

Improving technical preparedness of archers using directional development of their coordination skills on stage using the specialized basic training

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Abstract

The thesis is devoted to the technical training of skilled archer. Following the analysis of literature was found structure factors that determine the effectiveness of exercise in the technique of competitive archery. The ways of improving the technical preparedness archer at the stage of basic training specialist associated with playing rhythmic, dynamic structure and maintain stability kinematic characteristics of motor actions due to quality displays of coordination abilities. Theoretically and experimentally proven efficiency in improving the technical preparedness archer at the stage of basic training specialized complex coordinated increase in the proportion of training, shift in pedagogical orientation to complete the tasks and reduce the amount of funds for the development of maximum strength and speed-strength endurance. Formed scientific position on the use of exercise adversarial nature of the changed conditions in the complex control of technical training skilled archer at the stage of basic training and specialized completed qualification-determined differences skilled athletes on the basis of model parameters physical and technical preparedness skilled archer.

Keywords: technical preparedness, improve, skilled archer, coordination ability, skill differences.

Introduction

High level of Ukraine athletes results in this sport and high competition level on world arena form a need for creating a scientific and methodological basis for athletes preparation at different stages of long-term training period (Antonov, 2012; Briskin, 2010, 2014; Romanchyshyn, 2015).

In archery structure of competitive activity belongs to high coordinated sport group. By orientation the techniques are oriented to achieve maximum results that can be measured metrically which requires taking into account specific sports training principle – unity and relationship of structure of competitive activity and structure of training process and forming a perfect motor skills (shot execution) and its implementation in terms of competitive activities. Accordingly must be identified high value of technical training leading role in the structure of long-term training period of athletes in archery (Briskin, 2011, 2014; Yi-Chieh, 2010).

Researches of athletes training in archery are focused on errors in laying the bow, the physiological mechanisms of motor skills; modeling of the archer body and more. These results partially solve the issues of technical training in archery (Ertan, 1999, 2003, 2009; Leroyer, 1993).

Researches of the actual technical training in archery are focused mainly on the structure of motor actions using different means of technical training, evaluation of technical level, improving training process of high qualified athletes (Park, 2009; Part , 2014; Soylu, 2006).

However, several experts emphasized that specialized basic training level is one of the main in long-term training period of athletes. Within this stage there is a significant increase in special training means compared to previous stages and form the basis for a sharp increase of training amount on next stages of long-term training period and provides high amount of athletes participation in competitions (Khimenes, 2016; Miyazaki, 2013; Musta, 2003). Thus, improving areas of technical training in archery can be developing of specialized physical fitness of athletes, use of individual computer standards of biomechanical parameters, use of training devices, formation of the structure and content of training loads according to athletes' abilities.

A number of scientists note that the basis for the formation of technical preparedness of athletes is the optimal level of special physical qualities. In studies devoted to improving the technical preparedness of athletes on the basis of special physical qualities the main slope is made in improving the specific strength abilities (Alex, 2009; Briskin, 2016; Ertan, 2005; Keast, 1991; Tursi, 2013). However, in archery level of strength abilities of athletes is not high that considering the high coordination structure of competitive activity and the structure and content of existing researches forms an important scientific and practical task of improving the technical preparedness of the archers on the stage of specialized basic training using directed development of coordination abilities.

Purpose of the research

Improvement of technical training with use of coordination abilities directed development of qualified archery sportsmen.

Materials and Methods

Methods: theoretical analysis and synthesis; comparison; analysis of documentary materials; pedagogical observation; pedagogical experiment; mathematical and statistical methods of data processing.

To the research were attracted 70 athletes of different qualification. Of these, 25 athletes of Ukraine national archery team (stage of maximum realization of individual abilities) and 45 athletes on the stage of specialized basic training from sport schools "Elektron" from Lviv and "Kommunar" from Kharkiv.

Results

Based on the data set of scientific and technical literature study and information sources are set basic parameters of performance technology of competitive exercise as a component of technical preparedness of archers, set requirements for technical skills of athletes during long-term training period and generalized directions of technical training improvement of athletes on stage of specialized basic training (Antonov, 2012; Briskin, 2011; 2014).

During analysis revealed that the main factors that determine the effectiveness of techniques is the possibility of archers to play the correct rhythm, dynamic structure and maintain stability of kinematic characteristics of motor actions during the execution of the shot and in all its phases. This is possible due to high quality of coordination abilities displays on the background of optimal strength qualities level of athletes that is not taken into account during training of the qualified archers on the stage of specialized basic training (Leroyer, 1993; Yi-Chieh, 2010; Soylu, 2006).

Complex determination of technical training features of archers at various stages of long-term training must include special physical training; characteristics of competitive exercise techniques, complex indicators of technical training.

Qualification-determined differences of archers on the stage of specialized basic training during maximal realization of individual potential contained (Briskin, 2014):

- generally lower rates of special physical fitness ($p < 0,05-0,01$) and significantly lower results ($p < 0,001$) in exercise control: "Laser hold in target field" (with open and closed eyes); "Hold the bow in maximum tension" "Muscle sensitivity" (range 0,05 kgf. and the total deviation). Average results of qualified archers is made within 3 to 29% result of high qualified athletes;
- at lower ($p < 0,05-0,01$) parameters of shot techniques and complex indicators of technical training of the qualified archers. In some cases, found no significant differences ($p > 0,05$): duration of installation phase before work; angle at the shoulder joint after the shot, the difference in the angles of the elbow, the difference in angles of the shoulder joint; speed of forearm movement.

Authorial program of improving technical training of archers at stage of specialized basic training with the directional development of their coordination abilities formed considering the fundamental scientific propositions of the general theory of athletes training which includes directions of improving athletes training system and specific principles of sports training. Its implementation took place in pedagogical experiment, which included two periods of repetitive training macrocycles.

Experimental factors aimed at molding part of the author technical training improvement program of qualified archers were: increasing the part of training loads directed in the structure of general and special physical training on improving coordination abilities of skilled archers (35% and 45% respectively); increasing the share of training means directed on comprehensive development of various physical qualities combined with coordination skills (from 60 to 80%); reducing the emphasis on the development of special displays of maximum strength training and correction of training influences on speed-strength endurance (from 20 to 5% and from 25 to 20% respectively).

In the structure and content of the authorial training program constant were the following parameters and their values: total time allocated for teaching and training activities; duration and amount of training sessions; the ratio training session parts (preparatory, primary, final); the amount and focus of training work for techniques improvement; the amount of training work for improving physical fitness; the amount of training forms of competitive exercises.

Following two phases of the research were set significant differences between the parameters of control and experimental groups that indicated the overwhelming effectiveness of traditional and authorial program of technical training of qualified archers (Alex, 2009; Antonov, 2012; Briskin, 2014). Thus, representatives of the control group had significantly higher results in exercises "bow strength" (0,42 kgf, 2,68%, $p < 0,05$), "Hold the bow in maximum tension" (1,10 s, 5,47%, $p < 0,05$), "bow stretching the bow at 30 s with right and left hands (1,11-1,84 times 6,10-9,17%, $p < 0,05-0,01$) "maximum draft" right and left hand (3,99-4,74 kgf, 8,76-10,63%, $p < 0,05$).

The experimental group was generally better in exercises "Laser hold in target field" (open and closed eyes) – 2,13-4,91 s, 50,55-72,18% at $p<0.01$; indicators of muscle sensitivity (range $\pm 0,5$ kgf; $\pm 0,05$ kgf., the amount of deviation) – 29,42-146,59% at $p<0.01$. This has indicated on the conservation priorities of the traditional and authorial programs.

Considering the increases in separate groups can be stated the positive effects of both training programs at the level of preparedness of qualified archers with a slight advantage of the experimental program. It witnessed by significant changes in 13 and 11 indicators of athletes of the experimental and control group 15 of which were considered during the study.

Most of the changes that have taken place in special physical fitness of athletes of the experimental group were expected and ranged from 15,46 to 60,35% ($p<0,05-0,01$). Striking increases in some indicators as "Laser hold in target field" (open and closed eyes); "Muscle sensitivity" (range $\pm 0,05$ kgf), where their results grew in 2,5-5 times. It means that adaptation processes that have emerged against the background of small initial level of preparedness allowed realizing the potential that brought qualified athletes to a new level of special coordination qualities.

Along with that, for athletes of controls group only laser hold in target field (open eyes) revealed similar trends (increase in 2 times), which is much inferior to the experimental group ($p<0,01$).

The combination of dynamics analysis of special physical training combined with general physical preparedness indicators confirmed that traditional program had a strong focus on improving the complex strength qualities of qualified athletes. The structure and content of the authorial program was aimed at the development of coordination abilities and proved that adequate scientific and reasonable selection of training means has the ability to influence on the development of certain manifestations of strength quality, including strength endurance.

During pedagogical experiment generated significant differences ($p<0,05-0,01$) between archers of control and experimental groups in the parameters of shot performance techniques (Table. 1).

Table 1

Indicators of technique characteristics of qualified archers during the research

№	CONTROL TESTS					
	I observation		II observation		III observation	
	EG (n=24)	CG (n=21)	EG (n=24)	CG (n=21)	EG (n=24)	CG (n=21)
	M ± m	M ± m	M ± m	M ± m	M ± m	M ± m
1	200,50±34,17	202,71±28,16	197,38±19,25	200,05±22,00	192,04±10,49	198,14±16,20
2	180,42±25,37	179,90±23,47	184,13±19,37*	175,48±11,63	187,08±11,97*	176,24±14,51
3	148,42±18,82	158,57±21,45	163,42±12,52	156,29±12,31	170,21±7,77*	160,67±7,40
4	529,33±40,01	541,19±37,91	544,92±26,82	531,81±27,19	549,33±18,59*	535,05±23,95
5	44,04±9,23	46,71±7,47	42,08±4,93	45,10±2,83	40,88±2,76*	43,05±2,97
6	141,58±7,41	139,90±5,73	141,96±5,62	139,43±5,07	138,29±3,50	138,14±5,28
7	11,96±2,14	11,95±1,91	7,13±2,03	10,05±2,27	5,50±1,59*	8,95±2,26
8	21,67±9,99	32,52±9,47	20,38±3,12	26,29±2,74	20,04±2,31*	26,76±2,98
9	181,71±8,49	184,57±8,98	180,83±5,05	186,29±6,14	179,13±3,95	186,00±5,80*
10	10,71±3,65	10,90±2,84	6,13±2,01	9,19±2,46	4,83±1,69*	8,05±1,99
11	24,63±11,70	14,57±10,42	21,71±5,15	18,81±4,06	20,83±3,24*	16,29±3,33
12	40,13±8,68	44,67±9,91	38,88±7,32	46,38±5,85	40,83±4,78	48,14±7,47*
13	2,58±1,71	2,67±2,11	1,92±1,28	3,14±2,26	1,58±1,02*	1,95±0,92
14	0,17±0,09	0,10±0,08	0,13±0,03	0,12±0,03	0,12±0,02*	0,10±0,02
15	0,27±0,06	0,29±0,08	0,24±0,05	0,30±0,04	0,24±0,03*	0,30±0,05

Notes: - significance of differences between groups (EG and CG); **b** – differences at different stages in the same group; 1 – duration of the installation phase before work (ms); 2 – duration of extensions to the chin phase (ms); 3 – the duration of traction phase (ms); 4 – total time of major shot phases (ms); 5 – angle at the elbow before shot; 6 – angle at the shoulder before shot; 7 – left hand angle before shot; 8 – angle at the elbow after shot; 9 – angle at the shoulder after shot; 10 – left hand angle after shot; 11 – difference in the angle of the elbow joints; 12 – difference in the shoulders joints of the elbow; 13 – left hand angle difference; 14 – speed of forearm movement (deg/ms); 15 – speed of shoulder movement (deg /ms).

They showed preference of athletes of the control group on smaller overall shot duration (14,29 ms, 2,67%, with $p<0.05$) greater angle at the elbow (6,72°, 25,11%, with $p<0,01$), more shoulder joint in the angle after shot (6,88°, 3,70% at $p<0,01$) greater difference in the shoulder joint angles (7,02°, 14,68%, at $p<0,01$) and a slower movement of the forearm (0,02 deg/ms, 20.35%, with $p<0,01$).

In the experimental group athletes held more pronounced changes ($p < 0,05-0,01$) in: phase stretching to the chin (10,85 ms, 6,15%), the traction phase (9,54 ms, 5,94%) in the corner of the elbow before shot (2,17°, 5,05%), left hand angle before shot (3,45°, 38,56%), left hand angle after shot (3,21°, 39,94%), the difference in the angles of the elbow 4,55°, 27,92%) and speed of shoulder movement (0,06 deg/ms, 19,46%).

Analysis of the group dynamics of indicators pointed out that for athletes of both groups (control and experimental) tendencies had positive direction. It was seen in approaching to the model indicators of high qualified archers. For the experimental group there have been structural adjustment that were realized in the following indicators: duration of traction phase, the total time for major shot phases, angle of shoulder joint before shot, the angle of left hand after shot, the difference of angles for the left hand and the speed of forearm and shoulder movement of the right hand. Changes ranged from 2,32 to 54,86% ($p < 0,05-0,01$). For the control group changes rates occurred in fewer characteristics: the angle of the elbow before and after the shot, left hand angle before and after shot (7,85-26,2%, with $p < 0,05-0,01$). In other indicators changes were not found ($p > 0,05$).

As a result of forming pedagogical experiment could be stated positive dynamics of complex indicators of technical training of the qualified archers (Table 2).

Table 2

Comprehensive technical training indicators of qualified archers during the research

№	CONTROL TESTS					
	I testing		II testing		III testing	
	EG	CG	EG	CG	EG	CG
	M ± m	M ± m	M ± m	M ± m	M ± m	M ± m
1	143,67±7,24	144,33±5,41	148,33±4,63*	144,43±4,68	153,75±4,73*	148,48±5,82
2	376,29±25,20	381,33±19,88	372,17±26,02*	383,76±37,33	341,92±26,32*	366,33±41,01
3	247,79±9,17	248,33±8,60	252,79±5,84*	247,05±6,29	254,83±3,67*	250,71±4,19
4	251,63±12,10	251,86±11,98	251,08±7,19	252,62±6,01	256,71±4,42*	253,71±4,67
5	499,42±12,20	500,19±11,47	503,88±8,94	499,67±10,30	511,54±6,22*	504,43±6,25
6	55,08±3,05	55,90±2,43	58,17±2,22*	53,81±2,02	62,13±2,80*	56,81±4,12
7	52,04±2,46	52,05±2,73	54,46±2,17*	51,14±3,04	59,04±2,76*	54,24±3,02
8	110,67±14,88	108,05±14,22	124,38±8,91*	101,52±10,23	137,29±16,45*	110,29±16,42

Notes: * - significance of differences between groups (EG and CG); **b** – differences at different stages in the same group; 1 – results in exercise «18x18»; 2 – time for exercise «18x18»; 3 – amount of 1-30 shots in exercise M3; 4 – amount of 31-60 shots in exercise M3; 5 – amount of 1-60 shots in exercise M3; 6 – amount in exercise “Shots at sitting position”; 7 – amount in exercise “Shots standing on a platform”; 8 – amount in exercise “Shots with closed eyes”.

Following two phases of pedagogical experiment formed pronounced differences in all the comprehensive technical training indicators between athletes of control and experimental groups. Advantage of control group members is shown only in terms of time indicators of control exercise “Shooting 18x18”, its faster performance (24,42 seconds, 6,67%, at $p < 0,05$). In other exercises established dominance of experimental group archers (1,41-24,49%, with $p < 0,05-0,01$).

It is interesting that the differences that are confirmed in the final testing generated by increases of athletes indicators of experimental group in all control exercises (2,02-24,06%, with $p < 0,05-0,01$). Along with this significant improvement of control group archers preparedness installed only in the amount of exercise “Shooting 18x18” and option “Shooting standing on a platform” (4,14 Pts., 2,87% and 2,19 Pts., 4,21%, respectively, at $p < 0,05-0,01$).

Discussion

Theoretical and methodological approaches for learning and improving sport exercise technique in archery is determined by the features of competitive activity and focus on achieving maximum metric result. The impact of technique is provided by opportunities of archers to achieve correct rhythmic, dynamic structure, maintaining stability of kinematic characteristics of motor actions during the execution of the shot as a whole and in all its phases separate. One of the key factors that ensure optimal development and compliance of tempo-rhythm structure of competitive exercise technique archery at different stages of long-term training are quality displays of coordination abilities on a background of optimal strength quality of athletes that forms the current direction of the research.

Summarizing the results of the study made it possible to confirm the effectiveness of traditional means of physical training control (general and special), shot techniques characteristics and complex technical readiness indicators in determining physical fitness of archers at different stages of long-term training (Ertan, 2003; Keast, 1991); content and structure of the main shot techniques phases in archery, which defines the main important for

the results action – the actual performance of traction, while maintaining the integrity of the “shooter-weapon-target” system (Tursi, 2013; Lin, 2003).

Also supplemented and expanded scientific data about modeling indicators of physical and technical training of high qualified athletes which are on stage of maximum realization of individual abilities. Established trends that show higher level displays of strength-speed endurance, strength qualities (maximum strength, strength endurance) of men who dominated by indicators on women 34,4-54,9%, with $p < 0,05-0,01$. For women athletes at this stage featured higher flexibility results (28,7%, $p < 0,01$). In control exercise concerning the coordination abilities not displayed significant differences in the training of men and women ($p > 0,05$), which forms a constant in the structure of their physical fitness (Miyazaki, 2013; Park, 2009; Keast, 1991).

In the characteristics of shots specifications of men and women, only one of the indicators set reliable difference in the duration of direct traction, representing respectively $228,15 \pm 41,68$ (men) and $181,58 \pm 40,08$ ms (woman) at $p < 0,05$. Other indicators are within accurate similarity ($p > 0,05$) (Musta, 2003; Yi-Chieh, 2010 Khimenes, 2016).

Expanded scientific information about qualification differences of athletes who are different stages of long-term training. Qualified archers on the stage of specialized basic training in general have lower rates of special physical fitness ($p < 0,05-0,01$) and significantly lower results ($p < 0,001$) in control exercises related to specific coordination abilities. Average results of qualified archers are in the range from 3 to 29% to the results of high qualified athletes; lower are indicators of shot techniques and complex indicators of technical training of the qualified archers ($p < 0,05-0,001$). In some cases: installing the duration of the phase before work; angle at the shoulder joint after shot, the difference in the angles of the elbow, the difference in angles of the shoulder joint; speed of forearm movement there are no significant differences ($p > 0,05$) (Alex, 2009; Ertan, 2009).

By means of comparative characteristics of structures of relationships between indicators of physical and technical training of archers at different stages of long-term training shown clarified existing scientific knowledge about the interrelationships of various aspects of high qualified athletes training (stage of maximum realization of individual abilities) and qualified (stage of specialized basic training) archers. Qualified archers present dominance of strength quality indicators. In contrast, the relationships structures of high qualified archers main for technical training implementation were displays of coordination abilities (Ertan, 2005; Lin, 2003).

We have installed new scientific data on theoretical grounds the efficiency of technical training improvement of archers on stage of specialized basic training aimed to develop their coordination qualities that is confirmed by changes in special physical training in coordination skills and strength endurance (from 15,46 to 60,35 %, with $p < 0,05-0,01$); parameter characteristics of shot technique – the phase stretching to the chin, actually traction, values of angles in the elbow, left hand before shot, left hand after the shot, the difference in angles of elbow and movement speed (5,05-39,94% at $p < 0,05-0,01$); complex technical training indicators – the amount of exercise “Shooting 18x18” (3,65 and 8,13%, respectively, $p < 0,01$), and the amount of the second segment and the whole exercise “M3” (5,62-7,67 Pts., 1,52-2,24% with $p < 0,05-0,01$) and variants of competitive exercises with complicated conditions (6,81-10,39%, with $p < 0,01$). Also, the results of establishing relationships of control exercise results in changed conditions and other complex technical training indicators ($r = 0,40-0,67$, at $p < 0,05-0,01$), physical (general and special) preparedness ($r = 0,39-0,65$, at $p < 0,05-0,01$) of high qualified archers justified scientific positions on the use of competitive exercises in changed conditions in the complex of technical training control of archers on the stage of specialized basic training.

Conclusions

Model parameters of special physical training of high qualified archers on stage of maximum realization of individual abilities had next indicators: bow strength – 20,97 kgf (men) and 17,08 kgf (women); control exercise “Butterfly” options from 46,08-49,85 times (men) and 39,32-41,83 times (women); wrist dynamometry – 40,92-41,98 kgf (men) and 23,05-24,00 kgf (women); maximum traction force of the bow – 66,38-68,01 kgf (men) and 40,67-40,92 kgf (women). Approximate ($p > 0,05$) for athletes of different sexes are results for control exercises associated with maintenance of laser in target field was 22,76 seconds (men) 17,27 seconds (women), its version with closed eyes – 12,42 sec (men) and 9,18 seconds (women); indicators of own strength sense of the bow – falling in the ranges $\pm 0,5$ kgf – 6,15 times (men) and 6,08 times (woman) $\pm 0,05$ kgf – 1,54 times (men) and 1,50 times (woman); sum of all attempts – 0,23 kgf (men) and 0,36 kgf (women).

The similarity was found ($p > 0,05$) in model parameters of temporal characteristics of shot techniques of high qualified archers (men and women): arrow set phase – 176,62 ms (men) and 199,50 ms (women); traction – 205,56 ms; total duration of the shot 587,00 ms (men) and 610,03 ms (women) and the presence of significant differences due to gender ($p < 0,05$) in model parameters of direct traction duration (228,15 – men and 181,58 women). Total group average values of spatial characteristics ($p > 0,05$) accounted for the angle at the elbow of right hand – $38,72^\circ$ (before shot) and $19,64^\circ$ (after shot); the angle of the shoulder joint in right hand – $136,15^\circ$ (before fire) and $180,84^\circ$ (after shot); the angle formed by the left hand $2,24^\circ$ (before fire) and $0,88^\circ$ (after shot).

By complex indicators of technical training of high qualified athletes (men and women) are similar ($p > 0,05$) in control exercises and their indicators: “Shooting 18x18” – the amount of shots 169,33-172,62 Pts.

and duration of the performance – 298,08-303,54 seconds; shooting with changed conditions: sitting on a chair (75,25-76,08 Pts.), standing on the platform (74,33-75,92 Pts.), with closed eyes (230,00-237,00 Pts.). The exception is performance of control exercise “M3” (584,31 Pts. – men and 577,00 Pts. – women, at $p < 0,05$).

Set basic qualification-determined parameters of technical and special physical fitness of athletes on the stages of specialized basic training and maximum realization of individual abilities. They took place in terms of qualified archers:

- characteristics of shots techniques: duration of stretching to the chin phase – 180,50 ms (boys), 179,81 ms (girls); traction performance – 158,67 ms (boys), 146,86 ms (girls); total time of the main phases of the shot – 541,38 ms (boys), 527,43 ms (girls); angles of the main body link before shot – the elbow right hand – 45,04° (boys), 45,57° (girls), right hand shoulder – 140,83° (boys), 141,76° (girls), left hands – 11,96° (boys), 11,59° (girls) and after shot – right hand elbow – 28,13° (boys), 25,14° (girls), left hand – 11,08° (boys), 10,48° (girls), left hand angles difference – 1,96° (boys), 3,38° (girls); movement speed of the shoulder – 0,26 deg/ms (boys), 0,30 deg/ms (girls), which is 14 to 87% from results of high qualified archers ($p < 0,05-0,001$). In indicators of the phase of arrow installing before the work, angle of the shoulder joint after the shot, the difference in the angles of the elbow and shoulder joints; movement speed of forearm found similarity indices of archers at different stages of long-term training ($p > 0,05$);

- complex technical training indicators: “Shooting 18x18” – amount – 143,63 Pts. (boys), 144,38 Pts. (girls), exercises time 374,63 sec (boys), 383,24 sec (girls); “M3” – the amount (1-30 shots) – 247,04 Pts. (boys), 249,19 Pts. (girls); amount (31-60 shots) – 254,13 Pts. (boys), 249,00 Pts. (girls); overall result – 501,17 Pts. (boys), 498,19 Pts. (girls); shooting in changed conditions – sitting on a chair – 55,67 Pts. (boys), 56,14 Pts. (girls), standing on the platform – 51,92 Pts. (boys), 52,19 Pts. (girls), with closed eyes – 108,63 Pts. (boys), 110,38 Pts. (girls) which is 46-87% ($p < 0,05-0,001$) from indicators of high qualified archers;

- special physical training: “Bow strength” – 15,40 kgf (boys), 13,67 kgf (girls); “Hold laser in target field” – with open eyes – 4,25 sec (boys), 3,19 sec (girls), with eyes closed – 0,71 sec (boys), 0,24 sec (girls); “Bow tension hold” – 12,17 sec (boys) and 12,38 sec (girls); “Stretching the bow for 30 seconds with right hand” – 14,75 times (boys) and 13,52 times (girls), left hand – 14,29 times (boys), 12,86 times (girls); “Butterfly”, the main table – 21,54 times (boys), 14,33 times (girls), slope – 22,17 times (boys), 14,71 times (girls); “Wrist dynamometry” – right hand – 31,42 kgf (boys), 16,95 kgf (girls), left hand – 30,33 kgf (boys), 16,19 kgf (girls); “The feeling of the bow” in the range of $\pm 0,5 - 2,83$ times (boys), 3,57 times (girls); $\pm 0,05 - 0,25$ times (boys), 0,43 times (girls); “Maximum thrust” – right hand – 43,21 kgf (boys), 27,05 kgf (girls); left hand – 42,04 kgf (boys), 27,67 kgf (girls), which ranges from 3 to 80% from high qualified archers indicators ($p < 0,05-0,001$).

The used approach for technical training improvement of archers on stage of specialized basic training with the directional development of their coordination skills (increase 50,55-146,59%, with $p < 0,01-0,001$) is fairly effective that with the optimal development of strength qualities of qualified athletes of experimental group is demonstrated with significant growth of results in control exercises on complex indicators of technical training (results in exercises “Shooting 18x18”, sums of individual segments and whole in the exercise “M3”, amounts in exercises with changed conditions (sitting on a chair, standing on the platform, with eyes closed) on 1,41-24,49%, with $p < 0,05-0,01$ and optimization of shot techniques (the phase of stretching to the chin – 10,85 ms, 6,15 %, of traction phase – 9,54 ms, 5,94%, angle in the elbow before shot – 2,17°, 5,05%, left hand angle before shot – 3,45°, 38,56%, left hand angle after shot – 3,21°, 39,94%, the difference in the angles of the elbow – 4,55°, 27,92% and the movement speed of the shoulder – 0,06 deg/ms, 19,46%, with $p < 0,05-0,01$), which on 5,05-39,94% ($p < 0,05-0,01$) higher than in indicators of qualified archers from control group.

Conflict of interests

Authors confirm that there is no conflict of interest.

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