EFFECTS OF VIBRATION TRAINING ON BALANCE STABILITY IN LONG JUMPERS

EFEITOS DO TREINAMENTO DE VIBRAÇÃO NA ESTABILIDADE DO EQUILÍBRIO EM SALTADORES DE SALTO EM DISTÂNCIA

EFECTOS DEL ENTRENAMIENTO DE VIBRACIÓN SOBRE LA ESTABILIDAD DEL EQUILIBRIO EN SALTADORES DE LONGITUD

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ABSTRACT

Introduction: Vibration training refers to the introduction of vibration methods into the daily training of athletes for body stimulation. In this way, coaches improve athletes' strength, flexibility, and balance. Athletes can use vibration to stimulate neuromuscular activation. This allows more active units to be concentrated in the muscular contraction. In this way, the athlete's muscular strength can be increased. Objective: This study aimed to analyze the relationship between vibration training and the balance ability of long jumpers. Methods: This paper selects several long jumpers as research subjects. The effects of vibration exercises at different frequencies on athletes' stability are discussed, employing experimental comparison. In this context, statistical calculations are performed on the experimental results. Results: There was no difference in balance ability between the vibration and general training groups before training (P>0.05). The athletes in the vibration training group showed more significant improvement in balance after a training period than the general training group. There were significant differences in the data between the two groups (P<0.01). Conclusion: Vibration strength training can effectively improve the balance ability of jumpers. Athletes should increase the frequency of vibration training in their daily training. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: Vibration; Athletes; Postural Balance; Exercise; Strength Training.

RESUMO

Introdução: O treinamento vibratório refere-se à introdução de métodos de vibração no treinamento diário dos atletas para estimulação corporal. Desta forma, os treinadores melhoram a força, a flexibilidade e o equilíbrio dos atletas. Os atletas podem usar as vibrações para estimular a ativação neuromuscular. Isto permite que mais unidades ativas sejam concentradas na contração muscular. Desta forma, a força muscular do atleta pode ser aumentada. Objetivo: Este estudo teve como objetivo analisar a relação entre o treinamento por vibração e a capacidade de equilíbrio dos saltadores de salto em distância. Métodos: Este trabalho seleciona vários saltadores de salto em distância como objetos de pesquisa. Discute-se os efeitos dos exercícios de vibração em diferentes freqüências sobre a estabilidade do atleta, empregando a comparação experimental. Neste contexto, são efetuados cálculos estatísticos sobre os resultados experimentais. Resultados: Não houve diferença na capacidade de equilíbrio entre o grupo de vibração e os grupos de treinamento geral antes do treinamento (P>0,05). Os atletas do grupo de treinamento de vibração mostraram uma melhora mais significativa no equilíbrio após um período de treinamento do que no grupo de treinamento geral. Houveram diferenças significativas nos dados entre os dois grupos (P<0,01). Conclusão: O treinamento de força vibratória pode efetivamente melhorar a capacidade de equilíbrio dos saltadores. Os atletas devem aumentar a freqüência do treinamento por vibração em seu treinamento diário. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

Descritores: *Vibração; Atletas; Equilíbrio Postural; Exercício Físico; Treinamento de Força.*

RESUMEN

Introducción: El entrenamiento con vibraciones se refiere a la introducción de métodos de vibración en el entrenamiento diario de los deportistas para la estimulación del cuerpo. De este modo, los entrenadores mejoran la fuerza, la flexibilidad y el equilibrio de los deportistas. Los atletas pueden utilizar la vibración para estimular la activación neuromuscular. Esto permite concentrar más unidades activas en la contracción muscular. De este modo, se puede aumentar la fuerza muscular del deportista. Objetivo: Este estudio tiene como objetivo analizar la relación entre el entrenamiento de vibración y la capacidad de equilibrio de los saltadores de longitud. Métodos: En este trabajo se seleccionan varios saltadores de longitud como objeto de investigación. Se discuten los efectos de los ejercicios de vibración a diferentes frecuencias sobre la estabilidad del atleta, empleando la comparación experimental. En este contexto, se realizan cálculos estadísticos sobre los resultados experimentales. Resultados: No hubo diferencias en la capacidad de equilibrio entre el grupo de vibración y los grupos de entrenamiento general antes del entrenamiento (P>0,05). Los atletas del grupo de entrenamiento con vibración mostraron una mejora significativa del equilibrio tras un periodo de entrenamiento que los del grupo de entrenamiento general. Hubo diferencias significativas en

los datos entre los dos grupos (P<0,01). Conclusión: El entrenamiento de fuerza con vibración puede mejorar eficazmente la capacidad de equilibrio de los saltadores. Los deportistas deben aumentar la frecuencia del entrenamiento con vibraciones en su entrenamiento diario. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

Descriptores: *Vibración; Atletas; Equilibrio Postural; Ejercicio Físico; Entrenamiento de Fuerza.*

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INTRODUCTION

Mechanical vibration has been harmful to the human body for a long time. Some vibrational movement is inevitable in sports. For example, athletes in sports such as sailing, surfing, mountain skiing, mountain biking, and equestrian should be aware of the potential risks caused by vibration. In diving, the movement speed of the players should form a "resonance" relationship with the natural speed of the springboard.[1] The vibration at this time will be beneficial to the athlete's technical performance. Athletes can get the most help while taking off from the springboard. This allows for maximum takeoff speed. This gives the athlete enough air time to perform high-level jumps. Platform jumpers refer to this technique as "plywood." Athletes need to keep the vibration consistent with the elastic force on the platform to complete a perfect dive.[2] Whether daily vibration training in long jumpers helps their technical performance has not been studied in the literature. So far, this paper focuses on improving the balance of the body when high jumpers perform vibration strength exercises. The research theory of this paper has laid a solid theoretical and experimental basis for further development of vibration exercise.[3] At the same time, this paper discusses promoting whole-body vibration and finding more efficient methods.

METHOD

Research objects

This paper takes 40 high jumpers as the research target. Before the experiment, the athletes were divided into a vibration training group and a general training group. There are 20 people per group. Before the experiment, we tested the subjects' body mass index by t-test. The results showed no significant difference in the indicators of the two experiments.[4] This result satisfies the equal needs of all parties. The two groups of subjects carried out intensive exercises for eight weeks. The training frequency is four times a week. The vibration training group performed vibration exercises. Each workout requires a load movement with a frequency of 85%-90% in the amplitude range of 20cm to 30cm. The frequency of exercise is 20 times/3 groups. The general training group performed ultra-distance long jump training. At the same time, it will perform six hurdle actions.[5] The height of each hurdle is 40-50 cm. Athletes perform hurdle jumping. The frequency of exercise is two times/4 groups.

Test scheme

Fatigue testing was performed after both training groups completed a quick squat exercise with a 30% RM load. In this paper, the Kistler stereo dynamometer was used to measure the motion of two different frequencies.[6] The research contents mainly include force peak, the time required to reach peak value, elastic energy utilization rate, etc.

Discussion on Ballistic Mode of High Jump Action

Assume that the coordinates of the center of gravity of the athlete's body are (x_0, y_0, z_0) when taking off.[7] Let the athlete's speed at the starting point in the direction of the Y-axis be v_0^y. The velocity in the X-axis direction is v_0^x. The speed on the Z-axis is. This paper calculates the takeoff angle θ_0 corresponding to the takeoff point according to formula (1):

$$\theta_0 = \arcsin\left(\frac{\upsilon_0^x(x_{\max}-x_0)+v_0^z(z_{\max}-z_0)}{\upsilon_0^x(x_{\max}-x_0)+\upsilon_0^y(y_{\max}-y_0)+\upsilon_0^z(z_{\max}-z_0)}\right)^{1/2} \quad (1)$$

Calculate the left knee angle θ_1 of the human body at this time according to the law of cosines.[8] In this paper, θ_{10} is obtained by performing the following normalization processing on θ_1. The calculation expression is shown in formula (2):

$$\theta_{10} = (x'_{10}, y'_{10}, z'_{10}) = \left(\frac{x_{10}}{x_0}, \frac{y_{10}}{y_0}, \frac{z_{10}}{z_0}\right) \quad (2)$$

Data Analysis

This paper uses SPSS10.00 to process all data.[9] At the same time, we performed a between-group t-test and paired t-test for each group.

There is no need for a code of ethics for this type of study.

RESULTS

The role of maximal lower body strength in high jumpers during vibration

There was no difference in the peak of free vertical jumping ability between the vibration training group and the general training group before the experiment (P>0.05) (Table 1) The peak free vertical jump ability of the athletes after exercise was significantly different (P<0.01) (Table 2) The improvement in the vibration training group was more significant than that in the general training group by t-test.[10] There is a very significant difference between the two (P<0.01). It can be seen that both routine and vibration exercises can significantly improve the maximal lower limb ability of long jumpers.[11] The effect of vibration exercise is more evident in improving the lower body strength of athletes. Athletes' muscle vibration exercise effect is more significant.

A comparative study on the effects of two different tests on the rapid force of the lower limbs of long jumpers

The peak strength/time indexes to reach peak strength of both groups were significantly improved compared with those before training (P<0.01). There was no statistical significance in the exercise intensity of the two groups of athletes at different frequencies (P>0.05). (Table 3)

Table 1. The peak index of the free longitudinal force on the measurement platform before and after the test.

Peak force	Before experiment	After experiment	Paired t-test
Vibration training group	144.1±28.2	185.9±26.07	P<0.01
General training group	132±20.37	154±24.64	P<0.01
Between-group t-test	P>0.05	P<0.01	

Table 2. Time indicators of the free vertical jump of the force platform before and after the experiment to reach the peak value.

Peak force	Before experiment	After experiment	Paired t-test
Vibration training group	0.51±0.19	0.45±0.13	P>0.05
General training group	0.59±0.14	0.42±0.13	P<0.01
Between-group t-test	P>0.05	P>0.05	

The effects of different tests on the lower limb reflexes of high jumpers

There was no significant difference in the utilization rate of elastic force between the vibration and super isometric groups (P>0.05). There were significant differences in the utilization rate of elastic force before and after exercise in super-high-level jumping training (P<0.01). This shows that the super isometric deep jump training has a good effect on improving the utilization of elastic energy.[12] This is because the ultra-length jump training can effectively improve the rapid transformation of the muscles' centripetal force and centrifugal force in the eccentric movement. This significantly improves the utilization of elastic potential energy by the muscles. (Table 4)

Effects of different vibration groups on the balance of long jumpers

The fatigue duration of athletes in the designated exercise of barbell squat was significantly prolonged (P<0.05). This shows that the use of vibration exercises by athletes has a significant effect on improving the body's balance. (Table 5)

DISCUSSION

Rapid force is a kind of ability to make your body burst into a tremendous amount of energy in a short period.[13] The intensity of the fast force level is dependent on the contraction rate and maximal force of the muscle. In this paper, the maximum dynamic strength value and the free vertical jump value are tested. Research has shown that both training styles effectively improve speed and strength in athletes. This is because of their differences in performance at maximum intensity. There were no significant differences between the two athletes in terms of speed and improvement in speed. The main factors are as follows: First, improving the maximum strength of the lower limbs in vibration training has a more significant effect on the speed than the ultra-long jump.[14] The increase in muscle contraction rate during isometric jumping was less effective than during vibration training. Although the effect of the two is the same, the effect the two is not significant.

Table 3. Athlete's free jump movement on the test platform.

Time to peak	Before experiment	After experiment	Paired t-test
Vibration training group	281.6±127.6	315.7±118.8	P<0.01
General training group	269.5±95.7	317.9±69.3	P<0.01
Between-group t-test	P>0.05	P>0.05	

Table 4. Change of elastic coefficient on the force platform with time.

Elastic Energy Utilization	Before experiment	After experiment	Paired t-test
Vibration training group	2.89±0.12	2.9±0.08	P>0.05
General training group	2.97±0.09	3.21±0.77	P<0.01
Between-group t-test	P>0.05	P<0.01	

Table 5. Changes in Physical Coordination Metrics for Barbell Squat-Specific Exercises.

Balance ability	Before experiment	After the experiment	Paired t-test
Vibration training group	1.14±0.39	1.69±0.35	P<0.05
General training group	1.16±0.03	1.16±0.11	P>0.05
Between-group t-test	P>0.05	P>0.05	

The proprioceptors of nerves and muscles realize the balance of the human body. In the experiment, more active units and corresponding neurons will be stimulated.[15] Prolonged vibration exercises allow the action units of deep muscle groups to form adaptive connections. It is easier to motivate the body to move without vibrations motivating athletes. This improves the overall strength and stability of the muscle group. In addition, long-term vibration excitation can make the body feel - nerve impulse - center - output to improve the action. It can effectively reduce the error rate of the action and increase the success rate of the action.[16] This can achieve the training purpose of each coach. Adding a vibrating device to a workout can make an otherwise monotonous workout more fun for long jumpers. This paper argues that combining modern teaching methods with traditional teaching can enhance the athlete's learning interest and interest.

CONCLUSION

The use of vibration and traditional training techniques by athletes in the long jump affects maximum strength, rapid strength, reaction strength, and strength endurance. Due to the unique working model of strength training, the strength quality of the lower limbs has a unique effect. Vibration training is a kind of sports exercise with apparent characteristics. It is characterized by increasing the strength of the lower limbs of the long jumper and the maximum strength of the lower limbs. In this paper, no noticeable effect was found in determining whether it can improve the mechanism of muscle elasticity. We can't call it a "strength exercise" at the moment. Coaches should use vibration training methods carefully and scientifically when instructing athletes to train leg muscles.

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