



Prognostic predictors of special technical and tactical training of paralympic swimmers with lesions of the musculoskeletal system

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PhD, Associate Professor **L.V. Vinokurov**¹

Dr. Hab., Professor **D.F. Mosunov**^{1, 2}

Honored Coach of Russia **Yu.A. Nazarenko**³

¹Saint-Petersburg scientific-research institute for physical culture, St. Petersburg

²Lesgaft National State University of Physical Education, Sports and Health, St. Petersburg

³Nizhny Novgorod Regional Children and Youth Sports School of the Olympic Reserve "Zarya", Dzerzhinsk

Corresponding author: l.vinokur@ya.ru

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Abstract

Objective of the study was to identify and determine the predictors of special technical and tactical training of highly qualified Paralympic swimmers in the sport of persons with lesions of the musculoskeletal system (LMS).

Methods and structure of the study. When swimming highly qualified athletes with LMS using various sports methods, surface and underwater video filming of the phases of the swimming cycle was performed. 550 videos of swims at training and competitive events of athletes of the Paralympic national swimming team of the Russian Federation in swimming of the sport of people with LMS for the period 2019-2022 were analyzed. A survey was carried out (oral semi-structured interview) of coaches working with paraswimmers (from Candidate Master of Sports to Honored Master of Sports) of the sport of persons with LMS.

Results and conclusions. For paraswimmers with LMS, two groups of prognostic predictors of special (hydrodynamic) technical and tactical training (TTT) were found - specific and typical predictors-deviations that reflect the subject of pedagogical influence (elimination or compensation formed in the swimming technique of a particular paraswimmer) by the coach. The main relationships of specific predictors with informative indicators of swimming technique, the manifestations of typical predictors in technique and the possibility of their correction in a Paralympic swimmer have been established and described.

Keywords: sports of persons with LMS, hydrodynamic training, Paralympic swimmer, deviation predictors, technical-tactical, reserves.

Introduction. Experts consider the main direction of sports training for Paralympic swimmers, including in the sport of persons with lesions of the musculoskeletal system, special technical and tactical training, by which in Paralympic swimming they mean precisely the hydrodynamic training of the athlete [3], because most or even all elements of a paraswimmer's technique, especially in "heavy" sports and functional classes, they are formed individually and are developed, of course, taking into account the nosological forms of lesions of the musculoskeletal system.

Particular attention to hydrodynamic technical and tactical training is determined by the fact that it is the totality of hydrodynamic phenomenology generated

by the para swimmer as an active subject of aquatic locomotion, under the influence of the pedagogical transformative and corrective influences of the trainer on the organization of the motor work of the body and its parts in a particular para swimmer, in the process Directed training activity becomes significantly more controlled and even used by the athlete to accelerate progress over the swimming distance.

Hydrodynamic phenomenology is considered simultaneously as a substrate and partly "matter" for the systemic formation, identification and implementation of types (cyclic, tactical, strategic) of the main reserve of technical and tactical training of a Paralympic swimmer. In this regard, the adoption of scientific



cally based and effective methodological decisions in the system of sports training for para swimmers involves the search and identification of predictor deviations as determinants of the main reserve of technical and tactical training. Operational definitions, general characteristics of the essence and differences of specific and typical predictor deviations were previously formulated and productively used in the study of blind paraswimmers [2].

Thus, it was shown that the concept of predictors-deviations in the special technical and tactical training of a para swimmer allows the coach to clarify its goals, in what way and what motor skills or individual elements of swimming technique should be formed in the athlete in order to overcome or physically compensate for the negative consequences of limited health capabilities. To increase the conceptual validity and significance, and test the constructiveness of the operational-instrumental paradigm of predictors-deviations [2] regarding paraswimmers with a different nosology, we conducted a study of individuals with LMS in sports.

Objective of the study was to identify and determine the predictors of special technical and tactical training of highly qualified Paralympic swimmers in the sport of persons with lesions of the musculoskeletal system (LMS).

Methods and structure of the study. When highly qualified athletes with PODA were swimming in different sports methods, above-water and underwater video recording of the phases of the swimming cycle was performed. During the training period, LED indicators [1] were also used, attached to one or two of the available segments of the paraswimmer's body to

improve the quality of subsequent video analysis of the selected materials. A survey (oral semi-structured interview) was carried out among trainers working with paraswimmers (from Candidate Master of Sports to Honored Master of Sports) of the sport of persons with LMS. 14 coaches took part in the survey to recognize and attribute predictors of the main types of Paralympic swimming technique reserve. In general, 550 videos of swims at training and competitive events of athletes of the Russian Paralympic swimming team of the Russian Federation for sports of persons with LMS for the period 2019-2022 were analyzed.

Results of the study and discussion. Specific and typical predictors-deviations, most typical for Paralympic swimmers with LMS, have been identified and defined. Specific predictors reflecting the influence of the characteristics of the nosology and the consequences of the disease on the informative indicators of the swimming technique of Paralympic athletes with LMS (Table 1) are muscle imbalance, spasticity of the muscles of the trunk or parts of the body (voluntarily uncontrolled tension or contraction of muscles of different groups), spasticity of the leg muscles, level of coordination abilities. The identified four predictors determine most of the informative indicators of technique used by specialists and coaches today for paraswimmers with LMS, which indicates the complex nature of the connections of each selected indicator of Paralympic swimming technique with the indicated predictors. No specific predictors associated with indicators of cycle time and time of the working phase of the stroke were identified in athletes of this nosological group.

Table 1. Relationships between informative indicators of swimming technique and specific predictors of the reserve of technical and tactical training of Paralympic swimmers in the sport of persons with LMS

Informative indicators of swimming technique	Specific predictors of swimming technique indicators in swimmers with LMS
Angle of attack of the body, degrees	Muscle imbalance, spasticity of trunk muscles or body parts
Angular range of leg work, degrees	Leg muscle spasticity, muscle imbalance
Maximum leg flexion angle, degrees	
Angle of flexion in the elbow joint in the middle of the stroke, degrees	Muscle imbalance, spasticity of trunk muscles or body parts
Angle of flexion in the elbow joint at the end of the stroke, degrees	
Dynamics of the angle in the elbow joint, degrees	
Cycle time, s	—
Time of the working phase of the stroke, s	
Rhythm, %	Spasticity of the muscles of the trunk or parts of the body, level of coordination abilities
Rate, cycle/min	



Table 2. Typical predictors, their manifestations in the swimming technique of Paralympic swimmers of sports of persons with LMS and the possibility of correction

Basic typical predictors	Typical predictors as manifestations of swimming technique that require correction	Possibility of correction. Correction method
1. Muscle spasm (from exertion)	Premature end of the stroke, ineffective grip as the hand enters the water, distorted stroke trajectory	Possible. Massage
2. Muscle spasm (due to illness)	Premature end of the stroke, ineffective grip when the hand enters the water, distorted stroke trajectory, asymmetry of stroke movements	Impossible. Development of movement elements that compensate for deviations in swimming technique
3. Insufficient strength training	Premature end of the stroke, negative angle of flexion of the elbow, hand, downward stroke trajectory	Possible. Strength training
4. Insufficient level of development of coordination abilities (due to illness)	Asymmetry of rowing movements, distorted stroke trajectory, uncoordinated work of arms and legs	Impossible. Development of movement elements that compensate for deviations in swimming technique
5. Insufficient level of development of coordination abilities (not related to the disease)	Premature end of the stroke, distorted trajectory of the hands entering the water	Possible. Increasing the amount of work on land, adding simulation exercises
6. Low mobility of joints and torso	Insufficient arm extension when entering the water, reducing stroke length	Possible. Increasing work on flexibility
7. Low mobility of joints and torso (due to illness)		Impossible. Development of movement elements that compensate for deviations in swimming technique
8. High angle of attack	Non-streamlined position in the water ("verticalization" of the athlete's body)	Possible. Depending on the reasons: massage (for severe muscle spasms), changing swimming technique
9. High angle of attack (due to illness)		Impossible. Development of individual swimming techniques for maximum compensation of deviations
10. Insufficient speed and speed-strength endurance	Inability to maintain the required speed over a distance, inability to achieve the required competitive speed	Possible. Adding a training load to increase endurance
11. Asymmetry of movements (due to disease or amputation)	Asymmetry of stroke movements	Impossible. Development of individual swimming techniques for maximum compensation of deviations

As typical predictors, 11 basic predictors and thirteen deviation predictors were identified as particular manifestations of the basic ones, most often found in the individual swimming technique of athletes with LMS. Presented in table. 2 predictors symptomatically reflect constant or periodically recurring features of psychomotor regulation (involuntary, voluntary) of movements in the aquatic environment among para swimmers of various sports and functional classes. However, in a certain complex combination (in composition and severity), the indicated deviation predictors turn out to be permanently stable only for one specific sports-functional class (they are typical specifically for this class).

Table 2 also indicates that in fact, in 50% of cases in swimmers with LMS, it is impossible to correct typical predictor deviations. In this regard, it is necessary to form special elements of a paraswimmer's movements in the aquatic environment that effectively compensate for deviations in swimming technique, or to develop an individual model of swimming technique

for a specific athlete, taking into account his illness. For example, to maintain symmetry in the functioning of the musculoskeletal system of a para swimmer with partial amputation of the upper limb, it is possible to recommend the use of rowing plates during training to provide the necessary resistance to the amputated limb. In case of lower limb amputation, it is necessary to use modified fins during training to provide the necessary load on the stump and develop musculoskeletal symmetry [4].

For Paralympic swimmers with lesions of the musculoskeletal system, this study established typical predictors only for 17 (out of 29) sports-functional classes - S2, S5, S6, S7, S8, S9, S10, SB3, SB4, SB5, SB6, SB8, SB9, SM3, SM7, SM8, SM10. Identification of some predictor deviations, typical for sports-functional classes, which are not in this list, involves the development of special methodological solutions that ensure the multidimensionality of their spatio-temporal registration.



Conclusions. Scientifically based data were obtained on specific and typical predictors-deviations as active determinants of identifying and implementing the main reserve of technical and tactical training of highly qualified swimmers with lesions of the musculoskeletal system. In the aspect of subject-instrumental individualization, this means expanding the possibilities for objective analytical accounting, forecasting and controlled transformation by the coach of nosological features observed in different sports-functional classes into the forms of their individual implementation by a specific Paralympic swimmer as unique elements of aquatic locomotion technique. The use of the construct of predictors of technical and tactical training reserve is productive for the practice of hydrodynamic training, the evolution of private methodology and the system of sports training for swimmers with LMS.

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