UPPER LIMBS PHYSICAL FITNESS TRAINING IN VOLLEYBALL PLAYERS

TREINAMENTO DE APTIDÃO FÍSICA DE MEMBROS SUPERIORES EM JOGADORES DE VOLEIBOL

ENTRENAMIENTO DE APTITUD FÍSICA DE LOS MIEMBROS SUPERIORES EN JUGADORES DE VOLEIBOL

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ABSTRACT

Introduction: Dedicated fitness training has greatly influenced many qualities required of volleyball players, but specific upper limb training is still poorly documented. Objective: Study the impacts of fitness training on upper limb strength and functional impacts during volleyball players' ball throws. Methods: Twenty volleyball students were randomly divided into experimental and control groups for a six-week experiment. The experimental group mainly performed a training protocol involving ball throws while the control group continued with traditional training methods. The data regarding functional kinematics and fitness performance were collected and statistically compared. Results: In the experimental group, shoulder flexor strength evidenced an increase from 0.41±0.19 J/kg to 1.29±0.19 J/kg; elbow flexor strength elevated from 0.38±0.23 J/kg to 1.61±0.02 J/kg. On the specific functional performance, the peak score increased from 4.84±1.44 to 7.47±1.43; The overall score increased from 9.05±1.70 to 13.31±1.72. It was noted that the rate of increase of each index was more significant than that of the control group. Conclusion: Dedicated fitness training can improve the upper limb strength and hitting effect of volleyball players, and its combination with special strength training is recommended to improve the overall skills of athletes. *Level of evidence II; Therapeutic studies - investiga-tion of treatment outcomes.*

Keywords: Volleyball; Physical Education and Training; Upper Extremity; Physical Fitness.

RESUMO

Introdução: O treinamento dedicado de aptidão física tem mostrado grande influência sobre muitas qualidades requisitadas aos jogadores de voleibol, porém o treinamento específico em membros superiores ainda é pouco documentado. Objetivo: Estudar os impactos do treinamento de aptidão física sobre a força dos membros superiores e os impactos funcionais durante os arremessos de bola dos jogadores de voleibol. Métodos: Vinte estudantes de voleibol foram divididos aleatoriamente em grupo experimental e controle para uma experiência de 6 semanas. O grupo experimental realizou principalmente um protocolo de treinamento envolvendo arremessos de bola enquanto o grupo de controle prosseguiu com os métodos tradicionais de treinamento. Dados referentes a cinemática funcional e desempenho de aptidão física foram coletados e comparados estatisticamente. Resultados: No grupo experimental, a força do flexor do ombro evidenciou um aumento de 0,41±0,19 J/kg para 1,29±0,19 J/kg; a força do flexor do cotovelo elevou-se de 0,38±0,23 J/kg para 1,61±0,02 J/kg. Sobre o desempenho funcional específico, a pontuação do pico aumentou de 4,84±1,44 para 7,47±1,43; A pontuação geral aumentou de 9,05±1,70 para $13,31\pm1,72$. Notou-se que a taxa de aumento de cada índice foi mais significativa do que a do grupo de controle. Conclusão: O treinamento dedicado de aptidão física pode melhorar a força dos membros superiores e o efeito de acertos dos jogadores de vôlei, sendo recomendada a sua combinação com o treinamento especial de força para melhorar as habilidades gerais dos atletas. Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.

Descritores: Voleibol; Educação Física e Treinamento; Membros Superiores; Aptidão Física.

RESUMEN

Introducción: El entrenamiento físico específico ha demostrado una gran influencia en muchas cualidades exigidas a los jugadores de voleibol, pero el entrenamiento específico de extremidades superiores está aún poco documentado. Objetivo: Estudiar las repercusiones del entrenamiento físico en la fuerza de los miembros superiores y los impactos funcionales durante los lanzamientos de balón de los jugadores de voleibol. Métodos: Veinte estudiantes de voleibol fueron divididos aleatoriamente en grupo experimental y de control para un experimento de 6 semanas. El grupo experimental realizó principalmente un protocolo de entrenamiento tradicionales. Se recogieron y compararon estadísticamente los datos relativos a la cinemática funcional y el rendimiento físico. Resultados: En el grupo experimental, la fuerza flexora del hombro evidenció un aumento de 0,41±0,19 J/kg a 1,29±0,19 J/kg; la fuerza flexora del codo se elevó de 0,38±0,23 J/kg a 1,61±0,02 J/kg. Respecto al rendimiento funcional específico, la puntuación máxima aumentó de 4,84±1,44 a 7,47±1,43; la puntuación global aumentó de 9,05±1,70 a 13,31±1,72. Se observó que el índice de aumento de cada índice fue más significativo que el del grupo de control. Conclusión: El entrenamiento físico dedicado puede mejorar la fuerza de las extremidades superiores y el efecto de golpeo de





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los jugadores de voleibol, y se recomienda su combinación con un entrenamiento especial de fuerza para mejorar las habilidades generales de los atletas. **Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.**

Descriptores: Voleibol; Educación y Entrenamiento Físico; Extremidades Superiores; Aptitud Física.

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INTRODUCTION

The stability of hitting is one of the basic requirements in volleyball. Players need good physical ability and the ability to control the ball to achieve basic hitting success.¹ The higher the player's level is, the smaller the score gap is, the longer the game will be and the higher the physical requirements for the player will be.² At this time, it is easy to hit the ball off the net or the ball flies out of the line. The slightest deviation in hitting will lead to more mistakes and higher loss rate.³ Therefore, players should not only learn different ways of hitting the ball, but also strengthen the hitting skills, including the height of the service point, the swing force of the hitting arm, the shape of the hand when hitting the ball, and the ability to control the opposite arm and body. Only in this way can we have a greater chance to send high-guality balls.⁴ The accuracy and coordination of hitting action depend on the integrity of technical action on the one hand, and the strength connection between muscles and the ability of nerves to accurately regulate muscles on the other hand.⁵ Its coordination has a great relationship with the stretching ability. If the muscle development is not balanced, it is very easy to have twisting throwing action and muscle damage. The upper limb strength of athletes is particularly important.⁶ Therefore, through the relevant research on volleyball training, this paper further summarizes the importance of batting training in improving volleyball players' upper limb strength and batting effect.

METHOD

Experimental object

Through the methods of literature collection and actual interview, this experiment finally selected 20 sophomore volleyball students in a college of physical education through guestionnaires. The study and all the participants were reviewed and approved by Ethics Committee of Chongqing Normal University (NO.CQNU-PT20N018). Twenty students were randomly divided into experimental group and control group. Through the comparison of basic information, it is determined that there is no significant difference between the physical fitness and other basic indicators of the two groups of students before the start of the experiment, and the volleyball training years are between 5-6 years, and there is no significant difference between the professional level of volleyball. There were no other relevant training courses except during the experiment to avoid the influence of irrelevant variables. The students were in good physical condition and had no injuries or other basic diseases recently, meeting the basic requirements of experimental training. Before the experiment officially started, the 20 students were explained, signed a letter of understanding on the basis of fully understanding the relevant training content and purpose of the experiment, and ensured that there were no unexcused absence, late arrival and early leave during the experiment that would affect the overall experimental training results.

Design and implementation of experiment

Before the experiment, the students were randomly divided into experimental group and control group. The experiment lasted for 6 weeks. The training frequency of the two groups of athletes remained the same, three times a week, 80 minutes each time. Besides the formal training, the rest of the preparation activities are the same as the stretching activities, without additional related training. The formal training time in each training process is 60 minutes, including basic physical training, volleyball skill training and confrontation training. The difference between the two groups is that the experimental group mainly conducts hitting training while the control group does not change the traditional volleyball training methods according to the previous training plan.

The batting training of the experimental group mainly includes the empty hand swing exercise at the core starting point, the upward throwing and spiking exercise for training spatial perception, the service exercise for training stability, and the cushion exercise for training arm control. The students are required to master the correct hitting movements as much as possible, understand the essentials of the movements and use them skillfully.

In order to minimize the influence of independent variables during the experiment, the training ground and training time of the two groups were conducted in the volleyball court of the school gymnasium. After each class, the relevant indicators of the athletes should be measured. In addition, the living habits of the two groups of athletes remained relatively consistent. Ensure adequate sleep and rest time after training and class.

Experimental indicators

According to the purpose of the experiment, the main indicators of the test after the experiment include the relative total skill of the upper limb joints, the physical fitness of the players and the hitting effect. The test was conducted 24 hours after 6 weeks of training.

The relative total attack of upper limb joints was tested by the method of collecting EMG signals during exercise. The muscle groups of four parts, namely, shoulder flexor, shoulder extensor, elbow flexor and elbow extensor, were mainly selected for measurement. Before the test, athletes are required to prepare for about 20 minutes to avoid muscle strain during measurement. During the measurement, the EMG signal acquisition device should be fixed at a suitable position on the athlete's back for offline testing. Measure and record the data when selecting the spike swing action. Each indicator is recorded 3 times respectively, and the maximum value is taken. During the exercise, the interval between each measurement should be 1-2 minutes to avoid muscle fatigue.

The test of batting effect mainly includes four indicators, namely, spiking within the boundary, overhand service rate and expert skill score. It is used to measure the changes of players' hitting accuracy and volleyball skill level indicators after training. The measurement of athletes before and after the experiment is evaluated and recorded by the same experts and staff to avoid errors.

RESULTS

The improvement of upper limb strength of volleyball players by batting training

The change of relative total work of upper limb joints can reflect the characteristics of athletes' power generation during sports. After six weeks of training, first of all, statistical analysis was made on the effect of hitting training on the volleyball players' relative total skill of upper limb joints. The results are shown in Table 1.

Fable 1. The improvement of volleyball players' relative total skill of upper limb joi	int
by batting training.	

Control group							
Muscle group	Before experiment	After experiment	Rate of change	Ρ			
Shoulder flexor (J/kg)	0.405±0.1995	0.780±0.1985	48.0809%	0.0333			
Shoulder extensor (J/kg)	1.518±0.1688	1.786±0.2547	15.0002%	0.0128			
Elbow flexor (J/kg)	0.893±0.1383	1.519±0.1197	41.1765%	0.0303			
Elbow extensor (J/kg)	2.203±0.2329	2.608±0.1317	15.5489%	0.0275			
Experience group							
Muscle group	Before experiment	After experiment	Rate of change	Ρ			
Shoulder flexor (J/kg)	0.415±0.1995	1.294±0.1985	67.9072%	0.0210			
Shoulder extensor (J/kg)	1.538±0.1985	2.225±0.4584	30.8556%	0.0144			
Elbow flexor (J/kg)	0.387±0.2370	1.618±0.0200	76.0736%	0.0329			
Elbow extensor (J/kg)	2.203±0.2431	2.975±0.1418	25.9607%	0.0305			

The data in Table 1 shows that after the experimental training, the relative total work index of upper limb joints in the experimental group and the control group changes significantly (P<0.05), and the change rate is high. However, the change rate of the control group was significantly lower than that of the experimental group. Table 1 shows that after a period of experimental training, the upper limb strength of the two groups of athletes has been improved to varying degrees. But compared with the control group, the upper limb muscle strength of the experimental group athletes increased more rapidly. This shows that the experimental group uses more force when hitting the ball, which will improve the stability of hitting to a certain extent.

The improvement of volleyball players' physical quality by batting training

In order to further study the impact of batting training on the overall quality of volleyball players, a comparative analysis of the five indicators of the physical quality of the tested players was carried out. The results are shown in Table 2.

It can be seen from the data in Table 2 that after six weeks of experimental training, except for the volleyball throw distance indicators of the control group, the physical quality indicators of the two groups have relatively significant changes compared with those before training (P<0.05). In the experimental group, the two indexes of volleyball throw and push ups changed significantly (P<0.01). In contrast, except for the three indicators of badminton throw, pull up and rope skipping, the change rate of the experimental group and the control group is not much different, the experimental group has significantly improved on the two indicators of volleyball throw and push up. And the overall results of the five indicators of the experimental group are due to the control group. Because badminton throw far, volleyball throw far, push up and pull up are all greatly affected by upper limb strength, the improvement of the experimental group's performance further proves that hitting training has a more obvious effect on volleyball players' upper limb strength than general training.

Training of hitting effect on volleyball players

The hitting standard test is an important means to reflect the training results of experimental objects. After six weeks of experimental training, two professional volleyball coaches were invited to conduct technical evaluation on the standard test of spiking and serving of the two groups. The results are shown in Table 3.

The data in Table 3 intuitively shows that after six weeks of experimental training, the athletes in the experimental group have a large change rate in the four indicators of hitting effect, which has a significant Table 2. The improvement of volleyball players' physical quality by batting training.

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Control group						
Option	Before experiment	After experiment	Rate of change	Р		
Badminton throw (m)	6.773±1.4609	7.045±1.4371	3.8550%	0.0298		
Volleyball throwing distance (m)	10.887±2.0652	10.772±2.4867	-1.0735%	0.7335		
Push ups (pcs.)	18.270±6.5110	19.455±5.8039	6.0919%	0.0168		
Pull up (piece)	8.173±3.2672	8.733±3.4589	7.5275%	0.0851		
Rope skipping (piece)	118.290±28.4355	122.762±27.0196	3.6422%	0.3731		
	Experience group					
Option	Before experiment	After experiment	Rate of change	Р		
Badminton throw (m)	7.271±2.0273	7.548±1.7551	3.6708%	0.2363		
Volleyball throwing distance (m)	10.144±1.6901	10.910±2.5373	7.0212%	0.0010		
Push ups (pcs.)	18.643±6.9120	20.951±5.5859	11.0150%	0.0020		
Pull up (piece)	9.198±3.4500	9.728±3.1038	5.4490%	0.1043		
Rope skipping (piece)	119.772±28.7646	125.920±23.3352	4.8824%	0.3312		

Table 3. Trainin	g of hitting	effect on	volleyball	players.

Control group					
Option	Before experiment	After experiment	Rate of change	Р	
Spiking ball	4.669±1.1872	5.146±1.1813	9.2686%	0.0266	
Expert skill score	57.499±9.1326	66.276±9.3727	13.2424%	0.0078	
Overhand service rate	8.904±1.5842	10.768±1.6003	17.3104%	0.0386	
Expert skill score	53.779±6.0190	66.587±6.1100	19.2345%	0.0301	
Experience group					
Option	Before experiment	After experiment	Rate of change	Р	
Spiking ball	4.841±1.4466	7.477±1.4394	35.2520%	0.0285	
Expert skill score	60.983±6.6708	80.024±6.8461	23.7933%	0.0077	
Overhand service rate	9.053±1.7087	13.315±1.7260	32.0088%	0.0362	
Expert skill score	52.791±6.4041	79.321±6.5010	33.4461%	0.0372	

change compared with that before the experiment (P<0.05), among which the expert skill score indicators of spiking have a very significant change (P<0.01). Table 3 proves that batting training is helpful for volleyball players to improve their batting professional skills, especially in the two indicators of spiking and overhand service. At the same time, the traditional volleyball training will also help to improve the overall hitting skills, but the effect is relatively slower, so it is necessary to assist the hitting training in actual training.

DISCUSSION

The batting stage is a very aggressive action, which is characterized by a short time to perform functional actions and requires a certain amount of batting force to complete. The whole power launching process is to take the waist and abdomen as the axis, bend and stretch the trunk, rotate the body, so that the whole body can coordinate the force and drive the arm to swing. Following the principle of the power chain, the power and speed are transferred from the big arm to the small arm, and finally to the palm of the hand to accelerate the hitting of the ball. The process of hitting the ball in the air can be divided into three stages: the first stage refers to the moment when the ground releases to the maximum of the guidance arm when taking off; The second stage is the moment from the maximum movement of the guiding arm to the hitting;The third stage is to hit the volleyball until the ball crosses the net. In the first stage, that is, from the moment of taking off from the ground to the moment when the arm is raised to the maximum, different parts of the body are ready to hit the ball before hitting. In the second stage, the angle and speed of all parts of the body, as well as the change of angle and speed, have a great impact on the result of hitting from the moment when the lead arm is at its maximum to the moment of hitting. In the process of hitting, the body reaches the maximum back bow, and the trunk starts to contract. The moment when the body reaches the maximum rotation is the moment of hitting arm touches the ball. The third stage, from the moment of hitting the ball to the moment of crossing the net, is the result of completing the hitting action. The second stage is decisive. The upper limb strength in the power chain is the main guarantee for successful execution, and also the key factor to complete the action.

CONCLUSION

The swing speed and strength control of upper limbs play a decisive role in the whole stroke process of volleyball. The size of the upper limb muscles is also the end point of the initial speed during the swing, which is one of the most important aspects in quality training. This study theoretically analyzed the muscle type and strength characteristics of volleyball hitting, clarified the relationship between hitting action and muscle strength, and designed a related control experiment based on hitting training. The experiment proves that after six weeks of batting training, the experimental group has achieved higher batting performance than the control group, and the upper limb strength has also been strengthened to a certain extent, and the overall coordination of batting has been improved. This shows that the strengthening of small muscles in upper limbs is related to the mastery and control of hitting skills, and hitting training is conducive to the improvement of the overall level of volleyball players. The research in this paper will help to provide some reference for improving volleyball players' hitting skills, increasing the interest of volleyball training, and provide new ideas and practical skills for volleyball teaching and training.

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