EFFECTS OF VIBRATION TRAINING ON UPPER LIMBS OF VOLLEYBALL PLAYERS

EFEITOS DO TREINAMENTO VIBRATÓRIO SOBRE OS MEMBROS SUPERIORES DOS JOGADORES DE VOLEIBOL

EFECTOS DEL ENTRENAMIENTO CON VIBRACIONES EN LAS EXTREMIDADES SUPERIORES DE LOS JUGADORES DE VOLEIBOL

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ABSTRACT

Introduction: The research on vibration training has experienced a period of development in many projects, such as badminton, handball, long jump, and volleyball. However, there is still no quantitative research evaluation of its effects on the development of shoulder, elbow, and upper limb muscle strength in volleyball athletes. It is believed that a specific training protocol with vibration may bring benefits to sensory-motor performance and muscle strength implementation in volleyball athletes. Objective: To study the effects of vibration training on upper limb function in volleyball players. Methods: Literature, experimental, and mathematical-statistical research methods were used to explore the relationship between vibration training under the muscle strength of the upper limbs and their joints. Results: The vibration training with an amplitude of 2mm, at a vibration frequency between 30Hz and 45Hz, the frequency of vibration training presented inversely proportional to the effect of vibration training. Conclusion: Vibration training showed the benefits of motor coordination and increased muscle strength in volleyball players. An appropriate vibration training strategy can maximize athletes' skills, such as body coordination, flexibility, and jumping ability. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: Vibration; Resistance Training; Volleyball; Sensory Motor Performance.

RESUMO

Introdução: A pesquisa sobre o treinamento por vibração experimentou um período de desenvolvimento sendo aplicada em muitos projetos como badminton, handebol, salto em distância e voleibol. Entretanto, ainda não há uma avaliação quantitativa da pesquisa sobre seus efeitos em ombro, cotovelo e sobre o desenvolvimento de força muscular nos membros superiores dos atletas de voleibol. Acredita-se que um protocolo de treino específico com vibração possa trazer benefícios ao desempenho sensório-motor e implementação de força muscular nos atletas de voleibol. Objetivo: Estudar os efeitos do treinamento por vibração sobre a função dos membros superiores dos jogadores de vôlei. Métodos: Utilizou-se métodos de pesquisa bibliográfica, experimental e estatística matemática para explorar a relação entre o treinamento vibratório sob a força muscular dos membros superiores e suas articulações. Resultados: O treinamento vibratório com amplitude de 2mm, numa frequência de vibração entre 30Hz e 45Hz, a frequência do treinamento vibratório apresentou-se inversamente proporcional ao efeito do treinamento vibratório. Conclusão: O treinamento vibratório mostrou benefícios de coordenação motora e aumento de força muscular nos jogadores de voleibol. Uma estratégia adequada de treinamento por vibração pode maximizar as habilidades dos atletas, tais como coordenação corporal, flexibilidade e habilidade de salto. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

Descritores: *Vibração; Treinamento de Força; Voleibol; Desempenho Sensório-Motor.*

RESUMEN

Introducción: La investigación sobre el entrenamiento con vibraciones ha experimentado un periodo de desarrollo aplicándose en muchos proyectos como el bádminton, el balonmano, el salto de longitud y el voleibol. Sin embargo, todavía no hay una evaluación cuantitativa de la investigación sobre sus efectos en el hombro, el codo y en el desarrollo de la fuerza muscular en las extremidades superiores de los atletas de voleibol. Se cree que un protocolo de entrenamiento específico con vibración puede aportar beneficios al rendimiento sensomotor y a la implementación de la fuerza muscular en los atletas de voleibol. Objetivo: Estudiar los efectos del entrenamiento con vibraciones sobre la función de las extremidades superiores en jugadores de voleibol. Métodos: Se utilizaron métodos de investigación literarios, experimentales y estadísticos matemáticos para explorar la relación entre el entrenamiento con vibración bajo la fuerza muscular de los miembros superiores y sus articulaciones. Resultados: El entrenamiento vibratorio con amplitud de 2mm, en una frecuencia de vibración entre 30Hz y 45Hz, la frecuencia del entrenamiento vibratorio se presentó inversamente proporcional al efecto del entrenamiento vibratorio. Conclusión: El entrenamiento con vibraciones

mostró beneficios de coordinación motora y aumento de la fuerza muscular en jugadores de voleibol. Una estrategia adecuada de entrenamiento con vibraciones puede maximizar las habilidades de los atletas, como la coordinación corporal, la flexibilidad y la capacidad de salto. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

Descriptores: *Vibración; Entrenamiento de Fuerza; Voleibol; Desempeño Motor Sensorial.*

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INTRODUCTION

Physical fitness is an important factor in improving the level of competition in any sport, and the same is true for volleyball, good physical fitness is the premise for athletes to better play their technical and tactical arrangements and abilities. The research of college volleyball team is helpful to further excavate the new characteristics and forms of sports development in the new period, implement them to the level of the public, and improve the overall quality of citizens.[1] Theories and methods related to strength training have always been difficult and hot spots in sports training, and have always been the focus of attention of various countries. As a new training method, vibration strength training is favored by many scholars.[2] The research on vibration strength training has experienced a period of development, and it has been applied in many projects such as badminton, handball, long jump and volleyball, and has achieved certain results, however, there is no quantitative evaluation of the research on shoulder, elbow and lower body strength in volleyball by vibration strength training, lack of understanding of the source of strength growth, at the same time, there is a lack of in-depth research on the individual differences of vibration training.[3] The spiking movement is the core of volleyball and is a commonly used method in volleyball offense, and the completion of the spiking movement depends on the mutual cooperation and coordination of the strength of the shoulder, elbow and lower limbs.[4]

METHOD

Documentation method

Through the Wanfang Digital Resource System, China Academic Journals (China Knowledge Resource Database), VIP China Science and Technology Journals, EI, SCI and other databases, the keywords of vibration training, vibration training, volleyball strength training, volleyball sports, etc. are used for retrieval, collect literature and materials related to the subject, and consult literature or academic monographs in the library at the same time.

Experimental method and experimental objects

The subjects of the experiment were 30 volleyball players from the Sports Institute, among them, the 30 Sports Institute volleyball players included volleyball players in the main attack, secondary attack, setter and other positions, with a height of about 185, physical fitness is good, no family history of genetic disease, shoulder, elbow and lower limbs have not suffered major injuries.[5] The basic information of the experimental subjects is shown in Table 1.

Mathematical Statistics

The bounce test software in the experiment can directly output data, and use Excel software for further processing; For other strength indicators and other experimental results, the quantitative statistical software SPSS17.0 was used for analysis, among which, the results were expressed as mean ± standard deviation, and the significant difference was $P<0.05$.

Ethical Compliance

Research experiments conducted in this article with animals or humans were approved by the Ethical Committee and responsible authorities of Putian University, Chungbuk National University and Sangmyung University following all guidelines, regulations, legal, and ethical standards as required for humans or animals.

RESULTS

The results and analysis of the upper limb muscle strength test of the shoulder and elbow joints in the special group

Further analysis of the experimental results of Table 2, Table 3 and Table 4 shows that: Shoulder flexor: The total work of shoulder flexion in the vibration group gradually increased with the increase of the experimental time under the vibration frequency of 30Hz; Under the vibration frequency of 35Hz, the relative total work of the shoulder flexors in the vibration group gradually increased with the increase of the experimental time, and the increase range was smaller than that at the vibration frequency of 30Hz, among them, the shoulder flexors in the vibration group had the largest increase after eight weeks under the vibration frequency of 35Hz; Under the vibration frequency of 45Hz, the relative total work of the shoulder joint flexors in the vibration group did not increase significantly with the experimental time; The relative total work of the shoulder and elbow joint control group of the special athletes also gradually increased with the experiment,

Table 1. Basic information of experimental subjects.

Special	Group	N/person	Age	Height/cm	Weight/kg
Special group	Shoulder elbow vibration group 1	5	20.5±1.0	184.0±2.0	74.2±3.0
	Lower body vibration set 2	5	21.0±1.5	183.1±1.0	73.1±4.0
	Upper and lower body vibration group 3	5	21.5±1.5	183.0±1.0	73.8±3.1
	Shoulder and elbow control group 4	5	20.7±1.6	182.4±3.0	74.2±3.0
	Lower extremity control group 5	5	21.5±2.5	183.0±2.4	73.8±2.0
	Upper and lower extremity control group 6	5	21.5±1.5	181.5±1.5	72.5±1.5
	Shoulder elbow vibration set 7	5	21.0±3.4	182.1±3.1	74.1±1.0
	Lower body vibration set 8	5	22.1±1.7	181.0±3.4	74.8±4.3

Table 2. 30Hz special group shoulder and elbow joint vibration group, shoulder and elbow joint control group experimental results relative total work change Table Unit. (J/kg).

Vibration frequency	Joint	Muscle group	Group	Before experiment	Four weeks later	Eight weeks later	Twelve weeks later
30Hz	Shoulder joint	Flexors	1	0.4±0.2	0.7±0.2	0.9±0.3	1.3±0.2
			4	0.6±0.4	0.6±0.2	0.6±0.3	0.8±0.1
		Extensor muscles	1	1.5±0.2	1.8±0.3	2.0±0.2	2.2±0.5
			4	1.3±0.3	1.4±0.2	1.5±0.2	1.5±0.2
	Elbow joint	Flexors	1	0.9±0.2	1.1±0.2	1.4±0.1	1.6±0.1
			4	0.9±0.2	1.3±0.2	1.5±0.1	2.0±0.1
		Extensor muscles	1	2.2±0.2	2.4±0.2	2.7±0.1	2.9±0.1
			4	2.3±0.2	2.6±0.2	2.8±0.1	2.9±0.1

Table 3. 35Hz special group shoulder and elbow joint vibration group, shoulder and elbow joint control group experimental results relative total work change Table. Unit (J/kg).

Vibration frequency	Joint	Muscle group	Group	Before experiment	Four weeks later	Eight weeks later	Twelve weeks later
35Hz	Shoulder joint	Flexors	1	0.4±0.2	0.6±0.2	0.8±0.3	1.0±0.2
			4	0.6±0.4	0.6±0.2	0.6±0.3	0.8±0.1
		Extensor muscles	1	1.5±0.2	1.7±0.3	1.9±0.2	2.1±0.4
			4	1.3±0.3	1.4±0.2	1.5±0.2	1.5±0.2
	Elbow joint	Flexors	1	0.9±0.2	1.1±0.3	1.3±0.2	1.4±0.1
			4	0.9±0.2	1.3±0.2	1.5±0.1	2.0±0.1
		Extensor muscles	1	2.2±0.1	2.4±0.2	2.6±0.2	2.8±0.1
			4	2.3±0.2	2.6±0.2	2.8±0.1	2.9±0.1

Table 4. The relative total work change of the experimental results of the shoulder and elbow joint vibration group of the 45Hz special group and the shoulder and elbow joint control group. Unit (J/kg).

Vibration frequency	Joint	Muscle group	Group	Before experiment	Four weeks later	Eight weeks later	Twelve weeks later
45hz	Shoulder joint	Flexors	1	0.4±0.2	0.4±0.1	0.5±0.3	1.0±0.2
			4	0.6±0.4	0.6±0.2	0.6±0.3	0.8±0.1
		Extensor muscles	1	1.5±0.2	1.6±0.3	1.7±0.2	1.8±0.5
			4	1.3±0.3	1.4±0.2	1.5±0.2	1.5±0.2
	Elbow joint	Flexors	1	0.9±0.2	0.9±0.2	1.0±0.1	1.0±0.1
			4	0.9±0.2	1.3±0.2	1.5±0.1	2.0±0.1
		Extensor muscles	1	2.2±0.1	2.4±0.2	2.3±0.1	2.8±0.1
			4	2.3±0.2	2.6±0.2	2.8±0.1	2.9±0.1

and the growth rate of the control group is greater than that of the vibration training group.[6]

Shoulder extensors: The relative total work of the shoulder extensors in the vibration group gradually increased with the increase of the experimental time under the vibration frequency of 30Hz; Under the vibration frequency of 35Hz, the relative total work of the shoulder joint extensor muscles in the vibration group gradually increased with the increase of the experimental time, and the increase range was smaller than that of the vibration frequency of 30Hz, among them, under the vibration frequency of 35Hz, the shoulder extensor muscles of the vibration group increased the most after eight weeks; Under the vibration frequency of 45Hz, the relative total work of the shoulder joint extensors in the vibration group has no obvious increase trend with the experimental time; The relative total work of the shoulder and elbow joint control group of special athletes also gradually increased with the progress of the experiment, and the increase rate of the control group was smaller than that of the vibration training group. Elbow flexor: The relative total work of the elbow flexor in the vibration group gradually increased with the increase of the experimental time under the vibration frequency of 30Hz; Under the vibration frequency of 35Hz, the relative total work of the elbow flexors in the vibration group gradually increased with the increase of the experimental time, and the increase range was smaller than that of the vibration frequency of 30Hz, among them, the elbow flexor muscles in the vibration group increased the most after eight weeks under the vibration frequency of 35Hz; Under the vibration frequency of 45Hz, the relative total work of the elbow joint flexors in the vibration group did not increase significantly with the experimental time; The relative total work of the shoulder and elbow joint control group of the special athletes also gradually increased with the experiment, and the growth rate of the control group is greater than that of the vibration training group.[7,8]

DISCUSSION

To sum up, vibration training at different frequencies has less effect on athletes' shoulder and elbow flexors than on athletes' shoulder and elbow extensors; The vibration frequency is 30Hz, the vibration training with an amplitude of 2mm has the best effect on the muscle strength of the shoulder and elbow joints of volleyball players; The vibration training with the vibration frequency of 35Hz and the amplitude of 2mm has the best effect on the shoulder and elbow joint muscles of volleyball players in about eight weeks, and is suitable for regularly improving the shoulder and elbow joint muscle strength of athletes; For vibration training with an amplitude of 2 mm, when the vibration frequency changes between 30 Hz and 45 Hz, the effect of vibration training gradually weakens with the increase of the vibration training frequency.[9,10]

CONCLUSION

The vibration training at different frequencies has less impact on the tested person's shoulder and elbow flexor than on the tested person's shoulder and elbow extensor; The vibration training with a vibration frequency of 30Hz and an amplitude of 2mm has the best effect on the testers' shoulder and elbow muscle strength; Vibration training with a vibration frequency of 35Hz and an amplitude of 2mm has the best effect on the tester's shoulder and elbow muscle strength in about eight weeks, and is suitable for regularly improving the tester's shoulder and elbow muscle strength; For vibration training with an amplitude of 2 mm, when the vibration frequency varies between 30Hz and 45Hz, the effect of vibration training gradually weakens with the increase of the vibration training frequency. In vibration strength training, more emphasis should be placed on the balance of muscle strength, and in upper limb vibration testing, more emphasis should be placed on extensor strength training. The vibration frequency should be based on the trainee's own situation, starting from a smaller vibration frequency, and maintain it for a long time until the muscle strength is relatively stable before making adjustments, do not change the vibration frequency back and forth for training, so as not to burden the muscles or joints and cause injuries.

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