

# Prevention and rehabilitation of muscle hypotonicity of vertebrogenic origin during preparation for the main competitions of the season

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## Abstract

**Objective of the study** was to develop a methodology for testing the muscular system of athletes and special regular physical exercises as a method of preventing muscle hypotonicity in the biomechanical parts of the muscular topography of athletes, built into the structure of training sessions.

**Methods and structure of the study.** To identify muscle hypotonicity, muscle testing methods (according to L.F. Vasilyeva), used in kinesiology, and methods of functional tests for lateroflexion were used. The study of the state of the muscular system was carried out with the participation of athletes specializing in basketball, swimming, water polo, and kickboxing. To correct muscle condition, special physical exercises were developed and used.

**Results and conclusions.** Long-term observations have revealed an important pattern, namely: spastic conditions in skeletal muscles occur the next day after consuming sugar, rice and flour products in increased quantities, especially against the background of high physical activity during the period of centralized training. The developed and tested system of physical exercises allows not only to eliminate impaired muscle tone, but also to prevent the entire complex of dystrophic disorders in the muscular system of the spine.

**Keywords:** *hypotonia, functional muscle disorders, functional tests, physical exercises, correction of disorders.*

**Introduction.** The nature of sports activity forms a specific muscle topography with coordinated work of synergist-antagonist muscles, functional disorders in which prevent the maximum realization of the accumulated potential. In critical cases, disorders of vertebrogenic genesis can lead to the risk of trauma, various syndromes, including cardiac ones, and even sudden cardiac death. This problem was raised by top-level management (O.Yu. Vasilyeva, 2017). Thus, the study of functional muscle disorders has both sports and medical significance.

In human physiology, a phenomenon called the "Genetsinsky-Orbely effect" is known [3]. It lies in the fact that skeletal muscles are innervated not only by the nerves of the central nervous system, but also by

the nerves of the sympathetic nervous system, which control muscle metabolism. Electrical stimulation of these nerves does not cause muscle contraction, but does cause a reduction in fatigue caused by strenuous work. Conversely, compression of these nerves leads to weakening of muscle effort. In relation to the heart, the so-called vertebro-cardiac syndromes are known - heart rhythm disturbances: bradycardia, compensatory tachycardia, atrial extrasystole and temporary heart failure [2, 5]. These disorders are caused by compression of the sympathetic nerves that control the heart as they exit the spine as they pass between the spasmodic intervertebral muscles. Unlike motor and sensory nerves, the nerves of the sympathetic nervous system do not have a strong myelin sheath



and are easily compressed. Spastic conditions of the intervertebral muscles periodically occur during physical overload and can cause disturbances in the functioning of internal organs.

In sports practice, the effects of weakening the force of muscle contraction are observed. This is a phenomenon of muscle hypotonicity [1]. These conditions periodically occur in athletes and can be eliminated with the use of special corrective exercises.

**Objective of the study** was to develop a methodology for testing the muscular system of athletes and special regular physical exercises as a method of preventing muscle hypotonicity in the biomechanical parts of the muscular topography of athletes, built into the structure of training sessions.

**Methods and structure of the study.** To identify muscle hypotonicity, muscle testing methods (according to L.F. Vasilyeva) [1] used in kinesiology, methods of functional tests for lateroflexion, and manual muscle testing were used. Specially designed physical exercises were used to correct the condition of the muscles.

20 basketball athletes and 10 swimmers aged 22–24 years took part in examinations of the condition of the spinal muscular corset in 2016. The study of muscle hypotonicity was carried out at training camps

in 2022 of the Russian men's national water polo team - 22 athletes and kickboxing (women, men) 18 athletes aged 19–27. In 2023, 30 junior water polo players aged 13 to 17 years were also examined.

**Results of the study and discussion.** To identify *spastic conditions of the intervertebral muscles*, functional tests for lateroflexion were used. A study conducted on 20 basketball athletes showed that only six players did not have areas of intervertebral muscle blockage.

The examination was carried out using functional tests for lateroflexion and manual diagnostics of the spinal muscles. During lateroflexion, the subject had to inhale and stretch his bent elbow upward so as to tilt to the side along the entire length of the spine in one direction and the other. Using points placed on the projections of the spinous processes after photographing the back, the angles of bending in each segment of the spine were measured. A diagram based on the measured angles allows you to detect and graphically display areas of the spine with reduced mobility of the spinal motion segments.

Manual diagnosis was carried out by applying pressure with vibration to the paravertebral areas of the back at a distance of 2 cm from the line connecting the projections of the spinous processes. Pressure



*An example of measuring the mobility of spinal segments. The athlete's left upper and middle thoracic spine are blocked. This athlete has been experiencing back pain for more than a year. The athlete on the right has good mobility of the upper thoracic spine. There is no pain in the back*



was applied to areas of the intervertebral muscles, i.e. between the spinous processes of the vertebrae. The figure shows examples of functional tests of athletes.

Measuring the angles at which the spine can bend when bending to the side showed the presence of areas with limited mobility of the vertebral motor segments or their complete immobility (see figure, left photo). Normally, the mobility of the spinal motion segments should be 5 degrees. The first athlete examined had a completely blocked upper thoracic spine and hypermobility of the thoracolumbar junction. In the second athlete, the mobility of the vertebral motor segments is only slightly reduced (see figure, right photo).

For some athletes who had back pain, MRI examinations of the thoracic spine were performed. In areas of the spine with blocked spinal segments, changes in the condition of the intervertebral muscles were found. These muscles had an attenuated response on T1-weighted images (dark tone image, close to water tone). This indicates a lower proportion of lipids and a higher proportion of water in muscle structures. These changes are considered as a manifestation of long-term spastic conditions of the intervertebral muscles.

Muscle blocks in the spine often occur during physical overload and can persist for months or years. With the help of special exercises, muscle blocks can be easily eliminated.

An examination of water polo athletes for lateroflexion showed that out of 30 juniors, 10 had areas of low mobility of spinal segments in the upper thoracic region or, less commonly, in the lower thoracic region. However, palpation of the deep back muscles did not reveal painful muscles. Nine juniors had reduced lateroflexion without muscle flanks. This suggests that spastic conditions of the intervertebral muscles occur already in adolescence. And these conditions are easily reversible with the help of corrective exercises [6].

Study of hypotonicity of the muscles of the trunk, the belt of the upper and lower extremities. 22 athletes of the Russian national water polo team and 18 athletes of the Russian national kickboxing team were examined for the presence of hypotonicity of the muscles of the limbs and torso. Of the 40 athletes, 16 water polo athletes and 10 kickboxing athletes had hypotonicity in antagonist muscles that determine the effectiveness of working movements. During the two-week period of training camps, water polo athletes were given a set of special exercises built into the structure of the training sessions. An example of exercises built

into the warm-up structure of water polo players in the gym and in the water:

- initial standing position, legs are fixed with a rubber band, the left arm with the band is bent at the elbow joint. Perform abduction-adduction with your right leg, rotation in a circle to the right, rotation in a circle to the left. The same right hand and left leg;
- starting position standing, feet shoulder-width apart, hands in front of you in a lock. Perform crunches stretching the rubber left and right with your hands behind your head;
- opposite direction on the back with one-touch passes to different hands: received and given, with a strong turn to the side;
- during aerobic swimming, breaststroke arms, without the help of leg movements.

In total, the complex included 15 exercises.

At the end of the training camp, 22 water polo athletes were re-examined. Hypotonia disappeared in all examined athletes.

A study of the mobility of spinal segments in athletes showed that more than 50% of athletes under the age of 25 have problems with the intervertebral muscles. The intervertebral muscles are responsible for the rigidity of the spine due to stable tone. But at the same time, these muscles must ensure flexibility of the spine in the lateral direction and rotation of the spine around its axis. If disturbances are detected in functional tests for lateroflexion, this means that it is the intervertebral muscles that are in a spastic state. This is the same factor that leads to pain syndromes in the back and degenerative processes in the intervertebral muscles, vertebrae and the spinal muscles themselves [6].

Examination of athletes for the presence of hypotonicity showed that in the surveyed sports, the majority of athletes had reversible changes in the functional state of the muscles.

For different types of sports activities, a specific profile of hypotonicity is assumed. The detected functional disorders of the muscles, in our opinion, are associated with the presence of muscle blocks in the spine. Removing muscle blocks in the spine helps eliminate episodes of muscle hypotonicity.

A study of the possibility of eliminating muscle hypotonicity shows the connection between the condition of the athlete's spine and his physical condition. The corrective exercises we proposed showed the possibility of correcting the condition of the spinal muscles and skeletal muscles.



We believe that muscle hypotonicity may be caused by compression of the sympathetic nerves innervating individual muscles in the lower segments of the neck and in the upper segments of the thoracic spine.

Conclusions. Studies of the mobility of spinal segments and manual diagnosis of areas of the spine with pain have shown that neurological syndromes in the back and spine are caused by spastic conditions of the intervertebral muscles. These conditions manifest themselves as muscle blocks in the muscular corset of the spine - an area of impaired mobility of several adjacent motor segments of the spine. Long-term observations have revealed an important pattern, namely: spastic conditions in skeletal muscles occur the next day after consuming sugar, rice and flour products in increased quantities, especially against the background of high physical activity during the period of centralized training.

The developed and tested system of physical exercises allows not only to eliminate impaired muscle tone, but also to prevent the entire complex of dystrophic disorders in the muscular system of the spine.

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