

# АКТУАЛЬНІ ПРОБЛЕМИ ФІЗИЧНОЇ РЕАБІЛІТАЦІЇ, СПОРТИВНОЇ МЕДИЦИНИ ТА АДАПТИВНОГО ФІЗИЧНОГО ВИХОВАННЯ



## MEANS WITH EXTERNAL FEEDBACK FOR THE DEVELOPMENT OF SPEED AND POWER QUALITIES

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### Аннотация

В статье речь идет о выявлении возможностей развития скоростно-силовых качеств с помощью методики биологической обратной связи параметров рядов отдельных двигательных единиц.

**Ключевые слова:** скоростно-силовые качества, методика биологической обратной связи, двигательная единица.

### Анотація

У статті мова йдеться про виявлення можливостей розвитку швидкісно-силових якостей за допомогою використання методики біологічного зворотного зв'язку параметрів розрядів окремих рухових одиниць.

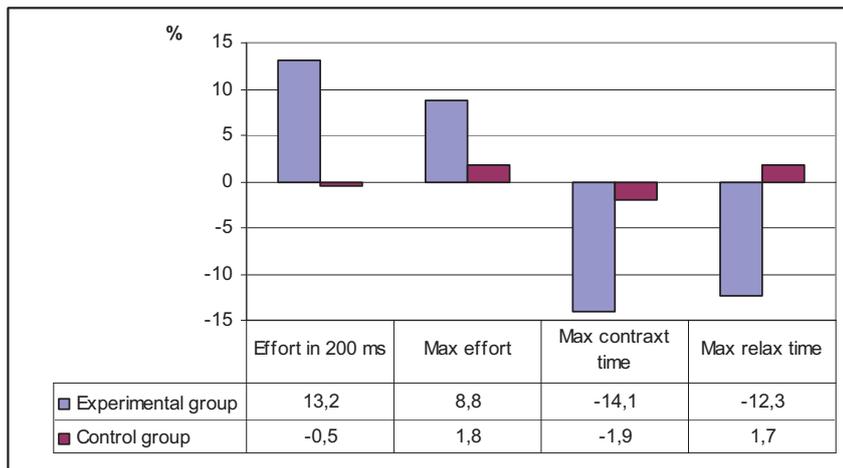
**Ключові слова:** швидкісно-силові якості, методика біологічного зворотного зв'язку, рухова одиниця.

Optimization of the training methods in different kinds of sports is closely connected with the increase of the physiological resources of different systems of a human body. It is known from the literary sources that using the methodology of the biological feed-back based on a sensory control of a human's body functions, it is possible not only to investigate the mechanisms of physiological regulation, but also allows changing neural, somatic and vegetative functions purposefully. The methodology of the biological feed-back works the most effectively in regulating skeletal muscle tone and movement qualities. It is proved that using special technical devices it is possible to get the biological feed-back that carries the immediate information about the muscle tension degree and muscle fiber activation. Considering this the aim of our research was to investigate the possibility of increasing the speed of muscle apparatus and strength qualities while purposefully changing the contractile qualities of motor units (MU) using the biological feed-back.

The qualities of muscle speed and strength depend on many factors including separate MU activation synchronization and the intervals of their first impulses. By increasing recruitment synchroniza-

tion and decreasing the intervals of impulses, the speed of muscle tension increases. In the works of many authors a possibility is shown to involve isolated MU in action, freely changing impulse frequency from rare to maximally often, as well as the possibility to make one, two or more impulses creating the biological feed-back with the help of the visual and aural signals carrying information about the activity of MU under our control. The summarization of the above mentioned recent data of neuro-physiology allowed us to forward the hypothesis about the development possibilities of muscle apparatus speed and strength qualities, using the methodology of the biological feed-back. With the help of special trainings it is possible to rearrange the parameters of MU activity frequency, decreasing the first three impulse intervals. It was suggested that a free decrease of the intervals between the first MU impulses, created by artificially made biological feedback would stimulate muscle tetanic contraction potentiating during the movement activity, as well as the increase of skeletal muscle speed and strength qualities. The totality of the above information allows to put the problem of the possibility of speed-strength muscular system through the use of biofeedback techniques on the pa-





**Fig. 1. Muscles' contracting parameters after special training (in % of the beginning parameters)**

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The theoretical base was approved in two series of experiments with 20 basketball players (aged 18 – 20) taking part. In the first series the participants of the experimental group had 10 special training sessions that allowed to decrease MU impulse intervals in the gastrocnemius muscle by using the biological feed-back. Before the experiment the participants acquired the ability to include separate MU in their actions and change freely the frequency of their impulsation. During every training session 50 attempts to activate muscles using maximally short impulse intervals were done. MU activity was registered by the device REV – 9000. The signal of the artificial biological feed-back was provided by visual control in the monitor switched to the biopotential intensifier. Bipolar electrodes with the diameter 10 mm with fixed electrode distance of 20 mm between them were put on the skin over the gastrocnemius muscle so as it is suggested in the literature – along the gait of the muscle fibers. The dominant lower extremity was tested. It included a 5 min. long stretching of the frontal and back part of a shin, 8 min. warming up using general exercises, 3 min special warming up on the isokinetic dynamometer REV – 9000.

The electro-miographic signal from the subject to the electro-miograph was made with the help of optical fibers. Not to allow the distortion of the depiction, the signal was intensified 10 times in the electro-miograph and led through the high frequency (10 Hz) and low frequency (200 Hz) filter. The signal was straightened and integrated. Five participants took part in the second control series. The testing of speed and strength qualities was done separately for each lower extremity, but the special training to decrease the impulse intervals of the gastrocnemius muscle MU was carried out only with the dominating extremity to exclude the influence of the genetic factors on speed and strength qualities. The registration of muscle isometric tension was done on REV -9000 in an analogous way as in the first experiment series. During the experiment all loads were similar. The obtained results were processed by the method of variation statistics. In our experiment the used biological feed-back minimized the parameters of  $\alpha$  - motoneuron activity in the muscles under investigation. In the course of the experiment it characterized by several changes - maximal speed and amplitude, caused by muscle extraordinary contractions. In the control group these parameters were not practically changed.

The percentage relation of the absolute parameters has a great importance, as thus mistakes, appearing due different conditions during the testing, are excluded. During the testing of the extremity the athlete could be in the perspiration condition, as a result the skin resistance is different in the end of the experiment from the one in the beginning. It could influence the comparison of the absolute parameters. Using percentage relation we not only limited the possibility of mistakes, but also obtained an adequate information about the influence of the resulting forces of the joint.

The degree of skeletal muscle speed and strength quality changes was higher with the basketball players who easier manipulated with the impulse parameters of separate MU and were able to activate the action of separate MU more selectively.

Due the fact that speed and strength qualities are greatly influenced by genetic factors, both lower extremities were tested in the control series of the experiment, but special trainings on REV – 9000 were done only involving the dominant leg. The training regimen for the dominant lower extremity was analogous as in the experimental series.

The results of the experiment proved that a special training to increase impulse intervals increases a basketball players' speed and strength qualities only in the extremity the muscles of which are trained using the mechanism of the biological feed-back. The increase of muscle contraction strength and speed with every further testing showed a progressively increasing character. If before the testing the length of contraction was on average 560 ms, then after the testing it decreased up to 480 ms. ( $\alpha < 0.05$ ).

Performing more complicated movements, for example, a jump, besides the gastrocnemius muscle also other muscles are working. In this situation the contribution of the gastrocnemius muscle, MU of which are trained using the biologi-





**Fig. 2. Muscles' contracting parameters dynamics after training process (in % of parameters) beginning**

cal feed-back method, is less important than in realization of a separate muscle contraction.

According the recent opinion that the increase of speed and strength qualities using the method of the biological feed-back to activate MU is related to the increase of supraspinal order efficiency increase what provides the decrease of the first impulse intervals that can create optimal conditions for separate MU contraction potentialization. The changes of microelement contraction ability are unlikely, so separate contraction parameters did not change after the experiment was over.

Conclusions. The results of our experiment testify the increase of

movement and strength qualities when training on special training machines and using the method of biological feed-back that activates MU of separate skeletal muscles.

Key words. Isokinetic dynamometer, muscle contraction, motor unit, biological feed-back.

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