# ANALYSIS OF TECHNICAL TRAINING ON PHYSICAL FITNESS IN COLLEGE TENNIS PLAYERS

*ANÁLISE DO TREINO TÉCNICO SOBRE A APTIDÃO FÍSICA EM TENISTAS UNIVERSITÁRIOS*

*ANÁLISIS DEL ENTRENAMIENTO TÉCNICO SOBRE LA APTITUD FÍSICA EN TENISTAS UNIVERSITARIOS*

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## ABSTRACT

Introduction: The stroke in tennis is a closed chain kinetic energy transfer starting from the lower limbs, through the trunk, to the upper limbs, and finally to the ball, requiring an upward coordinated muscular explosion. Due to its complex nature, it is believed that technical training can improve stability and accuracy in its players. Objective: Analyze the impacts of technical training on the physical fitness of college tennis players. Methods: Twenty tennis players from a tennis team at a university were selected and divided into an experimental group and a control group. The experiment lasted eight weeks. The experimental group received a technical training protocol on tennis strokes, while the control group received traditional physical training. Results: The hand-striking ability of the experimental group increased from 6.47 ± 2.02 to 8.67 ± 1.39 after four weeks and 10.56 ± 2.03 after eight weeks of training, while the control group increased from 4.42 ± 1.08 to 5.02 ± 0.59 in 4 weeks and 6.82 ± 1.46 after eight weeks of training. Conclusion: The application of technical movement training associated with traditional protocols is recommended to improve the physical fitness of athletes. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

**Keywords:** Education, Physical; Fitness, Physical; Tennis.

## *RESUMO*

*Introdução: O golpe no tênis é uma transferência de energia cinética em cadeia fechada partindo dos membros inferiores, através do tronco, para os membros superiores e finalmente para a bola, exigindo uma explosão muscular coordenada ascendente. Devido a sua natureza complexa, acredita-se que um treinamento técnico possa melhorar a estabilidade e precisão em seus jogadores. Objetivo: Analisar os impactos do treino técnico sobre a aptidão física de tenistas universitários. Métodos: Foram selecionados 20 tenistas de uma equipe de tênis em uma universidade, divididos em grupo experimental e grupo de controle. O experimento durou 8 semanas. O grupo experimental recebeu um protocolo de treinamento técnico em golpes de tênis, enquanto o grupo de controle recebeu o treinamento físico tradicional. Resultados: A habilidade de golpe manual do grupo experimental aumentou de 6,47 ± 2,02 para 8,67 ± 1,39 após 4 semanas e 10,56 ± 2,03 após 8 semanas de treinamento; enquanto o grupo controle aumentou de 4,42 ± 1,08 para 5,02 ± 0,59 em 4 semanas e 6,82 ± 1,46 após 8 semanas de treinamento. Conclusão: Recomenda-se a aplicação do treinamento de movimentos técnicos associados aos protocolos tradicionais, a fim de melhorar a aptidão física dos atletas.* ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

***Descritores*:** *Educação Física; Habilidade Física; Tênis.*

## *RESUMEN*

*Introducción: El golpe en el tenis es una transferencia de energía cinética en cadena cerrada que parte de los miembros inferiores, pasa por el tronco, llega a los miembros superiores y finalmente a la pelota, lo que requiere una explosión muscular coordinada ascendente. Debido a su naturaleza compleja, se cree que el entrenamiento técnico puede mejorar la estabilidad y la precisión de sus jugadores. Objetivo: Analizar las repercusiones del entrenamiento técnico en la aptitud física de los tenistas universitarios. Métodos: Se seleccionaron 20 tenistas de un equipo de tenis de una universidad y se dividieron en un grupo experimental y un grupo de control. El experimento duró 8 semanas. El grupo experimental recibió un protocolo de entrenamiento técnico sobre golpes de tenis, mientras que el grupo de control recibió entrenamiento físico tradicional. Resultados: La capacidad de golpeo con las manos del grupo experimental aumentó de 6,47 ± 2,02 a 8,67 ± 1,39 tras 4 semanas y a 10,56 ± 2,03 tras 8 semanas de entrenamiento; mientras que la del grupo de control aumentó de 4,42 ± 1,08 a 5,02 ± 0,59 en 4 semanas y a 6,82 ± 1,46 tras 8 semanas de entrenamiento. Conclusión: Se recomienda la aplicación del entrenamiento técnico del movimiento asociado a protocolos tradicionales para mejorar la aptitud física de los deportistas.* ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

***Descriptores*:** *Educación Física; Aptitud Física; Tenis.*



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## INTRODUCTION

The stroke of tennis is a process of transferring energy from the lower limbs, through the trunk, to the upper limbs, and finally to the ball through the coordinated strength of the whole body from bottom to top.[1] The complex nature, force application sequence and energy transmission process of this movement have high requirements on the joint function and neuromuscular control of the body.[2] The limitation of joint function and poor neuromuscular control of the body will affect players' hitting skills, and even cause sports injuries.[3] Action technology training is a multi joint, multi-level, multi-dimensional and proprioception training based on the body structure and specific technical characteristics to improve the neuromuscular control ability and the transmission efficiency of human power chain, so as to improve the effect and efficiency of sports technology.[4] Therefore, according to the physical function and characteristics of tennis players' hitting skills, based on the analysis of tennis players' hitting skills and their characteristics, combined with the advantages of technical action training, this paper proves the importance of designing tennis players' hitting skill training plans to optimize their hitting speed through comparative experiments.[5] Compared with traditional physical training, technical training can effectively improve the asymmetry in the process of physical movement, and improve tennis players' hitting speed, stability and accuracy.[6] Technical training can also improve athletes' flexibility and body control ability in the course of sports, so as to avoid overexertion and reduce the risk of injury.[7]

## METHOD

### Research object

According to the requirements of the study, this paper designed a technical training experiment aimed at optimizing tennis service technology. The research focuses on the technical training of tennis players' service technology. The study and all the participants were reviewed and approved by Ethics Committee of Inner Mongolia Minzu University (NO.21INMU046EC). Based on the analysis of service technology and its characteristics, combined with the principle of functional action screening, 20 tennis players from a tennis team in a sports school were selected as the research objects. The initial conditions of 20 students had no significant difference in age, length of study, height and weight. All subjects were healthy and had no adverse medical history. Before the experiment, each subject received an informed consent form, signed voluntarily and agreed to participate in the experiment. See Table 1 for the main information of students. Through the P value test of the basic information of the two groups of experimental objects, it can be seen that there is no significant difference between the control group and the experimental group in height, weight, age, ball age and other indicators, which meets the basic requirements of this experiment.

### Research methods

In this study, a total of 20 players, 10 players from the experimental group and the control group, were randomly and equally assigned for an 8-week experiment. The experimental group received systematic tennis technical action training, and trained according to the standardization of hitting action, while the control group received routine physical training. Through functional action screening and technical evaluation, this paper analyzed the difference between the experimental group and the control group in hitting skills 4 weeks and 8 weeks after the experiment. The experiment ensures that all groups have the same training time without adding additional training time.

Service speed test: use TEDA V-989 (2019) full-automatic server to serve. The player uses the technique of receiving the ball after forehand and backhand legal service, and the ball falls on the opponent's table as a value. Each player collected 10 valid balls for each test for analysis. After the test, convert the captured video to MP4 format, import the CP2MV8 software, reconstruct the three-dimensional trajectory of the ball, and analyze the relevant data.

The training effect of the subjects was monitored through the main indicators such as the change of ball speed, the change of hitting accuracy and stability of the forehand and backhand straight line and diagonal line. The comparison of ball speed before and after training and the effectiveness analysis of technical training methods can be obtained from the data after training. Technical action training focuses on improving the hitting speed of the experimental object. The subjects accelerated their swing, which accelerated the racket head when it finally hit the ball, resulting in an increase in ball speed.

**Table 1.** Basic information of the tested students.

| | Age | Height (cm) | Weight (kg) | Ball age (y) |
|---|---|---|---|---|
| Experience group | 19.57±0.57 | 175.31±5.27 | 67.85±3.11 | 4.01±0.31 |
| Control group | 20.03±0.47 | 176.12±4.28 | 67.54±2.78 | 3.73±0.72 |
| P value | P>0.05 | P>0.05 | P>0.05 | P>0.05 |

## RESULTS

### Effect of technical action training on forehand and backhand stroke speed

Forehand stroke is one of the most commonly used strokes in tennis. By testing the forehand stroke speed of the students before the experiment, 4 weeks after the beginning of the experiment and 8 weeks after the beginning of the experiment, the results of the increase in the stroke speed are shown in Table 2.

It can be seen from the data in Table 2 that after 4 and 8 weeks of training, the hitting speed of forehand straight line and forehand diagonal has been improved to varying degrees, and the forehand hitting speed of the experimental group after 8 weeks of training has significantly changed compared with that before training (P<0.01). The hitting speed of forehand straight line increased from 91.32 ± 6.02km/h before training to 95.69 ± 7.34km/h after 4 weeks of training, and to 98.56 ± 8.07km/h after 8 weeks of training; The hitting speed of forehand oblique line increased from 88.48 ± 7.58km/h before training to 93.87 ± 6.01km/h after 4 weeks of training, and increased to 96.77 ± 8.04km/h after 8 weeks of training. In contrast, the batting speed of the control group before and after training is also significantly different, but the overall improvement is smaller than that of the experimental group. It shows that both routine training and technical action training can improve the forehand stroke speed of the students to varying degrees, and the systematic technical training has a more obvious effect.

In addition, the speed of backhand hitting was also tested after the experiment, and the experimental change results are shown in Table 3.

Compared with the data in Table 3, after 4 and 8 weeks of training, the hitting speed of backhand straight line and backhand diagonal line is the same as that of forehand stroke, and has also been improved to

**Table 2.** Forehand speed change.

| | Group | Before training | Training for 4 weeks | Training for 8 weeks | P value after 8 weeks |
|---|---|---|---|---|---|
| Forehand straight line (km/h) | Experience group | 91.32±6.02 | 95.69±7.34 | 98.56±8.07 | P<0.01 |
| | Control group | 90.26±6.58 | 91.47±6.55 | 92.77±7.05 | P<0.05 |
| Forehand diagonal line (km/h) | Experience group | 88.48±7.58 | 93.87±6.01 | 96.77±8.04 | P<0.01 |
| | Control group | 87.33±6.76 | 88.24±7.56 | 90.02±8.69 | P<0.05 |

**Table 3.** Speed change of backhand stroke.

| | Group | Before training | Training for 4 weeks | Training for 8 weeks | P value after 8 weeks |
|---|---|---|---|---|---|
| Backhand straight line (km/h) | Experience group | 86.78±7.02 | 90.02±6.55 | 96.32±7.05 | P<0.01 |
| | Control group | 86.33±7.12 | 88.32±6.48 | 91.98±7.05 | P<0.05 |
| Backhand diagonal (km/h) | Experience group | 83.77±7.54 | 87.62±6.89 | 91.66±7.11 | P<0.01 |
| | Control group | 84.36±7.21 | 85.33±6.87 | 88.02±4.97 | P<0.05 |

**Table 4.** Changes in batting accuracy.

| | Group | Before training | Training for 4 weeks | Training for 8 weeks | P value after 8 weeks |
|---|---|---|---|---|---|
| Forehand stroke | Experience group | 6.47±2.02 | 8.67±1.39 | 10.56±2.03 | P<0.01 |
| | Control group | 6.27±0.87 | 7.42±2.02 | 8.71±1.34 | P<0.05 |
| Backhand stroke | Experience group | 4.42±1.08 | 6.77±2.11 | 9.97±1.64 | P<0.01 |
| | Control group | 4.31±1.25 | 5.02±0.59 | 6.82±1.46 | P<0.05 |

varying degrees. The change in the experimental group after 8 weeks of training is very significant (P<0.01), while the change in the control group is relatively small, and there is still significant change.

### Impact of technical action training on hitting accuracy

By testing the forehand hitting speed of the students before the experiment, 4 weeks after the experiment and 8 weeks after the experiment, the results of the increase in the hitting speed are shown in Table 4.

It can be seen from the data in Table 4 that the accuracy of forehand and backhand stroke in the experimental group and the control group has been significantly improved after training, P < 0.05, among which the improvement in the experimental group is more obvious, P < 0.01. In forehand stroke, the forehand stroke skill of the experimental group increased from 6.47 ± 2.02 before training to 8.67 ± 1.39 after 4 weeks of training, and to 10.56 ± 2.03 after 8 weeks of training; In the backhand hitting technique, the experimental group increased from 4.42 ± 1.08 before training to 5.02 ± 0.59 after 4 weeks of training, and increased to 6.82 ± 1.46 after 8 weeks of training. Compared with the control group, the improvement is small, but there is still significant change compared with before training.

### Effect of technical action training on hitting stability

The stability of hitting can largely determine the tennis players' directional control and overall coordination of the ball, and has a great impact on the accuracy of hitting. Therefore, this paper tests the stability of the students before and after training, and the results are shown in Table 5.

After analyzing the data in Table 5, it can be seen that after 8 weeks of technical action training, the experimental group has significantly improved the hitting depth and stability of the baseline forehand and backhand strokes. After 8 weeks of training, the changing range of the hitting depth of the baseline forehand and backhand strokes is very significant (P<0.01), and the changing range of the stability index of the baseline hitting depth is relatively significant (P<0.05). The baseline forehand stroke was 13.56 ± 2.21 before the depth training, 14.68 ± 1.88 after 4 weeks of training, and 16.02 ± 2.02 after 8 weeks of training; The baseline backhand hit was 10.21 ± 1.98 before the depth training, increased to 11.03 ± 1.85 after 4 weeks of training, and increased to 12.07 ± 2.01 after 8 weeks of training.

The average change of the total score of baseline hitting depth between the experimental group and the control group is shown in Figure 1.

**Table 5.** Changes in batting stability.

| | Group | Before training | Training for 4 weeks | Training for 8 weeks | P value after 8 weeks |
|---|---|---|---|---|---|
| Baseline forehand stroke depth | Experience group | 13.56±2.21 | 14.68±1.88 | 16.02±2.02 | P<0.01 |
| | Control group | 13.68±1.87 | 14.01±1.69 | 15.11±2.01 | P<0.05 |
| Backhand stroke depth of baseline | Experience group | 10.21±1.98 | 11.03±1.85 | 12.07±2.01 | P<0.01 |
| | Control group | 10.02±1.77 | 10.56±2.08 | 11.03±1.88 | P>0.05 |
| Stability of baseline hitting depth | Experience group | 5.21±1.02 | 6.22±0.98 | 7.05±1.12 | P<0.05 |
| | Control group | 5.17±1.33 | 5.44±1.12 | 6.02±0.77 | P>0.05 |

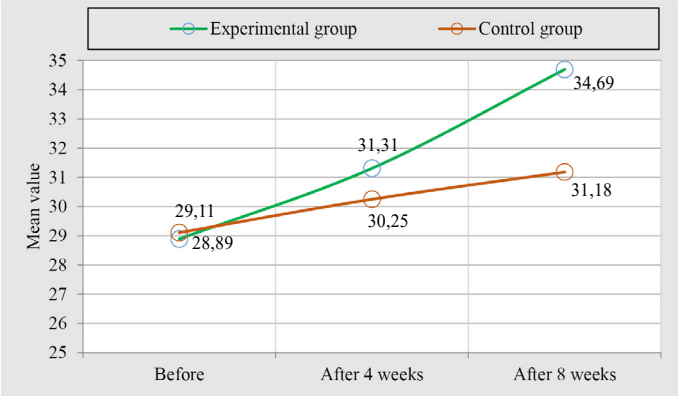


**Figure 1.** Trend chart of average value of total score of hitting depth.

## DISCUSSION

Technical training connects multiple movements through practice, in order to better match the strength of muscle groups required by specific technical movements; In training, we should emphasize the quality of the action, not the number of repetitions and negative weight of the action. Technical movement training can continue to give play to the talent of excellent athletes, not only can speed, agility, coordination, balance and other key factors be significantly improved, but also has a very positive impact on posture, movement and special skills.

In tennis, the ball comes with high speed and high rotation. Players must quickly evaluate the position of the ball in the movement and quickly adjust their body position according to the impact point of the ball. In long distance, fast and changeable batting competitions, players must have the ability to turn to the ground quickly and hit the ball. Sufficient physical strength can ensure that athletes' sports ability can be fully and continuously used, so that their sports ability can be clearly seen in the competition. Otherwise, the hitting effect will be seriously affected, resulting in poor performance or injury. Previous studies have shown that the hitting technique in tennis does not rely on a single joint to generate power, but the body uses the power generated by muscle contraction to guide the body's power chain, so as to better control the speed and impact of the ball. For example, if an athlete wants to make a high-quality forehand stroke, he must lower his body's center of gravity as much as possible, increase the starting speed of his wrists, rotate his hands inward, increase the reaction force of his lower limbs on the ground, increase the speed of his body's rotation, and increase the force of hitting the ball at the moment when the club contacts the ball. If an athlete wants to have a strong shot, it is not just a question of exerting force on a certain joint or muscle, but the coordination of all muscle groups involved in the shot. When the ball is hit, the athlete's thighs kick on the ground to generate force, and the force is converted

from gravitational potential energy, elastic potential energy and chemical energy to kinetic energy, which is transferred from lower limbs to upper limbs through the core area, back and abdomen. Therefore, the core force is particularly important in this process, because the core part is the fulcrum of body movement transmission.

## CONCLUSION

Technical training is a combination of some training actions, including stability, balance and core training, which is required to complete specific actions. The purpose of this study is to analyze the power chain of tennis hitting and the working principle of each part of muscle group by studying different aspects of tennis hitting technology, so as to formulate the physical skill training content and method suitable for tennis hitting technology. This study also analyzed the impact of technical training activities on tennis hitting skills, and studied the content and methods of physical skill training in tennis hitting skills training to improve the players' hitting skills and achieve excellent results. The experiment shows that systematic and targeted technical training has a positive effect on the development of specific tennis skills and the improvement of players' hitting skills. Through the analysis of the principle of tennis hitting technology, technical training is used to optimize each link of body strength transmission, solve the weak problem of athletes' body sports chain, reduce the loss of strength in the transmission process, optimize the transmission effect of the power chain, and thus improve sports performance.

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**AUTHORS' CONTRIBUTIONS:** The author has completed the writing of the article or the critical review of its knowledge content. This paper can be used as the final draft of the manuscript. Every author has made an important contribution to this manuscript. Xianjie Wang: writing and execution.

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