# METHODS OF CORE STRENGTH TRAINING IN COLLEGE TENNIS PLAYERS

*MÉTODOS DE TREINO DE FORTALECIMENTO DO CORE EM TENISTAS UNIVERSITÁRIOS*

*MÉTODOS DE ENTRENAMIENTO DE FORTALECIMIENTO DEL CORE EN TENISTAS UNIVERSITARIOS*

**Original Article**
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Xiao Liu[1]
(Physical Education Professional)

1. College of Physical Education, Wuchang Institute of Technology, Wuhan, Hubei, China.

**Correspondence:**
Xiao Liu
Wuhan, Hubei, China. 430070.
liuxiao121710@sina.com

## ABSTRACT

Introduction: Core strength training is essential for maintaining postural stability and explosive movement support, typical of tennis players. It has been proven that core strength training improves the motor coordination of the athlete's whole body. Therefore, it is essential to develop specific approaches to strengthen the core in tennis players. Objective: Analyze the effect of core strength training in college tennis players. Methods: Twenty college tennis players were selected and randomly divided into two groups: core strength training and general training. Comparative results of the experiment were statistically processed for analysis on the effect of core strength training versus general strength training. Results: There is a big difference in the level of fitness indicators before and after 14 weeks of core strength training ($P < 0.05$). The average gain in training speed of the athletes in the experimental group was 8.24% versus 1.05% in the control group. Conclusion: Core strength training can improve the physical fitness of tennis players. Complementary core strengthening training can favor performance in matches and competition results. ***Evidence level II; Therapeutic Studies - Investigating the results.***

**Keywords:** Strength training; Tennis; Sports; Athletes

## *RESUMO*

*Introdução: O treino de fortalecimento do core é importante para a manutenção de estabilidade postural e suporte para movimentos de explosão típicos dos tenistas. É comprovado que o treino de fortalecimento do core aprimora a coordenação motora de todo o corpo do atleta. Portanto, é de grande importância elaborar condutas específicas para fortalecimento do core em tenistas. Objetivo: Analisar o efeito da conduta de treino de fortalecimento do core em tenistas universitários. Métodos: Foram selecionados 20 tenistas universitários, divididos aleatoriamente dois grupos: treino de fortalecimento do core e treino geral. Os resultados comparativos do experimento foram processados estatisticamente para análise do efeito do treino de fortalecimento do core versus o treino de fortalecimento geral. Resultados: Existe grande diferença no nível de indicadores de aptidão física dos atletas antes e após de 14 semanas de treino com fortalecimento do core ($P < 0,05$). O ganho médio na velocidade de treino dos atletas no grupo experimental foi de 8,24%, contra 1,05% no grupo controle. Conclusão: O treino de fortalecimento do core pode melhorar a aptidão física de tenistas. O treino de fortalecimento do core complementar pode favorecer o desempenho nos jogos e no resultado das competições.* ***Nível de evidência II; Estudos terapêuticos - Investigação de resultados.***

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

## *RESUMEN*

*Introducción: El entrenamiento de la fuerza del core es importante para mantener la estabilidad postural y el apoyo para los movimientos explosivos típicos de los tenistas. Está demostrado que el entrenamiento de la fuerza del core mejora la coordinación motriz de todo el cuerpo del atleta. Por lo tanto, es de gran importancia desarrollar formas específicas para fortalecer el núcleo en los tenistas. Objetivo: Analizar el efecto de la realización de un entrenamiento de fortalecimiento del core en tenistas universitarios. Métodos: Se seleccionaron 20 tenistas y se dividieron aleatoriamente en dos grupos: entrenamiento de la fuerza del core y entrenamiento general. Los resultados comparativos del experimento se procesaron estadísticamente para analizar el efecto del entrenamiento de fortalecimiento del core frente al entrenamiento del fortalecimiento general. Resultados: Existe una gran diferencia en el nivel de los indicadores de aptitud física de los atletas antes y después de 14 semanas de entrenamiento de fuerza del core ($P < 0,05$). El aumento medio de la velocidad de entrenamiento de los atletas del grupo experimental fue del 8,24%, frente al 1,05% del grupo de control. Conclusión: El entrenamiento de la fuerza del core puede mejorar la forma física de los tenistas. El entrenamiento complementario de fortalecimiento del core puede favorecer el rendimiento en los juegos y en el resultado de las competiciones.* ***Nivel de evidencia II; Estudios terapéuticos - Investigación de resultados.***

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



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## INTRODUCTION

The core strength emphasizes core stability. Core stability controls the stable posture of the muscles of the pelvis and trunk during exercise. This creates a fulcrum for the upper and lower limbs' movement and coordinates the upper and lower limbs' exertion.[1] This method optimizes the generation, transmission, and control of power. The characteristics of core strength meet the actual needs of tennis training. Appropriate core strength training can improve the technical level of tennis players and enhance their self-confidence. At the same time, core strength training can effectively improve the training quality of tennis training classes.[2] Therefore, it is of great theoretical and practical significance to strengthen the core strength training of tennis players.

## METHOD

### Research object

We selected 20 tennis players from the Sports College. We use experimental methods to train the research subjects following the pre-made rapid strength training program.

### Research methods

#### The core strength training program

Tennis core strength training is based on physiology, sports biochemistry, biomechanics, and anatomy. We conduct teaching experiments on core strength training methods for tennis players.[3] We select 12 core strength training methods to apply content. Practice 3 times a week. The duration of the course is about 30 minutes. The interval is 2~3min.

#### Controlling factors of the experiment

In addition to imposing factors, the experimental requirements also require that the experimental group and the control group are equal. This compares the influence of applied factors on the experimental results.[4] We strictly controlled the physical condition, training years, exercise level, and mental status of the experimental subjects.

### The establishment of the mathematical model of the training load integrated state

At the end of the training session, adaptation $(A)$ and fatigue $(F)$ begin to subside. The rate of fading is related to the current fitness and fatigue $(\tau_a, \tau_f)$:

$$\frac{dA}{dt} = -\tau_a A \frac{dF}{dt} = -\tau_f F \quad (\tau_a, \tau_f > 0) \tag{1}$$

Training interval $1d$ every day. That is, the analytical solution of the above equation at $t = 1$ is as follows:

$$A_n = A_{n-1}e^{-\tau} \quad F_n = F_{n-1}e^{-\tau} \quad (\tau_a, \tau_f > 0, n \geq 1) \tag{2}$$

Training will cause gains in adaptation and fatigue, and $k_a$, $k_f$ is the gain coefficient. There is a limit $(G)$ for the increase in adaptation:

$$A_n = A_{n-1}e^{-\tau_n} + k_a w_n \left(1 - \frac{A_{n-1}e^{-\tau_n}}{G}\right) \tag{3}$$

$$F_n = F_{n-1}e^{-\tau_f} + k_f w_n \tag{4}$$

The difference equation of the physical state after the training session on day $n$ is expressed as follows:

$$P_n = A_n - F_n = A_{n-1}e^{-\tau_n} + k_a w_n \left(1 - \frac{A_{n-1}e^{-\tau_n}}{G}\right) - F_{n-1}e^{-\tau_f} + k_f w_n \tag{5}$$

$w_n$ represents the training load on day $n$. $p_n$ represents the physical status on day $n$. $A_n$, $F_n$ represents the fitness and fatigue on day $n$, respectively. ${}_nk_a$, $k_f$ represents the adaptation and fatigue gain coefficients caused by training, respectively. $\tau_a$, $\tau_f$ represents the time parameters of adaptation and fatigue subsidence, respectively. $G$ represents the limit of adaptation.

## RESULTS

### Description of tennis ball speed measurement

All links in the technical movements of serve and forehand must have a sense of rhythm and continuity.[5] The whole movement should be coordinated. The whole process is regarded as a coordinated chain of physical movement. This natural movement coordination chain is the movement from the legs to the straddle, the hips to the abdominal muscles, the shoulders, and the shoulders to the upper limbs of the arms. Then the rocket accelerates. This process is a gradual acceleration and coordinated physical movement chain. Core strength training connects the limbs participating in the completion of the movement into a "chain" in the process of completing the technical movement. Every part of the body that participates in the completion of the action is a link in the chain.[6] The completion of technical actions is achieved by transmitting momentum between various links (Table 1,2,3 and 4). The core force plays a "core" role in the transmission of momentum in the power chain. It plays a pivotal role in the momentum transmission of the upper and lower limbs. The strong and stable core stability can effectively transmit

**Table 1.** Result of serving speed before and after the experiment in the control group.

| | Serving speed | |
|---|---|---|
| Project | F | B |
| A | 123 | 125 |
| B | 139 | 140 |
| C | 138 | 139 |
| D | 143 | 147 |
| E | 138 | 139 |
| F | 142 | 142 |
| G | 134 | 135 |
| H | 128 | 128 |
| I | 141 | 142 |
| J | 137 | 138 |

**Table 2.** Results of the speed of service before and after the experiment in the experimental group.

| | Serving speed | |
|---|---|---|
| Project | F | B |
| A | 139 | 144 |
| B | 138 | 142 |
| C | 129 | 137 |
| D | 131 | 139 |
| E | 131 | 141 |
| F | 136 | 139 |
| G | 143 | 154 |
| H | 133 | 143 |
| I | 126 | 138 |
| J | 139 | 145 |

the force from the ground to the upper limbs. This way, the maximum acceleration or deceleration of the upper limbs or the held equipment is achieved.[7] In this way, the momentum of the upper limbs can be transmitted to the lower limbs, and the force of the lower limb muscles on the ground can be adjusted. This improves coordination efficiency between upper and lower limbs or technical movements. So, core strength training improves tennis serve speed and bottom-line shots.

## Analysis of core strength training on tennis ball speed test results

### Analysis of core strength training on the test results of tennis serve speed

The "analysis of variance" between the experimental and control groups before the tennis training test. (Table 5) It can be seen from Table 5 that the difference in serve speed between the experimental group tennis players after 14 weeks of core strength training and the control group reached a statistically significant difference ($p<0.05$). The serving speed of the control group after 14 weeks of traditional fitness training was not significantly different from before the experiment ($p>0.05$). Core strength training has a greater effect on tennis players' serve speed than traditional physical fitness training.[8]

**Table 3.** Results of forehand speed before and after the experiment in the control group.

| | Forehand speed | |
|---|---|---|
| **Project** | **F** | **B** |
| A | 88 | 90 |
| B | 85 | 88 |
| C | 87 | 89 |
| D | 91 | 94 |
| E | 96 | 95 |
| F | 90 | 91 |
| G | 93 | 95 |
| H | 93 | 94 |
| I | 95 | 93 |
| J | 92 | 91 |

**Table 4.** Results of forehand speed before and after the experiment in the experimental group.

| | Forehand speed | |
|---|---|---|
| **Project** | **F** | **B** |
| A | 92 | 96 |
| B | 91 | 97 |
| C | 90 | 92 |
| D | 92 | 95 |
| E | 91 | 94 |
| F | 95 | 97 |
| G | 91 | 94 |
| H | 89 | 92 |
| I | 91 | 95 |
| J | 90 | 96 |

**Table 5.** Significance comparison of tennis serves between the experimental and control groups before and after the experiment.

| Index | | Serve |
|---|---|---|
| Test group | Before the experiment | 131 |
| | After the experiment | 139 |
| Control group | Before the experiment | 129 |
| | After the experiment | 133 |
| Intra-group comparison | Before the experiment | $p<0.01$ |
| | After the experiment | $p>0.05$ |
| Comparison between groups | Before the experiment | $p>0.05$ |
| | After the experiment | $p<0.05$ |

### Analysis of core strength training on the test results of tennis bottom line forehand speed test

After 14 weeks of core strength training, tennis players in the experimental group had a statistically significant difference in forehand bottom line hitting speed than the control group ($p<0.05$). The top speed of the athletes in the experimental group forehand hitting the ball was 97km/h. An average increase of 6km/h. This is better than 1km/h, the fastest ball speed of 95km/h in the control group.[9] The average increase in serve speed of the athletes in the experimental group was 8.24%, while the average increase in the control group was 1.05%. According to the results of statistical experiments, it can be seen that the training content is well combined. This is conducive to the use and plays in practice or competitions.

## DISCUSSION

Athletes can't prepare for each game and spend more time preparing. Excluding the preparation period, how to use the rest of the time? Professional tennis players will participate in some low-level competitions as a training method before several major competitions. This can prepare for the next big game.[10] Therefore, the competition has become part of the preparation period in the systematic training plan of our national women's tennis team.

The concept of the training cycle of the world's elite athletes has all been updated. Mainly manifested in the following aspects: 1) Shortened training time during the preparation period. Nearly 17 weeks after the national women's tennis ended, the Australian Open entered the French Open. But the training week is only 7 weeks. The remaining 10 weeks are involved in different levels of competition. 2) The competition period is greatly extended.[11] International tennis tournaments are frequent. There are 47 weeks of competition in 52 weeks throughout the year. In this long game, whether it is spring, summer, autumn, or winter, various events continue one after another. The most important competition every year is also during this period. The competition has become an important part of the athlete's training content. Many athletes have to participate in 20-30 games or more. Special technical training must be completed by competition. The task of training between games is to maintain the exceptional quality level, improve technical details and adjust the physical and mental state. And the main purpose of many competitions is not to create the best results but actual combat training to serve the main competition.[12] These competitions have played an important role in regulating training and improving the quality and intensity of training. The training is divided into many small stages (10-15d). Each has a different purpose. This makes it easy to grasp and control the athlete's state. This is convenient for athletes to recover excessively during big competitions. This enables athletes to reach their best competitive state and create outstanding results. 3) In the competition that runs through the whole year, athletes can only conduct special short-term training during the idle period to improve the problems exposed in the previous competition. The athletes perfect the technical details, improve the exceptional quality level, and complete the next competition. This prepares for the next game.

We analyze the characteristics of today's tennis matches and the characteristics of Chinese national women's tennis team.[13] We can see that compared with the traditional training cycle theory; the modern cycle training theory is somewhat different. But in essence, the traditional cycle theory has not been discarded. Due to the frequent competitions of athletes, their training plans have been constantly changed and adjusted, but they are all carried out under the guidance of traditional periodic training theory. This is a further supplement and improvement to the traditional periodic training theory.

## CONCLUSION

Periodic training has different manifestations in the new era, but the essence is roughly the same. It is necessary to correctly understand the "period" and training cycle of the competitive state of sports development. International professional tennis tournaments are frequent, and the level of tournaments is divided. It has strict entry requirements. The training of Chinese women's tennis team follows the theory of periodic training. The training plan is divided into major and minor cycles, and the whole year is divided into multiple major cycles. The training method adopts the monistic training theory. A large number of athletes participated. Most of the year in the game state. Therefore, the selection and participation must consider both the points and the physical condition of the competition. Participating in some competitions has become a training method.

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