

ANALYSIS OF HITTING METHOD AND WRIST STRENGTH OF STUDENT TENNIS PLAYERS



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ANÁLISE SOBRE O MÉTODO DE TACADA E A FORÇA DO PULSO DE TENISTAS ESTUDANTES

ANÁLISIS DEL MÉTODO DE GOLPEO Y DE LA FUERZA DE LA MUÑECA DE ESTUDIANTES DE TENIS

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ABSTRACT

Introduction: Wrist joint strength is important in tennis for angle control and racquet direction. **Objective:** Study the changes in muscle strength in the wrist region and the characteristics of joint movement under different tennis stroke styles. **Methods:** 50 students from a professional tennis club team at a university were selected as study subjects, and systematic professional wrist strength training was performed in the experimental group. In contrast, routine training was performed in the control class. The experimental training lasted for six weeks. During this period, the learning time of all groups remained the same, and no additional training or learning was added. **Results:** The experimental group's stability increased significantly, from 1.78 ± 0.67 to 2.25 ± 1.34 before training, and backstroke strength increased significantly, from 6.21 to 10.21; total stroke score also increased from 8.02 to 12.69. **Conclusion:** Improving wrist strength in tennis students may improve overall sports performance. **Level of evidence II; Therapeutic studies - investigation of treatment outcomes.**

Keywords: Racquet Sports; Exercise Movement Techniques; Muscle Strength; Wrist Joint.

RESUMO

Introdução: A força da articulação do pulso é de grande importância no esporte do tênis para controle de ângulo e a direção da raquete. **Objetivo:** Estudar as alterações da força muscular na região do pulso e as características de movimentação articular sob diferentes estilos de tacadas no tênis. **Métodos:** 50 alunos de uma equipe profissional de um clube de tênis de uma universidade foram selecionados como sujeitos de estudo e o treinamento profissional sistemático da força do pulso foi realizado no grupo experimental, enquanto o treinamento de rotina foi realizado na classe de controle. O treinamento experimental durou 6 semanas. Durante este período, o tempo de aprendizado de todos os grupos permaneceu o mesmo, e nenhum treinamento ou aprendizado adicional foi acrescentado. **Resultados:** A estabilidade do grupo experimental aumentou significativamente, de $1,78 \pm 0,67$ para $2,25 \pm 1,34$ antes do treinamento, e a força de tacada de costas aumentou significativamente, de 6,21 para 10,21; a pontuação total da tacada também aumentou de 8,02 para 12,69. **Conclusão:** A melhoria da força no pulso dos estudantes de tênis pode aprimorar o desempenho esportivo global. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.**

Descritores: Esportes com Raquete; Técnicas de Exercício e de Movimento; Força Muscular; Articulação do Pulso.

RESUMEN

Introducción: La fuerza de la articulación de la muñeca es de gran importancia en el deporte del tenis para el control del ángulo y la dirección de la raqueta. **Objetivo:** Estudiar los cambios de la fuerza muscular en la región de la muñeca y las características del movimiento articular bajo diferentes estilos de golpe de tenis. **Métodos:** Se seleccionaron 50 estudiantes de un equipo profesional de un club de tenis universitario como sujetos de estudio y se realizó un entrenamiento profesional sistemático de la fuerza de la muñeca en el grupo experimental, mientras que en la clase de control se realizó un entrenamiento rutinario. El entrenamiento experimental duró 6 semanas. Durante este periodo, el tiempo de aprendizaje de todos los grupos siguió siendo el mismo y no se añadió ninguna formación o aprendizaje adicional. **Resultados:** La estabilidad del grupo experimental aumentó significativamente, de $1,78 \pm 0,67$ a $2,25 \pm 1,34$ antes del entrenamiento, y la fuerza en la brazada de espalda aumentó significativamente, de 6,21 a 10,21; la puntuación total de brazada también aumentó de 8,02 a 12,69. **Conclusión:** Mejorar la fuerza de la muñeca en los estudiantes de tenis puede mejorar el rendimiento deportivo en general. **Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.**

Descritores: Deportes de Raqueta; Técnicas de Ejercicio con Movimientos; Fuerza Muscular; Articulación de la Muñeca.



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INTRODUCTION

In tennis learning, beginners will make some mistakes, such as disordered footsteps, high hitting center of gravity and unstable wrists.¹ In particular, the instability of the wrist is one of the most common

problems. The traditional oriental forehand requires a firm wrist and a long swing, which is effective in the era of wooden rackets and grass courts, but is not suitable for modern tennis that emphasizes topspin.² More and more professionals choose to use wrist action actively when

hitting the ball, especially when rotating the wrist upward at the moment of hitting. This brings extra spin to the ball, allowing players to hit the ball with greater force without worrying about the ball flying. With this wrist movement, the swing will not end above the shoulder, but around the body.³ When using continental grip service, it is necessary to turn your wrist inward at the moment of hitting to avoid hitting the ball with the racquet frame. Modern high-speed photography shows that the angle of the wrist at the moment of hitting will greatly increase the power of hitting the ball, and it is also suitable for flat hitting and rotating throwing.⁴ To achieve this, the wrist must be fully relaxed. For the two handed backhand racket, you can point the racket head to the ground before hitting the ball, and use two wrists at the same time to lift the ball during hitting, so as to achieve full topspin, thus increasing wrist movement and exerting wrist strength.⁵ Correct movements not only help to maximize the physical strength, but also reduce wrist injuries when playing tennis. Therefore, this paper mainly studies the hitting style and wrist strength of students' tennis, explores the organic relationship between different hitting styles and wrist strength, and proves the influence of wrist strength on the accuracy of hitting depth.⁶

METHOD

Research object

According to the research needs, this study interviewed relevant experts of tennis clubs on tennis routine teaching, wrist stability training, tennis forehand stroke quality and other issues, and listened to the opinions and suggestions of experts. The study and all the participants were reviewed and approved by Ethics Committee of Henan University of Technology (NO.HNUT20ZD186). The basic information of students is shown in Table 1 below.

Research methods

In this study, students were divided into two groups, with the same proportion of men and women, and there was no significant difference in all aspects. Professional and systematic wrist strength training was conducted in the experimental group, and routine training was conducted in the control class. The experimental training lasted for 6 weeks. The data before and after the experiment were compared and analyzed to test the athletes' technical actions of hitting the ball with different hands.

The changes of wrist muscle mainly test the integral EMG value of wrist muscle. The wireless EMG testing system is mainly used to measure the relevant changes of wrist flexors and extensors during hitting. WCS-100 electronic grip tester is mainly used to test the grip strength of the students before and after training.

With the reference of expert interviews and tennis rating system, this paper uses the hitting depth and accuracy of both hands as indicators of the quality of different hitting methods. The sequence and number of tests are as follows: the forehand and backhand depth test is conducted with 8 strokes, the forehand and backhand accuracy test is conducted with 10 strokes (5 straight strokes and 5 diagonal strokes), the stability test is conducted at the same time as the depth and accuracy test, and the successful landing and hitting in the effective area will get 1 point, and the score will not be given if you get off the net or leave the effective area of the court.

Table 1. Basic information of the tested students.

Group	Age	Height (cm)	Weight (kg)	Ball age (y)	Wrist width (cm)	Elbow width (cm)
Experience group	20±0.56	174.5±5.25	66.5±4.21	4.2±0.12	6.57±1.27	8.45±1.78
Control group	21±0.21	176.2±4.12	68.7±3.78	4.1±0.22	7.01±1.21	8.58±1.59

During the test, two high-speed cameras were used to record the 3D video data of players' forehand and backhand stroke technology at the speed of 120 frames per second, a Spoas S4015 tennis server, 40 standard air pressure tennis balls, weighing 56.0g-59.4g, elastic 1350mm-1470mm, and new unopened balls, as well as DLT frame as a standard 3D frame, were used to analyze the standardization of several actions related to the test students' forehand and backhand strokes.

RESULTS

Effect of wrist strength training on wrist muscles

The wrist strength of the students was tested before and after the experimental test, and the specific results of the average wrist strength growth are shown in Table 2.

It can be seen from the data in Table 2 that the integral EMG values of the wrist flexor and extensor muscles of the two groups of students before and after wrist strength training have changed significantly. The magnitude and fluctuation of integrated EMG value can reflect the amount of muscle discharge during exercise in a certain period of time, and can judge the fatigue degree and force state of exercise muscles. From the change rate of wrist muscle integral EMG value of the experimental group and the control group, relatively speaking, the change of the experimental group's EMG value after wrist strength training is more stable and slow, in which the wrist flexor muscle changes from 668.23 ± 137.89 before training to 477.27 ± 121.32, P<0.05, with a relatively significant change; The wrist extensor muscle changed from 487.20 ± 115.26 before training to 388.69 ± 90.24, P<0.01, with a very significant change, which proved that the students in the experimental group had higher muscle endurance after the wrist strength training and lower fatigue during the exercise. The control group also had significant differences before and after training, in which the wrist flexor muscle changed from 705.56 ± 135.70 before training to 689.20 ± 148.77, and the wrist extensor muscle changed from 517.85 ± 118.34 before training to 498.36 ± 125.63, P values were less than 0.05, there were very significant changes, which proved that the general tennis training methods can also increase the wrist muscle endurance of students to a certain extent, and the effect of systematic wrist strength training was more obvious.

In addition, after the experiment, the grip strength test was used to compare and analyze the wrist strength. The grip strength test of the experimental group and the control group both used the right hand commonly used to grip the racket. The change of the average grip strength is shown in Figure 1.

The improvement of grip strength is of great significance to the stability of tennis hitting. It can be seen from the data in Figure 1 that the grip strength of the students in the experimental group after wrist strength training is significantly improved, with an average increase of 1.91kg in the experimental group and 0.86kg in the control group. The increase of grip strength has an important impact on gripping the tennis racket and forceful swing, to a large extent, it can improve the balance and stability of grip and swing, and plays an important role in the play of hitting action.

Table 2. Changes of muscle integral electromyography of students.

	Group	Before training	After training	P
Flexor carpi	Experience group	668.23±137.89	477.27±121.32	0.001
	Control group	705.56±135.70	689.20±148.77	0.028
Extensor carpi	Experience group	487.20±115.26	388.69±90.24	0.000
	Control group	517.85±118.34	498.36±125.63	0.042

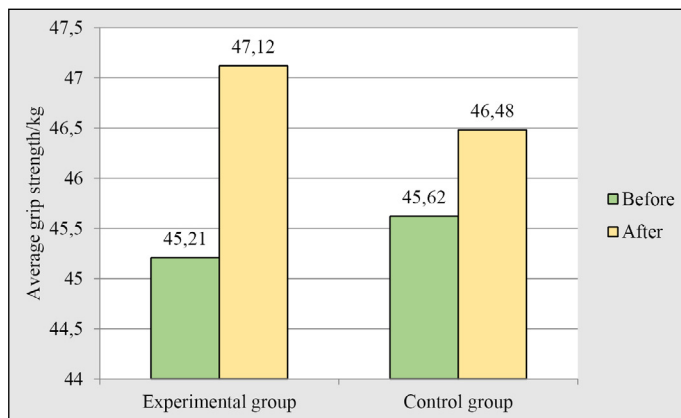


Figure 1. Average grip strength test results before and after training.

Changes in forehand stroke test results

Forehand stroke is one of the most basic strokes in tennis, and it is also a stroke that requires the most concentrated strength of all parts of the body. After training, the hitting depth of forehand stroke was tested, and the results are shown in Table 3.

It can be seen from Table 3 that after the wrist strength training, the experimental group has significantly improved the forehand hitting stability, hitting strength and total score of hitting depth. The stability has increased from 2.09 ± 0.59 before the training to 2.85 ± 1.57 . The forehand hitting strength has improved significantly, from 7.01 ± 4.83 before the training to 12.20 ± 4.62 , and the total score of forehand hitting depth has also increased from 7.87 ± 5.68 to 13.58 ± 5.78 . It is proved that the wrist strength training improves the strength of the students' wrists, thus improving the stability of their wrists. When hitting, they can smoothly transmit the whole body's strength to the hitting action, which has a significant impact on the forehand hitting depth of students' tennis, and promotes the depth and strength of forehand hitting.

In addition, the students' forehand hitting accuracy was tested, and the test results are shown in Figure 2.

From the data in Table 3 and Figure 2, it can be concluded that the students in the experimental group who have more wrist strength have significantly improved their forehand stroke stability, stroke strength, stroke depth and accuracy in the later period, while the students in the control group have a small increase, but they still have improved to varying degrees under the regular training.

Changes in backhand stroke test results

In addition to forehand stroke, this paper also tests the results of backhand stroke. The backhand stroke is mainly used to hit the ball coming from the left, which is divided into two different strokes: one hand and two hands. Table 4 shows the test results of backhand hitting depth after training.

It can be seen from the data in Table 4 that, similar to the result of forehand hitting, after wrist strength training, the experimental group has significantly improved the stability of backhand hitting, the hitting strength and the total score of hitting depth, of which the stability has improved significantly, from 1.78 ± 0.67 before training to 2.25 ± 1.34 , and the backhand hitting strength has improved significantly, from 6.21 ± 5.03 before training to 10.21 ± 4.33 . The total score of backhand hitting depth also increased from 8.02 ± 4.33 to 12.69 ± 4.98 . The control group also improved in three indicators to a certain extent, which was relatively small compared with the experimental group. Among them, the stability increased from 1.77 ± 0.25 to 1.94 ± 0.88 before training. The strength of backhand hitting increased significantly compared with the other two indicators, from 6.44 ± 5.04 before training to 8.25 ± 4.18 , and the

Table 3. Forehand hitting depth test results before and after training.

	Group	Before training	After training	P
Stability	Experience group	2.09 ± 0.59	2.85 ± 1.57	0.031
	Control group	2.21 ± 0.16	2.38 ± 1.02	0.047
Forehand stroke strength	Experience group	7.01 ± 4.83	12.20 ± 4.62	0.005
	Control group	7.48 ± 3.44	9.72 ± 5.11	0.042
Total forehand stroke depth	Experience group	7.87 ± 5.68	13.58 ± 5.78	0.001
	Control group	7.35 ± 5.23	8.97 ± 6.02	0.125

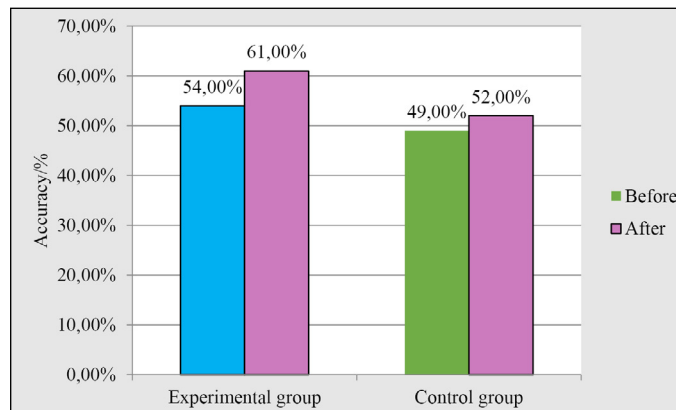


Figure 2. Forehand accuracy test results.

Table 4. Results of Backhand Stroke Depth Test before and after Training.

	Group	Before training	After training	P
Stability	Experience group	1.78 ± 0.67	2.25 ± 1.34	0.015
	Control group	1.77 ± 0.25	1.94 ± 0.88	0.072
Backhand stroke strength	Experience group	6.21 ± 5.03	10.21 ± 4.33	0.001
	Control group	6.44 ± 5.04	8.25 ± 4.18	0.054
Total Backhand Stroke Depth	Experience group	8.02 ± 4.33	12.69 ± 4.98	0.001
	Control group	7.88 ± 5.02	8.74 ± 6.21	0.177

total score of backhand hitting depth increased from 7.88 ± 5.02 to 8.74 ± 6.21 . Therefore, it is proved that the wrist strength training improves the wrist strength of students, which has a more obvious impact on forehand and backhand strokes, and can improve the stability of the overall stroke action, thus improving the accuracy of hitting.

DISCUSSION

For the hitting action in tennis, whether it is forehand flat shot or forehand topspin shot, or backhand shot with one hand and two hands, different body positions must work together in a specific time sequence. When performing the hitting action, the upper limbs, trunk and lower limbs have a specific force application sequence, so that the whole body can form a reasonable power transmission, minimize the power loss, and maximize the speed and angle of hitting. The reason why athletes can have differences in hitting skills is that different players have differences in strength coordination in different body positions. Power is generated from the bottom up, and most of the power comes from the legs rather than the arms. For example, in the technique of two handed backhand hitting topspin ball, topspin ball is produced by slight internal rotation of the non dominant hand, which can increase the rotation of the ball; The racquet face hits the lower center of the ball as much as possible, and keeps the club head high speed to produce more rotation. Therefore, the strength of wrist joint plays an important role in it, and it is a key link to determine whether the body strength can be transmitted to the hitting action smoothly. Therefore, according to the research results of this paper, after the wrist strength training, the experimental group has significantly improved the stability of forehand and backhand hitting, the hitting strength and the total score of hitting depth, and the accuracy of

forehand hitting has also been improved accordingly. At the same time, the routine training of the control group also has a certain impact on the overall tennis quality of students to a certain extent, but the experimental group for systematic wrist strength training has a relatively small increase. It proves the importance of wrist strength training.

CONCLUSION

Tennis emphasizes the combination of skills and movements, so the training of each joint in the process of hitting is extremely important. In this paper, the wrist strength is the main research focus, and the tennis stroke style and wrist strength are studied and analyzed. The experimental results have proved that there is a certain correlation between the two, that is, systematic wrist strength training can effectively improve the stability, strength and depth of forehand and backhand hitting of students in tennis, especially the improvement of hitting strength.

At the same time, the improvement of wrist strength has a more obvious impact on the accuracy of hitting. Because the change of wrist strength plays an important role in the stability of racket holding, it is necessary to train the wrist strength during tennis training. Especially for non professional athletes, the wrist stability is an important guarantee for the smooth stroke, which is of great significance for improving the overall level of tennis students.

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