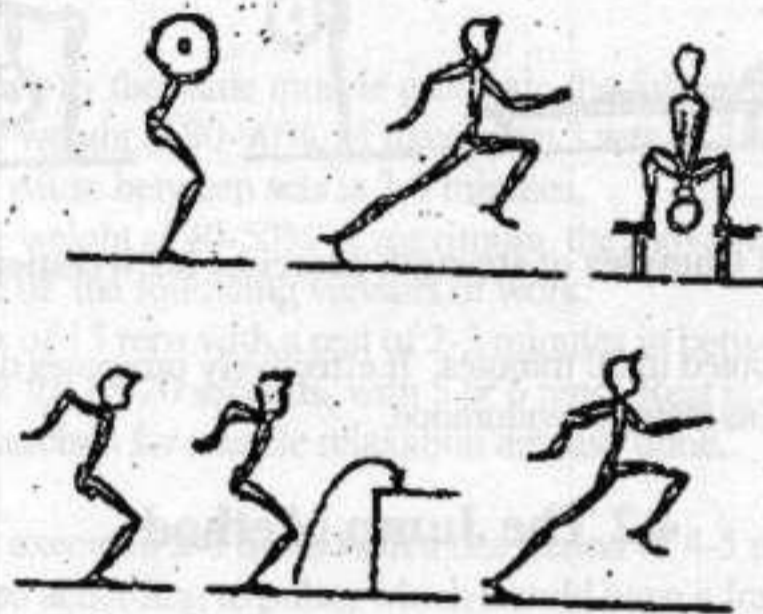


Figure 36: Complex of jumping strength exercises

4.3 The Circuit Method

Variants of the circuit method are as follows:

1. Eight stations at which the work interval is 60 seconds and the rest interval is 60 seconds. The following exercises are used (Fig. 37):
 - a) Squats with a 20 kg barbell disc held on the shoulders;
 - b) Jumps in place from a deep crouch position;
 - c) Arm flexion and extension in a front support position (push-ups);
 - d) Jump-out of a half squat with the feet shoulder width apart and at the same time, push the bar off the chest to an overhead position [jump with an overhead press]. Exercise can also be done from a lunge position (the scissor lunge) [similar to a push-press];
 - e) In a seated position with legs up and in front, execute cross movements of the legs from side to side with simultaneous movement to the other side with the arms holding a 25 kg disc;
 - f) Double leg jumps jumping as high as possible in place;
 - g) Lifting the bar from the ground to the chest (clean). Do not touch the floor;

- h) Run with a combination of acceleration and acrobatic exercises such as jumping, rolling and somersaulting.

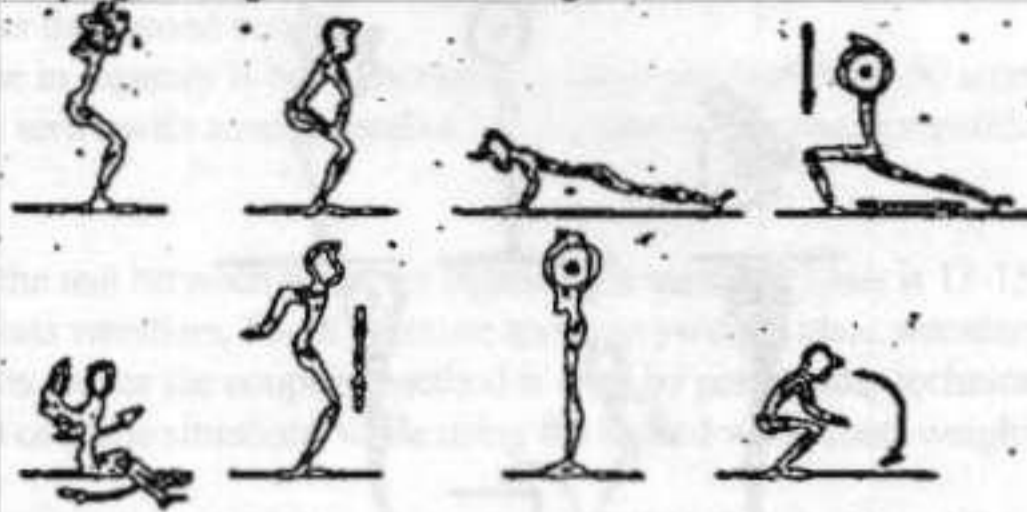


Figure 37: Example of a circuit method of strength training

2. Six stations are used. There is no rest between exercises and the rate of execution is maximal (Fig. 38).

- Arm flexion and extension in a front support position—20 reps (push-ups);
- Double leg jumps over 10-12 medicine balls—3 reps;
- Overhead medicine ball throwing to a partner—10-15 throws;
- Leg circles while lying flat on the back. The legs do not touch the floor—10 reps to each side;
- Single leg jumps over 10-12 medicine balls—2 reps on each leg; and
- Acrobatic exercises—3 body rolls and a forward somersault.

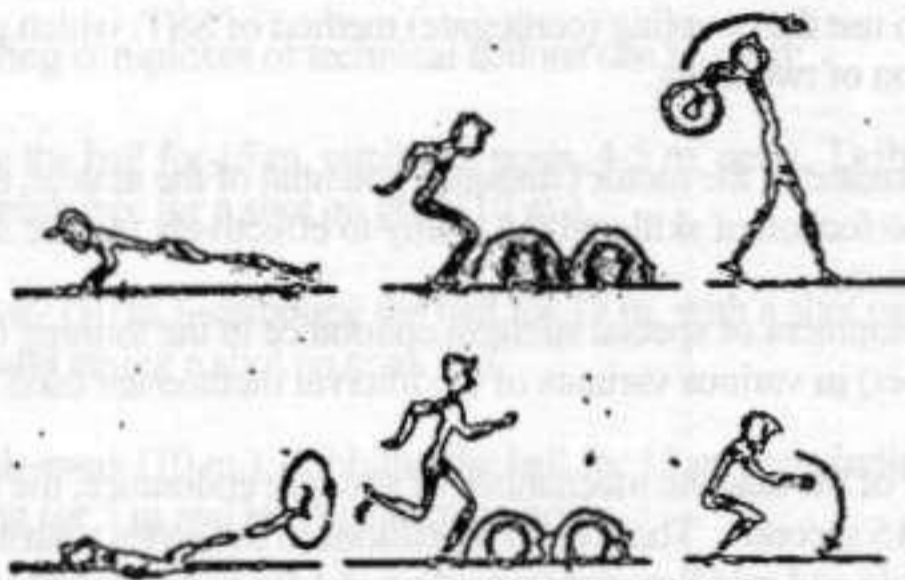


Figure 38: Example of the circuit method of strength training

3. Circuit training with six stations. The time of working on each exercise is 15-20 seconds at a maximum rate. Transition to the following stations takes 8-10 seconds (Fig. 39).

- Vertical jumps in place bringing the knees up toward the chest;
- Lifting the bar weighing 40-50 kgs. from the ground to the chest (clean);
- Standing triceps extension with a barbell disc weighing 20-25 kgs;
- Jerk of the bar weighing 40-50 kgs from the chest (military press);
- Jump onto a box 60-70 cm high;
- Snatch with a bar weighing 30-40 kgs.

The circuit is repeated 2-4 times with a rest of 6-8 minutes in between.

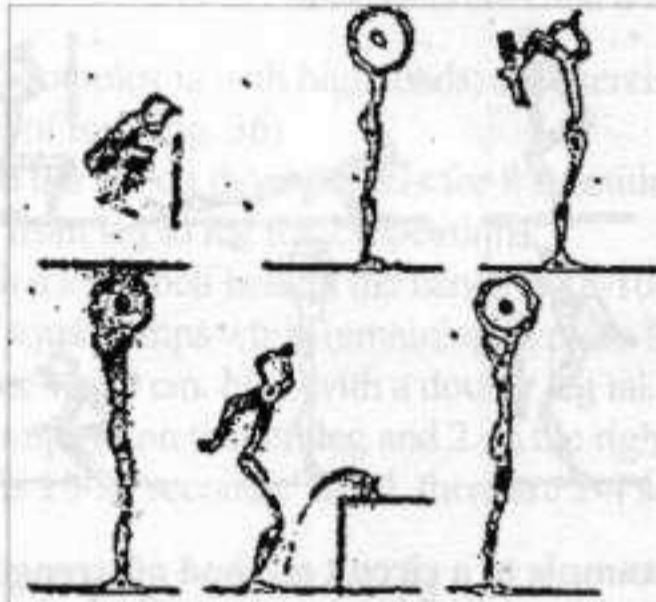


Figure 39: Example of the circuit method of strength training

4.4 The Coupling (Conjugate) Method

The training of high-level athletes in sports that have a variable mode of muscle function has specific features. For example:

---First, it is necessary to devote a significant amount of time to perfection of technical-tactical mastery and

---Second, it is used for a limited time in the preparatory period.

In this case it is best to use the coupling (conjugate) method of SST, which provides simultaneous resolution of two tasks.

- a) An increase in the motor (strength) potential of the athlete; and
- b) The perfection of skill and the ability to effectively use the skill in competitive conditions.

For example, for development of special strength endurance in the training of wrestlers, throws of a mannequin (puppet) in various variants of the interval method are used.

To develop the power of the alactate mechanism of strength endurance, the throws are executed at a maximal rate for 15 seconds. There are 6 repetitions in the series with a rest period of about 2 minutes for light and middleweight wrestlers and for heavyweight class wrestlers, 2-2.5 minutes. There are 2-3 series in a training session with the rest in between each for lightweight class wrestlers 6-8 minutes. For average middleweight class wrestlers, rest is 8-9 minutes and heavyweight class wrestlers 9-10 minutes.

For perfection of the lactate mechanism of strength endurance, two variants of sub-maximal intensity work are recommended:

- a) With primary emphasis on an increase in the glycolysis power; and
- b) To increase its capacity.

With the emphasis on increasing glycolysis function (power), the work is 1.5-2 minutes long with 3 repeats in the series. In all, there are 3 series with a rest of 2 minutes after the first series and 1 minute after the second series.

When an increase in capacity is being worked on, the work time is 30-50 seconds. There are 3 repetitions in the series with a rest period of 1.5-2 minutes in between repetitions. There are 3-4 series.

In both variants the rest between series for lightweight class wrestlers is 13-15 minutes. For middle weight class wrestlers, 16-18 minutes, and heavyweight class wrestlers, up to 20 minutes. In sports games the coupling method is used by performing technical-tactical actions based on models of game situations while using the loaded waist coats weighing 5-8 kg.

For example, in ice hockey, the following variants of play situations can be used.

1. Perfection of a zone attack. The formation of the players as follows: 11, 22, 33, 32, 4 x 3. The speed is 90-95% of maximum and there are 3-4 breaks with changes in direction at maximum speed and 3-4 with a defensive pressing action. The time for execution is 20-40 seconds and there are 4-7 repeats. Rest time is 2.5-3.5 minutes in between.
2. Perfecting an attack with a numerical advantage (5 on 4 players, 5 on 3 players). Speed is 60-80% of maximum which includes a defensive press and a fast break. Work time is 60-80 seconds and rest time is 50-90 seconds. There are 5-7 repetitions.

In soccer, the following complexes of technical actions can be used:

1. Dribbling the ball for 15 m. circling 2 posts, 4-5 m. apart. Dribbling 5-6 m. and passing the ball to break free for a shot on goal (10 m.).
2. Break away (10 m.)—dribbling the ball for 15 m. with a shot on goal. Break away to score a goal (10 m) and taking a shot on goal.
3. Fast break-away (10 m.), dribbling the ball for 15 m. and circling 2 posts 4-5m apart. Then dribbling for 5 m and taking a shot on goal.

The exercises are executed in 6-7 seconds and the number of repeats in the series is 8-10. The rest pause is 80-90 seconds in between. There are 4-5 series with a rest of 6 minutes in between.

In basketball using various variants of ball dribbling and circling of posts or players and finishing with a shot are all effective. The time for the exercise is 8-10 seconds and in one series there are 6-8 repeats. The rest pause is 2-3 minutes in between. There are 2-4 series with a rest of 5-6 minutes in between each series.

CHAPTER 5

THE ROLE AND PLACEMENT OF SPECIAL STRENGTH TRAINING IN THE YEARLY CYCLE

SST means can successfully resolve the tasks for which they are used only if they:

- first, are an organic part of the year-round training system;
- second, are effectively organized in relation to time, i.e. are united in a system.

5.1 Functions of SST in the Yearly Cycle

To resolve the task of intensifying the muscle work regime, SST means are used to execute three separate functions in the year-round training system. They are:

- Developing-- in relation to the current level of special work capacity;
- Supporting-- in relation to the level of specialized work capacity, which is achieved as a result of using the means of SST;
- Organizing--in relation to the contents of the training process.

The **organizing function** means that it is necessary to begin the planning (programming) of the training process by defining the tasks, structure, volume and location of means (of the loads) of the SST in the yearly cycle. After this, it is necessary to consider the order of resolving other tasks including the technical-tactical and high speed training.

However, following this principle does not mean you should overestimate the role of SST and belittle the importance of high-speed and technical-tactical preparation in the training system. On the contrary, this principle should be regarded as an expedient way of ensuring the creation of favorable conditions for effectively realizing the technical-tactical and high-speed preparation tasks.

Based on this it can be concluded that the basic understanding of a sports training system in the yearly cycle, is to be in conformity with the main targeted task (to ensure planned increases in the sports result). There are three main and closely interconnected directions of the training.

- a) An increase in the motor potential of the athlete (task of the SST system);
- b) Perfection of the skill to use this potential in the competitive exercise most effectively (the task of technical-tactical and high-speed training);
- c) An increase in the level and reliability of competitive mastery (the task of the competitive and physiological preparation).

In the framework of these directions, the separate methodological tasks are concentrated.

5.2 Selection and Organization of SST Means

When selecting and organizing SST it is necessary to keep in mind the following:

1. The training effect of any means (or complex of means) is reduced in accordance with an increase in the level of the athlete's special physical preparation. The latter is achieved by the means being used (or a complex of means)
2. The means used by the athlete should ensure an optimum training effect in regard to current functional level of his physical condition.
3. The effects of previous work done change the training effect of any means used.
4. The training effect of the complex of means is determined not so much by their volume but mainly by their combinations, the order of their use and their shared role during the time of use.
5. The rearrangement of the means (of loads) of SST in time changes the effect of their training influence considerably.
6. The complex of SST means should ensure the formation of the required strength preparation for the given structure of the sport involved. At the same time it should still take into consideration the particular level of the athlete's sports mastery.

Based on this the high effect of the SST system means can be supplied by:

1. The selection of the specialized means that have the necessary training potential. This means that it has the capability to create the required complex of adaptive reactions in the body.
2. Organizing the rational interaction of the training effects of the means (of the loads) with the various training influences.
3. Preservation of the SST training effect by systematic and timely introduction of new or different strength means that have higher training potential.
4. Effective alternation of loads with strong (the intensive SST method) and optimum (the extensive SST method) influences on the body.
5. Optimum duration of using the means having a definite training influence, that will be sufficient for creation of a steady adaptive effect.

5.3 System of SST Means

The system of SST means should be formed on the basis of objective criteria in regard to the motor specific character of the given type of sport (see Chapter I). Formation of the SST system should be based on the following schematic:

Regime → means → methods → organization → volume

It indicates the logical sequence of making the methodological programming for SST. For example:

1. To analyze the working regime of the body and the motor system that is predominantly inherent in the given sport.
2. To select the SST means that are adequate for this regime.
3. To select the method (the way) of executing the SST means which ensure the necessary training influence on the athlete's body.
4. To select the best form of organization of the strength means, i.e. in such a way that their cumulative effect will ensure the task of the SST at optimum expenditure of the athlete's time and energy.
5. Last, to define the volume of the special strength means that are necessary for resolving the SST tasks.

From the schematic it can be concluded that the search for and in order to get the most effective realization of this schematic, or other parameters of the SST load, can best be done only after exhausting the opportunities of the previous parameters.

For example, it is not effective to seek any effective SST methods without first searching for the effective strength means.

Along these lines it can be concluded that without first working out the effective form of organization of the strength means, it is unwise to define the volume of the SST loads.

5.4 Forms of Organization of SST

Two criteria define the organization of SST:

- Temporal -- relating to the way the SST means are distributed according to time; and
- Structural -- related to the way the SST loads are unified with the training influences having different effects in a uniform system, as for example, for development of maximal, explosive and high-speed strength, reactive ability or local muscular endurance.

Two forms of organization of SST based on the first criterion can be distinguished: They are distributed and concentrated (Fig. 40).



Figure 40: Distributed (A) and concentrated (B) forms of organizing the SST loads.

The Distributed Form (A)

This implies a relatively uniform arrangement of special strength means over the yearly cycle. This form is more suitable to low-level athletes, and uses an integrated approach to resolve all of the training tasks. It is characterized by the physical and technical preparation.

The Concentrated Form (B)

This form is characterized by the allocation of a high volume of SST means in a limited amount of time. This concentrated form ensures a powerful influence on the body. It is best used mainly with top level athletes as a condition for further increases in their special work capacity levels.

In regard to the structural criterion there are also two forms of organization of SST that can be distinguished (Fig. 41).

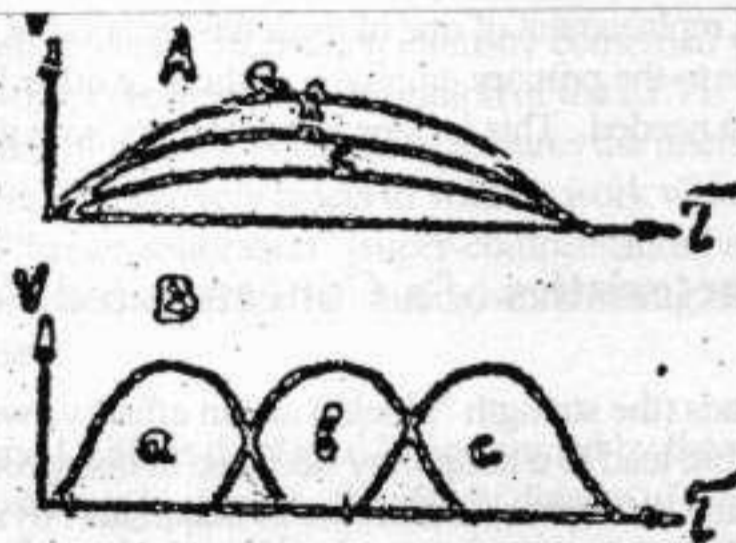


Figure 41: Complex-Parallel (A) and conjugate-sequence (B) forms of constructing SST loads

The Complex-Parallel Form (A)

This is characterized by simultaneous use of various means that have a primary effect (conditionally known as a, b, and c). Regulation of the training effect is ensured by the changes in volume and intensity of the training load. The complex—parallel form is best used mainly with low-level athletes.

The Conjugate--Sequence Form (B)

Unlike the previous form, the training effect here is ensured not only by volume and intensity of the load but also and mainly by the change in the structure of means with a gradual increase in their intensity. The sequence used in this case means a strict order and succession of introducing loads into the training that have different emphases. At the same time, it also takes into account the systematic intensification of the specific training effect on the body.

Conjugate assumes an expedient succession in the sequence of using the loading at which time one load, as for example, (a) creates the favorable conditions needed for successful resolution of the subsequent load tasks (b) and (c).

The characteristic feature of the conjugate-sequence form of SST organization is:

--Concentration, the allocation of the loads having one primary emphasis as for example (a), (b), or (c) in a limited amount of time. This makes it possible to have a mass training effect on the body by each of the loads.

--Separate, in relation to the timing of these loads that makes it possible to achieve the specific adaptive effect from utilizing each of them.

It is important to emphasize that the conjugate-sequence form of SST does not provide for the literal differentiation of the loads according to time (where one is finished another one begins). Instead there is a gradual replacement of one of the loads by another. In other words, the discussion is related more to the primary emphasis of these or other loads in the particular stage of training where they are needed. This is done in conformity with the logical development of the adaptive process.

5.5 Characteristics of a Concentrated Form of SST

Concentrated strength loads (the strength "block") are an effective way of increasing the athlete's motor potential but lead to a temporary decrease in his specific functional parameters (Fig. 42). More specifically, this means a decrease in maximal (P_0) and explosive (J) strength. However, in this case, there is no danger of having a lack of training success. If the training is built correctly, after a decrease in the load volume the functional parameters not only come back to the initial level, but considerably exceed this level. This phenomenon has received the name, long-term lagging of the training effect (LLTE) of the strength loads (Y.U. Verkhoshansky, 1976).

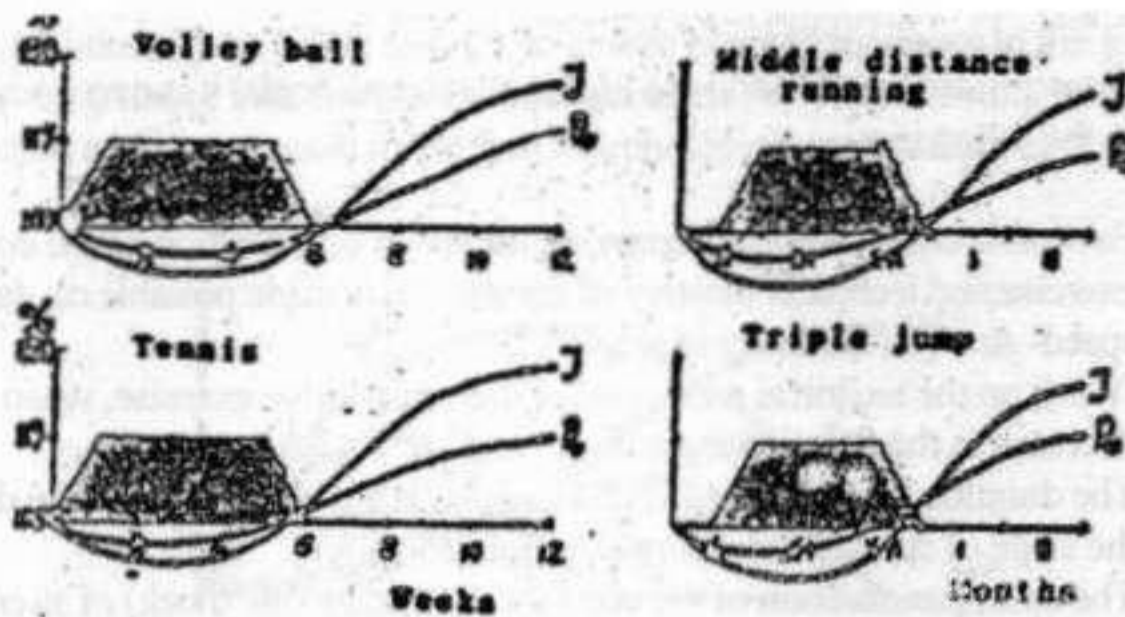


Figure 42: Examples of the long term lagging effect of the concentrated strength loads.

Specific research (Fig. 43) has shown that:

1. Formation of the LLTE has two phases. In the first (t_1) the conditions for an increase are created and in the second one (t_2) realization of LLTE occurs.
2. The basic condition for beginning the LLTE is the "block" of the strength load concentrated volume. This block ensures a deepened training effect on the body by means of intensifying the specific regime of its work and activating the appropriate adaptive restructuring. As a result, a decrease in the functional opportunities (f) of the athlete occurs.
3. The lower the speed-strength levels fall (within an optimal range) during the concentrated strength loading stage, the higher they subsequently rise in the realization of the LLTE phase (Graph f1 and f2). An excessive load concentration results in a significant drop in speed-strength and as a rule a disruption of adaptation (Graph f3).
4. Special work with gradually increasing intensity combined with a moderate volume of general developmental work, contributes to realization of the LLTE through concentrated strength loading (B). Because of this, the body easily endures the intensive loads in the phase of realizing LLTE. However, it negatively reacts to volume work which is expressed by a slowdown in the process of "super-restoration" [super-compensation] and even a decrease in the functional level. This is why the volume of training work during the realization of the LLTE should not be increased
5. The length of time LLTE is displayed is determined by the volume and duration of the concentrated strength loading. In general, the steady display of the LLTE (t_2) is equivalent to the duration of the strength work stage (t_1). In actual training conditions of highly qualified athletes, this tendency was observed for the duration of the first stage (t_1) from 4-6 to 12 weeks.
6. The display of LLTE is individually expressed and to a significant degree depends upon the athlete's ability to tolerate the volume loads. In addition it depends on his restorative abilities in the training sessions with volume loads that frequently follow.

When using the concentrated method and the LLTE of strength loads, it is necessary to take into consideration the following:

- a) Favorable conditions for improving the speed of execution of the competitive exercise and technical mastery of the athlete, is made possible on the stage of speed- strength increases in stage B.
- b) Work on the technical and speed of the competitive exercise, when there is a decrease in the functional parameters (stage A), is not rational.
- c) The duration for realizing LLTE (stage B) is basically equal to the duration of the stage of strength load concentration (stage A).
- d) The optimum duration of the concentration stage (the block) of strength loads is from 6-12 weeks.
- e) The volume of the concentrated strength load is set according to the individual and in each particular case should be determined experimentally. An excessive volume can result in overtraining.
- f) To avoid overtraining it is necessary to supervise the athlete's condition in a dynamic way which enables one to evaluate his ability to display explosive effort.
- g) The purposeful creation of conditions for using LLTE of special strength loads is an effective way of training the high-level athlete.

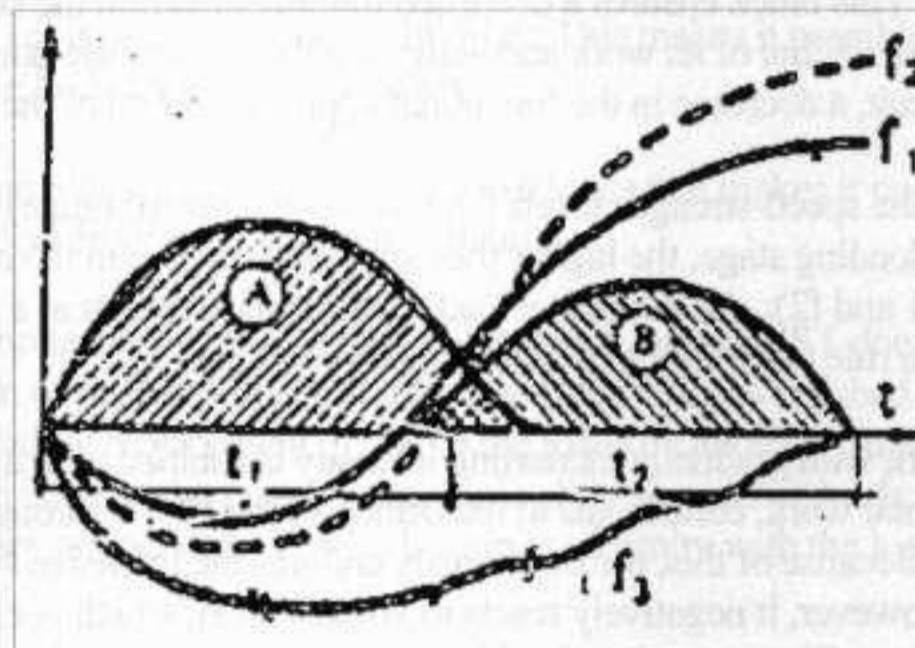


Figure 43: Basic scheme of the long term lagging effect of the concentrated strength loads.

5.6 Organization of the Concentrated Strength Load “Block”

The concentrated strength loads represent the so-called strength block in the annual system of training. When organizing it, one should be guided by the following rules:

1. The conjugate-sequence form of load organization in the strength block is effective for extended periods of up to 10-12 weeks. (Fig. 44). In this there is gradual replacement of

the means (conditionally (A), (B), and (C), to ensure planned increases in the force and specificity of the training influence of the strength loads (W). As a result, the essential training effect is reached and is expressed in the firm morphological reorganization of the body.

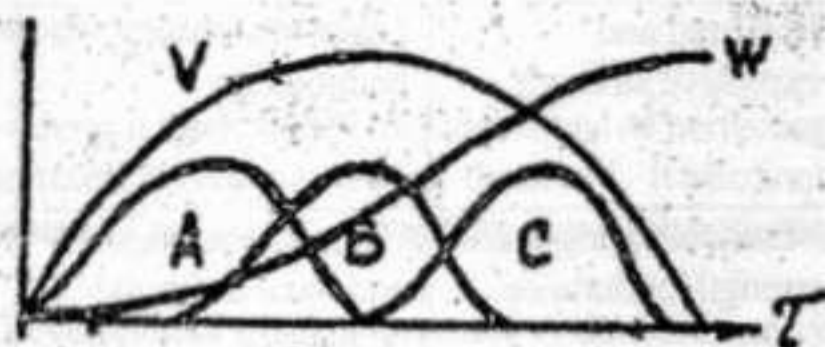


Figure 44: The conjugate-sequence form of organization of the strength "block" loads.

If time is limited to 4-6 weeks, the complex-parallel form of organizing the strength block using intensive means is more effective. In this case considerable functional shifts can be reached but the duration of their preservation will be short, mainly because there is not enough time for the morphological reorganization in the body to take place.

2. A schematic of the strength-load block with the conjugate-sequence form of organization is shown in Fig. 44. See Table 3 for the three groups of different sports. Keep in mind that:

- a) The means and methods used for development of strength abilities are selected from the appropriate parts of the book (see Chapters 2, 3, and 4).
- b) The highest volume (V) of the strength loads is in stage (see Fig. 37).
- c) In correspondence with the organizational features of the training in the yearly cycle in sports games (Chapter 4), the most significant part of the strength loads is executed using the coupling method.

5.7 Contents of the Strength Block in Various Sports

The primary emphasis of the special strength work in the different stages (A, B, and C) of the strength block in three different groups of sports is shown in Table 3.

Table 3

Organization of Loads in the Strength "Block"

Groups of Sports	Primary Emphasis of loads		
	A	B	C
Speed-strength sports	Maximal and explosive strength	Explosive and starting strength	Reactive ability and power of work effort
Cyclic sports	Maximal and explosive strength	Local muscular endurance	Power of work in specific motor regime, maximal anaerobic power
Sport games	Maximal strength and strength endurance	Explosive strength and local muscular endurance	Power of work in specific motor regime, maximal anaerobic power

More specifically, the contents of the strength block are as follows:

In speed-strength sports:

A. — The main focus here is on specialized resistance exercises for development of maximal and explosive muscle strength. Also used here is an optimally large volume of specialized exercises (which includes jumping exercises) of moderate intensity. The purpose of the exercises is to prepare the body as a whole, to the forthcoming intense work. This is done by strengthening the ligaments, perfecting flexibility and mobility in the joints, elasticity of the muscles, and development of specific endurance to multiple repetitions of explosive efforts.

B. — Means with a high level of effort. Used here are exercises with various weights, isometric exercises, and the complex method of SST. This ensures enough volume and a strong enough training influence on the body as a whole, and especially on the skeletal-muscular system, which causes deep adaptive changes.

C. -- High intensity specific means. These means create work conditions for the muscular system that most closely approximate the competitive ones including exercises in the shock regime of muscle work. The task of such means lies in perfection of the athlete's ability to display a highly concentrated explosive effort in order to reach new, never before accessible, levels of muscle tension power.

In cyclic sports:

A. --- Specialized exercises (with resistance, jumps, isometric, under more **difficult** conditions of movement) are oriented mainly toward in increase in maximum and explosive muscle strength bringing it up to the necessary level.

B. --- Means of local muscular endurance development including mainly resistance and jump exercises executed with the interval method.

C. — The means are directed to the development of the athlete's effort in the specific cyclic work regime depending on the motor specific character of the sport. Used here are jumping exercises, uphill running, various ways of making the conditions of movement more difficult, as well as means of developing maximum anaerobic power of the body.

In sports games and single-combat sports:

A. — Aerobic-strength loads which include means of perfecting technical-tactical mastery and specialized training on the anaerobic threshold. It also includes SST means directed to the development of maximum strength and strength endurance.

B. — Primary development of local muscular endurance and explosive muscle strength by means of special physical and technical-tactical preparation.

C. — Primary development of high-speed and speed-strength endurance mainly through technical-tactical preparation. SST means help develop local muscular endurance and maximum anaerobic power but with the prevalent display of explosive efforts.

5.8 Placement of SST in the Yearly Cycle

The placement of SST in the yearly cycle of training is determined by the specific character of the motor regime that is inherent in the specific sports event, the competitive schedule, and rules of competition. The high level athlete should be guided by the following requirements:

- a) The concentration of SST loads should be in the first half of the preparatory period:
- a) Concentrated strength loads should not be combined with in-depth work on sports technique and speed of the competitive exercise. These must be separated according to time of execution.
- b) The SST loads should precede concentrated work on sports technique and speed of the competitive exercise so that the latter is executed on the background of the LLTE of the strength loads.

Placement of the strength blocks in a yearly cycle depends on the specific character of the sport. This is schematically shown in Fig. 45.

The first three variants relate to the one cycle type yearly training program (with one competitive period). *Variant 1* has an extended preparatory period and a continuous series of starts in the competitive period. This includes some technically complex sports, speed-strength, cyclical and team sports. In such cases it is best to include the block of supporting SST in the competitive period.

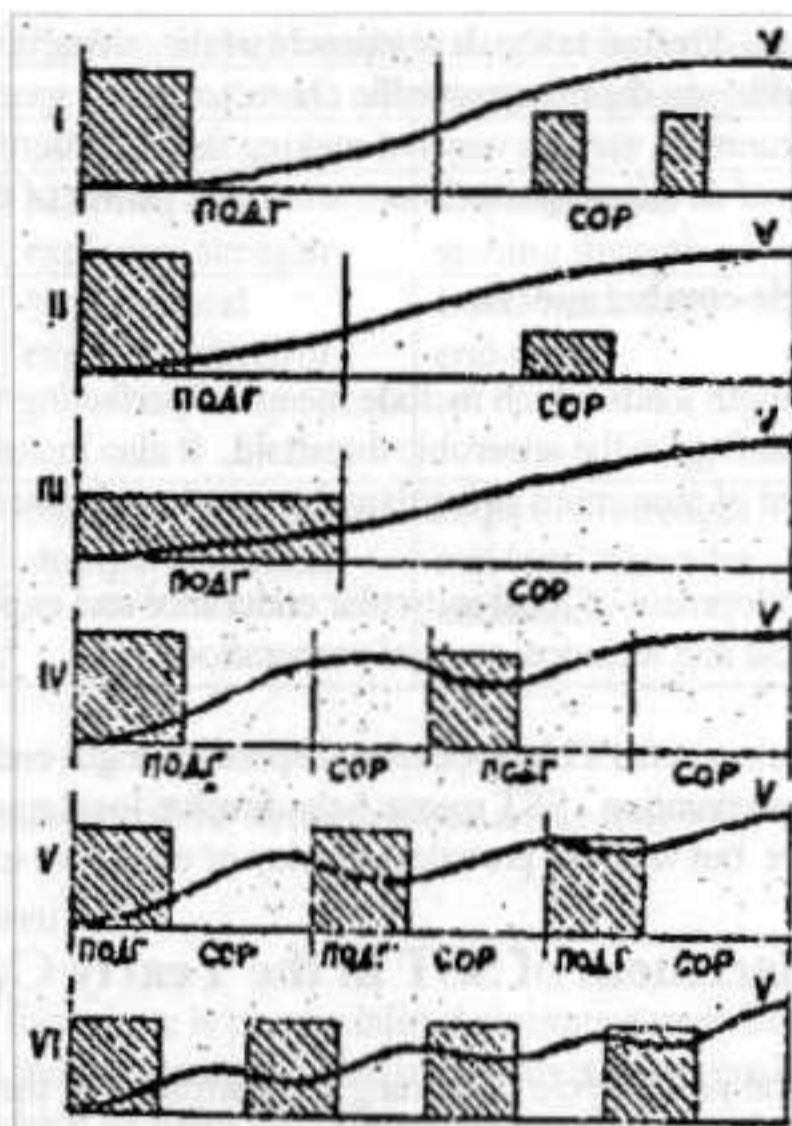


Figure 45: Placement of strength blocks in the yearly cycle in various sports.

ΠΟΔΓ = Preparatory Stage

COP = Competitive Stage

Variant 2 is characterized by sports having short preparatory periods and two stages of competitive periods. This includes soccer, hockey, fencing, and sailing. The block of supporting SST is in between these two periods. In both cases the SST loads are concentrated in the preparatory period.

Variant 3 relates mainly to cyclic sports that involve long competitive distances. For these sports a shortened preparatory period with evenly distributed SST loads is most characteristic.

Variants 4 and 5 are related to sports that have two or three competitive stages. This includes speed-strength sports, short and middle distances, cyclic sports, sports games and single combat sports. In these variants the SST loads are concentrated and greatly express the developing characteristic. Each block decides its own task in conformity with the general training strategy and is different from previous ones according to its higher intensity and specificity of means.

In Variant 6 there is no clear cut distinction between the preparatory and competitive periods. In the training process there is consecutive alternation of the concentrated load blocks of the SST with concentrated work on improvement of sports technique and speed of the competitive exercises. The intensity and specificity of loads are gradually increased; and participation in competition may take part in each of the separate cycles.

5.9 Principles of SST

The organization of SST in the training system is regulated by the following principles:

5.9.1 The Principle of Dynamic Correspondence of the SST Means to the Motor [Movement] Structure of the Competitive Exercise

The main requirement of the SST means that are expressed in this principle is that they:

—Ensure the **development** of the specific functional properties (contractile, oxidative, elastic) of the muscle groups predominantly used in competitive conditions;

—**Ensure perfection** of the dynamic structure of the sports action, i.e. rational organization according to the timing and spacing of the working efforts, developed by the separate muscle groups.

To successfully put these requirements into practice it is necessary to be guided by the following rules:

1. The **special strength exercises** must be selected so that they first of all, load the muscle groups which bear the main loads in competitive conditions.
2. Choose the same starting position and other aspects of the sports actions so that the movements correspond to the competitive exercise in relation to the direction of movement and range of movement.
3. **Accentuate the working effort** in the **part of the** movement range where it is necessary (as a rule, at the beginning of the movement).
4. The amount of effort and the speed of its display should be even higher than that seen in the execution of the competitive exercise.
5. The special exercises should imitate the muscle work regime (explosive, cyclic, isometric, ballistic, etc. that is predominant in competitive conditions.

Based on these rules, it is necessary to select the starting position, form of movements, the amount of external resistance and the way it is used, how the effort is displayed and the exercise method.

5.9.2 The Principle of Specificity of SST Means

During **systematic** training, the body adapts to the motor regime which is predominantly inherent in the particular sports activity. Functional and morphological changes that occur in the muscles have a very specific character. This means that the motor properties of the muscles developed by this or other motor regime can be utilized to the fullest only in the conditions of

this regime. Based on this principle, the SST contents should make possible acquisition of the specific functional qualities which are needed for the given sport.

The specific character of the morpho-functional reorganization in the body and the muscular system is determined by many factors. In particular:

—The posture [pose] of the athlete which determines the anatomical conditions of muscle work, the amplitude of movement, the site at which it is accentuated, and the angle in the joint at which maximum effort is developed;

—By the type of muscular contraction (concentric, eccentric, isometric) and their combinations;

—By the force and speed of the muscular contraction which in turn are determined by the size of the load or other external resistance to the movement.

5.9.3 The Principle of SST Load Concentration

The idea behind this principle consists in the creation of a massed training effect on the body with the use of specialized loads concentrated within a limited time period. As a result, the deepest morpho-functional reorganizations in the body are ensured. They act as a precondition to considerable increases in the specific work capacity of the body.

When using the concentrated strength loads it is necessary to take into account that:

a) The principle of concentrated strength loads applies mainly to the training of high level athletes.

b) The concentration of the strength loads should make it possible to use the LLTE for an increase in the efficiency of perfecting technical mastery and to increase the speed of execution of the competitive exercise.

5.9.4 The System Principle of the SST

There are many SST means at the disposal of a coach and all of them are variants of force and specificity of the training influence on the body. Therefore, high efficiency of the SST (and this is the main idea behind the system principle) can be achieved only when its means are so regulated, according to time of use, that each of them effectively resolves its own particular task. All of them together ensure the achievement of the required level of special work capacity with minimum expenditure of time and energy on the part of the athlete.

Such a system should make possible definite interrelationships and a clear sequence in the use of the means that have various force and specificity of training influences on the body. It is expressed in two forms of its organization.

—Single-moment form. This determines the rationale combination of means in one or adjacent training sessions (when the body reacts with integrated adaptive reactions to the whole complex of closely-spaced training influences);

—Consecutive form. This is determined by the order and sequence of introducing complexes of means on extended stages of training (when the current adaptive reactions of the

body are consistently applied onto the morphological reorganization which took place with the previous loads).

5.9.5 The Principle of Superimposing SST Loads Having Various Training Influences

The idea behind this principle is expressed in the distribution of the SST loads on the stage of their concentration. This makes it possible to consecutively superimpose more intense and specific training influences on the adaptive traces of the previous work.

In other words, the principle of superimposing provides for the gradual replacement of one load by another (as occurs in the conjugate-consecutive form of organizing the SST). See Section 5.4, Fig. 41. The previous loads must ensure the functional-morphological base in order to get an effective training effect of the subsequent loads on the body. At this time the subsequent loads, which resolve their own specific tasks, continue the further perfection of the previous adaptive changes acquired by the body but on a higher level of intensity (power) of work. The previous loads prepare the morpho-functional base for the subsequent loads to attain even stronger and more specific training influences.

5.9.6 The Priority Principle of SST in the Year-Round Training System

Perfection of sports mastery and progress in sports achievement are ensured by many factors. Do not belittle the importance of each of them, especially technical-tactical mastery. However, it is still necessary to admit that the main role in the long-term progress of the athlete's achievement, belongs to SST. When the sports result improves, the role of SST becomes more and more important because the level of the technical-tactical mastery and speed of movements by the athlete can increase only on the basis of increases in his physical potential.

This is totally related to the system of training in the yearly cycle.

Based on this, the essence of the priority principle consists in the fact that it is necessary to begin programming the training process by defining the tasks, structure, volume and placement of SST means (of the loads) in the yearly cycle. Only then is it possible to consider the order of resolving other tasks including the technical-tactical, high-speed training and preparation for competition. Because of this it is necessary to be guided by the schedule of competition and by the following methodological aims.

5.10 Methodological Aims to Resolve the Tasks of SST

For practical realization of the tasks (and principles) of SST it is necessary to be guided by the following methodological aims.

<p>The aim is to separate by time, the SST loads and work on perfection of technical-tactical mastery and speed of the competitive exercise.</p>
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This aim proceeds from the phenomenon of temporary decreases in the functional capabilities of the athlete's body during the stage of SST load concentration (Fig. 43). In such a functional state it is not wise to resolve training tasks requiring fine coordination, high power of effort and perfection of specific mechanisms of energy acquisition. In other words, it is not wise to try to improve technique and speed of the competitive exercises at this time. It is better to execute this work at a different time so that there is a separation of time between them.

The aim of the SST loads out-strips [gets ahead of] the emphasis on the technical-tactical and high speed preparation.

This aim indicates that the SST work must precede in-depth technique and speed of movement work so that preparation of the athlete can be done beforehand. When there is an insufficient level of functional preparation of the athlete, it can constrain the process of perfecting technique and speed of the competitive exercises. As a result, progress in sports achievement is reduced.

Besides this, this aim makes it possible to use the LLTE of the concentrated strength loads for effectively resolving training tasks in the subsequent stage of the yearly cycle.

The aim is to have highly efficient use of the body's energy resources for resolving the SST tasks.

This means that formation of the necessary morpho-functional changes in the body requires a huge expenditure of energy, especially from high-level athletes. Therefore, the aim is to use SST loads with "fresh" forces, i.e., when the power producing resources of the body are not spent from other work.

Thus, for effective resolution of SST tasks it is necessary to place the loads in an independent training session or, if it is a complex of trainings, the SST loads should assume the prime role.

CHAPTER 6

TRAINING PROGRAMS

This chapter contains the following specific SST programs for high level athletes:

- **Universal** Program for development of "jump force" in the preparatory stage of the yearly cycle;
- Program for perfecting starting **acceleration** speed of sprinters;
- Program for high level **middle distance runners**;
- Program for high level rowers;
- Program for development of "jump force" of volleyball players;
- Program for basketball players;
- Program for high level [American] football players;
- Program for high level tennis players.

1. The **programs are expounded** on in view of the specific characteristics of the sport and with the task of achieving a high training effect. This is done with optimal expenditure of the athlete's time and energy.

2. The programs have two main advantages:

—First, they are looked at from the **biological perspective** to objectively determine the contents and development of the **adaptive reorganization** in the body that occurs during intense muscular activity;

—Second, the **program structure** is based on the system principle, turning the separate training sessions into powerful monolithic and purposeful training influences on the athlete's body.

3. **Strong confirmation** of the high efficiency and the very important role of the recommended programs for improvement of sports skill, especially of high level athletes, has been proven in **sports' practice**.

4. **These programs** are intended for particular kinds of sports. They can also be used successfully in other sports that are close to the motor regime seen in these sports events. Besides this, coaches can develop their own original programs based on these programs and in view of the individual characteristics of the special physical preparation of the athlete.

5. The programs are intended for men and women. However, in the case of the women, the resistance and total load volume should be somewhat reduced.

6.1 Universal Program for Development of “Jump Force” In the Preparatory Stage of The Yearly Training Cycle

This program is intended for all sports where it is necessary to develop “jump force”. It can be used by athletes in all sports where it is necessary to run quickly, to jump, to have the ability to quickly accelerate, to run with sharp changes in direction, etc.

The program is based on the complex principle that foresees using the positive interaction of the training effect of various means: Squats and jumps with the bar on the shoulders, jumps holding weights (kettlebell) in the hands and take-offs after a drop down as in the depth jump.

There are three program variants, each of which has different complexities. Their effects can be seen in the increases in the skeletal-muscular system.

Variant 1

The program is executed in 6 weeks, 2 times per week. In all, there are 12 sessions.

1 st day	drop jump (0.75 m.)	3 x 10
2 nd day	drop jump (0.75 m.)	4 x 10
3 rd day	barbell squat (90-93%)	2-3 x 3
4 th day	drop jump (1.10 m.)	4 x 10
5 th day	barbell squat (90-93%) drop jump (0.75 m.) series is repeated 2 times	2 x 3 2 x 10
6 th day	barbell squat (90-93%) drop jump (0.75 m.) series is repeated 2 times	1 x 3 1 x 10
7 th day	barbell squat (90-93%) drop jump (0.75 m.) series is repeated 2 times	1-2 x 3 2 x 10
8 th day	barbell squat (93-95%) drop jump (1.10 m.) series is repeated 3-4 times	1 x 3 1 x 10
9 th day	barbell squat (93-95%) drop jump (1.10 m.) series is repeated 4 times	1 x 3 1 x 10

10 th day	barbell squat (93-95%) drop jump (1.10 m.) series is repeated 2 times	1 x 3 2 x 10
11 th day	drop jump (1.10 m.)	4 x 10
12 th day	drop jump (1.10 m.)	4 x 10

Note:

1. The height of drop down for drop jumping is in parentheses.
2. Weight for the squat mentioned in parentheses is percent of maximal squat.
3. Here and in the following variants, the rest between sets is 4-6 minutes and between series, 8-10 min.

Variant 2

This program is executed in 6 weeks, 2 times per week. There are 12 training sessions.

1 st day	drop jump (0.75 m.)	3 x 10
2 nd day	drop jump (0.75 m.) Drop jump (1.10 m.)	2 x 10 2 x 10
3 rd day	squat jumps with kettlebell (24 kgs.)	4 x 10
4 th day	barbell squat (90-93%) drop jump ((0.75 m.)	2-3 x 3 3 x 10
5 th day	drop jump (1.10 m.)	4 x 10
6 th day	barbell squat (90-93%) drop jump (1.10 m.) series is repeated 3 times	2 x 3 1 x 10
7 th day	barbell squat (90-93%) squat jumps with kettlebell (24 kgs.) series is repeated 2 times	2 x 3 2 x 10
8 th day	drop jump (1.10 m.)	4 x 10
9 th day	barbell squat (93-95%) squat jumps with kettlebell (24 kgs.) series is repeated 2-3 times	1 x 3 1 x 10
10 th day	drop jump (1.10 m.)	4 x 10

11 th day	barbell squat (93-95%) squat jumps with kettlebell (32 kgs.) series is repeated 2 times	2 x 3 2 x 10
12 th day	squat jump with kettlebell (32 kgs.) drop jump (0.75 m.)	1 x 10 1 x 10

Note: The series, with the kettlebell weight, mentioned in parentheses, is repeated 4 times.

Variant 3

This program presents the highly effective concentrated strength load for perfection of "jump force." It requires good preliminary preparation of athlete. The program is intended to be used for 5 weeks with 3 training sessions per week. In all, there are 15 sessions.

1 st day	barbell squat (90-93%) squat jumps with bar (30-40%)	2 x 3 2 x 8-10
2 nd day	depth jump (0.75 m.)	4 x 10
3 rd day	depth jump (1.10 m.)	4 x 10
4 th day	barbell squat (93-95%) squat jumps with kettlebell (24 kgs.) depth jump (0.75 m.) series is repeated 2 times	1 x 2-3 1 x 10 2 x 10
5 th day	squat jumps with kettlebell (32 kgs.) depth jump (0.75 m.) series is repeated 2 times	2 x 10 2 x 10
6 th day	drop jump (1.10 m.)	4 x 10
7 th day	barbell squat (93-95%) Squat jumps with kettlebell (32 kgs.) series is repeated 2 times	2 x 2-3 2 x 10
8 th day	barbell squat (93-95%) squat jumps with kettlebell (24 kgs.) drop jump (0.75 m.) series is repeated 2 times	2 x 2-3 2 x 10 2 x 10
9 th day	drop jump (1.10 m.)	4 x 10

10 th day	barbell squat (93-95%) squat jumps with bar (30-40%) series is repeated 3 times	1 x 2-3 2 x 10
11 th day	squat jumps with kettlebell (32 kgs.) drop jump (0.75 m.) series is repeated 2 times	2 x 10 2 x 10
12 th day	drop jump (1.10 m.)	4 x 10
13 th day	barbell squat (93-95%) squat jumps with bar (30-40%) series is repeated 3 times	1 x 2-3 2 x 10
14 th day	squat jumps with bar (30-40%) squat jumps with kettlebell (24 kgs.) series is repeated 2 times	2 x 10 2 x 10
15 th day	drop jump (0.75 m.) drop jump (1.10 m.)	2 x 10 2 x 10

When using programs such as these for development of "jump force" it is necessary to take into account the following:

1. The athlete should be well prepared to execute these programs. He should already have executed a finite volume of jump exercises and barbell exercises and must have the correct technique of the depth jump (the drop jump)

2. The separate training sessions that are used for development of "jump force" can be combined with other work in one training session. This includes exercises that imitate technical elements executed by the trunk and arms, etc. but the "jump force" training sessions should take place in the main part of the session. The "jump force" training should not be considered as an additive to some other work.

3. Work on perfection of "jump force" should not be combined with concentrated work on perfection of sports technique and speed of movements.

4. The Variant 3 program for development of "jump force" is based on the principle of **specific load** concentration in a limited amount of time. In this way the loads provide a great **intensive** influence on the body. This, as a rule, causes an appreciable decrease in some **functional** parameters and in particular, the ability to display explosive efforts. However, this is **not to** be feared as it is only temporary and a convertible phenomenon.

After completion of the 5-week program, all functional parameters, including the ability to display explosive effort, not only returns to the initial level, but considerably exceeds this level. This phenomenon was investigated and described in my previous works (1978, 1985), as the "long lasting training effect" [LLTE]. For details see Chapter 5.

Special research has shown that the organization of training, that creates the conditions for realizing the long lasting training effect, is an extremely effective way of organizing the specialized strength load. Intelligent use of this method creates great opportunities for resolving the training of high level athletes.

6.2 Program For Perfecting Starting Acceleration Speed Of Sprinters

The principles of this program were developed back in 1963 for my athlete, Boris Zubov. He was USSR and European record holder and Olympic Games finalist in Tokyo (1964) in the relay. Boris had great speed over the distance and finishing speed. He had no equals in the home stretch in the 200 m sprint. However, his starting acceleration was very bad.

We trained hard but unsuccessfully on speed of running. I had not yet realized that the run over the distance and starting acceleration were determined by different abilities and that for good starting acceleration it was necessary to have very strong legs.

I appeared to be right and a specialized strength program, which I developed, has confirmed my suppositions. Unfortunately, at that time I did not have scientific instruments, except a stop watch and tape measures, and I had no impressive figures to show for proof. But I remember well and I was convinced that Boris had increased the length of his first ten steps from the start by 60 centimeters. It shortened his time in the 30 m run with a start by 0.3 sec. This was enough to establish his place on the United Track and Field Team of the USSR that took part in the USSR-USA meet in California and then went on to the Olympic Games in Japan.

Later on, the strength program became more advanced and was successfully used by hurdlers and jumpers as well as in football, handball [European], rugby, baseball, and other sports.

The program is executed two times a week for six weeks for a total of 12 training sessions. The program uses the following exercises:

- Barbell squats with a weight of 80-90% of maximum for development of maximum strength and for toning the central nervous system;
- Squat jumps with the bar on the shoulders using a weight of 30-50% of maximum. They are used for development of explosive muscle strength;
- Squat jumps with the kettlebell (16, 24, or 32 kgs.) held in hands for development of reactive ability of the muscles;
- Depth jumps for development of explosive strength and reactive ability of the muscles;
- Jump exercises for development of the ability to display repeated explosive effort and anaerobic capacity of the body;
- Uphill running and jumping up stadium stairs for development of maximal anaerobic capacity.

It is necessary to say more about the uphill running and jumping in the stadium.

Uphill running (15-25 m.) should be executed at a low rate with emphasis on a forward take-off and active swing movements of the leg. Running with half bent legs like dribbling is a huge mistake. In addition, it lowers the specificity of the training influence of this exercise.

Stadium jumping should be executed with 2-3 steps at a time with an active take-off (6-10 repetitions) in an upward and forward direction.

I recommend the following program:

1ST day Barbell squats (85-90%) 2-3 x 5-6

The series is repeated 2-3 times.
Rest between sets is 4-5 min.,
between series, 8-10 min.

2nd day Barbell squats (80%) 1 x 10
 Barbell squats (90%) 1 x 5
 Barbell squats (93-95%) 1 x 12

The series is repeated 2-3 times.
The rest between sets is 4-5 min.,
and between series, 6-8 min.

3rd day Squat jumps with bar (30-50%) 2 x 6-8
 Six-fold jump from place 1 x 4-5

The series is repeated 2-3 times.
Rest between repeats is 4-6 min.,
and between series, 8-10 min.

4th day Barbell squats (70%) 1 x 12
 Barbell squats (80%) 1 x 10
 Barbell squats (85%) 1 x 6-7
 Barbell squats (90%) 1 x 4-5

The series is repeated 2 times.
The rest between sets is 5-6 min.,
and between series, 8-10 min.

5th day Depth jumps (0.75 m.) 2 x 10
 Ten-fold jump from place 1 x 3-4

The series is repeated 2-3 times.
The rest between sets is 4-6 min.,
and between series, 8-10 min.

6th day Squat jumps with kettlebell 3 x 8
 Ten-fold jump from place 1 x 3-4

Each series is repeated 2-3 times.
 The rest between sets (repeats) is 4-6 min.,
 and between series, 8-10 min.

7 th day	Squat jumps with bar (30-50%)	2 x 8
	Six-fold jump from place	1 x 3-4

Each series is repeated 2 times.
 The rest between repeats is 4-6 min.,
 and between series, 10-12 min.

	Rest 15 min.	
	Run up hill (15-25 m.)	1 x 5-6

Rest is 4-6 min.

8 th day	Depth jumps (0.75 m.)	4 x 10
	Rest 15 min.	
	Stadium jumps	4 x 10

Two series, rest between repeats is arbitrary
 and between series, 10-12 min.

9 th day	Barbell squats (93-95%)	2 x 2-3
	Depth jumps (0.75 m.)	2 x 10

The series is repeated 2 times.
 Rest between repeats is 4-6 min.,
 and between series, 10-12 min.

	Rest 15 min.	
	Run up hill (15-25 m.)	1 x 5-6

Rest 4-6 min. between repeats

10 th day	Depth jumps (0.75 m.)	4 x 10
	Rest 10-15 min.	
	Stadium jumps	4 x 10

In 2-3 series, rest between repeats is arbitrary,
 between series, 10-12 min.

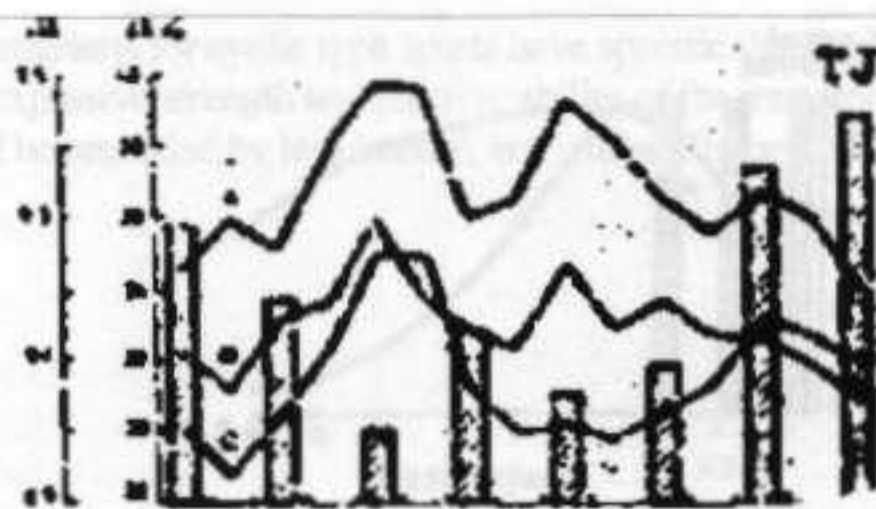
11 th day	Barbell squats (93-95%)	2 x 2-3
	Depth jumps (0.75 m.)	2 x 10

	The series is repeated 2 times. The rest between repeats is 4-6 min., between series, 8-10 min.	
	Rest 15 min. Run up hill (15-25 m.) Rest 4-6 min between repeats.	1 x 5-6
12 th day	Depth jumps (1.10 m.) Rest, 10-15 min.	4 x 10
	Stadium jumps	4 x 10
	There are 2-3 series. Rest between repeats is arbitrary, between series, 10-12 min.	

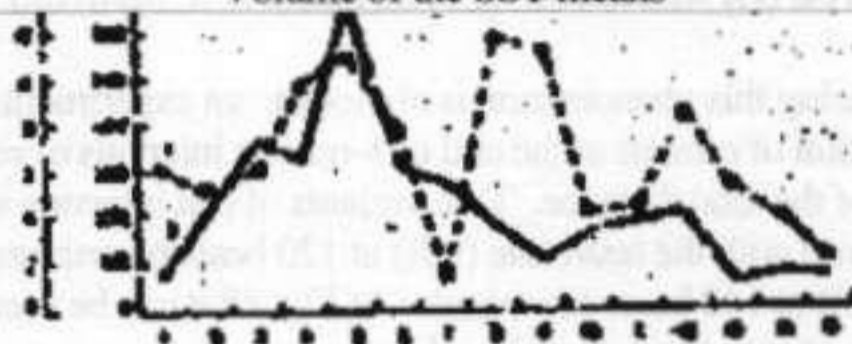
In summary, there are two recommendations regarding the application of strength programs in cyclic-type sports.

1. The program has a strong training influence on the skeletal-muscular system. As a result, such work causes a temporary increase in the hardness (entrapment) of the muscles and deterioration of high speed running results.

In Fig. 46 the relationships between the volume of specialized strength and jump means, elasticity of muscles and control [test] results in the triple jump from place for top class sprinters in the spring-summer stage of the yearly training is shown. It is easy to see that an increase in the volume of strength means (4th - 6th, and 8th - 9th weeks) results in an increase of muscle hardness and a decrease in the working effect in regard to explosive efforts (results in the triple jump from place are reduced).



Volume of the SST means



Weeks

Figure 46: Relationship between the volume of strength training means (B) and the state of the sprinters motor system (A). Elasticity of the muscles: A calf muscle, B quadriceps muscle, C hamstring muscle. 1. Jumping exercises, 2. resistance exercises.

This means that adverse conditions for perfecting running speed are created when speed is the main task of training. Besides this, the increased training load at this time results in a slowdown of the muscle contraction speed that as a rule, creates the precondition for injuries. Thus the strength program should never be combined with work for the development of speed, i.e., running at maximum speed.

2. There is one important circumstance that deserves attention as it can be used successfully for increasing the efficiency of the program being considered. It has been established that blood lactate contents during the restoration period after maximal work "to failure" (refusal) decreases faster with work of the same muscles than during passive rest (Fig. 47). Also, speed of lactate removal increases with an increase in the load up to the oxygen level needed that is equal to approximately 60-70% of the individual's maximum oxygen consumption (MOC). Thus, the speed of lactate removal, even at the highest loads (about 80% of MOC) is on the average well above that at passive rest.

The most active site of lactate oxidation is not so much in the liver and myocardium (of the heart muscle) as was always believed, but in the working skeletal muscles (as found in a well-prepared person). The blood flow through the muscles when they increase in hardness is increased, which in turn increases the turn-over of the various metabolites. A person working at an intensity of 75% of MOC has approximately a 75% lactate turnover (conversion to glycogen) carried out through oxidation in the skeletal muscles.

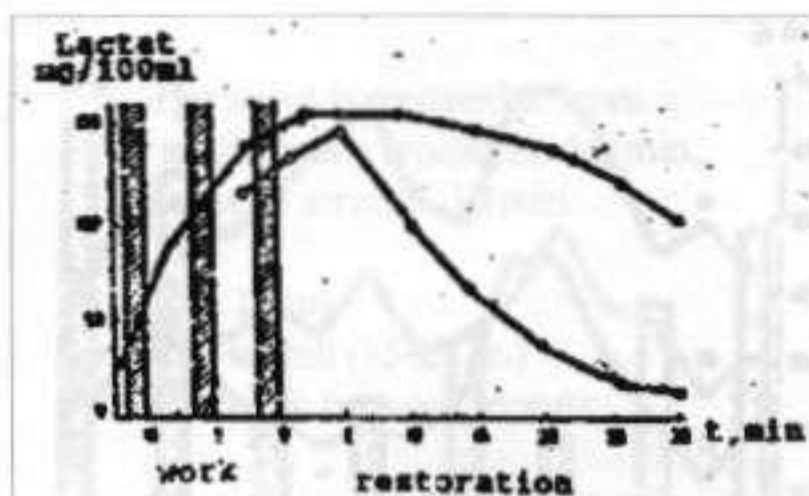


Figure 47: Blood lactate contents before, during, and after 3 bouts of hard work. A) Passive rest (B) Active rest. (L. Hermansen, J. Stenvold, 1972)

The practical effect of using this phenomenon is obvious from experiments that determine blood lactate concentration of runners at the end of 8-minute intervals of rest between repeated 1200 m runs, portions of the total distance. Two variants of rest intervals were used (8 times): A light run (like dribbling) with the heart rate (HR) at 120 beats per minute and a more intensive run with the HR at 140 beats per minute. In Fig. 48 it can be seen that in the second case (B) blood lactate concentration is considerably less.

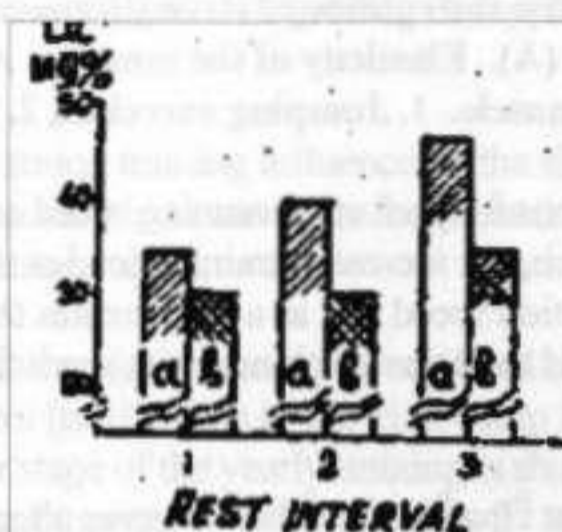


Figure 48: Concentration of lactic acid in the blood at the end of the rest pause between the repeated runs of 1200 meters. (A) Running with the heart rate at 120bpm, (B) running with the heart rate at 140bpm.

From this, it is now possible to make two conclusions

---First it is necessary to pay attention to the recommended duration of the rest pauses both between sets as well as between series in these programs. Under no circumstances should these recommendations be neglected; time economy leads to a loss in training efficiency;

---Second, in the rest pauses it is necessary to execute active work by the same muscle groups to which the training is directed and which receive the major training influence.

And finally, all programs for cyclic type sports have specific directions in regard to the development of explosive strength and reactive ability of the muscles. Therefore, before using them they should be preceded by less intense, but with sufficient volume, preparatory strength work.

6.3 Program for Top Level Middle Distance Runners

This program is used for development of local muscular endurance, as well as for perfection of reactive ability and elastic qualities of the leg muscles. As a result there is improvement in their ability to recover mechanical energy.

European middle distance runners have as a rule, two competitive stages in the year—winter and summer. This is why special strength training is carried out with two “blocks.” The first of them, lasting eight weeks, takes place in December-January, and the second block of six weeks, takes place in March-April. Even though the second block is executed on the base of the morpho-functional changes that took place as a result of doing the first block program, the muscle function regime in the second block is more intense.

The special strength training program uses basically two variants of exercises with the barbell on the shoulders.

- Squat jumps in place with the feet shoulder-width apart;
- The scissor-lunge jumps. In other words, jump out of a lunge [stride] position with a switch in the legs, alternating on every jump.

These exercises effectively ensure perfection of the contractile, oxidative and elastic muscle qualities while taking into consideration conditions of their work while running.

The weight of the bar used is within the limits of 35-45% of maximum in the barbell squat. This weight is used so that the athlete can execute one set of 10 movements with sub-maximal efforts and repeat 6-10 sets without considerable fatigue.

The interval-serial method of exercising is used.

The strength training is carried out two times a week and the dosage is increased as follows: 8 x 10 here means doing 8 sets of 10 movements which makes one series. The number of series is indicated in parentheses.

Program for the First Block

1st day	Squat jumps	6 x 8 (2)
	Rest interval between sets, 60 sec. between series, 8-10 min.	
2 nd day	Scissor-lunge jumps	6 x 8 (3)
	Rest interval between sets, 60 sec., between series, 8-10 min	
3 rd day	Squat jumps	8 x 10 (2)
	Rest interval between sets, 60 sec., between series, 8-10 min.	

4 th day	Scissor-lunge jumps Rest interval between sets, 60 sec., between series, 8-10 min.	8 x 10 (3)
5 th day	Squat jumps Rest interval between sets, 60 sec., between series, 8-10 min.	10 x 10 (2)
6 th day	Scissor-lunge jumps Rest interval between sets, 30 sec., between series, 8-10 min.	6 x 8 (2)
7 th day	Squat jumps Rest interval between sets, 30 sec., between series, 8-10 min.	6 x 8 (3)
8 th day	Scissor-lunge jumps Rest interval between sets, 60 sec., between series, 10-12 min.	10 x 10 (3)
9 th day	Squat jumps Rest interval between sets, 30 sec., between series, 8-10 min.	8 x 10 (2)
10 th day	Scissor-lunge jumps Rest interval between sets, 30 sec., between series, 8-10 min.	6 x 8 (2)
11 th day	Squat jumps Rest interval between sets, 10 sec., between series, 10-12 min.	8 x 8 (3)
12 th day	Scissor-lunge jumps Rest interval between sets, 30 sec., between series, 10-12 min.	10 x 10 (3)
13 th day	Squat jumps Rest interval between sets, 10 sec., between series, 10-12 min.	8 x 10 (3)
14 th day	Scissor-lunge jumps Rest interval between sets, 10 sec., between series, 10-12 min.	10 x 10 (3)
15 th day	Squat jumps	10 x 10 (4)

Rest interval between sets, 10 sec.,
between series 12-14 min.

16th day Scissor-lunge jumps 10 x 10 (4)
Rest interval between sets, 10 sec.,
between series 12-14 min.

Program for the Second Block

1st day Squat jumps 8 x 10 (2)
Rest interval between sets, 60 sec.,
between series, 8-10 min.

2nd day Scissor-lunge jumps 10 x 10 (3)
Rest interval between sets, 60 sec.,
between series, 8-10 min.

3rd day Squat jumps 10 x 10 (2)
Rest interval between sets, 30 sec.,
between series, 8-10 min.

4th day Scissor-lunge jumps 10 x 10 (3)
Rest interval between sets, 60 sec.,
between series, 8-10 min.

5th day Squat jumps 10 x 10 (3)
Rest interval between sets, 30 sec.,
between series, 8-10 min.

6th day Scissor-lunge jumps 8 x 10 (2)
Rest interval between sets, 10 sec.,
between series, 10-12 min.

7th day Squat jumps 10 x 10 (4)
Rest interval between sets, 30 sec.,
between series, 8-10 min.

8th day Scissor-lunge jumps 10 x 10 (3)
Rest interval between sets, 10 sec.,
between series, 10-12 min.

9th day Squat jumps 10 x 10 (4)
Rest interval between sets, 30 sec.,
between series, 8-10 min.

10th day Scissor-lunge jumps 10 x 10 (4)

	Rest interval between sets, 10 sec., between series, 10-12 min.	
11th day	Squat jumps Rest interval between sets, 10 sec., between series, 10-12 min.	10 x 10 (4)
12th day	Scissor-lunge jumps Rest interval between sets, 10 sec., between series 10-12 min.	10 x 10 (4)

Besides these exercises with the bar, runners effectively use special exercises for development of explosive strength and local muscular endurance of the hip flexors (hip joint flexion). For this a simple pulley device or other simple devices can be used. (See Fig. 31).

The movements are executed with emphasis on placing the effort at the beginning at the working amplitude [range of motion]. The weight is selected individually so that it is possible to execute the exercise at the rate of 6-8 repetitions in 10 seconds. Ten movements are done by one leg and then the other. The optimal amount in one series is 5-6 sets on each leg (by turns). In total, there are 2-3 series with a rest of 8-10 minutes in between.

Between repetitions, the weight should return to a support position in order to achieve instant relaxation of the muscles. The rate of executing movements should be increased by small degrees.

The exercises for the hip flexors should be included in the training two times a week so that the work for the leg extensors and for the hip flexors are executed on different days.

Experimental testing of the strength block programs involved comparison with a control group of runners who trained in the conventional way and did not perform the specialized strength program. It was found that:

1. The strength blocks program ensured a considerable increase in explosive strength, reactive ability and elastic properties of the athlete's muscles. It was positively expressed (Fig. 3) by higher significance in comparison to the control group of athletes. Positive increases were seen in the ten-fold jump from place from leg to leg, stride length when running at maximal speed and in speed when running at the anaerobic threshold level. The increase in stride frequency was insignificant.

2. The important correlation of reactive ability of the muscles with maximum running speed was $r = 0.87$, time of support during the run, $r = -0.71$ and to stride length during maximum speed running, $r = 0.91$. Total work volume with the bar was also found to have a significant correlation with stride length at maximum running speed ($r = 0.59$) and with blood lactate concentration in the control test for strength endurance ($r = -0.64$).

3. The improvement in the level of oxidative properties of the muscles are characterized by the local muscle endurance test or by the lactate test (Fig. 4). This test represents the short term (10 sec.) intense work (squat jumps with the bar on shoulders), repeated 8 times in 30 seconds. In each workout and 3 minutes after ending the last workout, blood lactate was taken. The testing was conducted three times in October (1st), January (2nd), and June (3rd).

The test results testify to the steady reduction in the blood lactate level curve during the year of training. In other words, there was less use of glycolysis as an energy source in standard conditions of muscle work. It shows the increase in the oxidative capacity of the muscles. But there was no such improvement in the lactate test in the control group of athletes. Thus, it is possible to assert that the increase in the oxidative quality of the runner's muscles in the experimental group, was due to the specialized program of strength preparation.

4. There is one other very important detail. The group of athletes using the specialized strength program demonstrated better running results. Most important was that the volume of their distance work (running load) was only 1976 km. That is 2.3 times less than athletes in the control group (4610 km). This is an extremely important argument for the benefit of the suggested program.

In summary:

- a) The recommended strength programs are not blueprints. These programs must be considered as beginning information for development of individualized programs for particular athletes. Similar programs are possible by varying these means with shock regimes of muscle work as for example:
 - Squat jumps with the kettlebell in the hands;
 - Jumping over hurdles with double leg takeoffs;
 - Various jump exercises;
 - After 2-3 steps, jumps onto a box with a double leg takeoff;
 - Repeated jumps onto a box at a high rate.
- b) The character of the rest breaks between sets and series is extremely important in determining the effect of the strength training. Specific work performed by the same muscle groups that executed the strength loads, promotes faster oxidation of the lactate produced during the work than in passive rest. It increases considerably the specificity of the training influence on the body in the following strength work series.

For active work between series it is possible to execute 2-3 long accelerations with the heart rate at about 140 beats per minutes.

- c) Last, it should be noted that the specialized program zeros in on perfection of the muscles' ability to display explosive strength and reactive ability when fatigue is developing. In general, this can be said about the total system of specialized strength training for runners which should include outstanding means such as jump exercises in different variants (especially in relation to how they are executed) barbell squats, and uphill running.

6.4 Program for Top Level Rowers

This program is specialized with the aim of making the athlete ready to display a high level of reactive ability and explosive leg muscle strength when there is developing fatigue. It provides that:

- The rowers have a high enough level of maximal muscle strength; and
- The specialized strength work for the arm, shoulder girdle and trunk muscles is executed at the same time.

The program objectives are to:

Increase the strength potential of the leg extensor muscles in view of their specific character of work in competitive conditions (race rowing). More particularly, it is expressed in the following:

- An increase in maximum and explosive muscle strength;
- Perfection of the ability to display a high level of explosive strength in conditions that require specific endurance;
- Improvement in the elastic properties of the muscles (ability to recover mechanical energy).

The program uses three basic exercises in the shock regime of muscle work. They are executed in different variants:

- Squat jumps with the bar on the shoulders with the weight about 40% of maximum in the barbell squat;
- Squat jumps with kettlebell (16, 24, 32, kgs—individually selected) held in the hands. The jumps are executed on the floor or on two parallel benches;
 - Jump onto a box (0.30 - 0.40m.);
 - Depth jump using a height of 0.5 and 0.7m.

The program can be varied by using other exercises for rowers as described below:

The base program uses the interval-serial method of exercising. Its essence is in the following: short-term intense repeat work with limited intervals of rest. A number of such sets make a series, which is repeated several times with relatively extended rest periods.

The load dosage is adjusted by the following work parameters:

- The number of repetitions in one set (and thus, the duration of work);
- The number of sets in one series;
- The number of series;
- The rest interval between sets in one series;
- The rest pause between series.

The key to describing the program is as follows:

8 x 10 (3) means the following:

- The exercise is executed for 3 series;

- In each series there are 8 sets;
- In each set there are 10 repetitions of the exercise.

The interval between sets and the duration of rest between series are also indicated.

The program is executed 2 times a week for 8 weeks. In total, there are 16 training sessions.

1 st day	Squat jumps with the bar on the shoulders (40% of maximum) The rest interval between sets is 60 sec., between series, 8-12 min	4 x 8 (2)
2 nd day	Squat jumps with bar on the shoulders (40 % from maximal) The rest interval between sets is 60 sec., between series, 8-12 min.	5 x 8 (2)
	Depth jumps (0.5m). The rest interval between sets is 1-2 min., between series, 5-6 min.	2 x 10 (2)
3 rd day	Squat jumps with bar on the shoulders The rest interval between sets is 60 sec., between series, 8-12 min.	5 x 10 (2)
	Depth jumps (0.7m)	4 x 10 (1)
4 th day	Squat jumps with the bar The rest interval between sets is 60 sec., between series, 8-12 min.	6 x 10 (2)
	Squat jumps with a kettlebell The rest interval between sets is 4 min.	4 x 10 (1)
5 th day	Squat jumps with the bar The rest interval between sets is 60 sec., between series, 8-10 min.	6 x 10 (3)
	Squat jumps with a kettlebell The rest interval between sets is 30 sec.	4 x 8 (1)
6 th day	Squats jump with bar The rest interval between sets is 30 sec., between series, 8-10 min	6 x 10 (3)

	Squat jumps with a kettlebell The rest interval between sets is 30 sec., between series, 4-6 min.	5 x 8 (2)
7 th day	Squat jumps with the bar The rest interval between sets is 30 sec., between series, 8-10 min.	8 x 10 (2)
	Squat jumps with a kettlebell The rest interval between sets is 10 sec.	6 x 10 (2)
8 th day	Squat jumps with the bar The rest interval between sets is 30 sec., between series, 8-10 min.	10 x 10 (2)
	Squat jumps with a kettlebell The rest interval between sets is 4-6 min, between series, 10 min.	8 x 10 (2)
9 th day	Squat jumps with the bar The rest interval between sets is 30 sec., between series, 8-10 min.	10 x 10 (4)
	Jumps with a kettlebell The rest interval between sets is 10 sec., between series, 4-6 min.	8 x 10 (2)
10 th day	Squat jumps with the bar The rest interval between sets is 30 sec., between series, 8-10 min.	10 x 10 (3)
	Squat jumps with a kettlebell The rest interval between sets is 10 sec., between series, 4-6 min.	10 x 10 (3)
11 th day	Squat jumps with the bar The rest interval between sets is 10 sec., between series, 8-10 min.	10 x 10 (4)
12 th day	Squat jumps with the bar The rest interval between sets is 10 sec., between series, 8-10 min.	10 x 10 (4)
13 th day	Squat jumps with the bar The rest interval between sets is 10 sec., between series, 8-10 min.	10 x 10 (3)

	Jumps on to a box (0.30 - 0.40m) at moderate rate The rest interval between sets is 4 min	4 x 10 (1)
14 th day	Jumps on to a box at higher rate The rest interval between sets is 3 min, between series, 10-12 min.	4 x 50 (2-3)
15 th day	Squat jumps on to a box at high rate The rest interval between sets is 2 min., between series, 10-15 min.	5 x 50 (2-3)
16 th day	Jumps on to a box The rest interval between sets is 2 min. between series, 10-15 min.	5 x 50 (3-4)

A few remarks:

1. The program presented is based on the principle of gradual increases in specificity and intensity of the muscle work. If this program proves to be monotonous it can be varied, as for example by the following exercises:

--After an approach run of 3-4 steps double leg jumps onto a box (0.1 - 1.0 m.). Execute 2-4 sets of 10 repetitions with a rest pause between sets of 5-6 minutes;

--With a powerful take-off, jump over hurdles (0.4 - 0.6m in height). Execute 3 sets of 10 reps with a rest pause of 1 minute between sets;

---Double leg jumps in place with rope skipping. Execute as quickly as possible for 3 sets executed in 1 minute each with a rest pause of 1 minute in between;

--Pull of the bar (80% of maximum) in a face down lying position on an exercise bench (barbell row). The bar is initially raised approximately 1/3 of the full range of motion and then lowered with a fast switching in direction and pulled up to the chest. Three sets of 6-8 repetitions with a rest of 4-6 minutes in between sets is executed. In total there are 2 series with a rest period of 8-10 minutes in between the series;

--Seated row, pull back with the arms on a low pulley apparatus in the same regime of work as in the previous exercise: At first the weight is raised approximately 1/3 of the total range of motion and then is lowered with a quick switch to overcome the lifting phase of the movement, imitating the working part of the stroke. The resistance is 80% of maximum with 3-4 sets of 8-10 repetitions with a rest pause of 4-6 minutes in between. There are 2-3 series with a rest of 10-12 minutes between series.

2. The program is directed mainly to development of explosive strength and reactive ability of the leg extensor muscles in conditions of developing fatigue. However, one should not forget the need to develop specific strength endurance of the trunk muscles (mainly of the back), hand, arms and shoulder girdle. This should be done 2 days a week. The program of special strength training can be as follows:

- Monday – work on the leg muscles.
- Tuesday – work on the muscles of the trunk and arms.
- Thursday – work on leg muscles.
- Friday – work on the muscles of the trunk and arms.

3. And, one more detail. Notice that the program each day takes a great deal of time if the recommended duration of the rest pause between sets and series is strictly observed. However, this is not a defect, rather it is an integral part of the program.

The way the work is organized in each training session provides for the perfection of the central-neural control of the muscle work, as well as the specific mechanism of its energy acquisition. The specialized strength work has such a strong effect on the body that it can replace many kilometers and hours of exhausting distance training. In other words, such work ensures the athlete's highly effective preparation with less expenditure of his time and energy.

6.5 Program for Development of Jump Force for Volleyball Players

There are three programs aimed at volleyball players.

Program 1 --- For average level volleyball players.

Program 2 --- For high level volleyball players in the preparatory stage of training;

Program 3 --- For high level volleyball players during the pre-competitive stage of the yearly cycle.

Program 1

The duration of this program is 4 weeks, done 3 times a week. In total, there are 12 training sessions. The program consists only of depth jumps. Each jump series consists of 10 jumps.

1 st day	Height, 0.60 m.	3 x 10
2 nd day	Height, 0.60 m.	3 x 10
3 rd day	Height, 0.70	3 x 10
4 th day	Height, 0.70	4 x 10
5 th day	Height, 0.75	4 x 10
6 th day	Height, 0.75	4 x 10
7 th day	Height, 0.75	4 x 10
8 th day	Height, 0.75	4 x 10
9 th day	Height, 0.75	4 x 10
10 th day	Height, 0.80	4 x 10
11 th day	Height, 1.10	4 x 10
12 th day	Height, 1.10	4 x 10

1. The recommended dose of strength work is related to the athlete and how well he executes the technique of the drop jump [drop down in the depth jump]. This determines the optimal load limit, which should be reached gradually, and which should not be exceeded.

2. The depth jumps in each session should be preceded by a special warm up, which includes double leg vertical jumping and some sub-maximal force take-offs following a jump down from a small height (0.3 to 0.4 meters).

3. The rest between jump series is arbitrary. The jumps are executed repeatedly as is convenient for the athlete, who should not increase the interval of rest between jumps.

4. The amount of rest between the jump series should be regulated by the working state of the athlete. The break between series should not be targeted for reduction or for an increase. The following series should begin after the athlete has a sensation of readiness to continue jumping. Three to five times is enough for this. The rest between series should not be a passive one. Exercises for relaxation, shaking up of the muscles and slow light running, promote restoration of muscle work capacity.

Program 2

The duration of this program is 6 weeks, executed 2 times a week. In all there are 12 training sessions. The program includes the following exercises:

- Barbell squats using various weights;
- Squat jumps with the bar on the shoulders using different weights;
- Double leg vertical jumps for height after a 2-3 step approach. The athlete should endeavor to touch by hand the highest point possible on a basketball backboard (or some other place).
- Depth jump from various heights.

1 st day	Barbell squats (85-90%) Series are repeated 2-3 times. Rest between sets is 4-6 min, between series, 6-8 min.	2-3 x 5-6
2 nd day	Barbell squats (80%) Series are repeated 2 times. Rest between sets is 4-6 min., between series, 8-10 min.	3 x 8-10
3 rd day	Barbell squats (90-93%) Squat jumps with bar (40-50%) Series is repeated 2 times. Rest between sets is 3-4 min, between series, 8-10 min.	2 x 2-3 2-3 x 6-8
4 th day	Barbell squats (90-95%) Squat jumps with bar (40-50%) Series is repeated 3 times. Rest between sets is 3-4 min,	2 x 2-3 2 x 6

	between series, 8-10 min.	
5 th day	Squat jumps with bar (60-70%) Double leg squat jumps Series are repeated 2 times. Rest between sets is 3-4 min, between series, 8-10 min.	2 x 8 2 x 8
6 th day	Barbell squats (90-95%) Double leg squat jumps Series are repeated 2-3 times. Rest between sets is 4-5 min., between series, 8-10 min.	2 x 2-3 2 x 8
7 th day	Depth jumps (0.5m) Double leg squat jumps Series are repeated 2 times. Rest between sets and rests between series, 4-6 min.	2 x 8 2 x 8
8 th day	Depth jumps (0.7 m.) Double leg squat jumps Series are repeated 2 times. Rest between sets 4-6 min.	2 x 8 2 x 10
9 th day	Barbell squats (90-95%) Depth jumps (0.75 m.) Series are repeated 2 times. Rest between sets, 4-6 min, between series, 10-12 min.	2 x 2-3 2 x 10
10 th day	Depth jumps (0.75 m.) Depth jumps (1.10 m.) Rest between sets is 4-6 min.	2 x 10 2 x 10
11 th day	Barbell squats (90-95%) Depth jumps (0.75 m.) Series are repeated 2 times. Rest between sets is 4-6 min, between series, 8-10 min.	2 x 2-3 2 x 10
12 th day	Depth jumps (0.75 m.) Depth jumps (1.10 m.)	1 x 10 3 x 10

Rest between sets is 4-6 min.

Program 3

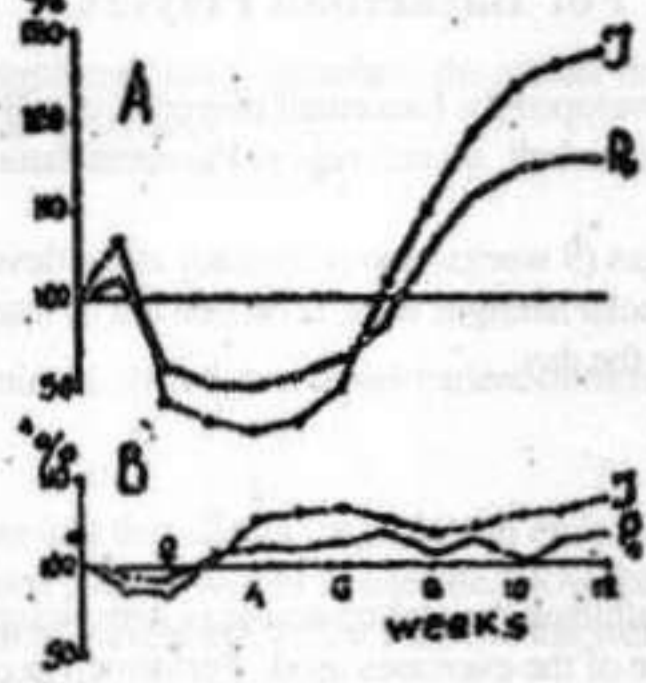
This program is 4 weeks long and is executed 3 times a week. In all, there are 12 training sessions. The program includes the same exercises as in the previous programs.

1 st day	Barbell squats (85-90%) Series are repeated 2 times. Rest between sets is 4-6 min, between series, 6-8 min.	2-3 x 5-6
2 nd day	Barbell squats (90-93%) Squat jumps with bar (40-50%) on the shoulders Series are repeated 2 times Rest between sets is 4-6 min, between series, 8-10 min.	1-2 x 2-3 2 x 6-8.
3 rd day	Barbell squats with bar (80%) Series are repeated 2 times. Rest between sets is 4-6 min, between series 8-10 min.	3 x 8-10
4 th day	Barbell squats (90-95%) Squat jumps with bar (40-50%) Series are repeated 2-3 times. Rest between sets, 4-6 min, between series, 10-12 min.	2 x 2-3 2 x 6
5 th day	Barbell squats (90-95%) Double leg squat jumps Series are repeated 2-3 times. Rest between sets, 4-6 min, between series, 8-10 min.	2 x 2-3 2 x 8
6 th day	Depth jumps (0.75 m.) Depth jumps (1.10 m.) Rest between sets is 4-6 min.	2 x 10 2 x 10
7 th day	Squat jumps with bar (60-70%) Double leg squat jumps Series are repeated 2-3 times. Rest between sets is , 4-6 min, between series, 8-10 min.	2 x 8 2 x 8

8 th day	Barbell squats (90-95%) Depth jumps (0.75 m.) Series are repeated 2 times. Rest between sets is 4-6 min, between series, 8-10 min.	2 x 2-3 2 x 10
9 th day	Depth jumps (0.75 m.) Depth jumps (1.10 m.) Rest between sets is 4-6 min.	1 x 10 3 x 10
10 th day	Barbell squats (90-95%) Depth jumps (0.75 m.) Series are repeated 4 times. Rest between sets is 4-6 min., between series, 10-12 min.	1 x 2-3 1 x 10
11 th day	Squat jumps with bar (60-70%) Double leg squat jumps Series are repeated 4 times. Rest between sets is 4-6 min, between series, 8-10 min.	1 x 6-8 1 x 8-10
12 th day	Depth jumps (0.75 m.) Depth jumps (1.10 m.) Rest between sets is 4-6 min.	2 x 10 2 x 10

Now we must address some objective characteristics of the training effect of this program. In this way the coach will know what kind of results can be achieved.

In the accompanying graphs the changes in maximum strength (Po) and explosive (J) strength of volleyball players is shown after using Program 3. Preliminary observations from using this specialized strength training program continued for 8 weeks as a control, and for 10 weeks up to the main competitions.



Changes in indicators of maximal (Po) and explosive (J) strength of the volleyball players leg muscles in the experimental and control groups.

The concentrated load, which consisted of the shock method (Group A) resulted in a sharp reduction in the speed-strength indicators. After this the functional indicators returned to the initial level and then considerably exceeded it. This phenomenon was discussed in Chapter 5. At the time of the main competitions (the 10th week) the functional indicators reached their maximum significance.

It follows to add that the team using the specialized strength training program (Group A) had good results in the competition. The other team that used the traditional method of training (Group B) demonstrated more modest results.

6.6 Special Strength Training Program For Basketball Players

Although this program was developed for basketball players it can also be useful in team sports or for players in sports such as football, soccer, rugby, European handball and others.

The program consists of 4 stages (9 weeks) and is directed to the development of explosive leg strength (jump force). The special strength work is carried out as a separate (independent) workout by the players during the day.

The First Stage (3 weeks, 9 workouts)

The Task: Preparation of the athletes skeletal-muscular system for specialized strength work as well as mastering the technique of the exercises used. Performed in one workout are:

Exercises with the bar:

- Squat. Use a weight that allows the athlete to execute 10 RM for 3-4 sets.
- Squat jumps with a weight that allows the athlete to do 20 RM for 3-4 sets.
- Standing calf raise with a weight so the athlete can do 10 RM for 3-4 sets.

Jump exercises

- Intense double leg jumps over low hurdles and over an exercise bench advancing to jumping over the length of the bench. Execute 8-12 take-offs for one set. Execute 4-6 sets.
- “Long” jumps (40-60 m.). Jumping from leg to leg with moderate intensity, repeated 3-4 times.

From the second week on, “long” jumps (50-60 m.) consisting of 2 jumps on the left leg—2 on the right leg, and 3 on the left leg—3 on the right leg, repeated 3-4 times, are included in the training.

Running Exercises:

- Run with high raising of the thigh and run with a heel kickback. In addition, run while dribbling and execute long accelerations.

All running exercises are executed for a distance of 60-100 m. but not at full strength. It is necessary to pay attention to correct technical performances without entrapment of any movements. Repeat 3-5 times.

Workout Schematic:

- Preparatory part—10 minutes (warm up running and flexibility exercises),
- Running exercises—10-15 min.,
- Barbell and jump exercises,
- Running at a quiet rate for 10 minutes.

Before doing the barbell exercises, warm up for 10 minutes with various resistances such as dumbbells, barbell plates, etc.

Between repetitions of strength and jump exercises, the athlete does easy running, accelerations, and abdominal exercises.

The Second Stage (2 weeks, 6 workouts)

The objective: The predominant objective is development of muscle strength with barbell exercises.

Bar exercises:

- Squats, using a weight that allows the athlete to execute 3-5 RM for 3-4 repetitions;
- Standing calf raises using a weight to execute 5 RM for 3-4 repetitions.

The transition from the 10 RM weight in the first stage, to the weight for 3-5 RM in the second stage, is done in small degrees.

Workout Schematic:

- Duration of work is 40 minutes.
- Warm up is not less than 20 minutes using general developmental exercises with barbell discs and abdominal exercises,
- In between repetitions of the strength exercises, the athlete does easy accelerations and hanging exercises.

The Third Stage (2 week, 6 workouts).

Objective: Perfecting the athlete's ability to display explosive effort.

Barbell exercises are excluded.

Jump Exercises.

---Double leg, 10 - fold jumps from place, as for example, jumps over hurdles for time. There are 5-6 repeats.

---Short" jump exercises (3, 6 and 8 - fold) executed in an aim to jump as far as possible. There are 8-12 repeats.

Running Exercises.

--Long accelerations (80-100 m.) aiming to reach maximum speed and then to run on inertia. It is necessary to preserve the frequency and correct technique of movements.

--Short accelerations (10-15 m.) at full strength. There are 6-8 repetitions.

--Standing and crouch starts (15-20 m) for 6-8 repetitions.

Workout Schematic:

- Work duration--about 1.5 hours.

- Warm up--about 20-25 minutes using running exercises and short accelerations.
- Jump exercises at full strength.
- Exercises for relaxation and flexibility are used throughout the workout.
- Between the jumping and running practice, the athlete does exercises with the ball (dribbling, passing, shots from different positions and free throws).

**The Fourth Stage
(2 weeks, 6 workouts)**

Objective: Perfection of speed abilities, predominantly with the use of high-speed runs.

Crouch starts and starts from various body positions (in the crouch position, facing away from the direction of movement, facing the direction of movement) are executed. No running exercises are used from the warm up. In addition, the athlete does high and crouch starts while maintaining correct sprint running technique.

The main requirement in execution of the running exercises is establishment of high frequency and speed of movement as well as showing the best times in portions of the distance run. The competitive method is used for this as it stimulates the athlete's interest to be first to the finish line. Between runs there are rest pauses, sufficient for total restoration.

The stage of competition now follows:

- Warm up
- Jumping
- Crouch
- High
- Running
- Ball exercises
- Relaxation
- Flexibility
- Cooling down
- Massage
- Stretching
- Breathery
- Swimming
- Cycling
- Tennis
- Badminton
- Table tennis
- Chess
- Reading
- Watching TV
- Listening to music
- Sleeping

6.7 Program for High Level American Football Players

The objective of this program is to develop explosive strength and reactive ability of the leg extensor muscles. They are realized in specific conditions of fatigue that is developed during the game. The program is designed for 12 weeks in which the training sessions are carried out twice weekly for the first eight weeks. From the 9th week on, workouts are three times a week, from the 17th to the 28th day.

Four base exercises are used in this program:

- The barbell squat;
- Jumps out of squat with the bar on the shoulders in 2 variants:
 - (1) feet shoulder width apart; and
 - (2) scissor- lunge position with alternation of the legs.
- Depth jumps
- Jumps onto a box using a double leg takeoff.

The loads used in the program are as follows:

- a) The weight of the bar is indicated in % of maximum, as for example "barbell squats (80%)". This means the maximum weight the athlete can handle for 1 squat.
- b) The dosage of 8 x 10 (2) means that 2 series are executed. In each series there are 8 sets of 10 repetitions.

1 st day	Barbell squats (90%) Rest is 4-5 min. between sets. Rest is 6-8 min. between series Barbell squats (80%) Rest is 2 min between.	2-4 x 5 2-3 x 10-12
2 nd day	Barbell squats (93-95%) Rest is 4-5 min. between sets, Rest is 6-8 min. between series Barbell squats (80%) Rest is 2-3 min.	2-4 x 3 3-5 x 8-10
3 rd day	Barbell squats (93-95%) Rest is 4-6 min. between sets. Rest is 6-8 min. between series Barbell squats (85%) Rest between sets is arbitrary	3-5 x 2-3 2 x 8 (+2-3)*

*Note: After completion of the last repetition in the squat with the weight at 85%, it is necessary to do 2-3 additional repetitions.

4 th day	Barbell squats (80%)	1 x 10
	“ “ (90%)	1 x 5
	“ “ (90-93%)	1 x 2

The series are repeated 2-3 times
Rest is 4-5 min. between sets
Rest is 6-8 min. between series

5 th day	Barbell squats (93-95%)	3-5 x 2-3
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Rest is 4-6 min. between sets
Rest is 6-8 min. between series

6 th day	Barbell squats (80%)	3-5 x 8-10
	Rest is 2-3 min.	

6 th day	Barbell squats (70%)	1 x 12
	“ “ (80%)	1 x 10
	“ “ (85%)	1 x 7

The series are repeated 2-3 times
Rest is 8-10 min in between series
Rest between sets is 5-6 min.

7 th day	Squat jumps with the bar (40%)	5 x 8 (2)
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Rest interval between sets is 60 sec.
Rest interval between series is 8-12 min.

8 th day	Barbell squats (85-90%) using the interval method	4-5 x 1-3
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Note: In the interval method it is possible to execute one series of several sets consisting of 1-2 repetitions using a heavy weight (85-90%) and with limited rest pauses. At the end of the series, the number of repetitions decreases and the duration of rest pauses increases. For example, in the first set of 3 repetitions the rest pause is 30-40 seconds; in the second set of 2-3 repetitions the rest pause is 40-60 seconds; in the third set consisting of 1-2 repetitions, the rest pauses is 60-90 seconds and in the in the 4th set there is one repetition.

9 th day	Squat jumps with the bar (40%)	8 x 8 (2)
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Rest interval between sets is 60 sec.

	Rest interval between series is 8-12 min.	
10 th day	Squat jumps with the bar (95%) using the interval method (See 8 th day program)	4-5 x 1-3
11 th day	Depth jumps (0.75 m.) Depth jumps (1.10 m.) Rest interval between sets is 10-12 min.	2 x 10 1 x 10
	Jump out of squat with bar (40%) Rest interval between sets is 60 sec. Rest interval between series is 10-12 min	8 x 10 (6)
12 th day	Depth jumps (0.75 m.) Depth jumps (0.10 m.) Rest is 8-10 min.	2 x 10 2 x 10
	Squat jumps with bar (40%) Rest interval between set is 30 sec. Rest interval between series is 8-12 min.	6 x 8 (2)
13 th day	Depth jumps (0.75 m.) Depth jumps (0.10 m.) Rest is 8-10 min.	3 x 10 1 x 10
	Squat jumps with bar (40%) Rest interval between sets is 60 sec. Rest interval between series is 8-12 min.	10 x 10 (2-3)
14 th day	Depth jump (0.75 m.) Rest is 8-10 min.	4 x 10
	Squat jumps with bar (40%) Rest interval between sets is 30 sec. Rest interval between series is 8-12 min.,	8 x 8 (2)
15 th day	Depth jumps (0.75 m.) Depth jumps (1.10) Rest interval is 8-10 min.	2 x 10 2 x 10
	Squat jumps with bar (40%) Rest interval between sets is 10 sec. Rest interval between series is 8-12 min.	6 x 10 (2)
16 th day	Depth jumps (0.75 m.)	2 x 10

	Depth jumps (1.10m.) Rest is 6-8 min.	2 x 10
	Squat jumps with bar (40%) Rest interval between sets is 30 sec. Rest interval between series is 8-12 min.	8 x 10 (2-3)
17 th day	Depth jumps (1.10 m.) Rest, 8-10 min.	4 x 10
	Squat jumps with bar (40%) Rest interval between sets is 0 sec. Rest interval between series is 8-12 min.	8 x 10 (2-3)
18 th day	Depth jumps (0.75 m.) Rest, 8-10 min.	4 x 10
	Squat jumps with bar (40%) Rest interval between sets is 30 sec. Rest interval between series is 8-12 min.	10 x 10 (2-3)
19 th day	Jumps on to a box (0.4-0.5 m.) Rest interval between sets is 3-4 min. Rest interval between series is 10-12 min.	4 x 40 (2)
20 th day	Depth jumps (1.10 m.) Rest is 8-10 min.	4 x 40
	Squat jumps with bar (40%) Rest interval between sets is 0 sec. Rest interval between series is 8-12 min.	10 x 10 (2)
21 st day	Depth jumps (0.75 m.) Rest is 8-10 min.	4 x 10
	Squat jumps with bar (40%) Rest interval between sets is 10 sec. Rest interval between series is 10-12 min.	10 x 10 (2-3)
22 nd day	Jumps on to a box (0.5-0.6 m.) Rest interval between sets is 3-4 min. Rest interval between series is 10-15 min.	6 x 40 (2)
23 rd day	Depth jumps (1.10 m.) Rest interval between sets is 10 sec. Rest interval between series is 8-12 min.	10 x 10 (2-3)

24 th day	Depth jumps (0.75 m.) Rest is 8-10 min.	4 x 10
	Jumps with bar (40%) Rest interval between sets is 10 sec. Rest interval between series is 10-15 min.	10 x 10 (3-4)
25 th day	Jumps on to a box (0.7-0.8 m.) Rest interval between sets is 2-3 min. Rest interval between series is 10-15 min.	5 x 50 (3)
26 th day	Squat jumps with bar (40%) Rest interval between sets is 10 sec. Rest interval between series is 10-15 min.	10 x 10 (3-4)
27 th day	Jumps with bar (40%) Rest interval between sets is 10 sec. Rest interval between series is 10-15 min.	10 x 10 (3-4)
28 th day	Jumps on to a box (0.7 – 0.8m.) Rest interval between sets is 2 min. Rest interval between series is 10-15 min.	6 x 50 (3)

This program is rather heavy, but it is specially designed for the real man who has chosen American football. Now some remarks.

1. The program is intended for players with good preliminary preparedness and who have great muscle strength.
2. This program is directed to the leg muscles. For the arm, shoulder-girdle and trunk muscles, parallel strength programs should be used.
3. It is important to draw attention to the following:
 - The program is constructed on the principle of gradually increasing the specificity and intensity of the load;
 - Rearranging the means or where they are placed is not recommended. In this program, each training workout prepares the body for effective execution of the following workout;
 - In the interval-serial method each work bout in one set is executed with maximum intensity;
 - For diversity, jumping out of a squat with the bar can be executed in two variants: feet shoulder width apart or in the "scissor-lunge position" with alternation of the legs;

—When maximum leg strength is increased, the weight used in the jumps out of squat must also be increased and should be about 40% of maximum when doing a barbell squat; and

—When using the interval method, what is done in the rest pause between series is very important for preservation of the specific work capacity of the athlete during the training session. Small volume work with the intensity at 60-70% of maximum oxygen consumption, executed by the same groups of muscles is expedient (see recommendations in the program for rowers).

This program with some additions and changes, can be successfully used by athletes in handball, baseball, rugby and other sports where it is necessary to be as strong as a locomotive and as fast as a rocket.

1 st day	Row interval 1000m Rest 4-10 min.	4 x 10
2 nd day	Squat jumps Rest 4-10 min.	10 x (3 x 10)
3 rd day	Jumps out of a box (1.5 m) Rest interval between series is 10-12 min.	4 x 40 (2)
4 th day	Row interval 1000m Rest is 8-10 min.	4 x 10
5 th day	Row interval 1000m Rest interval between series is 8 min. Rest interval between series is 8-12 min.	4 x 10
6 th day	Row interval 1000m Rest is 8-10 min.	4 x 10
7 th day	Row interval 1000m Rest interval between series is 8-12 min.	4 x 10
8 th day	Row interval 1000m Rest interval between series is 8-12 min.	4 x 10
9 th day	Row interval 1000m Rest interval between series is 8-12 min.	4 x 10
10 th day	Row interval 1000m Rest interval between series is 8-12 min.	4 x 10
11 th day	Row interval 1000m Rest interval between series is 8-12 min.	4 x 10
12 th day	Row interval 1000m Rest interval between series is 8-12 min.	4 x 10
13 th day	Row interval 1000m Rest interval between series is 8-12 min.	4 x 10
14 th day	Row interval 1000m Rest interval between series is 8-12 min.	4 x 10
15 th day	Row interval 1000m Rest interval between series is 8-12 min.	4 x 10
16 th day	Row interval 1000m Rest interval between series is 8-12 min.	4 x 10
17 th day	Row interval 1000m Rest interval between series is 8-12 min.	4 x 10
18 th day	Row interval 1000m Rest interval between series is 8-12 min.	4 x 10
19 th day	Row interval 1000m Rest interval between series is 8-12 min.	4 x 10
20 th day	Row interval 1000m Rest interval between series is 8-12 min.	4 x 10

6.8 Program for High Level Tennis Players

This program is designed to develop explosive leg strength and anaerobic capacity of the body both of which are necessary for improving the speed of play actions such as rushing the net, baseline movements, sharp changes in direction and reaching a short-hit ball. The program is intended to prepare the athlete for major competition; it runs 9 weeks (27 workouts) and has 4 stages:

- 1) The preparatory stage (3 weeks);
- 2) The strength stage (2 weeks);
- 3) The speed-strength stage (2 weeks);
- 4) The speed stage (2 weeks).

The First Stage—Preparatory (3 Weeks, 6 Workouts)

The objective of this preparatory period is to develop the skeletal-muscular system for intense specialized strength work.

Workout Schematics

The First Week (3 Workouts)

- 1) Warm-up—20 minutes (general developmental exercises, exercises for flexibility, stretching and relaxation of the muscles.
- 2) Running exercises—20 minutes. Run with high lifting of the thigh, run with a heel kickback, sprinting gradually increasing the distance to 60-80m.
- 3) Jump exercises:

--Jumps from leg to leg (60 m.)	1-2 times
--Double leg jumps over low (1 m.) hurdles (8 hurdles)	2-3 times
--Jumps over an exercise bench gradually increasing the distance to jump over the length of the bench	3-4 times
- 4) Exercises with the barbell:

--Barbell squat with the weight at 70% of maximum	2-3 x 10
--Heel (calf) raises with barbell on shoulders (70%) of maximum	1-3 x 10

- Jumps out of squat with bar on the shoulders 2-3 x 10
(weight of the bar at 40% of maximum)

In between series the athletes do easy sprinting gradually increasing the distance and number of abdominal exercises while hanging on gymnastics wall bars (high bar). In addition, exercises for relaxation and flexibility are executed.

- 5) Cool down—a 10 minute run at a slow rate and exercises for relaxation and flexibility.

**Second Week
(3 Workouts)**

- 1) Warm up—see the first week.
- 2) Running exercises—see the first week.
- 3) Jump exercises:

- Jumps from leg to leg (60 m.) 2-3 times
- Jumping 2 on the right—2 on the left for 60 m. 1-2 times
- Jumping 3 on the right—3 on the left for 60 m. 1-2 times
- Double leg jumps over low hurdles (1 m.) 2-3 times
8-10 hurdles are used
- Jumps over an exercise bench gradually 2-3 times
increasing to jump over length of the bench

(4) Bar exercises:

- Barbell squat with weight 70% of maximum 3-4 x 15
- Heel (cal raise) with bar on shoulders using 1-2 x 10
a weight of 80% of maximum
- Jumps out of squat with bar on shoulders using a weight 2-3 x 10
of 40-50 % of maximum

Between series, running exercises, exercises for the abdominals hanging on a high bar and exercises for relaxation.

- (5) The cool down—same as first week.

The Third Week (3 Workouts)

- 1) Warm up—same as first week.
- 2) Running exercises—same as first week.
- 3) Jump exercises:

--Jumps from leg to leg for 60 m using $3/4^{\text{th}}$ of maximum force 3-4 times

--Jumping—2 on the right, 2 on the left leg for 50 m at $3/4^{\text{th}}$ force 3-4 times

--Jumping—3 on the right, 3 on the left leg for 50 m using $3/4^{\text{th}}$ force 3-4 times

--Standing triple jump at maximum force 4-6 times

--Standing 6-fold jump at maximum force 3-5 times

- 4) Barbell exercises:

--Barbell squats using 80% of maximum 2-3 x 8

--Heel (calf) raises with barbell on shoulders using a weight of 90% of maximum 3-4 x 10

--Jumps out of squat with bar on shoulders using a weight of 60% of maximum 1-2 x 10

Running exercises, exercises for the abdominals and exercises for relaxation are performed between series.

- 5) Cool down—same as first week.

Note: The jump exercises in the first two weeks are not executed with total force. At this time it is necessary to pay attention to correct technique of their execution.

For all exercises with the barbell, the weight is indicated as a % of the maximum weight used in the barbell squat. In order to determine this weight it is not necessary to execute the squat at its maximum limit. It is only necessary to determine the weight with which it is possible to execute the exercise 3 times (not more) and then add 5% to this total. For example, if the athlete executes 3 repetitions with 100 kg the maximum weight will be equal to approximately

105 kgms. (5% of 100 kgs.= 5 kgs.) The maximum weight should be determined in the first workout of each week.

The Second Stage—Strength (2 Weeks, 6 Workouts)

The task in this stage is to increase muscle strength.

Workout Schematics

The First Week (3 Workouts)

- 1) Warm up—easy running for 10 minutes, and short bursts of speed (2-3 x 50 m.)
- 2) Also included are general developmental exercises, exercises with a barbell disc in the hands in combination with light running, and exercises for the abdominal muscles.
- 3) Barbell exercises:
 - Barbell squat with the weight at 90% of maximum 3-4 x 2-3
 - Heel (calf) raises with the bar on shoulders, weight 90% of maximum 1-2 x 3-4
 - Exercises for arm and shoulder girdle muscles with individually selected resistance and exercises for the abdominals
- 4) Cool down. Slow running for 8-10 minutes and exercises for muscle relaxation, flexibility and stretching.

The Second Week (3 Workouts)

- 1) Warm up—same as first week.
- 2) Bar exercises:
 - Barbell squats using a weight of 95% of maximum 3-4 x 2-3
 - Heel (calf) raises with the bar on shoulders, weight at 90% of maximum 3-5 x 2-3
 - Arm and shoulder girdle exercises with individual weights and exercises for the abdominals

- 3) Cool down—same as first week.

Note: Resistance is indicated in % of maximum in the barbell squat.

The Third Stage—Speed Strength (2 Weeks, 6 Workouts)

The objective in this stage is to perfect the ability to display explosive strength.

Workout Schematic

The First Week (3 Workouts)

- 1) Warm up—Running for 10 minutes, general developmental exercises, flexibility and stretching exercises, and exercises with wide swinging movements by the arms and legs.
- 2) Sprint exercises:
 - Long running accelerations for 80-100 m. The task here is to smoothly increase speed to maximum and then run freely on inertia. In this, preserve the frequency of movements and correct running technique. 3 x 5 times
 - Short running accelerations for 10-15 m. The task here is to develop maximum speed 6-8 times
 - Running from a standing and crouch start for 15-20 m 10-15 times
- 3) Jump exercises:
 - Double leg jumps over low hurdles (1 m.) with emphasis on fast and powerful, upward-forward takeoffs (10 hurdles) 3-5 times
 - The same exercise, but the task now is to execute all the jumps as quickly as possible for time 5-6 times
 - Standing jumps (triple, six-fold, and ten-fold) with measurement of results 6-8 times
 - Jumps from leg to leg for 50 m for time 2-4 times
- 4) Cool down. Slow running for 10-12 minutes and exercises for flexibility and stretching.

**The Second Week
(3 Workouts)**

- 1) Warm up—Same as first week.
- 2) Running exercises—same as first week.
- 3) Jump exercises:
 - Double leg jumps over 10 low hurdles as fast as possible. Execute all jump sets for time 5-7 times
 - Jumps from leg to leg for 50 m for time. Use a fast takeoff and active swing movements 4-6 times
 - Standing jumps for best results (triple, six-fold, ten-fold) 8-10 times
- 3) Cool down. Slow running for 10 minutes and exercises on flexibility and relaxation.

**The Fourth Stage—Speed
(2 Weeks, 3 Workouts)**

The objective here is to perfect high speed abilities.

Workout Schematics

**The First Week
(3 workouts)**

- 1) Warm up—running for 10 minutes, exercises for flexibility and stretching of the muscles, swing movements by the legs, easy jumping exercises.
- 2) Sprint exercises:
 - Short bursts of speed for 40-50 m 3-4 times
 - Standing starts for 25-30 m starting on a given signal 4-5 times
 - Crouch starts for 10-15 m starting on a given signal 3-4 times
 - Starts from a signal from various positions (sitting, facing the starter, side or back to the direction of movement) 6-8 times
- 3) Cool down—light running for 8-10 minutes. Exercises for flexibility and relaxation.

The Second Week (3 Workouts)

- 1) Warm up—same as first week.
- 2) High speed work
 - Standing and crouch starts for 10-15 m. from different initial positions (facing forward, backwards, sideways in relation to the direction of movement) 10-15 times
 - High speed shuttle run—6 times for 8m to the left and 3-4 times to the right along the baseline of the tennis court
 - 10 m forward and backward run executed 3 times from the baseline of the tennis court to the net and back 5-6 times

All high-speed movements are executed at full power using the competitive method.

- 3) Cool down—slow running for 10-12 minutes

The results of a 12-week experiment are presented to illustrate the effectiveness of this program. The study was carried out in the natural conditions of training of high-level tennis players to check on the efficiency of the recommended SST program. In the illustration (Fig.50) the dynamics of special motor tests are presented:

- 1) "Long" shuttle, 6 x 8m on baseline between singles side lines;
- 2) "Fan;"
- 3) "Short shuttle, 12 x 4m on baseline from the centerline to the singles sideline and back;
- 4) Advance to the net and parameters of specialized strength preparedness of the athletes J-explosive, Q-starting strength, and Po-maximum strength of the leg muscles.

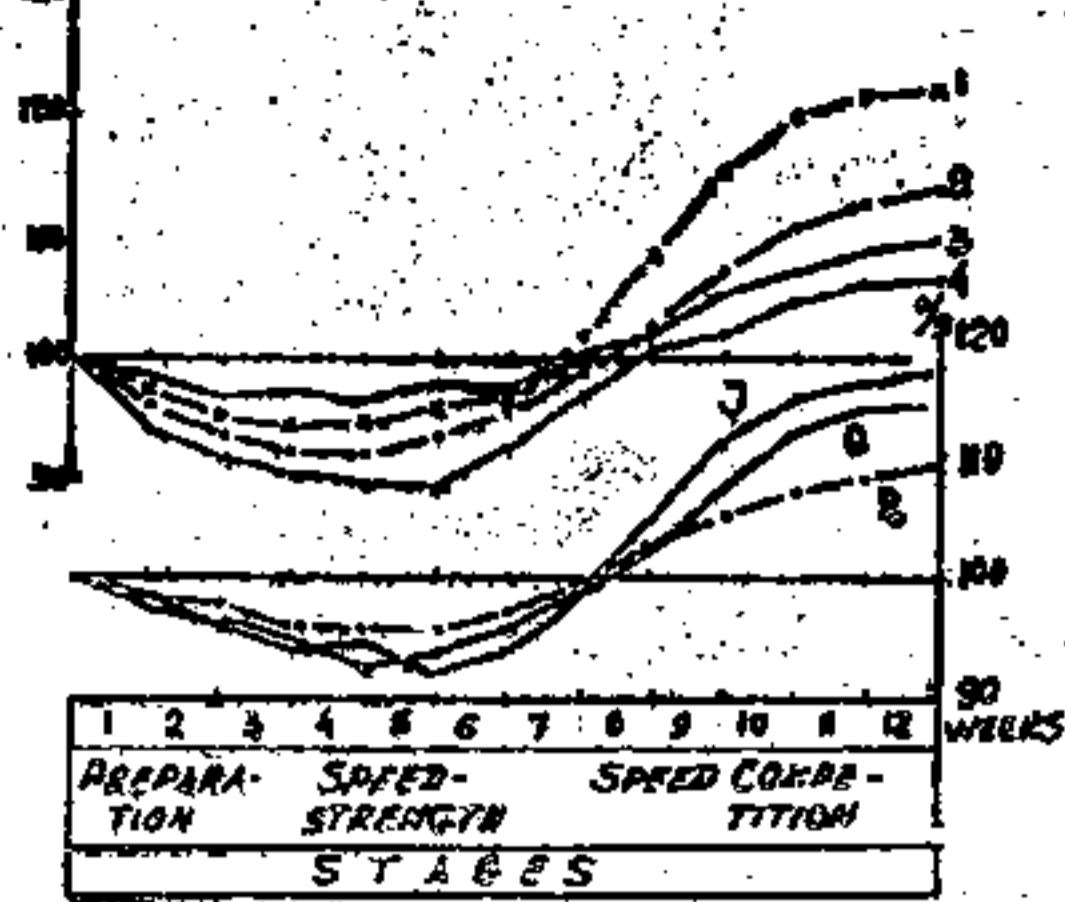


Fig. 50. Speed-strength and special motor task dynamics of tennis players.
 1. "long shuttle"; 2. "fan"; 3. "short shuttle"; 4. run up to the net; J - explosive strength,
 Q - starting strength, Po - maximum strength of leg muscles.

It is easy to see that during the concentrated stages of SST loads (preparatory and speed strength stages) are all the control indices are decreased. They then come back to the initial level and considerably exceed it (speed training stage). During the competitive stage all control tests reach the highest level.

CHAPTER 7

CONCLUSIONS

1. This book contains many specific examples of SST programs in various sports that have been verified in practice. However, the book does not provide recipes for all cases seen in sports. This is why when sitting at my desk I proceeded from well-known wisdom: "If you feed a man with fish he will be satisfied today but if you teach him how to fish he will be satisfied always."

The reader has been spared focusing main attention to principles of organizing the SST. In regard to the examples given, you should first of all see that they are pithy illustrations in regard to the practical realization of these principles. Be influenced by the latter and use the given examples as a model. The coach can always elaborate on the efficiency of the special strength programs in each particular case.

2. The practical recommendations regarding SST organization (Chapters 2 - 4), the optimum ranges for weight dosage, number of repetitions, sets and series for high-level athletes, are presented. In each case, these dosages should be selected depending upon the individual level of special physical preparedness of the athletes. The coach should always take into account (to feel!) the force of the training effect of the means and programs of the SST planned by him.

The means and programs should include development of the athlete's potential depending upon the current condition of the athlete's body. If their potential is below the current condition the means and methods are useless (it is non-effective expenditure of energy). If it is higher—the program is dangerous because it will lead to over straining of the body and the muscular system. Correctly determining the force of the training influence should be objective and necessary for each athlete. This is the responsibility of the coach and upon which his prestige rests.

3. At first glance, it appears that the SST examples shown in the book often rely on the rest pause between sets and series. If you make use of a calculator to determine the amount of strength training time expended in separate examples, it will not be difficult to see that it is quite substantial. This is not a defect of the SST program, it speaks of its integrity. The rest pauses between sets and series are important components of the SST programs and greatly determine their efficiency.

Any reduction in the rest pauses leads to an accumulation of non-oxidized products of the metabolic processes in the body and as a consequence, decreases the contractile properties of the muscles and changes the specific direction of the training effect of the loads. An excessive increase in the rest pauses causes a decrease in the optimal excitability of the central nervous

system and the athlete's readiness to work of the athlete. This results in cooling of the muscles and on the whole, decreases the force of the strength load training influence.

This is why, while keeping in mind the athlete's increased emotional condition inherent in the strength training, it is difficult to regulate the duration of the interval between repeated work. Because of this, caring about this deserves specific attention and should be the coach's **problem**.

4. The strength work requires a large expenditure of energy. This is why **it is best to** execute such work as a separate workout. Before each workout there should be ample rest, sufficient for restoration of the body's energy resources which were expended in the previous workout. Besides this, and this is especially important to emphasize, specific moderate volume work of optimal intensity should be done after the strength load during the rest pause. Such rest promotes the activation of protein synthesis and development of muscle hypertrophy. The special strength load is the main reason that this process occurs. Therefore, it does not make sense to perform such strength loads in addition to other training work or in a tired condition.

5. None of the SST means can be considered universal or absolutely effective. Each of **them** can and should have primary significance on one or another stage of training, depending on the level of preparedness of the athlete, the nature of the previous training, and the particular tasks of the current stage. This is why if we talk about the absolute effect of the SST, it should first of all be connected to the system principle, providing the best sequencing for introduction of various means in the training process. In addition, the succession and interrelations of the training influence on the body should be objectively stipulated. To make full value use of the recommendations contained in this book, the coach must be anxious to fill up with the knowledge available in the areas of sports sciences such as biomechanics, physiology, bioenergetics, medicine and psychology.

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