

Effects of Core Strength Training on Specialized Sports Abilities and Core Stability of Adolescent Tennis Players

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Abstract: Across the world, tennis as a competitive sport, is loved by many people. In the process of tennis playing, athletes are required to have strong physical capacity as well as strong mentality to resist pressure. If the athletes themselves have poor physical instantaneous force and endurance capacity, the performance of tennis sports will be greatly affected. Nowadays, core strength training has become a necessary training means and content for many competitive sports, and people have gradually realized that core strength not only has positive effects in the fields of fitness and rehabilitation, but also has a very important role in the field of competitive sports. In this study, core strength training is briefly analyzed, and then the significance of the core strength training for tennis sports is analyzed. The effects of implementing core strength training and routine training on the athletic capacity and core stability of adolescent tennis players are studied. Through periodic training, it is learned that the specialized tennis sports abilities of the experimental group gain an advantage over the control group ($P < 0.05$); the core stability capacity of the experimental group has obvious advantages over the control group ($P < 0.05$). Core strength training plays a significant role in strengthening adolescent tennis sports abilities, especially in terms of speed, strength durability and body stability. The effect from applying core strength training method is especially prominent. It is hoped that this can provide an operative reference for the improvement of the competitive capability of adolescent tennis sports.

Keywords: Tennis; adolescent sports; core strength training; specialized sports abilities; core stability

1. Introduction

Tennis as a sport item with racket operation, involves physical activity of a high level of intermittent and repetitive that may last 1 to 4 hours^[1]. It is an exercise that requires speed, flexibility, agility, dynamic balance, instantaneous force, anaerobic and aerobic regulation, as well as the abilities of rapid response and prediction^[2]. Tennis requires high physical ability. It is the basic element of modern tennis. Only by maintaining a good physical ability can the players deal with all kinds of emergencies on the court and win the match.

The core component mainly includes the spine, pelvis and the surrounding muscle groups. It is believed that the core muscle group are composed of the rectus abdominis, transverse abdominis, muscles of back, oblique abdominis muscles, lower back muscles and erector spinae, and the muscles around the hip joint - gluteal muscles, hip abductors, and hamstrings also belong to the core muscles of the human body^[3]. Core strength is an important part of tennis that cannot be ignored. In tennis competitions, according to the changing environment on the court, the transformation of techniques, and the implementation of techniques and tactics, the players need to flexibly adjust their body postures to deal with the game. Although each technique item requires the cooperation of the four limbs, the connection between the four limbs requires the core muscle group to complete. The intensity of core strength determines the movement ability and the level of the athlete's skills and tactics. The intensity of core strength can affect the technical level of adolescent. Through interviews with tennis stars such as Roger Federer and Novak Djokovic, Joel Press concluded that the core muscle group is an important area to ensure the rapid movement of the body and exertion one's strength. The more developed the strength of the core area, the higher the stability of the body and the accuracy of technical movements in a tennis match^[4].

According to the training characteristics and rules of tennis, combined with the physiological characteristics of adolescent athletes, it is formulated in this study a set of feasible core strength

training scheme. It is analyzed the technical characteristics of adolescent tennis, and explored the skills of adolescent tennis at a deeper level. Then, according to the data collection of adolescents before and after the experiment, the changes and variability are observed, and the shortcomings of training methods are summarized according to the results, so as to provide a reference basis for improving adolescents' training theory as well as practical basis for adolescents' training.

2. Methods

2.1 Participants

In this study, 30 adolescent male tennis players from Shanghai Sports School, aged between 16 and 18 years old, were randomly assigned as the experimental group and control group, with 15 people in each group. These players had no incidence of injury or illness in the past 6 months. As subjects of the experiment, they were distributed with research instructions and consent forms before participating in the experiment, and explained with the experimental steps, then the experiment was carried out after the consents to participate in the experiment were obtaining the.

2.2 Design of the experiment

The experiment for the study cost 8 weeks. During the training process, the training frequency of the 2 groups was 3 times / week, and the physical training was conducted at 15: 00 - 16: 00 on every Monday, Wednesday and Friday.

In this study, the specialized abilities of tennis sports and physical stability of adolescent tennis players were mainly compared and analyzed. For athletes' stability of upper limbs, the use of spring scales was adopted for the test. The endurance test equipment was selected for the studying the training of abdominal strength. For the athletes' left and right bridge tests, the corresponding equipment was also matched with.

2.3 Training plan

Table 1: Core Strength Training Plan

	Training Plan	Training Volume	Movement Time
Preparation activities	Free exercise(No equipment) Stretching Exercise(Statics & Dynamics)		10minutes
Core strength training	Bird Dog and Side Bridges Back Extension on the Floor Raised Upper Body and Lower Body Abdominal Crunch and Swiss Ball Crunch Plank, Lunge, Squat Russian Twist o the Swiss Ball Bicycle Crunch Medicine Ball Sit-up with Toss Medicine Ball Rotational Chest Pass Bilateral Squat and Unilateral Squat	15 times *3 sets 15 times *3 sets 15 times *3 sets 15 times *3 sets 15 times *3 sets 15 times *3 sets 15 times *3 sets 15 times *3 sets 15 times *3 sets 15 times *3 sets	40minutes
Relaxation exercises	Free exercise (No equipment) Stretching Exercise(Statics & Dynamics)		10minutes

According to the analysis of sport anatomy for the characteristics of tennis hitting, it is found that the human body needs the core muscle groups to provide continuous strength to ensure the stability and dynamic balance of the body when performing the tennis hitting action. In this study, it is proposed to improve the waist muscles as the focus for the application into exercise, with lumbar central muscles and large muscles as the center of the implementation, with a duration of about 40 minutes. Based on the subjects' exercise method and accommodation, the exercise intensity was gradually increased to improve the muscle strength near the lumbar spine, and the exercise was repeated for 2 to 3 sessions. The cool-down exercise takes 10 minutes, and a total of 60 minutes of exercise implementation. In order to improve the effect of the exercise, the implementation of the movement is changed from the

basic movements to transformed movements at different periods, and targeting external oblique muscles and internal oblique muscles that are required by tennis playing, the composite core training scheme is applied for implementation. The specific training procedures are shown in <Table 1>. The control group used traditional strength training methods for physical training.

2.4 Test item

The specialized sports abilities of tennis were tested on V-type movement, spiders drill, 30s-20kg clean and jerk, 30s-double swing jumping rope.

For core stability, they were tested for plank, lumbar extension, right bridge, and left bridge.

2.5 Statistical analyses

According to the experiment scheme, different experimental training methods were implemented for the experimental group and the control group respectively. Through an 8-week phased experiment, the core strength and core stability of two groups of adolescent tennis players were tested, and the data were recorded and analyzed. The collected data is passed through SPSS 22.0 software was used for data statistical analysis. The continuous data was expressed in ($\bar{x} \pm s$), and tested with T, with $P < 0.05$ as meaningful.

Comparison of the test data of the experimental group and the control group is focused, and the data between the two groups and comparison data between the two groups by using different training methods are compared respectively. Discontinuous data were expressed in (%), and χ^2 is used for the test, with $P < 0.05$ as significant. Through comparative analysis, it can be verified that which training method has a more prominent effect in promoting the training quality of adolescent tennis players compared with traditional strength training.

3. Results

3.1 Special sports ability test

After 8 weeks of core strength training, the experimental results of the tennis specific athletic ability of the experimental group were significantly improved compared with 8 weeks ago. In the 4 test items, v-row movement and Spiders drill results have a small increase, clean and jerk and double jump rope have a significant increase trend. However, the analysis of the control group showed that there was no significant difference in the special sports ability test of tennis ($P > 0.05$) (Table 2), and the overall test results of the experimental group showed an upward trend. Compared with the control group, the score of the experimental group was significantly higher, while the score of the control group had no significant change from the test result 8 weeks ago ($P > 0.05$). The special ability of tennis was compared between the two groups. The special ability of tennis in the experimental group was significantly better than that in the control group ($P < 0.05$), as shown in (Table 2).

Table 2: Comparison of tennis special ability between two groups

group		V-type movement	Spiders drill	30s-20kg clean and jerk	30s-Double swing jumping rope
The control group	Pre M \pm SD	26.47 \pm 0.88	18.51 \pm 0.84	18.74 \pm 1.84	49.08 \pm 0.86
	Post M \pm SD	26.03 \pm 0.67	18.12 \pm 0.71	19.56 \pm 1.98	50.78 \pm 0.92
The experimental group	Pre M \pm SD	26.43 \pm 0.91	19.84 \pm 0.88	19.07 \pm 1.47	49.12 \pm 1.11
	Post M \pm SD	25.07 \pm 0.74	18.72 \pm 0.76	22.45 \pm 1.75	53.56 \pm 1.38
t		2.275	3.280	3.987	10.904
P		0.037*	0.005**	0.001**	0.000***

* $p < .05$, ** $p < 01$ *** $p < .001$

3.2 Core stability test

After 8 weeks of core strength training, the experimental results of core stability of the experimental group improved significantly compared with 8 weeks ago. In the 4 test items, v-row lumbar extension results have a small increase, There was a small improvement in waist extension, a large improvement in plank, and a large improvement in both the right bridge test and the left bridge test. However, the analysis of the control group showed that there was no significant difference in the core stability test ($P > 0.05$) (Table 3), and the overall test results of the experimental group showed an upward trend. Compared with the control group, the score of the experimental group was significantly higher, while the score of the control group had no significant change from the test result 8 weeks ago ($P > 0.05$). By comparing the core stability of the two groups, the core stability of the experimental group was significantly better than that of the control group ($P < 0.05$), as shown in Table 3. The core stability ability of the two groups was compared, and the experimental group had a significant advantage compared with the control group ($P < 0.05$), as shown in (Table 3).

Table 3: Comparison of core stability between the two groups

group		plank	lumbar extension	right bridge	left bridge
The control group	Pre M \pm SD	90.56 \pm 13.18	72.31 \pm 16.75	24.01 \pm 2.77	24.84 \pm 3.13
	Post M \pm SD	92.71 \pm 14.26	74.13 \pm 17.16	24.98 \pm 3.01	25.67 \pm 3.59
The experimental group	Pre M \pm SD	91.04 \pm 13.48	73.04 \pm 16.64	24.54 \pm 2.86	24.34 \pm 3.37
	Post M \pm SD	108.24 \pm 15.04	85.34 \pm 18.13	31.21 \pm 3.23	30.19 \pm 3.75
t		2.861	3.431	4.349	6.085
P		0.001**	0.023*	0.000***	0.001**

* $p < .05$, ** $p < 01$ *** $p < .001$

4. Discussion

Tennis is highly competitive in the performing process, which requires athletes to develop good physical capacity in the daily training process, especially in terms of core strength and stability, the requirements for athletes will be more demanding. Similar to other sports, tennis players must have the abilities of balancing, agility, speed, rapid change of direction, multi-plane movement, dynamic posture control and flexibility^[5]. For adolescent tennis players, the training of core strength needs to focus on the selection of training content. The training of core strength specifically includes the intensive training of muscles in waist, abdomen, back and hip. It is of particularity to strengthening exercise on the muscle tissue of the above parts. At the same time, in the process of strength training on the core areas, athletes need to conduct from multiple dimensions and levels. In the study of the test on the effects of core strength on the training of tennis players, most of the adolescent tennis players who participated in the test were encountering the core strength training method for the first time, and their acceptance degree for such novel methods was low, resulting in the increased difficulties of training. Therefore, a training scheme from static training to dynamic training was developed in the study. The initial application in the experiment was a static training method, which mainly focused on the improvement of stability and balance of the athletes^[6]. Severetal conducted 8 weeks of core training for male tennis players in the 11 - 13 age group, and at the end of the process, it is known that the accurate service speed of the core training group has increased by 6.6%^[7].

During the process of training the core strength of adolescent tennis players, it is also necessary to focus on standardizing the movements in core strength training. This is because core strength training of athletes not only to strengthen their muscle strength, but also includes the strengthening of body posture stability and control ability. In the training process, whether normalization of movements is strictly controlled would determine the actual results of tennis special training to a certain extent. Therefore, in actual training, both the formulators and executors of the training content need to pay more attention to normalization of movements in core strength training. Secondly, based on the study, the setting of training load will also have a certain impact on the actual effects of core strength on adolescent tennis training. The experimental training load applied for this study is mainly static training, and it is gradually integrated with the content of dynamic training in the middle and late stages of the

experiment. During the training process, the exercise load gradually increases in a small range. The interval between the two training sessions should not be too long, which is generally controlled at about 1min.

In the process of core strength training for adolescent tennis players, emphasis is placed on strengthening the athletes' collaborative core strength. Core strength here includes the core strength of each part of the body in the process of movement. If it is muscle strength only being strengthened, the coordination and stability of all parts of the muscle tissue will be seriously negatively affected in the process of coordinated movement. Therefore, in the process of strength training for teenage tennis players, it is not only essential to strengthen the muscle groups of various body parts, but also to continuously enhance the control ability of core strength in different areas. It should be made clear that coordination and balance of muscle group movement mentioned here is not only limited to the coordination of muscles in an area, but also the coordination effect of the strength in the core area of muscle group between different areas^[8]. Therefore, in the process of training that targets core strength, training methods should be based on the basis of conventional strength training. In the process of conventional strength training, the focus of training is generally on the training of waist and abdomen strength. To a certain extent, the targeted training of trunk and other parts of strength is ignored. The ultimate goal for core strength training is to improve the strength of athletes' overall muscle group and strength durability of muscle group. Therefore, in order to improve the overall strength capacity of the body, firstly, the conventional strength training content should be applied, and to gradually integrate the content of core strength training into the traditional strength training. If any one of the conventional strength training and core strength training is missing in the training process, the training effect of tennis sports will be greatly reduced. By improving the core strength of adolescent tennis players, the coordination of athletes' muscle groups will be greatly strengthened. While the muscle strength is strengthened, the exercise ability of the muscle groups in the area will be improved accordingly^[9]. Core strength training does not exist independently of the conventional strength training methods. In fact, core strength training is included in conventional strength training, which can effectively modify the shortcomings of conventional strength training methods in practical applications, so as to achieve more efficient training effects. During the research process, if the core strength training method is analyzed from the perspective of strength training, it can be found that core strength training and conventional strength training have a high degree of consistency in terms of nature, effects and philosophy.

In recent years, for many sports including tennis, more and more attention has been paid to core strength training in the training process. Especially in the aspects of physical balance and control capacity of athletes, core strength training has a positive significance which is highly essential. Through many years of running-in in the application process, for the conventional strength training methods, a relatively adequate sports training system have already formed. However, if someone want to bring in the core strength training content, complete change of the content for conventional strength training from the beginning is not advisable, but should to include the conventional physical training content as the core part of training. Core strength training should be used as a supplement to conventional strength training to improve the actual effect of strength training for sports. The two parts should be effectively integrated so as to complement each other to jointly improve the actual effect of strength training for sports.

Core strength is of great significance to physical training. This is because strength quality has a core role that is fundamental in improving physical ability of human body, and would have important effects on the mastery of athletes' sports skills. Studies have shown that small loads of strength training, combined with continuous stimulation training on the core area muscles, can produce enhanced stimulation to the human cerebral cortex^[10]. In a state of high nerve excitability, the contraction and release of muscles will be significantly improved. From the overall performance of athletes during the process of movement, it can be observed that the position of human body will produce a rapid movement. If athletes assigned to carry out a large quantity of heavy-load strength trainings for a long time, it will lead to inhibition of the nerve excitability of athletes to a great extent, and would have certain negative impacts on the training effect. Therefore, it is of essential to plan the training and rest schedule according to the actual training purpose in the process of making a scheme for strength training. Although for moderate core strength training, it has been standardized in the training load, attention still needs to be paid to the important role of relaxation practice in sports training. Relaxation exercises include warm-up before exercise as well as muscle relaxation after exercise. Sufficient operation in these two aspects can not only provide guarantee for the protection of the physical health and safety of athletes, so as to avoid sports injuries, but can also effectively extend the sports career of athletes, which has a positive role on the overall career of athletes. During the operation of core strength training, relaxation can be carried out through limb stretching, intermittent stretching, as well

as external massage, which is beneficial to improve the effects of core strength training.

5. Conclusion

In this study, it is researched the effects of core strength training and conventional training on the athletic ability and core stability of adolescent tennis players. Through staged training, it is found that athletes of the observation group gained better specialized sports abilities in tennis than the control group ($P < 0.05$). The core stability ability of the observation group was significantly better than that of the control group ($P < 0.05$). In summary, core strength training has a significant role in strengthening tennis ability of adolescents, especially in term of speed, strength durability and physical stability, the effects from application of the core strength training are particularly prominent.

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