Original Article

Improving training of boxers based on the assessment of stabilometric indicators

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Abstract

The article focuses on improving motor coordination, since this is one of the reserves for increasing speed-strength motor skills in elite sport. The aim of the study was to assess the statokinetic stability of kick moves in boxing, which provides the reliability of technical actions. Materials and methods. The study involved 18 boxers aged from 17 to 20 years from South Ural State University. Individual stabilometric indicators were compared before and after the pre-competitive stage of preparation. Results and conclusions. It was established that the use of stabilometry for assessing the balance functions can significantly increase the efficiency of training. The following functions were studied: the velocity of the center of pressure, the area of the statokinesogram, the balance index, the increase in fluctuations of the center of pressure, the ratio of the length of the statokinesogram to its area, the stability index, the dynamics of the average position of the center of pressure in the frontal plane.

Key words: boxing, students, stabilometry, center of pressure, Romberg test, stability

Introduction

A large number of studies are devoted to the period of pre-competitive training in boxing (Shivit-Khurak, 2012). It becomes clear that for boxers with various experience almost the entire competitive period consists of pre-competitive mesocycles of preparation for the upcoming fights. Taking into account that during the season an athlete can take part in seven to eight tournaments, then the minimum break between competitions varies from 15 to 20 days.

The pre-competitive stage of training is a very stressful and responsible period. At this stage, fine planning and management of the training process is carried out taking into account the individual abilities and characteristics of the boxer. The task is not only to maintain previous achievements, but also to improve technical and tactical skills and abilities, physical, moral and volitional qualities.

It was shown that under the influence of systematic training, the level of adaptation to vestibular loads increases in all sports, less pronounced reactions to vestibular irritation develop (Skvortsov, 2000). Therefore, the training process is the physiological basis for the improvement of fitness and achievement of high sports results. The rate of formation of muscle programs is determined by the nature of sports and training activities (Surina-Marysheva, E.F., Malkov, V.P., Krivokhizhina, L.V., Erlikh, V.V., 2015).

It should be noted that in boxing there are enough situations when the speed of the reaction depends on the stable position of the body, and its improvement by one tenth or even hundredths of a second is of great importance. At the same time, complex motor reactions are characterized by the balance of the body in a dynamic process and are associated with "choice" reactions (Aminov A.S., Kokin V.Yu., Leshukov V.S., Shakhovskiy A.P. 2018).

Taking into account the importance of a comprehensive assessment of the functional status of athletes from complex coordination sports, the study of various indicators of stabilometry as an important aspect of the athletes' adaptation to physical and competitive loads is currently becoming particularly relevant (Bliznyuk, 2011).

Materials & methods

The complexity of the training process, insufficient knowledge of its laws and the impossibility of taking into account the whole variety of factors affecting its effectiveness, can lead to the fact that the program of pedagogical influences provides only for the likely course of this process. According to I.S. Kolesnik, it is necessary to provide information on the real progress of the training process and the reactions of the athlete's

body during the training process. Then, depending on the nature of the deviations of the real process from the planned one, it is possible to control the process (Kolesnik. 2015).

The features of the experimental training cycle in the pre-competitive stage consist in reducing the volume of general physical training (GP) and increasing the intensity of special training (ST).

Explosive muscle performance was carried out on command, on assignment, in pairs on the same punch bag alternately and with accelerations, with changing the punch bag several times per round, etc.

A rough exchange of blows is not allowed during training; athletes must improve their technique and tactics in a calm environment without excessive nervous tension and injuries (Stanek A., Berwecki A., Stanek P., 2017).

The choice of the sample is connected with practical necessity, which consists in the fact that the training of athletes with different experience varies significantly. Moreover, for such boxers, the traditional methods of training run counter to the principles that are used for a lower category of athletes and turn into a factor inhibiting the process of performance enhancement.

Computer stabilometry was used, which makes it possible to judge the features of the statokinetic stability of boxers. The postural system provides the following functions: maintaining the stability of the main stance in terrestrial gravity; generating a muscular response without impact and voluntary targeted movements; providing adaptive capabilities in changing environmental conditions (Erlikh V., Korableva Y., Epishev V., Polyakova O., 2018).

Results

Table 1 shows the initial indicators of stabilometry of boxers in the main stance with the eyes open and closed before the pre-competitive stage of preparation.

Table 1

Results of stabilometry (before)

Romberg coefficient QR (%)	270.93±21.99				
Indicator	Variable (unit)	Main Stance EO		Main Stance EC	
		M	m	M	m
Standard deviation of the center of pressure in the frontal plane	x (mm)	11.62	3.52	17.29	8.77
Standard deviation of the center of pressure in the sagittal plane	y (mm)	20	10.06	30.56	4.46
Velocity of the center of pressure	V (mm/s)	14.68	2.68	21.93	6.87
Level of 60% of the spectrum power in the frontal plane	xf60 % (Hz)	0.38	0.06	1.25	0.05
Level of 60% of the spectrum power in the sagittal plane	yf60 % (Hz)	0.43	0.12	0.73	0.19
Area of the statokinesiogram 90	S90 (mm ²)	146.48	48.22	388.87	113.4
Ratio of the length of the ellipse to its width	Le-We (c.u.)	1.28	0.08	1.56	0.12
Ratio of the length of the statokinesiogram to its area	LFS90 (1/mm)	3.16	0.14	3.2	0.49
Level of 60% of the spectrum power in the vertical component	xfZ% (Hz)	5.13	0.63	6.6	1.83
Stability Index	Stab (%)	92.23	1.51	90.59	1.4
Balance Index	BI (c.u.)	38.86	11.18	27.04	13.81
Dynamic component of balance	DC (c.u.)	61.14	11.18	72.96	13.81
Average position of the COP in the frontal plane in the European stance	Xe (mm)	23.05	3.35	24.46	4.69
Average position of the COP in the sagittal plane in the European stance	Ye (mm)	-14.9	17.19	3.02	13.73

Table 2 shows the indicators of stabilometry of boxers in the main stance with the eyes open and closed after the pre-competitive stage of preparation.

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Table 2

Results of stabilometry (after)					
Romberg coefficient QR (%)	164.77± 2.81				
Indicator	Variable (unit)	Main Stance EO		Main Stance EC	
		M	m	M	m
Standard deviation of the center of pressure in the frontal plane	x (mm)	14.03	1.35	75.39	4.72
Standard deviation of the center of pressure in the sagittal plane	y (mm)	24.39	58.77	42.41	10.97
Velocity of the center of pressure	V (mm/s)	11.06	3.01	18.3	3.68
Level of 60% of the spectrum power in the frontal plane	xf60 % (Hz)	0.32	0.13	0.37	0.05
Level of 60% of the spectrum power in the sagittal plane	yf60 % (Hz)	0.41	0.39	0.43	0.21
Area of the statokinesiogram 90	S90 (mm ²)	105.7	27.23	174.26	45.29
Ratio of the length of the ellipse to its width	Le-We (c.u.)	1.46	0.21	1.33	0.54
Ratio of the length of the statokinesiogram to its area	LFS90 (1/mm)	3.32	1.03	1.8	0.43
Level of 60% of the spectrum power in the vertical component	xfZ% (Hz)	5.53	0.95	6.59	0.4
Stability Index	Stab (%)	91.46	1.9	84.57	4.63
Balance Index	BI (c.u.)	28.3	5.11	18.75	3.05
Dynamic component of balance	DC (c.u.)	71.7	5.11	81.25	3.05
Average position of the COP in the frontal plane in the European stance	Xe (mm)	5.23	10.29	8.68	8.9
Average position of the COP in the sagittal plane in the European stance	Ye (mm)	-1.77	13.22	7.48	20.18

Dicussion

There are frequent cases in training athletes when it is difficult to understand why there is no increase in sports results. One of the many reasons for this is the deautomatization of coordination mechanisms. It is often difficult for a trainer to determine training loads, beyond which there are irreversible consequences of a decrease in performance.

The Romberg coefficient is a reciprocal value. with its increase the ability to maintain balance decreases. A decrease in the Romberg coefficient after the experimental training cycle (from 270.93 to 164.77) indicates that boxers began to better maintain balance with their eyes closed. i.e. maintaining balance is less dependent on the visual analyzer than before. In practical terms, this may mean a high ability to maintain balance, which will contribute to achieving a high sports result.

To assess the balance function, the following indicators of stabilometry were also used.

1. The velocity of the center of pressure (V) is a value determined by the ratio of the length of the pathway of the center of pressure to the study time. The lower this indicator, the higher the balance function. After the experimental training cycle, this indicator became lower both in the stance with EO (11.06) and with EC (18.3). An analysis of the velocity of COP also indicates a pronounced positive dynamics among boxers. The decrease in the values of this indicator reflects the improvement in balance in the post-experimental training cycle.

2. The area of the statokinesiogram (mm²) is an indicator characterizing the surface occupied by the statokinesiogram. A statokinesiogram can have a very complex path, but modern computer technology can easily cope with the calculation of the area of such surfaces. An increase in area indicates a deterioration in balance, and vice versa. A significant decrease in this indicator both in the main stance with EO and EC (105.7 and 174.26, respectively) indicates the effectiveness of the experimental training. The area of the statokinesiogram is a part of the plane bounded by the curve of the statokinesiogram, an indicator that depends on many parameters. In our study, the initial indicator before the experimental training cycle was 146.48 mm² with EO. After the

experimental training cycle. this indicator increased by 161%. characterizing a greater ability to maintain balance.

3. A decrease in the balance index (BI) from 38.86 and 27.04 to 28.3 and 18.75 also indicates an improvement in the function of balance. The dynamic component of balance (DC) is accompanied by a decrease in the range of oscillations.

4. The normal response from the body balance control system to the absence of the visual analyzer is an increase in the oscillations of the center of pressure (COP) in both the frontal and sagittal planes. The amplitude of the oscillations of the COP does not have significant differences in both planes. however. the spread of values after the experimental training cycle is significantly reduced.

5. When analyzing the power of the frequency spectrum. the following types are distinguished: slow high-amplitude oscillations (0-0.3 Hz) - respiratory movements controlled consciously; medium oscillations (0.5-1.5 Hz) - muscle contraction not controlled consciously; high-frequency oscillations (over 2 Hz) - in a healthy person there are few. With the eyes closed. there was an increase in the high-frequency oscillations components of boxers both before and after the experimental training cycle. which is a typical reaction. However. in the frontal plane. boxers showed statistically significant deviations ($p < 0.05$) from the initial data obtained in tests with open eyes and a shift in the spectrum maximum with eyes closed by 230%.

6. A change in the ratio of the length of the ellipse to its width from the initial values indicates an increase in the influence of the asymmetry of the fighting stance due to an increase in the share of specialized exercises to the end of the experimental training cycle.

7. The indicator of the ratio of the length of the statokinesiogram to its area (LFS) characterizes the energy cost of maintaining the posture. which for boxers at the end of the experimental training cycle reflects the cost-effectiveness due to the pronounced dynamics in the MS EO (from 3.2 to 1.8). which indicates dynamic restructuring of the functional system of statokinetic stability in new. complicated conditions.

8. The power indicators of the spectrum did not practically change. but in the measurement after the experimental training cycle they were more stable. which can be explained by an increase in fatigue.

9. The stability index (Stab. %). integratively reflecting the state of balance. has no significant differences either before or after the experimental training cycle. which confirms the presence of a stable norm among boxers. the stability of the coordination-spatial parameters and the effectiveness of technical actions.

10. The dynamics of the change in the average position of the COP in the frontal plane reflects the stabilization process. while the average position of the COP in the sagittal plane is expressed in a decrease in the deviation of this indicator. which reflects stability during transfer the support on the front of the feet and the pattern of maneuvering during the battle. Since the sign of the indicator changes from minus to plus. this fact probably suggests a high maneuverability of the body.

Conclusions

We believe that the level of sports skills is closely related to the development of the balance function. The effectiveness of competitive activity of boxers is provided not by the level of physical qualities. but by the level of neuromuscular coordination of movements. which in turn are fundamental in the formation of technical and tactical preparedness.

Taking this feature into account by including exercises aimed at improving balance when moving in a combat stance provides the most favorable conditions for the effective implementation of motor tasks and capabilities of athletes at the stages of long-term training.

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