

RECOVERY FROM MUSCLE INJURIE AFTER HIGH-INTENSITY TRAINING IN TABLE TENNIS

RECUPERAÇÃO DE LESÃO MUSCULAR APÓS TREINAMENTO DE ALTA INTENSIDADE NA PRÁTICA DO TÊNIS DE MESA

RECUPERACIÓN DE LESIÓN MUSCULAR TRAS UN ENTRENAMIENTO DE ALTA INTENSIDAD EN EL TENIS DE MESA



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ABSTRACT

Introduction: High-intensity training is an important point in table tennis training. Due to the high muscle load, occasional injuries may occur during the practice of this activity, requiring the intervention of dedicated physical rehabilitation. **Objective:** Explore the rehabilitation process of muscle injuries caused by high-intensity training in table tennis athletes. **Methods:** Thirty-one student table tennis athletes with indications for rehabilitation due to muscle injuries caused by high-intensity training were volunteers for this research. Data pertinent to the research were collected before and after the intervention. Muscle strength, tank test, lifting test, flexor and extensor group peak torque at 60°/s speed, and flexor and extensor group peak torque at 60°/s speed were analyzed, and data were stored and analyzed in statistical software. The results were analyzed and checked against the updated scientific literature. **Results:** The research shows that a good recovery method can relieve muscle pain and reduce psychological problems caused by pain and speed up joint motion gain. **Conclusion:** The protocol analyzed in this paper can improve the athletes' sporting level both from the physiological and psychological point of view, besides promoting faster recovery and being suitable for daily practical application.

Level of evidence II; Therapeutic studies - investigation of treatment results.

Keywords: Racquet Sports; Resistance Training; Soft Tissue Injuries.

RESUMO

Introdução: O treino de alta intensidade é um ponto importante no treinamento do tênis de mesa. Devido à alta carga muscular, podem ocorrer lesões ocasionais durante a prática dessa atividade, exigindo a intervenção de uma reabilitação física dedicada. **Objetivo:** Explorar o processo de reabilitação nas lesões musculares provocadas pelo treinamento de alta intensidade em atletas do tênis de mesa. **Métodos:** Foram voluntários dessa pesquisa 31 estudantes atletas do tênis de mesa com indicação para reabilitação devido a lesões musculares ocasionadas pelo treinamento de alta intensidade. Os dados pertinentes a pesquisa foram coletados antes e após a intervenção. Foi analisada a força muscular, teste de tanque, teste de levantamento, o torque de pico do grupo flexor e extensor à velocidade de 60°/s e o torque de pico do grupo flexor e extensor à velocidade de 60°/s, os dados foram armazenados e analisados em software estatístico. Os resultados foram analisados e confrontados à bibliografia científica atualizada. **Resultados:** A pesquisa mostra que um bom método de recuperação pode não só aliviar a dor muscular e reduzir os problemas psicológicos causados pela dor, como também pode agilizar o ganho de movimento articular. **Conclusão:** O protocolo analisado neste trabalho pode melhorar o nível esportivo dos atletas tanto do ponto de vista fisiológico quanto psicológico além de promover uma recuperação mais rápida, sendo apta na aplicação prática cotidiana.

Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.

Descritores: Esportes com Raquete; Treinamento de Força; Lesões dos Tecidos Moles.

RESUMEN

Introducción: El entrenamiento de alta intensidad es un punto importante en el entrenamiento del tenis de mesa. Debido a la elevada carga muscular, pueden producirse lesiones ocasionales durante la práctica de esta actividad, que requieren la intervención de un rehabilitador físico especializado. **Objetivo:** Explorar el proceso de rehabilitación en las lesiones musculares causadas por el entrenamiento de alta intensidad en atletas de tenis de mesa. **Métodos:** 31 estudiantes atletas de tenis de mesa con indicación de rehabilitación debido a lesiones musculares causadas por el entrenamiento de alta intensidad fueron voluntarios de esta investigación. Los datos pertinentes para la investigación se recogieron antes y después de la intervención. Se analizó la fuerza muscular, la prueba del tanque, la prueba de elevación, el par máximo del grupo de flexores y extensores a una velocidad de 60°/s y el par máximo del grupo de flexores y extensores a una velocidad de 60°/s, los datos se almacenaron y analizaron en un software estadístico. Los resultados fueron analizados y contrastados con la literatura científica actualizada. **Resultados:** La investigación demuestra que un buen método de recuperación no sólo puede aliviar el dolor muscular y reducir los problemas psicológicos causados por el dolor, sino que también puede acelerar la ganancia de movimiento de las articulaciones. **Conclusión:** El protocolo analizado en este trabajo puede mejorar el nivel deportivo de los atletas



Descriptores: Deportes de Raqueta; Entrenamiento de Fuerza; Traumatismos de los Tejidos Blandos.

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INTRODUCTION

Because of its inherent competitiveness and antagonism, sports injuries will inevitably occur in this process. If there is injury in daily training and competition, it will affect the athletes' mental state and competitive ability, thus affecting the competition results.¹ At present, the treatment and prevention of sports injury is not only a research hotspot, but also a difficult problem in the field of competitive sports.² The literature analyzes and summarizes the types of playing methods and actual injuries of different athletes, so as to analyze the sports injury of table tennis. According to the data, the common injury parts are knee joint, waist and shoulder, and the former accounts for a high proportion. According to the analysis and research of the actual sports injury of the National Women's table tennis team, it is found that the proportion of chronic injury is higher than that of acute injury, and the common injury parts are knee, ankle, shoulder and waist.³ According to the literature, the waist of table tennis players is the most common injury site, accounting for the largest proportion, and the players who play the straight racket single-sided loop ball have the highest injury probability among table tennis players with different playing methods.⁴ The literature analyzes and summarizes the table tennis players in many colleges and universities. Through the experimental investigation, it can be seen that the incidence of sports injury from high to low is lumbar muscle strain, meniscus injury, shoulder injury and so on; According to the literature survey, the knee injury accounts for the largest proportion of sports injury of excellent table tennis athletes, and the table tennis players with circle playing method have the highest probability of sports injury.⁵ Therefore, taking effective measures to recover the injured muscles of table tennis players with high-intensity sports can not only keep the athletes in good competitive state, which is conducive to the next sports training, but also reduce the injury caused by high-intensity sports and prolong their competition life, so as to achieve benign development.

METHOD

This paper selects 31 students majoring in table tennis in a university, including 19 male athletes and 12 female athletes. The study and all the participants were reviewed and approved by Ethics Committee of Changzhou University (NO.18CZUN45-SD). The specific situation is shown in Table 1.

After the athletes have finished the high-intensity exercise training, the muscle injury recovery scheme is carried out, including side lying support dumbbell side pulling, side dumbbell extension, rubber band straight arm rowing and other actions. Each action is divided into 12 times as a group, and three groups of exercises are carried out each time. The frequency is the same as that of the athletes' high-intensity exercise,

Table 1. Analysis of basic situation of athletes.

Option	Male athlete	Female athletes
Height (cm)	173.68 ±5.0790	162.21 ±5.3838
Weight (kg)	70.68 ±8.7055	56.57 ±2.4205
BMI (kg / m ²)	23.16 ±2.5395	22.61 ±1.4136
Age (Year old)	22.09 ±1.6698	20.16 ±1.9734
Exercise level	Level 2 or above	Level 2 or above

4 times a week, lasting for 6 weeks. Before and after the experimental training, the results of infraspinatus muscle strength, empty tank test, lift off test, the peak torque of flexor and extensor group at the speed of 60 ° / s and the peak torque of flexor and extensor group at the speed of 60 ° / s were collected and compared.

Using Excel software and SPSS software, the obtained data were uploaded, sorted and analyzed, and the method of independent variance t-test was used. If P < 0.05, there was significant difference.

RESULTS

Analysis of high intensity training and muscle injury

As shown in Figure 1, this paper makes simple injury statistics on the research objects, so as to have a more systematic cognition of the muscle injury of table tennis players.

As can be seen from Figure 1, among the three fast break table tennis players, one had shoulder injury symptoms and two had knee injury symptoms; Among the 15 arc fast table tennis players, 2 had shoulder injury symptoms, 2 had waist injury symptoms, 3 had knee injury symptoms and 1 had other injury symptoms; Among the 9 fast arc table tennis players, 2 had shoulder injury symptoms and 2 had knee injury; Among the four chopping table tennis players, one had shoulder injury symptoms and two had waist injury symptoms. According to the experimental results, table tennis players have a certain degree of muscle injury after high-intensity training. Due to different emphasis directions, the muscle injury parts of athletes with different playing methods are also different.

Analysis of recovery effect of muscle injury

As shown in Table 2, according to the muscle strength test results of infraspinatus muscle, the muscle strength test results before recovery training are 2.01 ± 2.1846 and after recovery training are 1.70 ± 1.8867, indicating that the pain in infraspinatus muscle area is reduced, P > 0.05, indicating that there is no significant difference; According to the empty tank test, the test result before recovery training is 4.23 ± 1.6335, and

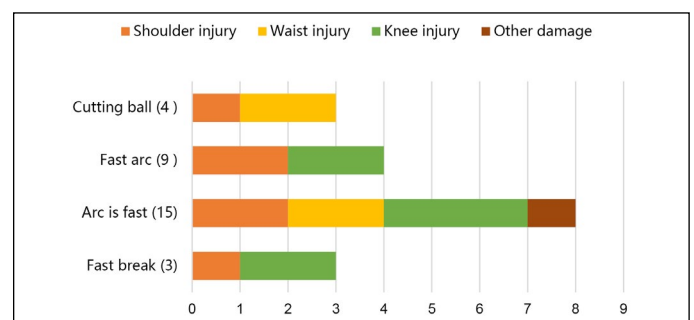


Figure 1. Analysis of injuries of athletes with different playing methods after high-intensity training.

Table 2. Muscle condition test before and after recovery training.

Option	Before resuming training	After recovery training	P
Okamus muscle strength	2.01 ±2.1846	1.70 ±1.8867	0.3009
Empty tank test	4.23±1.6335	3.44±1.4352	0.0875
LIFT OFF test	0.89 ±2.0937	0.81 ±2.3478	0.1773

the test result after recovery training is 3.44 ± 1.4352 , indicating that the muscle pain is reduced, $P > 0.05$, indicating that there is no significant difference; It can be seen from the lift off test that the test result before recovery training is 0.89 ± 2.0937 and that after recovery training is 0.81 ± 2.3478 , indicating that the muscle pain is reduced, $P > 0.05$, indicating that there is no significant difference.

As shown in Table 3, in terms of PRI sensory score, it was 2.17 ± 0.2944 before recovery training, and the general evaluation range was moderate pain, which was more serious. After recovery training, it was 1.37 ± 0.3279 , and the general evaluation range was mild pain, which was relieved, $P > 0.05$, indicating that there was no significant difference; The score of pain recovery before and after training was approximately 290.05, indicating that there was no pain, and the score of recovery after training was approximately 290.38, indicating that there was a significant difference in the range of severity, $P < 1.05$; In terms of PRI total score, it was 2.05 ± 0.4975 before recovery training, the general evaluation range was from moderate pain to extreme pain, and the situation was more serious. After recovery training, it was 1.74 ± 0.3722 , and the general evaluation range was from mild pain to moderate pain. Although it was still serious, the situation was relieved relatively, $P < 0.05$, indicating that there was a significant difference.

Through the 6-week muscle injury recovery experiment, it can be seen that the pain of athletes has been significantly improved, which has a good effect on the improvement of their sports level and sports comfort. Therefore, this experiment is beneficial to the recovery of athletes' muscle injury and pain relief.

Analysis of peak flexion and extension moment of muscle group after recovery training

As shown in Table 4, the peak left flexion torque of male athletes increased from 77.18 ± 4.1209 (N·m) to 100.29 ± 16.0472 (N·m), $P > 0.05$, indicating that there was no significant difference; The peak moment of left extension of muscle group increased from 152.90 ± 6.5311 (N·m) to 180.26 ± 3.4959 (N·m), $P > 0.05$, indicating that there was no significant difference; The peak right flexion torque of muscle group increased from 84.35 ± 1.5614 (N·m) to 127.39 ± 4.4615 (N·m), $P > 0.05$, indicating that there was no significant difference; The peak moment of right extension of muscle group increased from 153.67 ± 8.8646 (N·m) to 183.00 ± 5.1055 (N·m), $P > 0.05$, indicating that there was no significant difference.

As shown in Table 5, the peak left flexion torque of female athletes increased from 40.08 ± 2.9029 (n m) to 55.20 ± 5.4100 (N·m), $P > 0.05$, indicating that there was no significant difference; The peak moment of left extension of muscle group increased from 82.36 ± 3.7886 (N·m) to 117.00 ± 6.2950 (N m), $P > 0.05$, indicating that there was no significant difference; The peak moment of right flexion of muscle group increased from 40.24 ± 3.6490 (N·m) to 62.60 ± 7.8663 (N·m), $P > 0.05$, indicating that there was no significant difference; The peak right extension torque of muscle group increased from 87.54 ± 7.9886 (n m) to 120.18 ± 4.0093 (N·m), $P > 0.05$, indicating that there was no significant difference.

DISCUSSION

The technical characteristics of table tennis have high requirements for athletes' sensitivity and coordination. Therefore, strengthening the training of special quality can not only improve athletes' special skills and improve their performance, but also effectively prevent sports injuries, so as to kill two birds with one stone. For example, the coordination of practice movements can effectively improve the neural control ability of the body, so as to stabilize the realization of technical movements; The training of sensitivity quality can help athletes quickly realize the transmission of nerve impulse in different postures, so as to improve

Table 3. Analysis of pain grading index before and after recovery training.

Option	Before resuming training	After resuming training	P
PRI feel	2.17 ± 0.2944	1.37 ± 0.3279	0.1106
PRI emotions	1.90 ± 0.2935	0.38 ± 0.1821	0.0415
PRI total points	2.05 ± 0.4975	1.74 ± 0.3722	0.0232

Table 4. Peak flexion and extension torque of male athletes' muscle group at the speed of $60^\circ / S$ (unit: N·m, n = 19).

Option	Before resuming training	After resuming training	P
Left	77.18 ± 4.1209	100.29 ± 16.0472	0.2769
Leftstay	152.90 ± 6.5311	180.26 ± 3.4959	0.1796
Right injection	84.35 ± 1.5614	127.39 ± 4.4615	0.2985
Right out	153.67 ± 8.8646	183.00 ± 5.1055	0.2530

Table 5. Peak flexion and extension torque of female athletes' muscle group at the speed of $60^\circ / S$ (unit: N·m, n = 12).

Option	Before resuming training	After resuming training	P
Left	40.08 ± 2.9029	55.20 ± 5.4100	0.2858
Leftstay	82.36 ± 3.7886	117.00 ± 6.2950	0.1997
Right injection	40.24 ± 3.6490	62.60 ± 7.8663	0.3080
Right out	87.54 ± 7.9886	120.18 ± 4.0093	0.2813

their reaction ability; Practicing strength quality can effectively prevent sports injury, effectively reduce joint load and stabilize the joint, so that the muscles and ligaments around the joint can provide strong support. Most of the mechanism of sports injury is muscle strength antagonism and loss of balance, so as to reduce the control ability of the body. Therefore, strengthening the strength quality can fundamentally prevent sports injury, and can also improve the power generation ability of table tennis players, make their hitting more simple, rapid and transparent, and make the power transmission speed faster and more accurate, so as to help athletes improve the ball speed, competitive ability and competition performance. In the process of hitting table tennis, because the racket is connected with rubber, the ball will be hit under the joint action of rubber strike and friction. This process is affected by the explosive force of players, that is, the strength quality will affect the explosive force and determine the flying speed and rotation speed of table tennis after being hit. The main attacking way of table tennis is forehand attack, and the stroke is guided by the forehand to the rear side of the body. At the moment of hitting the ball, the tiptoe points the ground and drives the hip joint to change the center of gravity of the body, then the trapezius and latissimus dorsi muscles are used to make it shrink backwards and drive the arm to complete the swing action. In this process, there will be "beyond the instrument" effect, that is, when swinging, the athlete's arm completes the "whipping" action, which is manifested as the arc swing action with the shoulder joint as the axis, so as to increase the swing distance to a certain extent, make the force more sufficient and hit the ball with higher quality. Not only that, training strength quality can also improve athletes' ability to control muscles, enable them to complete the force at will, and reduce the sports injury caused by improper swing force.

The use of protective equipment can protect specific parts of the body. The common types of protective equipment on the market are: ankle protective equipment, knee protective equipment, elbow protective equipment and wrist protective equipment, hip protective equipment, waist and hip protective equipment and muscle compression protective suit, etc. According to the type of use, the protective equipment can be divided into daily protective equipment, medical protective equipment and sports protective equipment. The effect of sports protective protector is to support and protect the joints, ligaments and other tissue parts that

have suffered sports injury, and further limit the movement of the injured parts, so as to prevent the aggravation of the injury. Healthy people can also use sports protective equipment, which can alleviate muscle pain caused by long-term inactivity. Its design concept is to protect people's physical safety during sports, produce support and protection effects when people wear, protect them and improve their sports experience, so that the wearer can complete the movement with less worry and effort.

CONCLUSION

The high-intensity training of table tennis has a certain impact on the physiological and psychological aspects of athletes, which is reflected in the muscle changes and the muscle injuries in all aspects of the body.

Therefore, effective recovery methods are needed. The research results of this paper show that a good recovery method can not only alleviate muscle pain, but also reduce the psychological problems caused by pain, but also improve muscle movement, so as to improve athletes' sports level from both physiological and psychological aspects and promote their recovery as soon as possible, so as to achieve good recovery effect and promote the improvement of athletes' sports level. Therefore, coaches and athletes should consciously add relevant muscle recovery training in the daily training process, so as to make athletes get a better sports state.

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