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Improving the Performance of Competitive Activity of Volleyball Players based on the Correction of Techniques

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Abstract--- Object: *Improving the serve effectiveness in volleyball using urgent information.*

Methods: *Theoretical analysis, review of sources and scientific data by studying the scientific, methodical and program-normative literature on the problem; pedagogical observation; testing the technical preparedness level of volleyball players (control exercise method); biomechanical characteristics registration; formative experiment; mathematical processing of the results.*

Findings: *The paper analyzes the biomechanical parameters when performing the floating and power serve in the unsupported position. The interrelation between the indicators and the effectiveness of implementing this technique in competitive activity is shown. Based on the data of the optoelectronic biomechanical complex, the main errors in the technique made by the experiment participants are revealed, and the author's method is presented, which aims at correcting the technique of power and floating serve in the unsupported position (in the group of volleyball players studied).*

Conclusions: *The possibilities of using urgent information in training athletes at various levels are shown. The work substantiates the expediency of using optoelectronic biomechanical complexes for flat and three-dimensional methods of locomotion research for the correction of gaming techniques.*

Keywords--- *Technical Training; Volleyball Players, Sportsmanship, Serve Technique, Urgent Information, Correctional Program, Preparatory Exercises.*

I. INTRODUCTION

The current level of volleyball development requires long comprehensive training aimed at the development of

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physical qualities, at mastering the technique of specific activities, tactics of the game and psychological stability.

Further development of volleyball is impossible without the latest achievements of scientific and technological progress. Material resources are the foundation of progress both in the sport of the highest achievements, and in the physical improvement of athletes.

Modern training process aimed at improving specialized motor activities (techniques) in sports identified the problem of obtaining urgent objective information and, therefore, of new tools and teaching methods that will allow rational and effective use of athletic capabilities; all these tasks cannot be solved without the use of modern technical devices.

One of the main methods of attack in the technical arsenal of volleyball players is service. Service in volleyball is not just making the ball enter the game but one of the ways to win a point. The art of serving is the only element in the game the success of which depends exclusively on one person – the server [4]. The process of improving the technical skills of volleyball players is a complex managed system, which determines the need for a systematic approach to using technical means of urgent information.

The purpose of the study is to improve the performance indicators of game actions in volleyball based on the use of urgent information.

To achieve the objectives of the study, the following tasks were formulated:

1. To determine the biomechanical features of the serving technique in volleyball;
2. To identify the technical preparedness dynamics of the volleyball players participating in the experiment;
3. To experimentally substantiate the effectiveness of using urgent information for techniques correction (at the example of the serve) in volleyball training.

II. MATERIALS AND METHODS

Pedagogical research was organized at Kabardino-Balkarian State University of Nalchik. The study involved 23 volleyball players aged 18-24, representing the student teams of the Kabardino-Balkarian Republic (KBR) and the Republic of North Ossetia – Alania (RNO-A) (including: master of sports – 4 people, candidates for master of sports – 12 people and 7 people with Level 1).

To solve the tasks, the following research methods were used: theoretical analysis and generalization of literary sources to obtain the necessary information on the main methods and means of improving the technical preparedness of volleyball players, ensuring improvement in the performance of competitive activities.

The effectiveness of the tools used and methods of technical training was analyzed by assessing the dynamics of statistical indicators of control exercises at the beginning and at the end of the study.

Pedagogical observation was carried out at training sessions of volleyball players of the KBR and RNO-A national teams to study the means and methods of technical training for athletes. Assessment of the techniques effectiveness in competitive activities and of the serve quality was made.

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Pedagogical testing consisted in evaluating indicators of the technical preparedness level (serve technique). Control exercises evaluated serve accuracy by zones. Control tests determined the level of mastering the technique of floating and power serve in the unsupported position, as well as the effectiveness of implementing the technique not only in training sessions but also in competitive activities.

The serve was evaluated by the achieved result during training and calendar games.

The pedagogical experiment in this study was of a formative nature; tasks were realised by comparing the results of technical preparedness testing, the content of program material for improving the technique using urgent information in training sessions when performing the overhand serve in various ways. The factors affecting the quality of performance were also determined.

Mathematical statistics methods were used to verify the reliability of differences in the studied using application software packages. The quantitative parameters obtained during the control tests and expert assessment were statistically processed. For this, the following values were determined: 1) the average result in the group, 2) the standard deviation, 3) the mean error, 4) the performance before and after the pedagogical experiment.

The significance of differences was determined by the *Student's t*-test. To determine whether there is a relationship between performance indicators for overhand serve and the biomechanical components of volleyball players aged 18–24, the rank correlation coefficient was calculated.

III. Literature Review

The constantly increasing level of competitive activity leads to the search for new effective ways of training volleyball players and requires even closer attention to intensifying the processes of teaching and training athletes using special devices.

The specific features of volleyball require special conditions for successful mastering of the game, and training devices and simulators greatly facilitate the organization of classes and increase the ‘density’ of training sessions.

The study (Bogdanis G.C., Tsoukos A., Kaloheri O., Terzis G., Veligekas P. and Brown L.E. 2017) compared the effects of one-sided and two-sided plyometric training in jumping, and estimated the maximum speed of force development. According to the research results, one-sided plyometric training was more effective with an increase in both single and two-stroke jumps and isometric maximum pressing force compared to two-sided training.

A number of authors identified the relationship between volleyball techniques and physical fitness. Thus, according to the research (Corvino M., Tessitore A., Minganti, C. and Sibila M. 2014), special technical devices in the training process of volleyball players can be used to manage external and internal loads on players in order to increase the efficiency of competitive activity.

Gabbett T.J. conducted research to determine the impact of speed-strength training on technical skills. Players (of junior age) participated in a six-week training session on technical and tactical skills with an assessment of the biomechanical structure of the jump; the technique of performing a jump on the block after moving in various ways

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was evaluated. This information is valuable for volleyball coaches during the planning of the training season and will contribute to the effectiveness of competitive volleyball players.

Kristicevic T. and Krakan I. conducted research to assess the degree of influence of 5-week plyometric training on the quality of the vertical jump of young volleyball players. Special media characterizing biomechanical indicators were used; the information obtained helps trainers plan the training process, improving performance using safe movements. Using the program allows adjusting the movements of the volleyball player, increasing the productivity of actions and reducing the risk of injury to the athlete.

The results of the study by Lehnert M., Sigmund M., Lipinska P., Varekova R., Hroch M., Xaverova Z., Stastny P., Hap, P. and Zmijewski P. (2017) showed that a specially applied pre-season training program caused a number of changes in the observed parameters that indicate the importance of systematic planning of training programs in team sports, aimed at developing muscle strength in certain periods of the annual training cycle in order to improve the performance of technical actions, as well as reduce the risk of injury.

Sattler T., Hadzic V., Dervisevic E. and Markovic G. investigated the influence of the playing position and the level of competition on the quality of performance of such technical parameter as the vertical jump in volleyball players of both sexes, since vertical jump is an important element of successful volleyball practice. The purpose was to study the overall performance of the jump techniques for players of different roles with an assessment of the biomechanical parameters transmitted by technical information media. It was found that male players swing their arms during the game much better than women ($p \leq 0.05$), while using the eccentric part of the jump to improve performance seems to be equally effectively mastered by women and men alike. The results of this study help coaches plan the training process aimed at developing the jumping ability of volleyball players by adjusting the implementation of technical actions. In addition, the presented regulatory data for the jumping heights of highly skilled male and female volleyball players can be useful in selecting and profiling young volleyball players.

Sheppard J., Hobson S., Barker M., Taylor K., Chapman D., McGuigan M. and Newton R. (2008) conducted studies to evaluate the effectiveness of training associated with the use of accentuated jumps with eccentric load, with lowering power characteristics in highly skilled volleyball players. The results of this study show that training with an additional regulated load during the eccentric phase of the oncoming movement jump gives superiority when pushing out compared with the typical training of jumping with obstacles where a large amount of jumping is performed.

Trajkovic N., Kristicevic T. and Baic M. (2016) obtained a number of results on the evaluation of the effect of plyometric training on sports tests in women volleyball players. The study revealed that plyometric and artificial (created by special devices) conditioning led to an improvement in jumping and throwing capabilities. Such training additionally caused positive changes in the anthropometric and sprint abilities of athletes; higher intensity, together with the possibility of more accurate adjustment of the training load in plyometric training, is the most important factor determining the differential effect on the performance of techniques.

Voelzke M., Stutzig N., Thorhauer H.A. and Granacher, U. (2012) conducted a comparison of the effect of short-term training with resistance, aimed at improving technical and tactical actions and the development of explosive

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forces among elite volleyball players. The authors concluded that training with artificial resistance led to a significant improvement in the development of physical qualities, as well as the performance of game actions.

There is an obvious lack of research on the effectiveness of plyometric and artificial conditioning in volleyball. The study by Bahri Gjinovic, Kemal Idrizovic, Ognjen Uljevic and Damir Sekulic evaluated the effects of 12-week training in plyometric and volleyball skills on specific abilities of female volleyball players. The experiment tested two training programs: plyometric and skills-based. Both programs were run twice a week; the results determined that, despite the fact that both training methods caused positive changes in the ability to jump and strike, plyometric training was more effective.

The studies of Yevgeniy Imas, Olga Borysova, Olha Shlonska, Iryna Kogut, Viktoria Marynych and Viktor Kostyukevich (2017) allowed obtaining a number of results to improve the sports skills of high-class volleyball players. Analysis and synthesis of literature data and the experience of leading experts in improvement of sportsmanship of high-class volleyball players showed that technical and tactical training of athletes are the main factors influencing the achievement of high sports results and the definition of the educational process content. Technical and tactical training of highly skilled volleyball players requires further development based on technical means of information.

Marcelino R., Sampaio J. and Mesquita I. (2012) conducted research on attacking actions and evaluating competitive activity in accordance with the match period and the opponent's forces in high-level games.

The results obtained revealed the best attack characteristics at the beginning of the game. Since an attack is a game action most associated with the result, the results found that players, regardless of their level, managed the risk according to their individual attack skills in order to increase their advantage in the score as soon as possible. The advantage belonged to those players who were able to vary their efforts at the maximum risk in the match. On the contrary, ‘weaker’ players did not take such risky decisions, which reduced the effectiveness of technical actions in the attack.

In terms of training sessions, neither the coach nor the athlete is able to quickly process a large amount of information about the various characteristics of the many elements of the movement. Therefore, it is advisable to use technical means that greatly facilitate the creation and processing of such information.

‘Bulky’ technical means that require equipping an athlete with numerous sensors that violate the naturalness of the movements performed are ineffective.

Recently, methods of ultra-urgent current information supplied during the game actions are becoming more common. The use of technical means of urgent information has a very tangible effect in accelerating the learning process, as evidenced by numerous examples from the practice of sports. They allow consciously controlling even such quantitative characteristics of the movement that often remain unconscious in the usual training process [1].

The use of special technical tools in training which provide artificial controlled conditions for the implementation of mastered exercises makes it possible to learn without mistakes and retraining.

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The modern system of training athletes can be considered as a process of targeting a person's neuro-muscular system, which ensures an optimal training effect.

Most coaches and many researchers have a negative attitude to technical devices as one of the means to improve the sportsmanship of athletes, so there are no tasks for developing and designing new technical means of information for sports. Therefore, in the field of sports those funds are mainly used that have arisen in the field of engineering, and the sport itself had a weak influence on the development of technical devices and engineering itself [7].

Improving the technical skills of athletes is a complex managed system, which determines the need for a systematic approach to researching the development of technical tools for urgent information. Methods of urgent information can significantly improve the efficiency of training athletes.

The existing system of sports training of volleyball players can be more effective when using additional reserve capabilities of the body, which determined the search for promising new approaches to organizing the training process, allowing for a more rational use of the kinesiological potential of athletes (V.K. Balsevich, 2000; S.S. Ermakov , 2006; Yu.N. Kleschev, 2008; V.A. Kashirin, 2008, etc.).

IV. RESULTS

Technical and tactical actions of players in volleyball during the serve, as well as the quality of its performance depends on the degree of manifestation and level of development of the target accuracy, which is provided by the contours of feedback and high accuracy of intermuscular and articular coordination. Due to the fact that the accuracy of the direction of the ball is determined by the amplitude of movement (accompanying the ball) with a brief contact of the impacting surfaces (ball and hands), it is necessary to build a methodology for initial training in techniques and further improvement in the performance with these factors in mind.

Evaluation of the technique of floating and power serve in the present study included the following control exercise – hitting for accuracy in various zones, taking into account the speed of the ball. The serve was evaluated in terms of four competitions – two at the initial stage of the study and two at the final stage; each competition evaluated the effectiveness of four games. When calculating the serve in competitive activity, the following indicators were compared: the total number of serves, the number of lost serves, the number of complex serves that were not passed on over to the linking player, the number of serves won (aces). As a result, the number of aces, serves that did not lead to attacks, the easy serves and the unfulfilled serves (to the net and out) was determined.

Comparing the results of the initial and final testing during the floating serve, the following data were obtained: at the beginning of the study (when performing aces) the result was 2.4% while at the end it was 4.2%; the increase was 42.8%. The total number of complex serves at the beginning of the study was 27.6%, at the end – 43.2% (an improvement of 36.1%). The number of easy serves at the initial stage was 45.9%, at the final – 32.4% (an improvement of 29.4%). The total number of errors (net and out) at the beginning of the study was 18.2% and 5.9%; at the final stage, the number decreased by 11.5% and by 30.5%. The final result was 16.1% and 4.1%.

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Approximately the same picture is observed in a comparative analysis of the indicators characterizing the effectiveness of the power serve in competitions. When performing aces, the initial indicator was 1.7%, at the end of the study the indicator was 3.4%, the increase in the result was 50%.

The total number of complex serves at the beginning of the study was 19.4%, at the end – 31.5% (an improvement of 38.4%). The number of easy serves at the initial stage was 36.7%, at the final – 27.4% (an improvement of 25.3%). The total number of errors (net and out) at the beginning of the study was 34.9% and 7.3%; at the final stage it decreased by 7.4% and by 26.0%, so the result was 32.3% and 5.4%.

The measurement of the biomechanical parameters of the serve technique was carried out using a hardware-software complex 'Video analysis – Biosoft 3D' designed for video analysis of movements (flat and three-dimensional methods of locomotion research) [8]. The hardware-software complex allowed determining the following characteristics: the speed of the ball falling after throwing; the speed of the ball after impact; the height of the impact point during a serve; the angle between the vertical axis (over the shoulder of the athlete) and the position of the ball at the moment of impact; the angle between the axis of the net and the body during the takeoff.

The processing system of the images of the floating serve at the initial stage of the study (performed for accuracy) revealed that the average speed of the ball falling when tossing was 3.2 m/s; the speed of the ball after hitting was 32.5 m; the height of the impact point was 252 cm; the angle between the vertical axis and the position of the ball at the moment of impact was 18.7^0; the angle between the net axis and the feet position during the takeoff was 82.5^0; the height of throwing the ball in relation to the horizontal axis laid through the head was 64.8 cm.

The average group parameters of the power serve technique at the initial stage of the study were slightly different from those o f the floating serve: the average speed of the ball falling when tossing was 4.8 m/s; the speed of the ball after hitting was 44.7 m; the height of the impact point was 271.4 cm; the angle between the vertical axis and the position of the ball at the moment of impact was 25.3^0; the angle between the net axis and the feet position during the takeoff was 72.1^0; the height of throwing the ball in relation to the horizontal axis laid through the head was 184.5 cm.

A significant difference between the listed characteristics is observed in the ball's speed after hitting, since the task of the one performing a floating serve is not to hit the ball with maximum force, thereby giving the ball the highest speed, but to give the ball a floating trajectory due to the short duration of the impact of a flat palm hitting the ball. A significant difference is also observed in the angle between the net axis and the position of the feet and the in height of throwing the ball relative to the horizontal axis laid through the athlete's head.

When performing a power serve, a large role is played by the lever 'the forearm - the hand' which gives rotational movement to the ball. This is why during the takeoff when performing a power serve, the running does not allow a straight angle, and the takeoff is smaller than during a floating serve. In order to give the ball the highest speed, it is necessary to use all the levers when hitting: the forearm-hand, forearm-shoulder, shoulder-back; this is possible only with a high throwing of the ball before the takeoff; therefore, the height of throwing the ball in relation to the horizontal axis during power serve is much greater than during a floating one.

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After examining the video and photo materials of the hardware-software complex 'Video Analysis - Biosoft 3D' at the initial stage of the study, as well as indicators characterizing the serve accuracy by zones, the authors of the present study formulated the following conclusions: the main error in performing both the floating and the power serve is throwing the ball and the takeoff when the athlete is located under the falling ball (the vertical axis of the falling ball coincides with the vertical axis passing through the shoulder).

This error leads to a decrease in the angle between the vertical axis laid across the athlete's shoulder and the position of the ball at the moment of impact, which means an increase in the percentage of errors (net and out) or a decrease in the impact force, which reduces the speed of the ball after impact and makes things easier for the opponent.

After evaluating all the errors, the authors proposed a program (special exercises: preparation and techniques) which contributed to the work of the athletes according to an individual plan on the serve method where errors were observed in the technical phases.

The processing system of the floating serve images at the final stage of the study (performed for accuracy) revealed that the average speed of the ball falling when tossing decreased and amounted to 2.7 m/s; the speed of the ball after hitting increased and amounted to 39.5 m; the height of the impact point was 269 cm (due to which the speed of the ball 'from top to bottom' was increased); the angle between the vertical axis and the ball position at the moment of impact was 36.5^0; the angle between the net axis and the feet position during takeoff was 87.4^0; the height of throwing the ball in relation to the horizontal axis laid through the head was 59.2 cm.

The average group parameters of the power serve technique (determined with the help of the aforementioned hardware-software complex) at the final stage of the study were slightly different: the average speed of the ball falling when tossing was 5.4 m/s; the speed of the ball after hitting was 62.8 m; the height of the impact point was 278.5 cm; the angle between the vertical axis and the ball position at the moment of impact was 39.9^0; the angle between the net axis and the feet position during takeoff was 86.3^0; the height of throwing the ball in relation to the horizontal axis laid through the head was 225.7 cm.

V. DISCUSSION

To identify a correlation between the performance of the serve and the biomechanical components (height of the impact point; the angle between the vertical axis laid across the athlete's shoulder and the ball position of the time of impact; the height of throwing the ball in relation to the horizontal axis laid through the head), the rank correlation coefficient was calculated.

According to the data obtained, which characterized the biomechanical components (shown by the hardware-software complex) and the level of technical readiness of the athlete, the correlation coefficient was r = 0.751, which characterizes a significant connection (in volleyball players participating in the experiment) between the floating serve performance indicators in the game and competitive activities and the biomechanical components (the height of the impact point when serving; the angle between a vertical axis laid over the shoulder and the position of the ball at impact; the height of throwing the ball in relation to the horizontal axis laid through the head (the critical value is

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0.631)). When performing a floating serve, in 12 cases out of 23 there was a reliably close relationship between the various indicators of biomechanical parameters and the serve efficiency during the competition.

According to the ranking position of volleyball players (the experiment participants) when performing power serve, the correlation coefficient was also calculated determining the degree of interrelation between the serve efficiency during competitive activity and various biomechanical parameters. When performing a power serve, in 17 cases of 23 there was a reliably close relationship between the various indicators of biomechanical parameters and the serve quality during the competition.

The rank correlation method made it possible to establish that when performing power serve, there is a relationship between performance indicators and biomechanical components (height of the impact point; the angle between the vertical axis laid over the athlete's shoulder and the ball position at the time of impact; the height of throwing the ball in relation to the horizontal axis laid through the head (r = 0.863)) than when performing the floating serve. The indicators analysis revealed that in all three cases, the calculated correlation coefficients are higher than the critical value. Thus, the results of the relationship manifestation can be considered reliable.

The pedagogical experiment revealed that a complex floating serve in the unsupported position is a more stable option for putting the ball into play; however, considering the percentage of a complex serve, there is an advantage for the players performing the power serve in the unsupported position. The urgent information means made it possible to evaluate the biomechanical structure of the serve technique of each player of KBSU national team. Recommendations with a phased assessment of the technique made it possible to develop individual correctional programs to eliminate defects in its performing.

Special exercises, as well as those with special devices, made it possible to eliminate errors, thereby raising the level of technical preparedness of the athletes participating in the experiment, which affected the performance of competitive activities, as recorded in Table 1.

Table 1: The Dynamics of Serve Performance (n=24)

No	Effectiveness indicator	floating serve		power serve		Reliability differences at P < 0,05	
		initial	final	initial	final		
		M ± m		M ± m			
		1	2	3	4	1/2	3/4
1.	Won (aces) (%)	2.4 ± 0.31	4.2 ± 0.38	1.7 ± 0.57	3.4 ± 0.38	< 42.8%	< 50%
2.	Complex (%)	27.6 ± 0.57	43.2 ± 0.19	19.4 ± 0.57	31.5 ± 0.57	< 36.1%	< 38.4%
3.	Easy (%)	45.9 ± 0.34	32.4 ± 0.57	36.7 ± 0.57	27.4 ± 0.57	< 29.4%	< 25.3%
4.	Net (%)	18.2 ± 0.57	16.1 ± 0.38	34.9 ± 0.57	32.3 ± 0.57	< 11.5%	< 7.4%
5.	Out (%)	5.9 ± 0.34	4.1 ± 0.57	7.3 ± 0.57	5.4 ± 0.57	< 30.5%	< 26.0%

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The urgent information tools helped to identify errors in the serve technique of volleyball players participating in the study, which adversely affected the efficiency of implementation of this technique in competitive activities.

Purposeful individual program aimed at improving the biomechanical parameters of the serve technique in phases helped eliminate the main mistakes during the performance, as well as errors in the takeoff and hitting movements. A comparative analysis of indicators characterizing the accuracy of hitting during the power and floating serves by zones found an improvement in the number of attempts at the target. There is a decrease in errors (net and out).

The results of the final testing confirmed the effectiveness of a focused program for eliminating the serving technique errors of volleyball players – participants in the experiment.

VI. CONCLUSION

A major role in the training of athletes belongs to the technical means of urgent information in the training process, which allows speeding it up; this is confirmed by numerous studies.

Using urgent information means in the preparation of volleyball players made it possible to evaluate the biomechanical structure of the serve technique. Recommendations with a phased assessment of the technique made it possible to develop individual correctional programs to eliminate errors.

Thanks to these means of urgent information, the authors of the present study were able to identify errors in the serve technique that adversely affected the effectiveness of its implementation in competitive activity. The correctional program, which includes preparatory and technical exercises, helped eliminate those errors (the players participating in the experiment) and improve the serve performance indicators during games and competitions.

The advantage of the hardware-software complex ‘Video analysis - Biosoft 3D’ is the absence of test devices on the body that restrict freedom of movement. Due to this, the possibility of distortion of natural motor activity is excluded.

Thanks to this complex, it is possible to conduct a comprehensive contactless study of the motor activity of the subject, primarily, the kinematics of locomotions (articular and linear kinematic profiles). Functional electromyography in the process of locomotion with the study of intermuscular interaction and synergy of the motor act successfully complements the diagnostic, expert and prognostic perspectives of computer video analysis of movements.

The use of technical means of urgent information, namely the hardware-software complex ‘Video analysis - Biosoft 3D’ in the process of learning and improving the serve technique provided artificially controlled conditions for performing the exercises. These means will allow coaches to conduct the learning process without retraining and with timely correction of errors.

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