Features of the stroke in the process of integrating physical and technical training of crawler swimmers at the stage of improving sportsmanship

UDC 797.212.4

PhD, Associate Professor **A.V. Arishin**[1]
Dr. Hab., Professor **A.I. Pogrebnoy**[1]
[1]Kuban State University of Education, Sport and Tourism, Krasnodar

Corresponding author: ondrugo@mail.ru

Received by the editorial office on 01.06.2023

Abstract

Objective of the study was to identify the features of changes in stroke characteristics in the process of integrating the technical and physical training of swimmers at the stage of improving sportsmanship.

Methods and structure of the study. The three-year experiment involved 45 swimmers of the stage of improving sportsmanship, who qualified as candidates for master of sports of Russia and made up the experimental (EG) and control groups (CG). The training programs in the experimental group included modified load options, specially selected exercises that simultaneously affected the parameters of physical and technical readiness, which are leading in the formation of maximum swimming speed. The training plans of the athletes in the control groups were carried out in accordance with the regulations of the Federal Standard of Sports Training for the sport – "swimming". The work used methods of computer video analysis of swimmer movements, analysis of intra-cycle swimming speed, dynamic parameters of swimming technique, testing, and mathematical statistics.

Results and conclusions. Significant differences were revealed in 24 out of 30 parameters of stroke movements in athletes from the EG and CG, indicating pronounced positive changes in the stroke in athletes from the EG. At the same time, differences were established in the mechanism of formation of stroke power in the propulsive phases - pulling up and pushing off. The use of special exercises in training programs for swimmers at the stage of improving sportsmanship, aimed at developing the strength component of swimming technique in the context of integrating means of physical and technical training, leads to characteristic changes in the structure of the stroke. The identified differences in the indicators of strength, speed and power of the stroke in its propulsive phases among swimmers from the EG and CG ensure a significant increase in the maximum swimming speed in athletes of the first group compared to the second.

Keywords: *integration, technical and physical training, crawler swimmers, stage of improving sportsmanship, training tools, stroke characteristics.*

Introduction. The stage of improving sportsmanship is characterized as a period of athletes mastering the loads characteristic of modern elite sports and maintaining a high level of physical, technical, tactical, and psychological preparedness [3-5]. At this stage of sports training, the share of general physical training is reduced (to 12-25%) and the percentage of special physical training is increased (to 40-52%). At the same time, only 15-20% of the total volume is allocated for technical training, which, in our opinion, is extremely small to ensure a high level of sportsmanship among swimmers [1, 2]. It is at the stage of sports improvement that swimmers reach the maximum volume of swimming - about 3000 km per year [6]. As we approach the maximum values of the total volume of loads, the task of optimizing training means, primarily through their integration, becomes acute.

As is known, the effectiveness of a swimming technique is determined by the propelling or propulsive force that the swimmer creates during the stroke, while minimizing the resistance forces acting on the body [4]. Research on increasing swimming speed

has shown that the highest pulling forces are achieved by the arms when swimming at maximum speed [7]. Previously, in our works [1, 2], devoted to the integral training of swimmers, statistical ROC analysis was used, which determined the most specific kinematic and dynamic parameters of the stroke, the change of which leads to a change in the maximum swimming speed. It should be noted that according to ROC analysis, stroke indicators identified as significant also have high sensitivity, that is, they are subject to change. On the other hand, their specificity makes it possible to select associated means on land and in water that have an accentuated effect on biomechanical parameters and increase the efficiency of the stroke.

Objective of the study was to identify the features of changes in stroke characteristics in the process of integrating the technical and physical training of swimmers at the stage of improving sportsmanship.

Methods and structure of the study. The three-year experiment involved 45 swimmers at the stage of improving sportsmanship, qualified as candidates for Master of Sports of Russia - 20 in the experimental group and 25 in the control group. The work used methods of computer video analysis of the swimmer's stroke movements, analysis of intra-cycle swimming speed, dynamic parameters of the stroke, testing, and mathematical statistics.

The training programs in the experimental group included modified load options, specially selected exercises that simultaneously affected the parameters of physical and technical training, which are leading in the formation of maximum swimming speed.

To improve physical qualities and technical readiness in the gym and in the water, exercises with similar characteristics and direction of impact were used: with the StretchCordz Modular Set device of varying rigidity on land and in water, using blades of different sizes, various options for coordinating rowing movements with varying intensity and weights, using KINESIS, VASA Ergometer, VASA Trainer simulators. At the considered stage of preparation, the work was focused (taking into account the results of the ROC analysis) on increasing the power and strength of the stroke in the push-off phase, reducing the tempo of movements on land and water, reducing the speed and acceleration of the hand in the pull-up phase. It should be noted that at this stage of preparation, the "step length" parameter showed high specificity. In this regard, exercises on land and in water were selected to optimize the pace-step ratio.

The training plans of the athletes in the control groups were carried out in accordance with the regulations of the Federal Standard of Sports Training for the sport "swimming".

Results of the study and discussion. A comparative analysis of the results obtained during three years of preparation at the stage of improving sportsmanship revealed the characteristic features of the kinematic and dynamic parameters of the stroke, in particular, the heterogeneity of the dynamics of its individual parameters among athletes from the EG and CG. It should be noted that the main factors in the formation of the propulsive phases of the stroke are indicators of the strength and speed of wrist movement. They also determine the power of the stroke as a derivative indicator of strength and speed. In this sense, the power indicator can be equal for different multiplier values (for example, speed is higher and strength is lower and vice versa). Thus, in the first year of preparation at the stage of improving sportsmanship in the CG, the increase in the stroke force indicator in the grip phase (non-propulsive) was almost the same as in the EG (2.5% in the CG and 2.6% in the EG), and in the pull-up (propulsive) phase, the stroke force of swimmers from the EG increased by 31.5%, and in the CG, on the contrary, decreased by 34%. By the second year of training, the increase in strength among swimmers from the EG decreased and amounted to only 5%, and by the end of the third year – 4%, which can be explained by the "law of the initial level". At the same time, the indicator of stroke strength in the catching phase by the end of the third year of training among athletes from the EG and CG was practically no different (table).

The stroke power in the pull-up phase of athletes from the CG increased by 12.7% in the first year, and in the EG - by 5%, and then the trend of changes during the second and third years of training was maintained. The observed decrease in the increase in the stroke power indicator in the pull-up phase in swimmers from the EG occurred against the background of an increase in stroke strength, and in the CG – in the speed of wrist movement (table).

In the repulsion phase (propulsive) in the athletes from the CG, stroke strength indicators in the first year showed a slight increase, and in the EG, the force applied by the hand to the water flow increased by 18.3% compared to the initial data. However, further, due to a sharp increase in the speed of wrist movement among swimmers from the EG (in the first year by 13.6%, in

Indicators of the dynamic and kinematic structure of the stroke among athletes at the stage of improving sportsmanship at the end of the third year of training ($\bar{x}\pm\delta$)

Indicators	EG (n=20)	CG (n=25)	Mann-Whitney statistics U	p
Dynamic stroke parameters				
Strength (capture phase), N	198,3±8,174	198,416±8,157	227,0	>0,05
Power (capture phase), Watt	229,381±30,873	227,26±30,482	225,0	>0,05
Strength (pull-up phase), N	391,25±6,576	145,76±11,406	0,0	<0,001
Power (pull-up phase), Watt	160,983±10,135	101,556±10,747	0,0	<0,001
Force (repulsion phase), N	248,85±17,181	228,8±27,876	80,0	<0,001
Power (repulsion phase), Watt	839,675±239,39	298,584±42,696	3,0	<0,001
Power avg. (on land), Watt	218,123±7,847	206,948±8,095	87,0	<0,001
Power min. (on land), Watt	192,815±3,724	186,228±4,465	66,5	<0,001
Power max. (on land), Watt	243,43±12,232	227,668±11,902	90,0	<0,001
Kinematic parameters of the stroke				
Speed in the capture phase, m/s	1,153±0,117	1,141±0,107	217,5	>0,05
Speed in the pull-up phase, m/s	0,412±0,026	0,698±0,061	500,0	<0,001
Speed in the repulsion phase, m/s	3,328±0,779	1,305±0,077	0,0	<0,001
Pace in water, movements/min	58,62±4,233	68,139±4,942	459,0	<0,001
Pace on land, movements/min	60,01±4,605	71,002±6,609	451,0	<0,001
Cycle time, s	1,403±0,117	1,269±0,136	105,5	<0,001
Stroke time, s	1,176±0,129	1,039±0,121	118,5	<0,01
Brush depth, cm	55,08±4,984	53,042±3,796	178,5	>0,05
Trajectory length in the capture phase, m	0,441±0,05	0,428±0,031	206,5	>0,05
Trajectory length in the pulling phase, m	0,946±0,046	0,974±0,279	123,0	<0,01
Trajectory length in the repulsion phase, m	0,76±0,078	0,668±0,058	72,5	<0,001
“Step”length, m	2,026±0,182	1,815±0,099	96,5	<0,001
Speed avg. per cycle, m/s	2,603±0,43	2,014±0,194	65,5	<0,001
$ICS_{max.}$, m/s	1,693±0,069	1,632±0,053	107,5	<0,001
$ICS_{min.}$, m/s	1,303±0,109	1,197±0,066	118,5	<0,01
$ICS_{avg.}$, m/s	1,501±0,087	1,417±0,059	115,0	<0,01
Acceleration of the hand in the grip phase, m/s^2	1,766±0,899	1,76±0,672	202,5	>0,05
Acceleration of the hand in the pulling phase, m/s^2	-6,17±2,359	-3,776±2,186	381,0	<0,01
Acceleration of the hand in the repulsion phase, m/s^2	8,352±3,778	5,681±3,27	114,0	<0,01
Swimming speed max., m/s	2,095±0,114	1,86±0,057	0,0	<0,001
Test swimming speed, m/s	2,054±0,029	1,934±0,063	9,5	<0,001

the second - by 41.4% and in the third - by 30.1%), the increase in the power parameter of their stroke decreased and by the end of the third year of training, the increase was only 0.5% (in the CG – 14.4%). That is, in the swimmers of the EG, a reverse pattern of formation of the calculated stroke power indicator was observed in the push-off phase compared to the pull-up phase. The increase in stroke power in the take-off phase among swimmers from the EG increased in the first year by 34.7%, in the second year - by 51% and in the third year - by 31% (in the CG - in the first year a regression of the indicator by 30.7% was found, and in in the second and third years, the increase in the power parameter relative to the first year of preparation was

50% and 31.2%, respectively). When analyzing stroke power on land, the increase in indicators in the control and experimental groups was almost the same.

The stability of the technique can be judged by the indicators of intra-cycle swimming speed (ICS) [4]. The results obtained showed that the difference between the minimum and maximum values of the ICS in the EG by the end of the third year of training was 0.39 m/s, and in the CG – 0.44 m/s, that is, the ICS graph for swimmers from the EG was smoother than in the CG, which indicates a more stable and effective swimming technique (see table).

The use of special exercises on land and water had a positive effect on the swimming technique of athletes from the EG, compared to the CG. In particular, by the end of the third year of training, significant intergroup differences were revealed between swimmers from the EG and CG in terms of the power of wrist movement in the take-off phase (for swimmers from the EG the indicator was 280% higher than in the CG). It should be noted that the applied means of integrating physical and technical training at the stage of improving sportsmanship also led to a significant increase in the maximum swimming speed of athletes from the EG compared to the CG. Moreover, all the athletes from the EG fulfilled the standard of the Master of Sports of Russia and repeatedly became winners and prize-winners of All-Russian swimming competitions.

Conclusions. The use of special exercises in training programs for swimmers at the stage of improving sportsmanship, aimed at developing the strength component of swimming technique, in the context of integrating means of physical and technical training, leads to characteristic changes in the structure of the stroke. The identified differences in the indicators of strength, speed and power of the stroke in its propulsive phases among swimmers from the EG and CG ensure a significant increase in the maximum swimming speed in athletes of the first group compared to the second.

References

1. Arishin A.V., Pogrebnoy A.I. Obosnovaniye kontseptsii tekhniko-fizicheskoy podgotovki plovtsov v mnogoletnem trenirovochnom tsikle. Teoriya i praktika fizicheskoy kultury. 2022. No. 10. pp. 21-23.
2. Arishin A.V., Akhmetov S.M., Pogrebnoy A.V. Sopryazhennoye ispolzovaniye sredstv fizicheskoy i tekhnicheskoy podgotovki plovtsov vysokoy kvalifikatsii v bazovom mezotsikle. Teoriya i praktika fizicheskoy kultury. Krasnodar. 2020. No. 12. pp. 92-94.
3. Platonov V.N. Osnovy podgotovki sportsmenov v olimpiyskom sporte. Coach's handbook: 2 volumes. Moscow: Printleto publ., 2021. Vol. 1. 592 pp.
4. Caty V., Aujouannet Y., Hintzy F., Bonifazi M., Clarys J.P., Rouard A.H. Wrist stabilisation and forearm muscle coactivation during freestyle swimming. J Electromyogr Kinesiol. 2007. pp. 285-291.
5. Jaric S. Force-velocity relationship of muscles performing multi-joint maximum performance tasks. Int J Sports Med. 2015. pp. 699-704.
6. Leblanc H., Seifert L., Tourny-Chollet C., Chollet D. Velocity variations in breaststroke swimmers of different competitive levels. International Journal of Sports Medicine. 2007. pp. 140-147.
7. Ruiz-Navarro J.J., López-Belmonte Ó., Gay A., Cuenca-Fernández F., Arellano R. A new model of performance classification to standardize the research results in swimming. Eur. J. Sport Sci. 2022. pp. 1-11.