THE EFFECTS OF STRETCHING ON TRAINING CYCLISTS

OS EFEITOS DO ALONGAMENTO NO TREINAMENTO DE CICLISTAS

LOS EFECTOS DE LOS ESTIRAMIENTOS EN EL ENTRENAMIENTO DE CICLISTAS

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ABSTRACT

Introduction: Scientific and rational post-competition training can help athletes mobilize their competitive state. Stretching is an integral part of the physical recovery program after a cycling event, increasing muscle extensibility, decreasing muscle soreness, and the likelihood of injury. Objective: This study aims to analyze the effect of stretching training on cyclists. Methods: This paper selects 20 cyclists who perform stretching training after the competition. The athletes' fatigue recovery after stretching training and the probability of sports injuries after stretching exercise are statistically analyzed. Results: The athletes demonstrated poor physical flexibility before stretching. In the forward bending test, the athletes demonstrated scores of 15.31 and 17.89, respectively. After stretching training, the athletes improved to 23.68 and 25.36 in the seated forward flexion test. The data collected were statistically significant (P<0.05). Conclusion: Stretching exercises can effectively improve the competitive ability of cyclists. It is recommended that athletes devote about 10 to 15 minutes of relaxation and stretching exercises after cycling. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: Muscle Stretching Exercises; Bicycling; Fatigue; Exercise Training.

RESUMO

Introdução: O treinamento científico e racional pós-competição pode ajudar o atleta a mobilizar seu estado competitivo. O alongamento é parte integrante do programa de recuperação física após um evento de ciclismo aumentando a extensibilidade muscular, diminuindo a dor muscular e a probabilidade de lesões. Objetivo: O presente estudo visa analisar o efeito do treinamento de alongamento sobre os ciclistas. Métodos: Este trabalho seleciona 20 ciclistas que realizam o treinamento de alongamento após a competição. A análise da recuperação da fadiga dos atletas após o treinamento de alongamento e a probabilidade de lesões esportivas após o exercício de alongamento são analisados estatisticamente. Resultados: Os atletas demonstraram pouca flexibilidade física antes do alongamento. No teste de flexão para frente, os atletas demonstraram resultados de 15,31 e 17,89, respectivamente. Os atletas melhoraram para 23,68 e 25,36 no teste de flexão sentado para frente após o treinamento de alongamento. Os dados coletados foram estatisticamente significativos (P<0,05). Conclusão: Os exercícios de alongamento podem efetivamente melhorar a habilidade competitiva dos ciclistas. Recomenda-se aos atletas dedicarem cerca de 10 a 15 minutos de exercícios de relaxamento e alongamento após o ciclismo. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

Descritores: *Exercícios de Alongamento Muscular; Ciclismo; Fadiga; Treinamento Físico.*

RESUMEN

Introducción: El entrenamiento científico y racional después de la competición puede ayudar al deportista a movilizar su estado competitivo. Los estiramientos son una parte integral del programa de recuperación física después de una prueba de ciclismo, lo que aumenta la extensibilidad de los músculos y disminuye el dolor muscular y la probabilidad de lesiones. Objetivo: El presente estudio pretende analizar el efecto del entrenamiento de estiramientos en ciclistas. Métodos: Este trabajo selecciona a 20 ciclistas que realizan un entrenamiento de estiramiento después de la competición. Se analizan estadísticamente la recuperación de la fatiga de los atletas después del entrenamiento de estiramiento y la probabilidad de lesiones deportivas después del ejercicio de estiramiento. Resultados: Los atletas mostraron poca flexibilidad física antes de los estiramientos. En la prueba de flexión hacia delante, los atletas demostraron resultados de 15,31 y 17,89, respectivamente. Los atletas mejoraron a 23,68 y 25,36 en la prueba de flexión hacia delante sentados después del entrenamiento de estiramiento. Los datos recogidos fueron estadísticamente significativos (P<0,05). Conclusión: Los ejercicios de estiramiento pueden mejorar eficazmente la capacidad competitiva de los ciclistas. Se recomienda que los deportistas dediquen entre 10 y 15 minutos a ejercicios de relajación y estiramiento después del ciclismo. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

Descriptores: Ejercicios de Estiramiento Muscular; Ciclismo; Fatiga; Entrenamiento Físico.

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INTRODUCTION

Cycling is a physical fitness project in the sports group theory. Short-distance track cycling is a physical-dominant speed event. Mid- and long-distance track cycling and road cycling are endurance sports dominated by physical fitness. This sport has exceptionally high physical demands on the athletes. Cycling plays a vital role in competitive sports. Athletes who use overload training methods for physical fitness and skill training will cause different degrees of fatigue to the body. Excessive exercise may even cause sports injuries.[1] Stretching exercises stretch muscles by applying tension to various parts of the body or using gravity, body posture, active movements, and internal forces. Its purpose is to increase the length of human soft tissues, especially muscles and tendons. Stretching exercises are divided into two categories: dynamic stretching and static stretching. Dynamic stretching includes elastic stretching, isometric stretching, and "neuromuscular proprioceptive stretching" (PNF). Static stretching includes passive-static stretching and active static stretching. Dynamic stretching affects dynamic flexibility, and static stretching mainly affects static flexibility. In this paper, the method of stretching exercise is used to guide athletes to recover from fatigue after exercise, to prevent and timely deal with sports injuries, and to guide their self-recovery after training.

METHOD

Research objects

This paper takes 30 members of the cycling team's road group, middle-long group, and the short group as the survey objects.[2] This article examines the effects of stretching on the training of professional cyclists.

Research methods

This article aims at alleviating sports fatigue and physical rehabilitation of professional cyclists.[3] This paper analyzes the effects of stretching on athletes' fatigue recovery and rehabilitation training.

Kinetic equation of human bicycle motion

In this paper, the model of human motion in the cycling state is simplified into a conventional tree-shaped multi-rigid body system.[4] The holonomic hinges bound them. We know from the multi-rigid system dynamics and computational multi-system dynamics that the dynamic equation is expressed as follows:

$$A^*\ddot{q} = B^* \tag{1}$$

q is the generalized coordinate of the multi-rigid body system.

$$A^* = (PT)^* K^* (PT)^T - \left[PT \times C^* (TmT)\kappa^T\right] - \left[PT \times C^* (TmT)\kappa^T\right]^T + \kappa (TmT)\kappa^T \tag{2}$$

$$B^* = (PT)^* \left[K^* V + G - L + (CT) \times (F + mTh - m\mathrm{r}_{01}1_{12} -\right](\kappa T)^* \left[F + mT^T (g+h) - m(CT)^T \times V - mr_{01}1_{12}\right] + Q \tag{3}$$

m_i is the mass of rigid body B_i. $m = diag(m_1 m_2 \cdots m_{12})$; A^* is a generalized mass matrix. F, L is a 12×1 array of principal vectors and principal moments of the active forces acting on the rigid bodies in the system.[5] The acceleration of the center of mass of the rigid body of a purely rotational hinge system. J_i is the inertia tensor of the rigid body to the center of mass, $J = diag(J_1 J_2 \cdots J_{12})$. According to the definition of the augmented body centroid, we can get:

$$\sum_{j=1}^{12} b_{ij} m_j = 0, (i = 1, 2, \cdots\cdots, 12) \tag{4}$$

The relationship between the path vector d_{ij} and the augmented volume vector b_{ij} is expressed as follows:

$$d_{ij} = b_{i0} - b_{ij} (i, j = 1, 2, \cdots\cdots, 12) \tag{5}$$

Matrix K is the following matrix for the inertia tensor elements of the augmented matrix element to the hinge points on it, leading to the zero rigid body.

$$K_{ij} = \begin{cases} J_i + \sum_{k=1}^{12} m_k (d_{ik}^2 E - d_{ik} d_{ik}), (s_i = s_j) \\ M(b_{j0} * d_{ij} E - b_{j0} d_{ij}), (s_i < s_j) \\ M(d_{ji} * b_{i0} E - d_{ji} b_{i0}), (s_i > s_j) \\ 0, \text{other} \end{cases} \tag{6}$$

Where $i, j = 1,2, ...,12$.

There is no need for a code of ethics for this type of study.

RESULTS

The principle of action of stretching exercise in fatigue recovery

Achieving excellence in competitive sports is the goal. Stretching is mainly used to focus on pulling specific parts after training. This exercise relieves muscle stiffness and fatigue. Athletes performed a 15-min warm-up before cycling training. If the temperature is not particularly low in winter, you can directly perform stretching exercises. If the environment's temperature is shallow, you need to jog for about 5 to 10 minutes before the stretching exercise to make the body move slightly. The athlete then stretches again.[6] The method used in stretching exercises is dominated by dynamic stretching. This can better "warm" the muscles and increase the elasticity of muscles, ligaments, and tendons.

Influence of stretching exercise on biochemical indicators

It can be seen from Table 1 that the serum CK enzymes of the elite cyclists reached 888.36 and 503.68 in the morning after the first stretching training session. During the previous routine strength training, the highest serum CK enzymes of the players were 608.5 (men) and 362.1 (women). It can be seen that the serum CK enzyme of athletes after stretching exercise is significantly higher than that of the previous strength training. After eight weeks of stretching exercise, athletes' serum CK enzyme levels were 261.23 and 181.68, respectively.[7] The data are all lower than the previous values after strength training. This experiment shows that athletes who only pay attention to strength training and not stretching exercises will cause the muscles to be in a state of contraction for a long time. The muscles are passively elongated after stretching exercises. This causes the muscle cells to break down and causes a large amount of the CK enzyme in the muscle cells to flow into the blood. Serum CK enzyme decreased after eight weeks of stretching exercises after that. This is due to a particular improvement in muscle flexibility after eight weeks of stretching exercises. Gradual adaptation of muscles to stretching exercises results in a decrease in serum CK enzymes.

It can be seen from Table 2 that the 30 cyclists had poor flexibility before the flexibility training. The athlete had only 15.31 and 16.88 on the pre-training seated forward bend test. 48.12 and 48.68 on the

squat reach test, respectively. This value is slightly higher than the third level. This is not the standard a good cyclist should have.[8] Elite cyclists should be at the fifth level. After eight weeks of stretching, the athlete's seated forward bend test improved to 23.68 and 25.36, respectively. This value exceeds the excellent level of the national physique standard. The squat arm reach was increased to 56.33 and 56.10, respectively. The values all reached the fifth level. It can be seen that after eight weeks of stretching exercises, the physical flexibility of the athletes has been dramatically improved.

Effect and influence of stretching exercise on fatigue recovery

Fatigue during exercise training is typical. Training must also reach a certain degree of fatigue to cause drastic changes in the body to adapt. This can improve the function of all aspects of the body. 66.67% of the players can complete the training with high quality after rehabilitation.[9] Athletes who completed their training as planned accounted for 20%. Most of the athletes who completed the training accounted for 13.33%, and those who could not train accounted for 0%. (Table 3)

DISCUSSION

Injuries caused by sports training in competitive sports are unavoidable. Injuries can occur for many reasons. The content includes lack of concentration during training, insufficient ability, insufficient preparation activities, etc. And when the physical and mental fatigue reaches a certain level, the probability of injury will also be significantly increased.[10] Athletes doing proper stretching exercises after exercise can improve soreness due to lactic acid buildup and allow tense muscles to relax after exercise. This prevents muscle stiffness and slowed blood return from overtraining and reduces blood pooling in the extremities farther from the heart. Stretching also lengthens muscles and tendons. A strong pull prevents the muscles from being tightened after a high-intensity training session. At the same time, the method increases the flexibility and coordination of the body. This method can effectively prevent sports injuries. Stretching exercises require the practitioner to breathe naturally and emphasize the coordination of movement and breathing. The athlete holds a stretch for some time. Training interval athletes also do stretches on their own. This prevents and reduces muscle strains and spasms during training.

Combination stretching uses dynamic stretching to avoid the detrimental effects of static stretching on explosive power. The addition of dynamic stretches did not promote explosive performance. Dynamic stretching was the only one of the three stretching methods in which no decrease in CMJ jump height was observed immediately after stretching. However, it has only a fragile promotion effect on the improvement of CMJ performance and is not statistically significant. Dynamic stretching improves explosive power may be related to the increase in muscle and body core temperature after stretching. Studies have shown that increases in muscle and core temperature and heart rate may cause increased neuroreceptor sensitivity. Increased nerve sensitivity can increase motor nerve conduction velocity (MCV) to improve muscle contraction performance. This allows it to contract faster and generate more force.[11]

Cycling is an intense sport. It has a lot of compound movements of rapid muscle contractions. On the one hand, these movements require the muscle-tendon complex of the athlete to have sufficient stiffness to transmit a large amount of elastic energy. On the other hand, the muscle-tendon complex also requires a specific deformation ability under force.[12] This increases the tendon's ability to absorb energy. Athletes may cause tendon or muscle damage if their muscles and tendons cannot absorb enough energy. Decreased range of motion is often one of the essential factors in sports injuries. Using any of the three stretches in cyclists' pre-race preparations can significantly improve seated forward bend performance. Among them, static stretching has the best effect on improving flexibility. The mechanism by which static stretching improves static range of motion may be related to increased muscle tolerance to stretching and the decrease of muscle-tendon complex stiffness after stretching.[13] Decreased stiffness of the muscle-tendon complex reduces resistance due to antagonistic muscle tension. This helps to increase the range of motion of the joints. Neural effects may also play a role. Static stretching may cause a decrease in H-reflex activity. Decreased H-reflex activity promotes muscle relaxation and thus increases muscle extensibility.

Table 1. Changes in CK enzymes in rowers.

Gender	Number of people	The first CK enzyme value	Last CK enzyme value
Male	15	888.36±158.68	261.23±58.65
Female	15	503.68±65.48	181.68±65.32

Table 2. Flexibility index test results before and after stretching training.

Gender	Number of people	Sitting forward bend		Squat reach	
		Before training	After training	Before training	After training
Male	15	15.31±2.54	23.68±3.03	48.12±4.88	56.33±3.02
Female	15	16.88±2.42	25.36±1.66	48.68±2.38	56.10±3.41

Table 3. Proportion of post-rehabilitation training.

Train	High-quality finish	Completed on schedule	Mostly done	Can't train
Number of people	20	6	4	0
Proportion(%)	66.67	20	13.33	0

CONCLUSION

Stretching can improve muscle flexibility and joint range of motion. This training method helps muscles recover from fatigue and reduces the possibility of injury during exercise. The training method can make players concentrate and relieve mental fatigue such as stress and anxiety caused by training and competition. Stretching is relatively safe and reliable in terms of methods and means. It is effective for exercise-induced fatigue.

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