EFFECTS OF FLEXIBILITY EXERCISES TO PREVENT KNEE INJURIES IN TENNIS PLAYERS

EFEITOS DOS EXERCÍCIOS DE FLEXIBILIDADE PARA PREVENÇÃO EM LESÕES DO JOELHO NOS TENISTAS

EFECTOS DE LOS EJERCICIOS DE FLEXIBILIDAD PARA PREVENCIÓN DE LESIONES DE RODILLA EN JUGADORES DE TENIS

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Zheng Zheng[1]
(Physical Education Professional)
Qiudong Xia[2]
(Physical Education Professional)

1. Shanghai University of Finance and Economics Zhejiang College, Department of Physical Education, Jinhua, Zhejiang, China.
2. Zhejiang Gongshang University, Physical Education Department, Hangzhou, Zhejiang, China.

Correspondence:
Qiudong Xia
Hangzhou, Zhejiang, China.
310018.
xiaqiudong456@126.com

ABSTRACT

Introduction: Despite the intrinsic benefits of sports practice, the adherence to tennis by a large part of the population without the due physical preparation apparently resulted in a high rate of knee joint injuries in tennis players, either in daily training or competitions. Objective: Prevent tennis players' knee joint injuries by exploring ways to improve lower limb joint stability. Methods: This paper selected 50 national second-level professional tennis players and divided them into two groups. Both groups had daily tennis training, but the experimental group experienced additional lower limb flexibility exercises. Results: The tennis players in the experimental group increased their seated forward flexion from 22.19 cm to 26.96 cm, the knee joint extensor muscle strength index increased from 142.69 to 176.23, and the knee joint flexor muscle strength index increased from 93.21 to 149.28, P<0.05, with significant differences. The general stability index was changed from 0.23 to 0.20, the internal and external indices varied from 0.13 to 0.08, and the frontal and posterior indices changed from 0.13 to 0.08. Conclusion: Knee joint injuries in tennis players can be effectively combated by adding lower limb flexibility exercise protocol to daily training. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: Flexibility; Physical Exercise; Lower Limbs; Knee Injuries; Tennis.

RESUMO

Introdução: Apesar dos benefícios intrínsecos da prática esportiva, a adesão do tênis por grande parte da população sem o devido preparo físico aparentemente resultou numa alta taxa de lesões articulações do joelho dos tenistas, seja no treinamento diário de tênis ou em competições. Objetivo: Prevenir a lesão das articulações do joelho dos tenistas, explorando as formas de melhorar a estabilidade das articulações dos membros inferiores. Métodos: Este artigo selecionou 50 tenistas profissionais nacionais de segundo nível e os dividiu em dois grupos. Ambos os grupos tiveram treinamento diário de tênis, porém o grupo experimental experimentou exercícios adicionais de flexibilidade para os membros inferiores. Resultados: Os tenistas do grupo experimental aumentaram sua flexão sentados para frente de 22,19 cm para 26,96 cm, o índice a força muscular extensora da articulação do joelho aumentou de 142,69 para 176,23, e o índice da força muscular flexora da articulação do joelho aumentou de 93,21 para 149,28, P<0,05, com diferenças significativas. O índice de estabilidade geral foi alterado de 0,23 para 0,20, os índices internos e externos variaram de 0,13 para 0,08, e os índices frontal e posterior mudaram de 0,13 para 0,08. Conclusão: As lesões articulares nos joelhos dos tenistas podem ser efetivamente combatidas adicionando o protocolo de exercício de flexibilidade para os membros inferiores ao treinamento diário. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

***Descritores*:** *Flexibilidade; Exercício Físico; Membros Inferiores; Traumatismos do Joelho; Tênis.*

RESUMEN

Introducción: A pesar de los beneficios intrínsecos de la práctica deportiva, la adhesión del tenis por gran parte de la población sin la debida preparación física aparentemente resultó en un alto índice de lesiones articulares de rodilla de los tenistas, ya sea en el entrenamiento diario de tenis o en competiciones. Objetivo: Prevenir las lesiones articulares de rodilla de los tenistas explorando formas de mejorar la estabilidad articular del miembro inferior. Métodos: Este trabajo seleccionó a 50 tenistas profesionales nacionales de segundo nivel y los dividió en dos grupos. Ambos grupos realizaron un entrenamiento diario de tenis, aunque el grupo experimental experimentó ejercicios adicionales de flexibilidad de las extremidades inferiores. Resultados: Los tenistas del grupo experimental aumentaron su flexión sentada hacia delante de 22,19 cm a 26,96 cm, el índice de fuerza muscular extensor de la articulación de la rodilla aumentó de 142,69 a 176,23, y el índice de fuerza muscular flexor de la articulación de la rodilla aumentó de 93,21 a 149,28, P<0,05, con diferencias significativas. El índice de estabilidad general varió de 0,23 a 0,20, los índices interno y externo variaron de 0,13 a 0,08, y los índices frontal y posterior variaron de 0,13 a 0,08. Conclusión: Las lesiones de la articulación de la rodilla en jugadores de tenis pueden combatirse eficazmente añadiendo un protocolo de ejercicios de flexibilidad de las extremidades inferiores al entrenamiento diario. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

***Descriptores*:** *Flexibilidad; Ejercicio Físico; Extremidades Inferiores; Traumatismos de la Rodilla; Tenis.*

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INTRODUCTION

As a famous ball game in the world, tennis started relatively late in China compared with other ball games. Like other ball games, tennis is also an explosive sport, which has high requirements for the flexibility of tennis players' lower limbs.[1] At present, due to the late start of China's tennis, China's tennis does not have great advantages in international competitions. At the same time, in many professional tennis competitions in the world, the performance of Chinese tennis players is not very good.[2] There is a big gap between the physical quality and tennis skills of Chinese tennis players and the world's top tennis players. With the continuous promotion of China's sports power strategy, we should constantly improve the physical quality and tennis skills of Chinese tennis players. In order to cultivate more high-quality tennis players and promote the development of tennis in China.[3] In tennis, not only the joint movement of tennis players is required, but also the physical flexibility of tennis players is required. When tennis players serve and receive the ball, the strength of serving, the speed of running on the court and the endurance of hitting the ball will be affected by the flexibility of the lower limbs.[4] If tennis players have good flexibility of lower limbs, they will have higher endurance and strength when playing tennis. The flexibility of the lower limbs is crucial to the improvement of the professional level of tennis players.[5] At the same time, tennis players with high flexibility of lower limbs will also have less sports injury of knee joint. As the most complex joint in human body structure, knee joint has very powerful functions. At the same time, the bearing capacity of the knee joint is very strong.[6] Make every effort. Even without muscle support, the knee joint can well bear the weight of the body alone. In tennis. The force on the knee joint is relatively large. Any slight change can easily cause injury to the knee joint.[7] Therefore, it is very important to explore the lower limb flexibility of tennis players to prevent sports injuries.

METHOD

Research object

In order to avoid the difference in physical fitness due to gender differences, this paper selected 50 professional young male tennis players as the research object, and conducted a 14-week experiment at the tennis training center. The study and all the participants were reviewed and approved by Ethics Committee of Shanghai University of Finance and Economics Zhejiang College (NO.SHUFE20F015). The specific situation of 50 professional male tennis players selected in this study is shown in Table 1. The age of 50 male tennis players is between 22 and 23 years old, the average height is 175 cm, the average weight is 72 kg, the exercise duration is more than 6 years, and the exercise level is the national second level. 50 professional young male tennis players were randomly divided into two groups, with 25 tennis players in each group.

Research methods

50 professional male tennis players were divided into two groups, one of which was the experimental group. The other group was the control group. The experimental group was trained in lower limb flexibility. Before and after tennis, the sports stretching is carried out by combining the dynamic and static characteristics. Select professional coaches and experts to guide tennis players' flexibility training to prevent sports injuries. The training includes transverse fork, left longitudinal fork, right longitudinal fork and forward bending in sitting position. The control group did not receive any lower limb flexibility training, but only received normal tennis training. Before and after training, the age, height and. Record the basic physical fitness information. At the same time, the flexibility information of tennis players should be recorded.

Table 1. Basic information of the tennis players studied.

Group	Age	Height (cm)	Body weight (kg)	Years of exercise	Sports level
Experience group	22.821 ±1.275	177.501 ±4.111	72.775 ±5.068	6.303 ±1.322	Second level
Control group	23.258 ±1.245	173.270 ±4.190	71.407 ±5.191	6.456 ±1.297	Second level

Control of experimental factors

The only independent variable in this experiment is the method and action of stretching. The dependent variable is the lower limb flexibility test index of tennis players. In the course of this study, the research objectives, the strength of flexibility movement and the density of flexibility movement are all guided by professional coaches. During this experiment. The control group only received tennis training. In addition to daily tennis training, the experimental group also needs to carry out lower limb flexibility training. In addition, neither group did any training.

RESULTS

Changes of flexibility quality of tennis players after lower limb flexibility training

From Table 2, it can be seen that the tennis players in the control group increased their sitting forward bending from 22.382cm before the experiment to 25.245cm after the experiment, and the degree of vertical leg splitting of the left and right legs changed from 169.336 ° and 170.953 ° before the experiment to 173.843 ° and 171.555 ° after the experiment, with a small change. The extensor muscle strength of the knee joint increased from 147.575 before the experiment to 188.607 after the experiment. The flexor muscle strength of the knee joint increased from 85.953 before the experiment to 130.234 after the experiment.

It can be seen from Table 3 that the tennis players in the experimental group increased their sitting forward bending from 22.193cm before the experiment to 26.964cm after the experiment, $p<0.01$, with a very significant difference. The degree of vertical split of the left and right legs changed from 169.245 ° and 170.861 ° before the experiment to 178.856 ° and 177.153 ° after the experiment. There was a significant difference between the degree of vertical split of the left leg and the degree of vertical split of the right leg ($p<0.05$), and there was a very significant difference between the degree of vertical split of the right

Table 2. Changes in the flexibility quality of tennis players in the control group.

Option	Experience group	Control group	t	P
Forward flexion in sitting position (cm)	22.382 ±2.471	25.245 ±1.752	-0.2338	0.8152
Left leg vertical split (°)	169.336 ±10.777	173.843 ±5.359	-0.0298	0.9953
Right leg vertical split (°)	170.953 ±10.462	171.555 ±6.116	-0.0296	0.9388
Extensor muscle strength of knee joint	147.575 ±49.266	188.607 ±47.210	-3.6053	0.5588
Flexor muscle strength of knee joint	85.953 ±37.749	130.234 ±37.151	-7.5140	0.8017

Table 3. Changes of flexibility quality of tennis players in the experimental group.

Option	Experience group	Control group	t	P
Forward flexion in sitting position (cm)	22.193 ±2.562	26.964 ±1.345	3.3654	0.0020
Left leg vertical split (°)	169.245 ±7.205	178.856 ±4.717	2.6708	0.0112
Right leg vertical split (°)	170.861 ±7.615	177.153 ±4.448	3.0902	0.0041
Extensor muscle strength of knee joint	142.693 ±53.827	176.236 ±73.643	-2.8154	0.0089
Flexor muscle strength of knee joint	93.210 ±34.354	149.285 ±37.568	-2.0656	0.0469

leg (p<0.01). The extensor muscle strength of the knee joint increased from 142.693 before the experiment to 176.236 after the experiment (p<0.01), with a very significant difference. The flexor muscle strength of knee joint increased from 93.210 before the experiment to 149.285 after the experiment (p<0.05), with significant difference.

Due to the significant difference between P<0.05 and P<0.01, it can be found from the comparative experiment results that the tennis players in the control group have no significant changes in the flexibility indicators of the lower limbs without any flexibility training, P values are greater than 0.05, and there is no significant difference. Under the guidance of the coach, the experimental group carried out regular flexibility. Before and after the experiment, the various flexibility indicators of its lower limbs had significant changes, P values were less than 0.05, there was a significant difference. In particular, the changes of body flexion in sitting position are the most obvious, with very significant differences. This shows that lower limb flexibility training can effectively improve the flexibility quality of tennis players, and then make tennis players better play in the field and achieve better results.

Prevention effect of lower limb flexibility exercise on tennis players' knee joint injury

Table 4 shows that the overall stability index of tennis players in the control group was 0.259 before the experiment and 0.244 after the experiment, p>0.05, with no significant difference. The internal and external index was 0.142 before the experiment and 0.119 after the experiment, p<0.05, with significant difference. The anteroposterior index was 0.132 before the experiment and 0.120 after the experiment, p<0.05, with significant difference. The comprehensive score of Y balance test was 97.195 before the experiment and 108.646 after the experiment (p<0.05), with significant difference.

Table 5 shows that the overall stability index of tennis players in the experimental group was 0.239 before the experiment and 0.203 after the experiment, p>0.05, with no significant difference. The internal and external index was 0.132 before the experiment and 0.081 after the experiment, p<0.05, with significant difference. The anteroposterior index was 0.132 before the experiment and 0.084 after the experiment, p<0.05, with significant difference. The comprehensive score of Y balance test was 94.489 before the experiment and 108.757 after the experiment (p<0.05), with significant difference.

Before and after the experiment, the range of knee stability of tennis players in the control group who did not have lower limb flexibility exercise was lower than that in the experimental group. At the same time, the indexes of knee stability of tennis players in the control group after the experiment were also lower than that in the experimental group. This shows that the lower limb flexibility exercise can significantly improve the knee stability of tennis players, and there are significant changes in the overall stability index, the lateral and lateral index, the anteroposterior index, and the comprehensive score of Y balance test. However, there is no significant difference in the overall stability index between the experimental group and the control group, indicating that the improvement of the overall stability index is difficult, or the effect is not obvious in the short term. In the future professional tennis training, we can increase the flexibility of athletes and prevent sports injuries by increasing the flexibility of lower limbs.

Table 4. Changes of knee joint stability of tennis players in the control group.

Option	Experience group	Control group	t	P
Overall Stability Index (OSI)	0.259 ±0.030	0.244 ±0.030	-2.7970	0.0642
Inside and outside index (MLI)	0.142 ±0.010	0.119 ±0.020	2.6850	0.0462
Preposition index (API)	0.132 ±0.030	0.120 ±0.040	-0.7960	0.0407
Comprehensive score of Y balance test	97.195 ±4.200	108.646 ±5.448	0.5720	0.0415

Table 5. Changes of knee joint stability of tennis players in the experimental group.

Option	Experience group	Control group	t	P
Overall Stability Index (OSI)	0.239 ±0.081	0.203 ±0.041	-1.2570	0.0630
Inside and outside index (MLI)	0.132 ±0.030	0.081 ±0.022	-9.4060	0.0498
Preposition index (API)	0.132 ±0.040	0.084 ±0.031	-3.9680	0.0427
Comprehensive score of Y balance test	94.489 ±9.316	108.757 ±8.661	-2.9720	0.0442

DISCUSSION

The knee joint is the most important joint of the lower limb of the human body. Whether it is in the slow movement or in the rapid antagonistic movement, the knee joint bears various contradictory forces. Especially in tennis, because tennis includes many sports within the limits of physical fitness. There are injuries caused by various sports in the process of tennis. At the same time, because of the strong antagonism of tennis. If unscientific and unreasonable tennis training methods are adopted in the daily tennis training, and there is no professional coach to guide, it is likely to cause knee injury. Tennis coaches not only need to master the most basic tennis training knowledge, but also need to know some anatomy related knowledge, so as to better guide athletes in training and prevent knee injury. The knee joint plays a role in adjusting muscles and ligaments in tennis. However, if the knee joint is injured in the daily tennis training and tennis competition, the knee joint cannot perform these functions normally, and cannot play its functions normally, which will cause greater damage.

The physical quality of tennis players is very important, and it is the key factor to improve the skill level of tennis players. The improvement of tennis players' physical quality can not only improve tennis players' competition endurance, but also help to more effectively prevent physical injuries caused by sports, and is conducive to tennis players' physical health. So how to test the sports level and training results of tennis players? Tennis competition is a very important way. Through tennis competition, the skill level of tennis players can be effectively tested. At the same time, tennis competition can also attract public attention and attention, and stimulate public enthusiasm for tennis competition. But. The frequent holding of tennis matches also means higher requirements for the physical quality of tennis players. In the process of frequent preparation for tennis matches, tennis players need to constantly improve their physical quality and improve their flexibility. Every tennis match is an explosion of strength. Once the movement is unreasonable and exceeds the physical limit, it is easy to cause injury to tennis players. The research results of this paper show that the lower limb flexibility exercise can effectively improve the lower limb flexibility of tennis players, provide a good buffer for the explosive force impact of tennis players, and effectively prevent the knee joint injury for tennis players.

CONCLUSION

In recent years, with the development of tennis in China, the upsurge of tennis has gradually arisen in China. There is a deep research on the training content and methods of tennis in China. However, there are still deficiencies in the flexibility of the lower limbs of tennis. Knee joint, as a very important organ of human lower limb, is easy to cause injury to tennis players in their daily training. In recent years, people pay more attention to the prevention of knee joint injury. In daily tennis training, if high intensity training is carried out frequently, it is easy to cause injury to the knee joint. Once an athlete makes a mistake, it will cause greater injury to the knee joint and affect the performance of the athlete. At the same time, because tennis is not a mild sport, its sports intensity is

very high. Therefore, in daily training, it is inevitable to cause injury to the knee joint. In daily training. Proper increase of lower limb flexibility exercise can effectively prevent knee joint injury caused by tennis. In daily flexibility exercises, we should follow the principle of gradual progress. At the same time, stretch training should be carried out before and after training to prevent knee joint injury. The research conclusion of this paper shows that increasing the strength of lower limb flexibility training can improve tennis players' lower limb flexibility quality and effectively improve tennis players' lower limb stability.

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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. Zheng Zheng and Qiudong Xia: writing and execution.

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