Improving the effectiveness of serves by elite volleyball players through the differentiation of muscular effort

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Abstract

Objective of the study is to improve the effectiveness of the serve among elite volleyball players by developing their ability to precisely modulate muscle effort through the use of specialised exercise programmes.

Methods and structure of the study. Serve performance indicators were assessed based on competition data: for the main team 'Dynamo-LO' – in the Russian Men's Volleyball Championship, and for the reserve team 'Dynamo-LO-2' – in the Russian Youth League. Parameters characterising technique, situational conditions and the direction of serves among skilled volleyball players were analysed. 10 matches involving leading teams were analysed using the professional software Data Volley 4Pro. The athletes' baseline fitness level was determined through pedagogical testing. The ability to differentiate muscle effort was assessed using a DK-140 hand dynamometer, which allowed for the measurement of the accuracy of reproducing specified force levels (25%, 50%, 75% of maximum effort). The experimental part included specialised exercise blocks aimed at developing upper body strength and force discrimination sensitivity. 24 qualified volleyball players took part in the study.

Results and conclusions. It was established that the qualified volleyball players of the 'Dynamo-LO 2' team perform a placement serve more frequently than a power serve during competitive play. The performance indicators of the skilled volleyball players from the 'Dynamo-LO-2' team show statistically significant differences from those of the players from the 'Dynamo-LO' team across all six analysed characteristics. It was found that it is advisable to identify four narrowly focused sets of exercises for developing the ability to differentiate muscle effort (using TRX loops, resistance bands, medicine balls and volleyballs). Among the skilled volleyball players of the 'Dynamo-LO-2' team, a positive trend was observed in the number of placement and power serves, the effectiveness of their execution, and a reduction in the number of errors during their execution.

Keywords: *muscle effort, volleyball, performance, blocking exercises.*

Introduction. When serving, the ability to differentiate between levels of force determines the quality of the force applied and the accuracy of the strike on the ball [2]. The ability to distinguish spatial parameters is a factor in the accuracy and appropriateness of an athlete's movements in all team sports [1]. This ability is developed through specialised training and correlates directly with the athlete's level of skill [4]. The effectiveness of competitive performance depends directly on the athlete's developed ability to control the parameters of time, space and muscular effort [3, 5].

Experimental, narrowly focused sets of tasks ensure the simultaneous development of strength qualities and the ability to differentiate muscle effort, which has a positive effect on the accuracy and effectiveness of the serve. These indicators of increased effectiveness can serve as benchmarks for structuring the training process.

Objective of the study is to improve the effectiveness of the serve among elite volleyball players by developing their ability to precisely modulate muscle effort through the use of specialised exercise programmes.

Methods and structure of the study. Serving performance indicators were assessed based on competition data: for the first team, 'Dynamo-LO',

in the Russian Men's Volleyball Championship; and for the reserve team, 'Dynamo-LO-2', in the Russian Youth League. Parameters characterising technique, situational conditions and the direction of serves among skilled volleyball players were analysed. 10 matches involving leading teams were analysed using the professional software Data Volley 4Pro. The athletes' baseline level of fitness was determined through pedagogical testing. The ability to differentiate muscle effort was assessed using a DK-140 hand dynamometer, which allowed for the measurement of the accuracy of reproducing specified force levels (25%, 50%, 75% of maximum effort). The experimental part included specialised exercise blocks aimed at developing upper body strength and force discrimination sensitivity. 24 qualified volleyball players took part in the study.

Results of the study and discussion. Table 1 provides a clear overview of the performance metrics for serving between the two volleyball teams.

It has been established that highly skilled volleyball players, regardless of the type of serve they use, execute it with greater effectiveness. The performance metrics of the 'Dynamo-LO' team show statistically significant differences in all six metrics compared to those of the 'Dynamo-LO-2' team.

During the testing (Table 2), baseline indicators of muscle effort differentiation were determined across the volleyball groups, revealing significant differences between the two teams.

We then devised four specialised sets of exercises to develop the ability to differentiate muscle effort (using TRX straps, resistance bands, medicine balls and volleyballs). The load was adjusted by changing the length of the TRX straps, the resistance of the elastic bands, the angle of effort, grip variations, the number of repetitions and sets, and the duration of ball exercises.

The training programme included two exercises from blocks 2, 3 and 4, with 30 minutes allocated to this in the main part of the session. Exercises to develop dynamic strength in the arm muscles (Block 1), lasting 10 minutes, were performed at the end of the main part or at the start of the final part of the session. The indicators of muscle effort differentiation in the volleyball players following the experiment are presented in Table 3.

Table 1. Serving performance of volleyball players in the descriptive experiment

Indicator	Team (X±Sx)	
	Dynamo-LO	Dynamo-LO-2
Number of planned digs	20,22±36,7	75,4±58,08
Conclusion on the difference	p≤0,05	
Number of errors during dig planning	1,4±2,55	5,6±6,5
Conclusion on the difference	p≤0,05	
Effectiveness on planned digs (%)	41,5±31,29	36,85±9,5
Conclusion on the difference	p≤ 0,05	
Number of power digs	80,33±60,5	47,2± 46,5
Conclusion on the difference	p≤ 0,05	
Number of errors during power dig planning	16±12,1	17,6±15,3
Conclusion on the difference	p≤ 0,05	
Effectiveness on planned power digs	38,25±12,8	33,1±10,2
Conclusion on the difference	p≤ 0,05	

Table 2. Indicators of muscle effort differentiation in groups of volleyball players

Indicator	Results (X±Sx)		Student's t-test	P-value	Conclusion regarding differences
	Dynamo-LO	Dynamo-LO-2			
Max. strength (kg)	53,0±7,44	49,92±7,4	2,4	0,004	p≤0,05
Max. strength with eyes closed (kg)	51,6±6,8	46,4±8,9	2,6	0,001	p≤0,05
25% of max. strength	25,58±8,4	19,6±4,8	2,3	0,002	p≤0,05
50% of max. strength	31,5±11,4	27,8±5,95	2,2	0,007	p≤0,05
75% of max. strength	40,5±7,5	37,08±5,74	2,3	0,003	p≤0,05

Table 3. Indicators of muscle effort differentiation during the experiment

Indicator	Period	Results (X±Sx)		Student's t-test	P-value	Conclusion regarding differences
		EG				
		X	Sx			
Max. strength (kg)	Before the experiment	49,92	7,40	-0,9	0,037	p≤0,05
	After the experiment	52,5	6,40			
	Difference	+2,58	-1			
Max. strength with eyes closed (kg)	Before the experiment	46,4	8,9	-0,78	0,043	p≤0,05
	After the experiment	49,08	7,75			
	Difference	+2,68	-1,15			
25% of max. strength	Before the experiment	19,6	4,8	0,84	0,04	p≤0,05
	After the experiment	18,25	3,25			
	Difference	-1,35	-1,55			
50% of max. strength	Before the experiment	27,8	5,95	0,76	0,045	p≤0,05
	After the experiment	26,33	3,20			
	Difference	-1,47	-2,75			
75% of max. strength	Before the experiment	37,08	5,74	-0,65	0,041	p≤0,05
	After the experiment	38,41	4,07			
	Difference	+1,33	-1,67			

Table 4. Group performance (EG) before and after the experiment

Indicator	Team (X±Sx)	
	EG before	EG after
Number of planned digs	75,4±58,08	87,57±32,96
Conclusion on the difference	p≤0,05	
Number of errors during dig planning	5,6±6,5	6,57±3,4
Conclusion on the difference	p≤0,05	
Effectiveness on planned digs (%)	36,85±9,5	46,85±7,88
Conclusion on the difference	p≤ 0,05	
Number of power digs	47,2± 46,5	48,0± 44,49
Conclusion on the difference	p≤ 0,05	
Number of errors during power dig planning	17,6±15,3	13,8±11,19
Conclusion on the difference	p≤ 0,05	
Effectiveness on planned power digs	33,1±10,2	46,9±7,34
Conclusion on the difference	p≤ 0,05	

The indicators of changes in discriminative sensitivity point to statistically significant positive changes, which confirm the effectiveness of the exercise programmes in the training process.

A comparison was made of the final indicators of serving effectiveness in the experimental group (Table 4).

It has been established that the effectiveness of both the planned serve and the jump serve has increased significantly. The number of errors on the jump serve has also decreased.

Conclusions. It has been established that the experienced volleyball players of the 'Dynamo-LO-2' team use the placement serve more frequently than the power serve during matches. The performance indicators of the skilled volleyball players of the 'Dynamo-LO-2' team show statistically significant differences from those of the players of the 'Dynamo-LO' team in all six characteristics analysed.

It has been determined that the dynamometric indicators at 75% of maximum force, relative to the calculated values, show the smallest deviations in both

teams. The task of exerting 55% of maximum force appears to be difficult. The task of exerting 25% of maximum force appears to be the most difficult for the athletes. Deviations in dynamometer readings at 25% of maximum force are greatest in the two teams.

It has been found that it is appropriate to identify four specialised sets of exercises for developing the ability to differentiate muscle effort (using TRX loops, resistance bands, medicine balls and volleyballs). It was established that an increase in maximum hand muscle strength is accompanied by changes in the indicators of muscle effort differentiation at 25%, 50% and 75%.

Among the skilled volleyball players of the 'Dynamo-LO-2' team, a positive trend was observed in the number of float serves and power serves, the effectiveness of their execution, and a reduction in the number of errors during their execution.

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