EFFECTS OF FUNCTIONAL TRAINING ON THE HITTING QUALITY OF TENNIS PLAYERS

EFEITOS DO TREINAMENTO FUNCIONAL SOBRE A QUALIDADE DE GOLPE DOS JOGADORES DE TÊNIS

EFECTOS DEL ENTRENAMIENTO FUNCIONAL EN LA CALIDAD DEL GOLPE DE LOS TENISTAS

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ABSTRACT

Introduction: Functional training values the athletes' physical activity and the integral exercise proper of the practiced sport. Tennis frequently integrates this exercise into regular training, aiming to enrich teaching. Objective: Compare the effects of functional training in daily exercise on the tennis players' strokes based on the athletes' performance. Methods: A research sample of 18 young male tennis players in tennis clubs were used. The volunteers were randomly divided into two groups, control and experimental. The control group received traditional physical training methods in their daily training. The experimental group had functional physical training added to their daily training. Before and after training, the ITN and functional movement screening methods were used to study the hitting quality of the tennis players. Finally, a mathematical and statistical analysis of the results ascertained in the tests was performed. Results: After 12 weeks, the mean level and accuracy of the experimental group were significantly higher (P<0.05). The control group showed a slight improvement in the mean level and ball accuracy but without statistical significance (P>0.05). Conclusion: Functional training associated with regular training positively improved the quality of hitting in tennis players. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: Physical Functional Performance; Tennis; Athletes.

RESUMO

Introdução: O treinamento funcional valoriza a atividade física dos atletas e o exercício integral próprio do esporte praticado. O tênis frequentemente integra este exercício ao treinamento regular, visando enriquecer a forma de ensino. Objetivo: Comparar os efeitos obtidos pela inserção do treinamento funcional no exercício diário sobre aos golpes dos jogadores de tênis com base no desempenho dos atletas. Métodos: Utilizou-se uma amostra de pesquisa composta por 18 jogadores de tênis jovens do sexo masculino em clubes de tênis. Os voluntários foram divididos aleatoriamente em dois grupos, controle e experimental. O grupo de controle recebeu métodos tradicionais de treinamento físico em seu treinamento diário. O grupo experimental teve o treinamento físico funcional adicionado em seu treinamento diário. Antes e depois do treinamento, os métodos de triagem do ITN e do movimento funcional foram usados para estudar a qualidade de acerto dos jogadores de tênis. Finalmente, realizou-se uma análise matemática e estatística dos resultados apurados nos testes. Resultados: Após 12 semanas, o nível médio e a precisão do grupo experimental foram significativamente superiores (P<0,05). O grupo de controle mostrou uma leve melhora no nível médio e na precisão da bola, porém sem significância estatística (P>0,05). Conclusão: O treinamento funcional associado ao treinamento regular demonstrou um efeito positivo na melhoria da qualidade de acerto nos golpes dos jogadores de tênis. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

***Descritores*:** *Desempenho Físico Funcional; Tênis; Atletas.*

RESUMEN

Introducción: El entrenamiento funcional valora la actividad física de los deportistas y el ejercicio integral propio del deporte practicado. El tenis integra con frecuencia este ejercicio al entrenamiento regular, con el objetivo de enriquecer la forma de enseñanza. Objetivo: Comparar los efectos obtenidos por la inserción del entrenamiento funcional en el ejercicio diario sobre los golpes de los tenistas en función del rendimiento de los deportistas. Métodos: Se utilizó una muestra de investigación compuesta por 18 jóvenes tenistas masculinos en clubes de tenis. Los voluntarios se dividieron aleatoriamente en dos grupos, el de control y el experimental. El grupo de control recibió métodos tradicionales de entrenamiento físico en su formación diaria. Al grupo experimental se le añadió el entrenamiento físico funcional en su entrenamiento diario. Antes y después del entrenamiento, se utilizaron los métodos de cribado del movimiento funcional y del ITN para estudiar la calidad del golpe de los tenistas. Por último, se realizó un análisis matemático y estadístico de los resultados obtenidos en las pruebas. Resultados: Después de 12 semanas, el nivel medio y la precisión del grupo experimental fueron significativamente mayores (P<0,05). El grupo de control mostró una ligera mejora en el nivel medio y en la precisión de la bola, pero sin significación estadística (P>0,05). Conclusión: El entrenamiento funcional asociado al entrenamiento regular mostró un efecto positivo en la mejora de la calidad del golpeo en tenistas. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

***Descriptores*:** *Rendimiento Físico Funcional; Tenis; Atletas.*

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INTRODUCTION

Tennis is a net-separated confrontation project with many fine movements, complex tactics, intense confrontation, and high physical requirements. The technical quality of tennis players is an essential condition for winning the game. At the same time, physical fitness also plays a vital role in tennis. Physical fitness is an essential element of all sports techniques.[1] The physical fitness of tennis players is a crucial factor affecting the game's performance. Functional training is a modern form of exercise. The concept of core training that it advocates is just a vacancy in the current domestic competitive sports development concept. International high-level athletes have also proved the effect of functional training. Functional training can effectively improve an athlete's movement and control. Functional training is an important idea and means to improve the overall technique of athletes.

METHOD

Experimental subjects

This article uses 18 young male athletes in tennis clubs as a research sample. The subjects were randomly divided into two groups: the control group and the experimental group.[2] The control group also added traditional physical training methods to the routine exercise regimen. The control group added functional physical training to their daily training. Before and after training, the ITN and functional movement screening methods were used to study the hitting quality of tennis players.

Test scheme

Before the trial, this study first tested subjects' baseline hitting and functional movement screening (FMS). The trial lasted 12 weeks. In addition to routine technical exercises, the experimental group performed functional training three times a week. The control group received traditional physical training three times a week.[3] Twelve weeks later, the baseline hitting and functional motor screening tests were conducted separately.

Test inspection

ITN test

The International Tennis Association Tennis Rating Exam measures a player's strength.[4] The depth and accuracy of the baseline shot are the essential criteria for measuring the quality of a tennis player's shot. The above two indicators can well reflect the quality of a player's batting.

Functional Movement Screening (FMS)

The functional movement screening system mainly includes seven movements and three exclusion test movements. In the experiment, subjects completed three basic movements and took the highest score as the final score. Trial subjects must perform the behavior of a two-way trial. If there is a difference in scores between the two trials, the lowest score is used as the benchmark.

Prediction of the best hitting point for a tennis serve

This paper takes the mixed Gaussian group composed of Q Gaussian components as the research starting point.[5] The method is a mathematical expression for the probability assignment of time pixels. The probability of α_j for a pixel at time t is expressed as:

$$P(\alpha_j) = \sum_{i=1}^{Q} \xi_{j,t}^{i} \cdot \lambda(\alpha_j; \theta_{j,t}^{i}, \prod_{j,t}^{i}) \quad (1)$$

$\xi_{j,t}^{i}$ is the weighting of the i Gass component in the mixture Gaussian pattern of pixel j at time t. $\theta_{j,t}^{i}$ and $\prod_{j,t}^{i} = (\varepsilon_{j,t}^{i})^2$ are the mean and covariance of the i Gaussian components. ε is the standard deviation. l represents a cell array. λ is a function of Gauss' density:

$$\lambda(\alpha_j; \theta_{j,t}^{i}, \prod_{j,t}^{i}) = \frac{1}{(2\pi)^{\frac{d}{2}} |\prod_{j,t}^{i}|^{\frac{1}{2}}} \alpha \exp\left\{-\frac{1}{2}(\alpha_j - \theta_{j,t}^{i})^T (\prod_{j,t}^{i})^{-1} (\alpha_j - \theta_{j,t}^{i})\right\} \quad (2)$$

d is the dimension of α_j. The mixed Gaussian method for each pixel is continuously updated with different scenes. This paper arranges the Q Gaussian components in the order of size $\xi_{j,t}^{i} / \varepsilon_{j,t}^{i}$ in the mixed Gaussian group.[6] The current value α_j of the pixel is then compared with its Q Gaussian components in the Gaussian mixture model one by one. If the difference between α_j and the average G of the Gaussian components is less than ψ (ψ is often set to 2.5 to 3.5), then J is updated. The other Gaussian components are not changed, and the formula is:

$$\xi_{j,t+1}^{i} = (1-\alpha)\xi_{j,t}^{i} + \alpha \cdot W_{j,t}^{i} \quad (3)$$

$$\theta_{j,t+1}^{i} = (1-\gamma)\theta_{j,t}^{i} + \gamma \cdot \alpha_j \quad (4)$$

$$(\varepsilon_{j,t+1}^{i})^2 = (1-\gamma)(\varepsilon_{j,t}^{i})^2 + \gamma(\alpha_j - \theta_{j,t}^{i})^T \cdot (\alpha_j - \theta_{j,t}^{i}) \quad (5)$$

$$\gamma = \frac{\alpha}{\xi_{j,t}^{i}} \quad (6)$$

α represents the learning rate of the mode. If the Gaussian component of i matches α_j, then $W_{j,t}^{i} = 1$, otherwise it is $W_{j,t}^{i} = 0$. If neither α nor the Q Gaussian component of pixel j matches, then replace it with the end part of the mixed Gaussian pattern. The new Gaussian components are averaged α_j, and the weighting coefficients of ε_{init} and ξ_{init} are the initial standard values. The weighted value of each Gaussian component is normalized to $\prod_{i=1}^{Q} \varepsilon_{j,t+1}^{i} = 1$ after correction.

In this paper, the mixture Gaussian mode of the pixel is used to represent the probability distribution of its eigenvalue α_j in the time domain. It is classified according to the weight of each Gaussian component and the ratio of the standard deviation. In this way, it can be judged that the Gaussian component of each pixel is generated from A_j in front of the background. The formula for A_j is this:

$$A_j = \arg\min_{a}\left(\prod_{i=1}^{a} \xi_{j,t+1}^{i} > T\right) \quad (7)$$

Threshold T measures the minimum proportion of Gaussian components in all pixels. In the smaller scope of T it is expressed by the assignment of a single pattern. T large value of T reflects a multimodal background.

Statistical analysis

Descriptive statistics were processed using SPSS 23.0. This paper used the independent sample t-test to compare and analyze the data between the control and experimental groups and the data before and after the test. $P<0.05$, $P<0.01$ means the difference is significant.

Ethical Compliance

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

RESULTS

Analysis of Baseline Hit Test Results

After 12 weeks, the experimental group had a significant improvement in the mean scores of depth and accuracy at the baseline, and the data were statistically significant (P<0.05), while the control group had a significant improvement in depth and accuracy at the baseline.[7] There was a slight improvement in the degree of measurement, but the data were not statistically significant (P>0.05). (Table 1)

Research on FMS test results

After the experiment, the FMS test scores of the control group were not significantly different from those before the experiment (P>0.05). Except for trunk stabilization and push-ups, the experimental group's performance in all sports improved (P<0.05). There were significant differences between the experimental groups in straight knee leg raising, trunk rotational stability, and the final total score (P<0.01). (Table 2)

Table 1. Comparative analysis of the baseline hitting the quality of the two groups before and after the test.

Tennis-specific ability index	Group	Before experiment	After the experiment
Baseline Depth Test	Control group	43.23±4.3	46.53±4.96
	Test Group	42.89±8.52	64.41±7.14
Baseline Hit Accuracy Test	Control group	37.32±4.44	42.71±4.56
	Test Group	37.84±4.2	58.68±4.64

Table 2. Comparison of the average scores and overall scores of the subjects in the FMS exam before and after the experiment.

Group	Control group		Test Group	
Testing time	Pretest	Post test	Pretest	Post test
Squat	2.6±0.56	2.78±0.53	2.6±0.56	2.95±0.42
Hurdle step	2.08±0.66	2.43±0.53	2.26±0.78	2.95±0.42
Straight lunge	1.56±0.56	1.56±0.56	1.22±0.42	2.26±0.42
Shoulder flexibility	1.22±1.02	1.56±0.56	1.04±0.93	1.74±0.53
Active straight knee lift	1.22±0.42	1.22±0.42	1.39±0.53	2.26±0.42
Torso Stabilization Push-Ups	2.6±0.56	2.6±0.56	2.6±0.56	2.6±0.56
Torso Rotational Stability	1.74±0.84	1.56±0.56	1.39±0.53	2.26±0.78
Total score	13.02±2.52	13.72±2.67	12.84±2.52	17.01±2.04

DISCUSSION

Functional training is mainly aimed at exercising the unique qualities of athletes to achieve comprehensive improvement in sports performance. Functional training sees the body as a whole.[8] This training focuses on the connection and interaction of individual movements and reflects a holistic view. Although the body volume of athletes in functional training is not large, functional training can improve the strength of muscle groups required for particular technical movements. Functional training improves physical fitness and athletic ability to cooperate. Functional training focuses on the balance of movement and mastery of the body's core strength.

Tennis is a very delicate technique. It requires the athlete to transfer the energy obtained through the movement chain to the whole body. At the same time, players need to use the precise control of the bat with their hands to achieve precise control of the depth and angle of the ball. There was a significant improvement in ITN test scores between the experimental groups. This indicates that tennis players have a stable center of gravity and enhanced body balance after functional training.[9] The athlete's power chain transmission is smoother and more effective when hitting the ball. After functional training, athletes can better control their posture when hitting the ball. Athletes enhance precise control of their muscles and coordination through somatosensory exercises. In addition, functional training can enhance the sensation of proprioceptive organs in the muscles and joints of tennis players. This training aids in improving the athlete's proprioception and precise control of the body when unstable.

Tennis players mostly rely on a significant return shot to get the lead. Athletes will run back and forth over short distances to avoid losing points. Players must get to the hitting zone quickly to get a high-quality return. When the athlete rushes to the hitting position quickly, it is often too fast to maintain the body's stability. This is an excellent test of the athlete's flexibility.[10] Flexibility training can reduce the chance of injury and improve the athlete's physical coordination. Excellent flexibility reduces the negative response of muscles during contraction to a certain extent. Unlike conventional flexibility exercises, functional training tends to use somatosensory neuro-muscular stimulation. This training method is based on people's usual daily activities to enhance muscle tension and achieves muscle relaxation. This method advocates the joint participation of multiple joints and multiple muscle groups. PNF exercises require partnership. The opposite direction of the strength of the two athletes during training allows the athletes' muscles to be stretched in the case of hyper-stretching. This technology can effectively improve the physical flexibility of tennis players to better cope with large-scale hitting movements in competitions and reduce sports injuries.

In tennis, players hit the ball from a large angle so that the opponent's hitting point is always on both sides of the court, which leads to the opponent's forced error. The athlete must maintain stability in each counterattack under the unfavorable situation of running fast. You can avoid mistakes and gain a lead in the game. Some foreign scholars have found that athletes' muscles on both sides of the abdomen and back will have significant joint contractions during a specific period of serving. This helps the athlete maintain the stability of the waist when hitting the ball. The muscle groups of the torso have a great relationship with the athlete's athletic ability. Strengthening the exercise of the muscle group in the body can improve the performance of the athlete's trunk muscle group. The functional practice treats the swing in tennis practice as a dynamic chain. This allows the movement to utilize functional exercises better to develop its core strength. The ultimate goal is to achieve continuous improvement of the core control ability. At the same time, functional training increases the leg's energy transfer speed, and swing quality.

CONCLUSION

Functional training can effectively improve tennis players' movement posture and technical operation. At the same time, it enhances the efficiency of the athlete's power transmission. Kinetic training enhances the precise control of the motor nerve over the racket. This training provides beneficial help for improving the quality of the bottom line of tennis players.

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