

FUNCTION MONITORING AND RECOVERY METHODS IN THE REHABILITATION OF TENNIS PLAYERS



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MONITORAMENTO DE FUNÇÃO E MÉTODOS DE RECUPERAÇÃO NA REABILITAÇÃO DE JOGADORES DE TÊNIS

SEGUIMIENTO DE LA FUNCIÓN Y MÉTODOS DE RECUPERACIÓN EN LA REHABILITACIÓN DE TENISTAS

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ABSTRACT

Introduction: Sports injury is a common injury among professional tennis players compared to other sports. Updated rehabilitation methods can accelerate players' recovery and ensure a return to sporting activity. However, contemporary rehabilitation monitoring practices want updated reporting. **Objective:** Monitoring tennis players' function and recovery methods during rehabilitation training after injury. **Methods:** The tennis player underwent arthroscopic capsulotomy of the left ankle joint, free body removal, and synovectomy. The athlete's body composition, blood routine, biochemistry, nutritional indices, and physiological indicators were monitored. Data were collected before, during, and at the end of the four months (6-10 months) of rehabilitation after the operation. **Results:** 1 month after the operation, weight and lean mass decreased significantly; body fat percentage increased; static heart rate increased significantly ($P<0.05$). Three months after surgery, the athlete's lean mass increased significantly to 43.7 kg; body fat percentage decreased to 24.5% ($P<0.05$); hemoglobin, serum iron, total protein, and albumin improved; in rehabilitation during October, blood routine and biochemical blood indices were regular; Resting, maintained-load and recovery heart rate decreased significantly ($P<0.05$). **Conclusion:** Tennis players should begin function monitoring, rehabilitation training, and nutritional recovery as soon as possible after ankle joint surgery. **Evidence Level II; Therapeutic Studies - Investigating the result.**

Keywords: Tennis; Rehabilitation; Physical Functional Performance.

RESUMO

Introdução: A lesão esportiva é uma lesão comum entre os tenistas profissionais, em comparação com outros esportes. Métodos atualizados de reabilitação podem acelerar a recuperação dos jogadores e garantir um retorno à atividade esportiva. Porém o monitoramento das práticas de reabilitação contemporâneas carece de relatórios atualizados. **Objetivo:** Explorar o monitoramento da função e métodos de recuperação dos jogadores de tênis durante o treinamento de reabilitação após uma lesão. **Métodos:** O tenista foi submetido a capsulotomia artroscópica da articulação do tornozelo esquerdo, remoção de corpo livre e sinovectomia. Foram monitorados a composição corporal do atleta, rotina sanguínea, bioquímica sanguínea, indicadores nutricionais e indicadores fisiológicos. Esses dados foram coletados antes, durante e ao final dos 4 meses (6-10 meses) de reabilitação após a operação. **Resultados:** 1 mês após a operação, o peso e a massa magra diminuíram significativamente, aumentando a porcentagem de gordura corporal; o ritmo cardíaco estático aumentou significativamente ($P<0,05$). 3 meses após a cirurgia, a massa magra do atleta aumentou significativamente para 43,7 kg, a porcentagem de gordura corporal caiu para 24,5% ($P<0,05$); a hemoglobina, o ferro sérico, a proteína total e a albumina melhoraram. Na reabilitação durante o mês de outubro, a rotina sanguínea e os índices bioquímicos do sangue foram normais; a frequência cardíaca em repouso, com carga mantida e de recuperação diminuiu significativamente ($P<0,05$). **Conclusão:** Os tenistas devem começar o monitoramento das funções, treinamento de reabilitação e recuperação nutricional o mais rápido possível após uma cirurgia na articulação do tornozelo. **Nível de evidência II; Estudos Terapêuticos - Investigação de Resultados.**

Descritores: Tênis; Reabilitação; Desempenho Físico Funcional.

RESUMEN

Introducción: La lesión deportiva es una lesión común entre los tenistas profesionales en comparación con otros deportes. Los métodos de rehabilitación actualizados pueden acelerar la recuperación de los jugadores y garantizar la vuelta a la actividad deportiva. Sin embargo, el seguimiento de las prácticas contemporáneas de rehabilitación carece de informes actualizados. **Objetivo:** Explorar el seguimiento de la función y los métodos de recuperación de los tenistas durante el entrenamiento de rehabilitación después de una lesión. **Métodos:** El tenista fue sometido a una capsulotomía artroscópica de la articulación del tobillo izquierdo, a la extracción del cuerpo libre y a la sinovectomía. Se controló la composición corporal del atleta, la rutina sanguínea, la bioquímica sanguínea, los indicadores nutricionales y los indicadores fisiológicos. Estos datos se recogieron antes, durante y al final de los 4 meses (6-10 meses) de rehabilitación tras la operación. **Resultados:** 1 mes después de la operación, el peso y la masa magra disminuyeron significativamente, aumentando el porcentaje de grasa corporal; la frecuencia cardíaca estática aumentó significativamente ($P<0,05$). 3 meses después de la operación, la masa magra de la atleta aumentó significativamente hasta 43,7 kg, el porcentaje de grasa corporal disminuyó hasta el 24,5% ($P<0,05$); la hemoglobina, el hierro sérico, la proteína total y la albúmina mejoraron. En el periodo de entrenamiento de rehabilitación en el mes de octubre, la rutina sanguínea y los índices



bioquímicos sanguíneos fueron normales; la frecuencia cardíaca en reposo, con carga mantenida y en recuperación disminuyó significativamente ($P < 0,05$). Conclusión: Los jugadores de tenis deben comenzar el control de la función, el entrenamiento de rehabilitación y la recuperación nutricional lo antes posible después de la cirugía de la articulación del tobillo. **Nivel de evidencia II; Estudios terapéuticos - Investigación de resultados.**

Descriptor: Tenis; Rehabilitación; Rendimiento Físico Funcional.

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INTRODUCTION

Sports injury is a common injury among professional tennis players, compared to other sports, tennis is used more frequently on the shoulders, serving, high pressure, smashing and other actions all have a great dependence on the shoulder.¹ In long-term training and competition, these high-intensity shots continuously hit the shoulder joints and ligaments repeatedly, causes different degrees of strain on the shoulder muscles, this can induce shoulder injuries. In addition to the characteristics of tennis, the special structure of the shoulder is also an important cause of injury. The shoulder joint is a ball-and-socket-shaped soft tissue network, which is one of the most flexible joints in the human body.² There are few ligaments near the shoulder joint, the joint capsule is thin and loose, lack of hard bone support and protection, therefore, when the shoulder joint suddenly exerts force or rotates repeatedly, it may cause ligament or joint strain around the shoulder.³

METHOD

Research objects

Excellent tennis player, 25 years old, height 167cm, weight 57kg. Injured in the game on April 30, 2019, diagnosed as left ankle joint capsule impingement syndrome, under the left ankle arthroscopy in a third hospital of a certain hospital, the posterior joint capsule was incised and the free body was removed and the diseased synovectomy was performed. System rehabilitation training began in early June, two months of training started in early October and returned to the game at the end of October.⁴

Rehabilitation measures after surgery

1 month after surgery, the athletes gradually implement systematic rehabilitation training. The goal is through rehabilitation and physical training, achieve basic painless training at the injured area and prevent new injuries. Rehabilitation training 6 days a week, once a day, rest on Sunday. Specific content: (1) Before training: 20 minutes of warm-up activities such as bicycles and treadmills, with a heart rate of 120-140; (2) During training: 30 to 60 minutes each time, focus on the stability and strength training of the ankle joint, combine strength training of upper limbs, waist, abdomen and back muscles; (3) After training: Apply ice for 10-15 minutes, stretch and relax at the same time (PNF: Promoting the wrist, elbow, shoulder, lower back, hip, knee, and ankle joints. Each action is held for 5-10 seconds and repeated 10-20 times); (4) Rehabilitation treatment: Full body massage and relaxation every night, with treatments such as rational therapy, hydrotherapy and magnetic therapy.

Test indicators and instruments

1. Morphological test

During the monitoring period, test once a month. Jiewen DX-200 body composition analyzer (Korea) was used to measure body weight, lean body mass, body fat percentage and other indicators.

2. The blood biochemical test is tested 3 times a month during the monitoring period. During the test, in the morning on an empty stomach and in a quiet state, take blood from a vein in the elbow. The test content includes: Use XE.2100i automatic blood analyzer (Japan)

to test multiple blood routine indicators such as hemoglobin (Hb), red blood cell count (RBC), white blood cell count (WBC); HI.TACHI7600.020 automatic biochemical analyzer (Japan) was used to measure blood urea (BU) and creatine kinase (CK) as biochemical indicators of skeletal muscle tissue damage and protein metabolism evaluation; The domestic MAGIMuZYME magnetase immunoassay (M1 type) was used to test the hormone levels of blood testosterone (T) and cortisol (C).⁵

Statistical analysis

Use SPSS12.0 software to perform statistical analysis on relevant data, data is expressed as mean \pm standard deviation, the difference between the groups was analyzed by t test, and the difference was significant with $P < 0.05$.

RESULTS

Body composition

As shown in Figure 1, compared with before surgery, athlete weight and lean body weight decreased after surgery, and the percentage of body fat increases; From June, August to October, the weight first increases and then decreases, body fat percentage continues to decrease, lean body mass continues to increase and maintain a high level.

The results of this study also show that the lack of systematic training caused the loss of muscle mass in athletes one month after the suspension of training, the body fat metabolism decreases, and the accumulation of adipose tissue increases the body fat percentage.⁶ After entering the rehabilitation period training, athletes' morphological indicators all have benign changes, indicating that after systematic training, athletes' muscle fat metabolism increases and muscle mass increases. After entering the training, the research team hopes to increase the proportion of aerobic training and promote the rationalization of diet, keep your weight at 57~59 kg (in the weight range of previous competitions), and then achieve the reduction of body fat, at the same time, the purpose of maintaining lean body mass.

Blood routine index

As shown in Table 1, compared with before surgery, athletes' Hb decreased significantly one month after the operation ($P < 0.05$), it rebounded

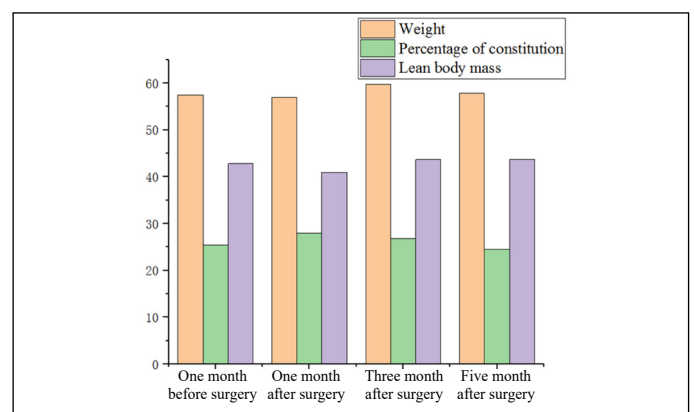


Figure 1. Changes in athlete's body composition.

significantly in August ($P<0.05$), and showed a downward trend after entering winter training. The RBC fluctuates within the normal range. 1 month to 6 months before surgery, WSC shows a downward trend, even lower than the normal range; It showed an upward trend in August and returned to normal.

The reasons for the drop in hemoglobin levels of athletes are: (1) The violent contraction of skeletal muscle causes a sharp increase in intravascular pressure, the red blood cells are destroyed and the amount of hemoglobin in the red blood cells is reduced; (2) The accumulation of metabolites (such as lactic acid, free radicals) will seriously damage the structure of red blood cells. This study believes that poor postoperative nutritional status may be the main reason for the decline in athletes' Hb (see Nutritional Index Analysis for details), therefore, the nutritional status of athletes improved in June. Hb rebounded; After entering the winter training, the exercise load continues to increase, and the Hb has a downward trend, however, the Hb level (1249/L) at the end of the training was significantly higher than the level over the same period.⁷

Biochemical indicators

As shown in Figure 2, compared with June, creatine kinase showed an increasing trend in August and October ($P<0.05$); Blood urea decreased first ($P<0.05$), then increased; Blood testosterone drops first ($P<0.05$), then recovers ($P<0.05$); Cortisol increased first ($P<0.05$), then decreased ($P<0.05$). The above results indicate that when athletes just started rehabilitation training, the amount of exercise and exercise intensity are small, there was no abnormal change in the biochemical indicators reflecting the exercise load stimulation.⁸ After entering the training, with the exercise load continues to increase significantly, CK increased significantly, T decreased significantly, and C increased significantly.

As shown in Table 2, compared with preoperative resting heart rate (53.5 ± 3.2 beats/min), after the operation, the resting heart rate of athletes increased significantly ($P<0.05$); Compared with June, its resting heart rate, exercise heart rate and recovery heart rate decreased significantly

Table 1. Changes of some athletes' blood routine indexes.

Date	Hb	RBC	WBC
1 month before surgery	135.0±4.5	5.66±0.08	7.50±0.44
1 month after operation	130.0±3.0	5.50±0.10	6.24±0.20
3 months after surgery	135.0±3.66	4.60±0.15	4.88±0.36
5 months after surgery	144.0±5.0	5.86±0.05	5.40±0.11

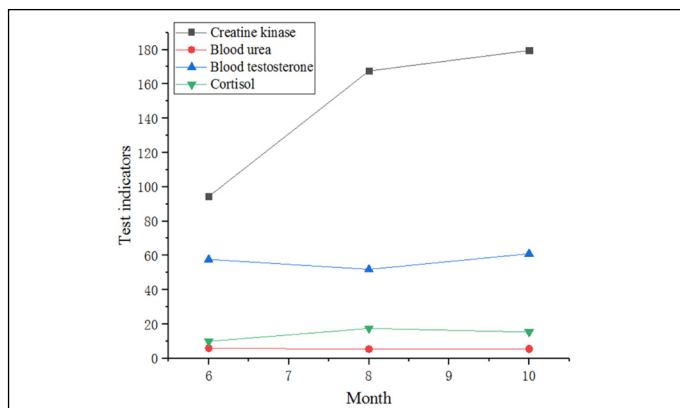


Figure 2. Changes in the main biochemical indicators of athletes.

Table 2. Changes in resting heart rate, exercise heart rate and recovery heart rate under the same load.

Test index	June	August	October
Resting heart rate	75.3±4.5	60.7±4.1	44.5±2.9
Exercise heart rate	188.3±2.9	175.4±3.4	177.8±3.6
Recover heart rate after 1 minute	133.5±5.9	125.6±3.0	131.6±4.9

in August ($P<0.05$); Compared with August, its resting heart rate, exercise heart rate and recovery heart rate under the same load decreased significantly in October ($P<0.05$).

DISCUSSION

Research has shown that, stop training or insufficient training will reverse the benign adaptive state of the cardiopulmonary system and metabolism induced by training, as a result, athletes have poor performance such as increased resting heart rate, decreased blood volume, and decreased muscle mass. The resting heart rate of the athlete in this case increased significantly after stopping training for 1 month ($P<0.05$), this is consistent with the research results.⁹ Research shows that after athletes stop training for 14 days, during submaximal exercise ($75\sim 90\%V_{O2max}$), the heart rate increases by 11 times/rain, and the maximum heart rate has also increased by 9 beats/min.¹⁰ This study found that, in the quantitative load test, athletes have a higher heart rate immediately after exercise, even unable to complete the test and slower heart rate recovery after exercise, this shows that the athlete's cardiovascular system has not yet recovered, it may be due to adverse changes in the athlete's cardiopulmonary function, energy metabolism and skeletal muscle function metabolism after stopping training, such as the decrease in heart volume, decrease in blood volume, decrease in maximum oxygen uptake, etc. This study showed that 2 months of systematic rehabilitation training and nutritional recovery significantly reduced the athlete's resting heart rate ($P<0.05$); In the quantitative load test, exercise heart rate and recovery heart rate decreased significantly ($P<0.05$), the research results are similar to foreign research. This shows that after the system training, the athlete's cardiovascular function is restored, the ability to adapt to exercise load is further strengthened, it has made a good reserve of functions and physical fitness for winter training. (3) Compared with 1 month after operation and recovery period, athletes' resting heart rate, exercise heart rate at the same load, and recovery heart rate show a downward trend, explain that after systematic training and recovery measures, the athletes have been able to tolerate the heavy-load training mode, and the cardiopulmonary function has basically returned to normal.¹¹ Try to participate in a domestic competition at the end of October, and won the championship, but also verified that his body has the ability to withstand high-intensity competition.

CONCLUSION

Studies have shown that abnormal body posture and muscle balance are important risk factors for sports injuries, it is one of the root causes of sports injuries. The results of this study show that, tennis players perform early functional monitoring and rehabilitation training after ankle joint surgery, improve the nutritional and functional status of athletes, and improved its ability to adapt to training and competition. It can play a positive role in the rehabilitation of sports injuries.

All authors declare no potential conflict of interest related to this article

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