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ON THE PRESERVATION OF EQUILIBRIUM IN THE ORTHOGRADE AND INVERTED POSITIONS OF THE BODY

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Translation of "O sokhranenii ravnovesiya v ortogradnom i perevernutom polozhenii tela", Teoriya i praktika fizicheskoy kul'tury, No. 5, 1979, pp 29-30

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16. Abstract

This article discusses the mechanism which regulates the vertical posture when maintaining equilibrium in an inverted position of the body.

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The supporting function of the human organism in relation /29* to the visual, vestibular, auditory and tactile functions ensures biophysical contact in the "human being-environment" system and is implemented in movements and postures. The maintenance of the human orthograde posture is achieved by virtue of the coordinated action of a large number of functional systems which organize and regulate the adaptive behavior during which the individually habitual stereotype of the postural-tonic reactions is formed.

All the diversity of sport-related movements includes the elements of postural equilibrium in the various body positions. The specific difficulties which arise in achieving postural equilibrium in inverted, horizontal and inclined positions of the body pose new problems in research and in the understanding of the series of functional mechanisms which ensure optimum interaction of the human being with the environment.

The present experimental work was proposed to clarify the features of the mechanism which regulates the vertical posture when maintaining equilibrium in an inverted position of the body. In this connection, we studied the features involved in regulating a stable position of the body during a handstand. In choosing a research method we were guided by the fact that regulation of a vertical posture unequivocally and specifically reflects the degree of interrelationship of the human being with other structural elements of the environmental system (support, space, their modification) and provides the material for analyzing the microstructure of a given function in the form of a pattern of bodily oscillations over the support area fixed by the method of stabilography.

57 gymnasts of senior ranks (master of sport and candidates

*Numbers in margin indicate pagination of foreign text.

for master of sport), ages 17 to 20 years (27 women and 30 men) were researched. The experimental program provided for the carrying out of exercises, sufficiently adapted to the subjects: the maintenance of vertical equilibrium on one foot while the other leg was bent toward the supporting knee and the hands were on the belt and the maintenance of a handstand. The exercises were performed on a stabilographic platform.

When comparing the various experimental exercises put together, taking into account the positions of the body and the supports, the dynamics of the oscillations of the body and the numerical indicators of the stabilographic indices were analyzed. Comparison of the "handwriting" of the oscillatory motions of the body expressed in the graphs of the stabilographic curves has shown that regardless of the sex of the subjects, the manifestations of the tactics of the regulatory mechanisms ensuring the preservation of equilibrium are diverse and are of intensely expressed individual character in the orthograde as well as the inverted body positions. The tactics for regulating the posture in equilibrium on one foot in the case of women, as distinguished from men, is of a more orderly character, which is expressed in the smaller amplitude of the oscillations in the sagittal as well as the frontal planes (Figure 1). As regards the comparison of the stabilographic data from subjects of both sexes involving handstands, no such regularity was detected here. It may be assumed that the mastery of a large amount of exercises connected with the specifics of the work on bars exerts a positive influence on the tactics for regulating the posture of female gymnasts in an orthograde position.

Comparison of the stabilographic data concerning equilibrium on foot and on hands did not disclose any substantial difference in the quality of the regulation of posture. The individual stabilographic "handwriting" in the inverted position of the body did not vary in principle; only numerical variations in the

indicators of the stabilographic indices were present (Figure 2). In the inverted position of the body, the numerical indicators of the stabilograms increased in all cases.

Correlational analysis of the numerical characteristics of the stabilographic indices for the maintenance of equilibrium on foot and on the hands showed the presence of an interrelationship among the maximum and the mean amplitudes and the frequencies of the oscillations of the body in handstands in the sagittal plane and in the equilibrium on one foot in the frontal plane (cf. the table).

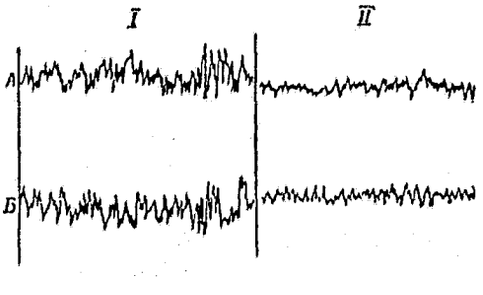

Figure 1. Stabilograms for the achievement of equilibrium on one foot in the case of men (A) and women (B) in the sagittal (I) and in the frontal (II) position.

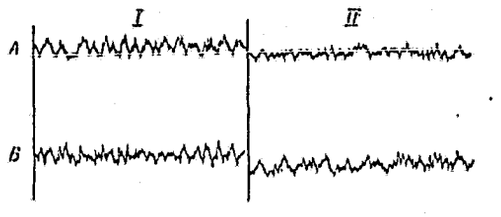

Figure 2. Stabilograms for the achievement of equilibrium in handstands (I) and on one foot (II) in the case of a male (A) and a female (B) gymnast.

Such a "cross-over", rather than parallel, relationship of the numerical indicators of the stabilographic indices is obviously explained by the fact that the greatest probability of losing equilibrium is during a handstand in the sagittal plane and while balancing on one foot (in our case) in the frontal plane. /30

Correlational relationships between the stabilographic indices of the body's oscillations in equilibrium on a foot and on the hands

on foot		sex	on the hands: in the sagittal plane MA	F	AA	in the frontal plane MA	F	AA
in the sagittal plane	MA	M	0.279			0.566*		
		F	0.270			0.817*		
	F	M		0.043			0.583*	
		F		0.077			0.794	
	AA	M			0.177			0.573*
		F			0.123			0.733*
in the frontal plane	MA	M	0.651*			0.078		
		F	0.830*			0.033		
	F	M		0.658*			0.120	
		F		0.751*			0.200	
	AA	M			0.730*			0.283
		F			0.645*			0.178

An analysis of the numerical indicators of the stabilograms shows that the subjects with the least amplitude of body oscillations when maintaining equilibrium on one foot also have a comparatively small oscillatory amplitude in handstands. And, conversely: A large amplitude of body oscillation when maintaining equilibrium on one foot and in handstands is typical of the same gymnasts. Taking into account the fact that when stability increases, the amplitude of body oscillations decreases in equilibrium postures, we are justified in concluding that the capacities to preserve a stable position in the orthograde and the inverted positions of the body are interrelated.

Preservation of individual stabilographic "handwriting" in an inverted position of the body is the basis for concluding that the sensory action in response to a change in body and support position is organized by the use of specific tactics. Regulation of postural activity is accomplished by means of the same techniques.