CORE STRENGTH TRAINING IN UNIVERSITY FEMALE TENNIS PLAYERS

TREINO DE FORTALECIMENTO DO CORE EM TENISTAS UNIVERSITÁRIAS

ENTRENAMIENTO DE LA FUERZA DEL CORE EN TENISTAS UNIVERSITARIAS

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ABSTRACT

Introduction: Core strength training has been extensively used in competitive sports training, achieving remarkable results in the most competitive sports training by maximizing athletes' strength and accuracy. It is believed that a specific protocol for female university tennis players can bring the same results. Objective: Verify the effectiveness of core strength training in the performance of female university tennis players. Methods: Randomized controlled trial of female university tennis players (n=40) with a specific core strength training protocol versus traditional strength training methods. Changes in tactical skills pre and post-experiment were compared. Descriptive statistical treatment of the collected results was confronted with current literature. Results: Compared with traditional strength training, core strength training proved to be more conducive to developing core strength in female college tennis players. Conclusion: Core strength training assists in the development of skills and tactics in female college tennis players. ***Evidence level II; Therapeutic Studies - Investigating the results.***

Keywords: Strength training; Tennis; University; Athletes.

RESUMO

Introdução: O treino de fortalecimento do core tem sido amplamente utilizado no treinamento esportivo competitivo, alcançando resultados notáveis no treino esportivo mais acirrado ao maximizar a força e precisão dos atletas. Acredita-se que um protocolo específico para as tenistas universitárias possa causar os mesmos resultados. Objetivo: Verificar a eficácia do treinamento de força do core no treinamento de tenistas universitárias. Métodos: Estudo randomizado controlado de tenistas universitárias (n=40) com protocolo específico de fortalecimento de core para fortalecimento versus métodos tradicionais de treino de força. Foram comparadas as alterações das habilidades táticas pré e pós experimento. O tratamento estatístico descritivo dos resultados coletados foi confrontado com a literatura atual. Resultados: Comparado com o treinamento de força tradicional, o treinamento de força do core revelou-se mais propício ao desenvolvimento da força do core em tenistas universitárias. Conclusão: O treinamento de força do core auxilia no desenvolvimento da habilidade e tática das tenistas universitárias. ***Nível de evidência II; Estudos terapêuticos - Investigação de resultados.***

Descritores: *Treinamento de Força; Tênis; Universidades; Atletas.*

RESUMEN

Introducción: El entrenamiento de la fuerza del core se ha utilizado ampliamente en el entrenamiento deportivo de competición, logrando resultados notables en el entrenamiento deportivo más competitivo al maximizar la fuerza y la precisión de los atletas. Se cree que un protocolo específico para los tenistas universitarios puede provocar los mismos resultados. Objetivo: Comprobar la eficacia del entrenamiento de la fuerza del core en el entrenamiento de las tenistas universitarias. Métodos: Estudio controlado aleatorio de jugadoras de tenis universitarias (n=40) con un protocolo específico de entrenamiento de la fuerza del core para el fortalecimiento frente a los métodos tradicionales de entrenamiento de la fuerza. Se compararon los cambios en las habilidades tácticas antes y después del experimento. El tratamiento estadístico descriptivo de los resultados recogidos se confrontó con la literatura actual. Resultados: En comparación con el entrenamiento de fuerza tradicional, el entrenamiento de fuerza del core demostró ser más propicio para el desarrollo de la fuerza del core en las tenistas universitarias. Conclusión: El entrenamiento de la fuerza del core ayuda al desarrollo de la habilidad y la táctica de las tenistas universitarias. ***Nivel de evidencia II; Estudios terapéuticos - Investigación de resultados.***

Descriptores: *Entrenamiento de Fuerza; Tenis; Universidades; Atletas.*

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INTRODUCTION

Core strength training has been widely used in competitive sports training and has achieved remarkable results in most competitive sports training. Tennis sports have higher requirements for athletes' explosive power and control. The kinematic chain theory believes that core strength training directly affects the athlete's body. In particular, it affects the control ability of the core parts of the body, the ability of motor muscle perception, and the probability of injury.[1] Core strength training improves athletes' strength and application efficiency, enabling athletes to maximize their strength and accuracy of shots. This article compares the effects of core strength training and traditional strength training for tennis players and observes the impact of core strength on tennis players' hitting speed and accuracy.

METHOD

Research object

We have selected 23 tennis players from the Sports Academy. The athletes were randomly divided into a control group and an experimental group. There are 11 and 12 athletes in each group.[2] All subjects are national second-level athletes. The control group received traditional strength training, and the experimental group received core strength training. (Table 1)

Table 1. Basic statistics of experimental subjects.

Group	Age	Height (cm)	Weight (kg)
test group	18.2±1.9	175±3.7	73.55±7.5
Control group	17.9±2.2	177±2.9	74.15±9.7

Core strength training methods

The experiment site was the tennis court and tennis hall of the Sports College. The time is divided into three stages and lasts a total of = 9 weeks. Core strength training methods include the Swiss ball, balance pad, balance board, suspension, and other training methods. Practice 3 times a week, the course time is about 30 minutes.[3] There are 6 groups of each action at a time, and the interval of each action is 1min.

Tennis sports modeling based on Mean Shift algorithm

1. Shaping the target model of tennis sports video. We regard the HSV color feature as the feature area of the target. Then the tennis sports video target model can be used to describe the probability value of the HSV feature value.[4] If the center point of the target range is x_0, the probability density distribution of the tennis sports video target template is:

$$\hat{q}_u = C\sum_{t=1}^{n} K\left(\left\|\frac{x_0 - x_t}{h}\right\|^2\right)\delta[b(x_i) - u] \quad (1)$$

2. Shaping the candidate model. If the center of the candidate target range is y, the probability density distribution of the candidate model is:

$$\hat{p}_u(y) = C_h\sum_{t=1}^{n_k} K\left(\left\|\frac{y - x_t}{h}\right\|^2\right)\delta[b(x_i - u)] \quad (2)$$

3. Similarity measurement. We treat the Bhattacharyya coefficient as a similarity function. The higher the value of $0 \le \hat{\rho}(y) \le 1$, the higher the similarity between the candidate target and the target template:

$$\hat{\rho}(y) = \rho(\hat{p}(y), q) = \sum_{u=1}^{m}\sqrt{p_u(y)q_u} \quad (3)$$

4. Target positioning of tennis sports video. Perform Taylor expansion of equation (3) at the position $\hat{\rho}(y_0)$, then:

$$\rho(\hat{p}(y), q) = \frac{1}{2}\sum_{u=1}^{m}\sqrt{p_u(y_0)q_u} + \frac{f_{n,k}}{2}\sum_{i=1}^{n_k}\omega_i k\left(\left\|\frac{y - x_t}{h}\right\|^2\right) \quad (4)$$

Where: $\omega_i = \sum_{u=1}^{m}\sqrt{\frac{\hat{q}_u}{\hat{p}_u(y_0)}}\delta[b(x_i) - u]; f_{n,k} = \sum_{i=1}^{n_k}\frac{C_h}{2}\omega_i k\left(\left\|\frac{y - x_t}{h}\right\|^2\right)$.

The highest value of formula (4) is the highest value of the similarity function. This can ensure that the Mean Shift theory continues to obtain a new y_1 until $\|y_1 - y_0\| < \varepsilon$ obtains the final position y_1 of the target.

Test indicators and statistical methods

The test index consists of two parts. The first part is the core strength test indicators, including supine leg lift, supine back extension, left bridge-type test, right bridge-type test, and abdominal fatigue test. The second part is tennis-specific technical evaluation indicators.[5] The content includes forehand and backhand bottom line draw, volley, serve, and so on. All measured data are expressed as mean ± standard deviation. SPSS17.0 software was used for the single-factor analysis of variance to compare data such as serving speed, accuracy, and core strength.

RESULTS

Comparison of core strengths before and after the experiment

The experimental group had significant differences before and after the experiment in the left and right bridge test and abdominal fatigue test.[6] This shows that core strength has a good effect on the core ability training of tennis players (Table 2).

Comparison of Tennis Technical Indicators

The athletes in the experimental group served at a maximum speed of 139km/h, while the control group only had 132km/h.[7] The average increase of athletes after core strength training is 9km/h, higher than the 3km/h of the control group (Table 3).

Table 2. Comparison of core strength indicators before and after the experiment.

Gender		Male		Female	
Index		Before the experiment	After the experiment	Before the experiment	After the experiment
Supine leg lift	Control group	54.11±1.50	59.00±2.5	45.01±1.13	51.40±2.12
	test group	52.01±0.59	61.00±1.9	47.11±1.50	55.00±2.12
Supine back extension	Control group	55.23±1.02	58.95±1.7	53.20±1.02	57.95±2.15
	test group	56.14±0.93	60.95±2.1	54.23±1.02	60.95±2.15
Left bridge-type test	Control group	71.21±10.44	73.45±22.34	68.43±8.57	69.46±9.51
	test group	71.33±23.23	75.33±12.7	70.03±18.11	75.43±12.09
Right bridge-type test	Control group	70.14±6.17	75.33±10.12	64.80±9.88	74.03±8.16
	test group	69.01±8.34	81.43±22.74	70.80±9.88	79.46±16.56
Abdominal fatigue test	Control group	163.88±68.14	165.54±56.34	145.1±56.45	149.34±35.78
	test group	155.18±56.45	234.64±45.12	155.8±42.04	163.05±46.11

Table 3. Tennis technical indicators comparison.

		Male		Female	
Index	Group	Before the experiment	After the experiment	Before the experiment	After the experiment
Serve accuracy	Control group	0.52±0.11	0.61±0.12	0.49±0.12	0.53±0.13
	test group	0.50±0.09	0.59±0.23	0.47±0.09	0.60±0.14
Forehand and backhand bottom line draw count	Control group	8.75±1.23	9.02±0.82	7.13±1.09	8.14±0.56
	test group	8.83±1.01	9.34±1.00	7.73±1.32	9.88±2.01
Volley	Control group	8.82±1.36	9.03±2.01	8.46±1.00	9.11±0.55
	test group	8.77±1.42	9.35±1.44	7.56±1.21	9.03±0.55
Ball speed	Control group	129±10	132±9	121±21	125±15
	test group	130±15	139±13	120±21	131±11

DISCUSSION

Core strength training methods are divided into training under stable conditions and unstable conditions. It is divided into three modes of exerting force: static force, dynamic force, and static power alternately. This study uses a combination of stable and unstable conditions to train tennis players. Studies have found that core strength training is better than traditional strength training for the core stability training of tennis players.[8] This is because traditional strength training often attaches importance to large muscle strength exercises and neglects functional training of small muscle groups. The kinematic chain theory believes that relying only on large muscle strength in competitive sports is not enough to maintain the advantage of the event. The stability of the core part is the key link to ensure the action output and control ability. Core strength training pays more attention to the innervation and control of muscles by nerves, more emphasis on the development of small muscle groups and the cooperation between active muscles, auxiliary muscles, an antagonist's muscles, and more emphasis on the relationship between strength and coordination and flexibility. This is a kind of strength ability whose main purpose is to develop and stabilize the key links of the human body, control the movement of the center of gravity, and transmit and integrate the strength of the upper and lower limbs. Core strength training focuses on the strength training of deep muscles. Therefore, we need to improve the core ability of tennis players, especially the stability ability.

This study also found that core strength training significantly improved tennis players' serve and forehand shots.[9] Core strength training helps tennis players use the force of the ground to apply the force of the body effectively and reach the force of the arm. This allows the end of the limbs to hit the ball at the maximum instantaneous speed and can improve the coordination between the upper and lower limbs or technical movements as a whole. Therefore, core strength training helps to improve the quality and speed of tennis serve and forehand.

Many scholars have used EMG to study muscle work during core strength training. Some scholars believe that the main core muscles of the human body, the transversus abdominis, and the multifidus muscle, have been activated before the hip exercises. And the superficial core muscles (external abdominal, rectus abdominis, and erector spinae) are in the same direction as the preparatory movements and the movement of the body's center of mass. Some scholars have shown that the human body will first adjust the trunk posture before the voluntary movement of the lower limbs through the study of the electromyography of the core parts.[10] It can quickly transfer the power of the lower limbs and torso to the upper limbs and gather the power of the whole body in the whipping action. Some scholars concluded that the EMG of the core muscles occurred earlier than the upper and lower muscles, especially the EMG of the transversus abdominis was significantly earlier than the deltoid muscles and the main muscles of the lower limbs. They believe that the core muscles prepare the athletes for action and establish a fulcrum for the limbs. Previous studies have found that after 14 weeks of core strength training for tennis players, the speed and accuracy of forehand bottom line shots have been significantly improved. Some scholars have used high-speed camera methods to study the serve movements of high-level tennis players and found that 51% of the kinetic energy and 54% of the power comes from the thigh-hip joint--torso during the serve. Some scholars have found that core strength training can satisfy the acceleration and deceleration of tennis players in the game. Athletes' hitting power is mainly transmitted between the legs, waist, shoulders, and arms.

According to the stability of the supporting surface, core strength training mainly includes stability training and core free strength training in an unstable state. There are two forms. For example, small trampolines, upside-down suspension, balance plate, supine bridge, and multi-dimensional waist and abdomen strength training methods to strengthen the innervation of the nerves to the muscles. Some scholars recommend that core stability be divided into four stages: static contraction, the lower core dynamic stability exercises, the upper core dynamic stability exercises, and post-core dynamic stability exercises. Some scholars suggest that the core stability should be contracted from the core muscle isometric.[11] The three stages of slow-motion in a stable state and experiencing support in an unstable state, dynamic motion, dynamic resistance motion, and dynamic motion in a stable state are carried out sequentially. Emphasize the coordination between large muscle groups and small muscle groups, and emphasize the connection between strength and coordination, and flexibility. The stability of the core part creates conditions for the transmission of upper and lower limbs. At the same time, this is a body posture that provides strength for the stability and movement of the body's center. This research trains tennis players through core strength training under stable and unstable conditions. This improves the athlete's core stability and special sports skills. The training effect of male tennis players is better than that of girls. This may be because male tennis players usually train more traditional strengths. Core stability training provides great support for the activities of the major muscles of the limbs.

CONCLUSION

Core strength training can significantly improve the athlete's core stability and movement ability. It can effectively improve the speed and quality of the tennis player's shot. Core strength training has a more significant effect on the training of college male tennis players.

All authors declare no potential conflict of interest related to this article

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