Improving the effectiveness of technical and tactical actions of volleyball players at the stage of sports improvement

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Abstract

Objective of the study is to develop and experimentally substantiate a methodology for optimizing the technical and tactical skills of the libero in the defensive phase at the stage of high sports mastery.

Methods and structure of the study. The experimental study was conducted at the National State University of Physical Education, Sport and Health named after P. F. Lesgaft in St. Petersburg. The sample included 46 male volleyball players aged 18 to 25, with qualifications ranging from 1st category to master of sports. The participants were divided into two equal groups: a control group and an experimental group, each consisting of 23 players. The pedagogical experiment lasted for 36 weeks and involved a strictly structured distribution of training loads across key areas. The main focus was on developing anticipatory abilities (15% of the total workload), special coordination training (20%), and modeling game situations (30%). These components ensured the comprehensive development of defensive skills in competitive environments.

Results and conclusions. Mathematical and statistical processing of the experimental results confirmed the effectiveness of the proposed methodology. The experimental group's performance significantly exceeded that of the control group ($p<0.05$). In particular, the level of tactical awareness increased by 18.2%, the effectiveness of receiving an attacking shot increased by 14.7%, and the success rate of receiving a serve increased by 9.3%. The most noticeable changes occurred in the anticipation of the spatial and temporal parameters of the ball's movement, which increased by 2.8 times compared to the control group, representing a 22.3% increase.

These findings highlight the crucial role of perceptual and cognitive indicators in the initial stages of training. Their accelerated development provides a solid foundation for improving the technical and tactical skills of volleyball players. The obtained results suggest that the proposed approach can be widely applied in the training process of athletes aiming to achieve high athletic performance.

Keywords: *volleyball, libero, technical and tactical actions, defensive actions, the stage of sports improvement, anticipation.*

Introduction. Modern volleyball is characterized by a significant increase in the speed of play in competitive activities. This has led to an increase in the importance of the libero position, which was introduced by the International Volleyball Federation (FIVB) in 1998. The libero is a key element of the defensive line, ensuring the effectiveness of the team's defensive strategies. A comprehensive analysis of competitive activities in international volleyball tournaments, taking into account the dynamics of interaction between key players and team members, reveals a significant gap in the effectiveness of receiving the ball. This gap manifests itself in significant differences in the tactical and technical characteristics of players, which has a significant impact on the overall performance of teams [3]. This aspect indicates a significant potential for improving the level of sports performance at the professional training stage through the optimization of technical and tactical strategies specific to the libero position.

Currently, the scientific and methodological framework for training liberos at the sports improvement stage is fragmented, which leads to a decrease in the importance of cognitive processes such as anticipation and tactical thinking.

Objective of the study is to develop and experimentally substantiate a methodology for optimizing the technical and tactical skills of the libero in the defensive phase at the stage of high sports mastery.

Methods and structure of the study. The methodological basis of this study was based on the principles of a randomized controlled experiment aimed at evaluating the pedagogical intervention through the implementation of the author's training methodology. The experimental intervention was conducted for 36 weeks, from September 2024 to May 2025. The study involved 46 male volleyball players, with an age range of 18 to 25 years and an average sports experience of 8.7 ± 1.9 years. The participants' level of sports qualification was as follows: first category – 39.1%, candidates for master of sports – 43.5%, masters of sports – 17.4%. The inclusion criteria were the role of a libero, the absence of injuries, the regularity of training activities, and the voluntary consent to participate in the pedagogical experiment. The exclusion criteria were chronic diseases that hindered the training process, as well as missing more than 15% of the total number of planned training sessions.

The distribution of participants into experimental and control groups was carried out by the method of stratified randomization. To ensure the homogeneity of groups, the Mann-Whitney U test was used, which demonstrated the absence of statistically significant differences between groups ($p > 0.05$).

The main research method was structured observation, the objectivity of which was confirmed by a high Kappa Cohen score of 0.83 of the expert assessments. The assessment of students' readiness level was carried out through testing aimed at determining the effectiveness of the execution of a strike/serve, the ability to anticipate the trajectory of a strike, tactical literacy (expert assessment), as well as the analysis of movement time and reaction time. The monitoring included the implementation of these tests and video analysis using the Kinovea software. A significant characteristic of the diagnostic complex was the inclusion of subjective assessments of volleyball players as a component of monitoring their readiness to perform defensive actions. Statistical data processing was carried out using IBM SPSS Statistics software version 26, including the Shapiro-Wilk, Mann-Whitney, Student's t-test, and Wilcoxon tests ($p<0.05$), as well as the calculation of the effect size using Cohen's d. The experimental group, which followed the author's method, conducted training sessions for six weeks at ninety minutes each, while the control group followed the traditional method.

The author's methodology combines five priority components:

1. Development of anticipatory abilities (15%): implementation of a set of exercises aimed at identifying the kinematic characteristics of attacking actions, as well as performing exercises in conditions of limited visibility.

2. Situational modeling based on the analysis of Super League matches (30% of the time): development and testing of 12 typical game situations characterized by dynamic complexity, including parameters of speed, number of attacking players, force of impact, and blocking.

3. Weekly video analysis (10% of the time), including analysis of your own mistakes and analysis of examples of the game played by highly qualified specialists.

4. Special coordination training (20% of the time) includes exercises aimed at developing reaction speed, spatial orientation, kinesthetic differentiation, and movement adaptability [1].

5. Technical and tactical training (25% of the time) is aimed at improving the skills of receiving the ball, with a special focus on increasing the accuracy of technical elements. Attention is also paid to the details of tactical schemes for player interaction on the playing field [4].

The training process in the experimental group was structured according to the methodology of complification, which includes a weekly detailed analysis based on monitoring data.

Results of the study and discussion. The initial homogeneity of the groups was established by the absence of statistically significant differences at the pre-testing stage ($p > 0.05$ using the Mann-Whitney U test). Although there was a general positive trend at the end of the 36-week study, the experimental group showed a more significant increase in performance.

The results of the study demonstrate a positive trend in the performance of defensive actions in both study groups. However, the most significant improvement in the technique of receiving an attacking blow was observed in the experimental group (EG). In this group, the effectiveness increased by 14.7% (from the initial 42.1% to the final 48.3%, which is confirmed by the d=0.89 value, indicating a high level of statistical significance). In the control group (CG), the increase was 10.8% (from 41.8% to 46.3%; d value =

0.52, which corresponds to a moderate effect). The increase in efficiency in the experimental group can be explained by the synergistic interaction between anticipation processes and technical skills. This phenomenon allows players to optimize their movement patterns and, as a result, achieve more accurate ball passes. Thus, the obtained results confirm the hypothesis that the purposeful development of anticipatory abilities, combined with the improvement of technical skills, can significantly increase the level of sports training and the performance of players [2].

Within the experimental group, the quantitative indicators of the effectiveness of receiving the serve demonstrated a less pronounced increase (9.3%) compared to the reception of the attacking shot. This is due to the higher initial level (54.2%) and the lower difficulty of performing this element. Despite this, the intergroup differences remain statistically significant ($p < 0.05$). The effect size in the experimental group ($d = 0.78$) exceeds the result in the control group ($d = 0.41$).

The most significant contrast is observed in the anticipation of the direction of the blow. In the experimental group, the increase was 22.3% (from 47.9% to 58.6%), with a d value of 1.12, which is classified as large. In the control group, the increase was only 7.9% (from 48.3% to 52.1%).

The high results in the experimental group are due to the integration of targeted work on recognizing the kinematic features of attacking actions and the use of video analysis technologies into the training process. In the receiving of an attacking blow, the experimental group showed an increase of 14.7% ($d = 0.89$) compared to 10.8% in the control group. This is due to the synthesis of improved anticipation and movement techniques. In the receiving of the feed, the dynamics in the experimental group was 9.3% ($d = 0.78$), which also exceeds the results of the control group ($d = 0.41$); less pronounced progress is associated with a high base level of training and a smaller dependence of the element on anticipation. The greatest growth was recorded in anticipation of the direction of the blow: 22.3% in the experimental group ($d = 1.12$ - a very large effect) against 7.9% in the control group. This result was achieved through video analysis and cognitive exercises aimed at developing perceptual skills.

The growth rates of key indicators varied. First of all, perceptual-cognitive metrics improved, and tactics and shot reception developed linearly. The process of mastering the reception of a serve after a long latent period demonstrated a noticeable acceleration. In a real match, the libero of the experimental group showed an average of 4.7 successful defensive actions per set, which significantly exceeded the results of the control group.

Conclusions. The results of the pedagogical experiment indicate that the traditional algorithm for training players in the libero position provides only a moderate positive change in performance, ranging from 5% to 10%. At the same time, the developed integrated approach showed a statistically significant improvement in all the studied parameters with a high effect size.

Table 1. Dynamics of indicators of technical and tactical preparedness of volleyball players of the control and experimental groups (M ± SD)

Indicator	CG/EG	Before the experiment	After the experiment	Growth (%)	p intra-group	d Cohen
Effectiveness of the offensive stroke (%)	CG	41,8 ± 5,2	46,3 ± 5,0	+10,8	<0,05	0,52
	EG	42,1 ± 5,4	48,3 ± 4,6	+14,7	<0,01	0,89
Feed Reception Efficiency (%)	CG	54,6 ± 4,8	57,4 ± 4,5	+5,1	<0,05	0,41
	EG	54,2 ± 5,1	59,3 ± 4,2	+9,3	<0,01	0,78
Anticipation of the direction of the blow (% of correct answers)	CG	48,3 ± 6,7	52,1 ± 6,4	+7,9	<0,05	0,38
	EG	47,9 ± 7,0	58,6 ± 5,8	+22,3	<0,01	1,12
Tactical literacy (points, max. 5.0)	CG	3,21 ± 0,42	3,47 ± 0,39	+8,1	<0,05	0,44
	EG	3,18 ± 0,45	3,76 ± 0,35	+18,2	<0,01	0,98
Movement speed in the defensive stance, herringbone (s)	CG	8,64 ± 0,38	8,47 ± 0,35	-2,0	>0,05	0,31
	EG	8,61 ± 0,41	8,18 ± 0,33	-5,0	<0,01	0,82
Motor Response Time of Choice (ms)	CG	312 ± 28	298 ± 26	-4,5	<0,05	0,36
	EG	315 ± 30	279 ± 23	-11,4	<0,01	0,95

In the experimental group, where the author's methodology was tested, the effectiveness of receiving an attacking shot increased by 14.7%, and the serve improved by 9.3%. It is especially worth noting the pronounced dynamics of the development of tactical literacy, which increased by 18.2%, and anticipation, which increased by 22.3%. The most significant results were achieved in the field of anticipation and tactical skills, which confirms the dominant role of the cognitive component in the structure of the professionally significant qualities of the libero at the stage of sports improvement.

At the initial stages of training, there is an accelerated development of perceptual and cognitive indicators, which serves as a basis for technical and tactical improvement. This pattern is of key importance in planning training cycles aimed at the formation of integrative skills. Video analysis of competitive activity has confirmed its effectiveness in developing tactical thinking and reducing the number of technical errors in volleyball players. The implementation of the proposed methodology allowed to adapt the training process to the conditions of competitive activity, as a result of which the players of the experimental group demonstrated an increased level of efficiency of defensive actions.

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