Research on training and application of core strength in swimming activities

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Abstract: In swimming, strength constitutes the core component of physical fitness and plays a pivotal role in swimmer speed and technical execution. Given the critical importance of core strength in swimming, its training has gained increasing emphasis in swimming programs. This paper investigates the training methods and applications of core strength in swimming, aiming to provide practical insights for training practices.

Keywords: swimming, core strength, training, application

1. Introduction

Nowadays, swimming is becoming increasingly popular among competitive and recreational participants worldwide. Amidst the fierce competition in the international swimming arena, even minor improvements in swimming techniques can exert a significant impact on athletes' competitive state and movement efficiency, sometimes even directly determining the outcome of a race. In the past, training for swimmers focused primarily on the strength and technical practice of their limbs, while the core stability and core strength received insufficient attention in daily training arrangements. Today, as our understanding of the torso's transmission and stabilizing role in swimming deepens, core strength training has gradually gained wide recognition and expanded to various events within competitive and mass sports. However, in practical training applications, core training should be scientifically tailored to the technical characteristics of different swimming strokes as well as athletes' individual physical conditions to improve body control, reduce energy consumption and ultimately enhance swimmers' competitive performance.

2. The crucial role of core strength in swimming

2.1. Play an important supporting role in swimming techniques

Compared with other sports, swimming has a prominent characteristic: from the moment athletes dive off the starting block, their entire bodies are in an unstable environment without fixed support. Therefore, athletes must constantly adjust their postures in water to maintain body balance. Core strength plays a vital role in athletes' ability to continuously adjust body postures. Accordingly, core strength training is required to develop and improve such capability among athletes [1].

2.2. It can enhance athletes' coordination ability

In swimming, the coordination of athletes' force exertion is extremely important. Only with sound coordination of force exertion can athletes avoid stiff movements and maintain proper technical postures in water. This allows athletes to move forward at the highest speed with low energy consumption. For the cultivation of athletes' coordination ability, strengthening coordination exercises on land is of primary importance, such as mat exercises and ball games on land. These exercises can improve athletes' physical coordination and body control. In addition, it is necessary to enhance athletes' ability to control and coordinate their bodies in water. To achieve this goal, athletes need to transfer physical strength to arms and legs through body rotation during swimming and then move forward relying on spinal strength. Therefore, only when athletes possess strong core strength can they master and exert swimming techniques better [2].

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2.3. Core strength acts as a hub in swimming

When the human body exercises, multiple joints and muscle groups are involved. Therefore, a key issue in sports is how to organically coordinate movements of different joints and muscle contractions to form a muscular kinetic chain consistent with mechanical principles, enabling athletes to generate force efficiently in water. In swimming, past training laid excessive emphasis on limb movements, such as upper-limb pulling techniques and lower-limb kicking techniques. Nevertheless, such training ignored the function of the trunk during swimming. When athletes exert force with their limbs while swimming, power is transmitted to all body parts via the trunk. For this reason, the core region is regarded as the hub of the human muscular kinetic chain and the primary source of core strength. It follows that insufficient core strength prevents effective force generation by the limbs, which means athletes cannot deliver their swimming techniques to full effect.

2.4. Core strength can effectively reduce and prevent sports injuries among athletes

During exercise, when athletes perform rapid force-generating movements, the core muscles guarantee the stability of deep small muscle groups that maintain their normal anatomical positions within the body, thereby preventing acute injuries to athletes. Conversely, improper force exertion will greatly raise athletes' risk of injury. Conventional swimming training mostly focuses on strengthening major muscle groups yet neglects training for small muscles responsible for spinal stability. Athletes undertake heavy training loads, so these inadequately trained small muscles are relatively prone to fatigue. If such fatigue persists for a long time, athletes will sustain injuries such as low back pain. The control capacity derived from core strength enables athletes to maintain proper body posture, reduce injury risks, and allow them to fully demonstrate their swimming techniques.

3. Methods for core strength training

3.1. Forearm muscle training

Muscles include flexor carpi ulnaris, flexor carpi radialis, brachioradialis and palmaris longus belong to forearm muscles. The forearm muscle group consists of extensor carpi radialis brevis, extensor carpi radialis longus, extensor carpi ulnaris and other muscles. The forearm muscle group plays a dominant role during water catching, water holding and water pushing movements in swimming. Therefore, strengthening the training of forearm muscle groups is of great significance for swimmers. The following methods can be adopted in training:

Elastic band wrist flexion and extension. Secure one end of the elastic band, wrap the free end around the palm, and complete wrist flexion and extension exercises.

Weighted wrist flexion and extension with overhand and underhand grips. Perform wrist flexion and extension exercises with an overhand grip on the barbell.

Weighted hammer wrist flexion and extension with forward wrapping. Wrap the weighted hammer strap forward around the palm and perform wrist flexion and extension movements.

When practicing with the above methods, the load should be increased progressively, followed by repeated exercises [3].

3.2. Upper arm muscle group training

Muscles such as the biceps brachii and triceps brachii are upper arm muscles, which collectively form the upper arm muscle group. The upper arm muscle group plays a considerably important role in swimming. Training for the upper arm muscle group can be carried out through the following methods:

Underhand barbell and dumbbell curls are adopted to develop the biceps brachii.

Triceps can be trained via bench tricep extensions and overhead tricep extensions.

3.3. Chest, shoulder and back muscle group training

The chest muscle group mainly comprises the pectoralis minor and pectoralis major. These muscles perform vital functions in swimming and are especially important during technical movements such as catching and holding water. The trapezius muscle is critical for the execution and velocity of swimming

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motions. Accordingly, swimmers should continuously strengthen training for muscular strength and endurance. In practice, elastic band cross chest fly exercises can be used to train the pectoralis major and pectoralis minor, while weighted shrugs are suitable for training the trapezius muscle.

3.4. Thigh muscle group training

The quadriceps femoris, rectus femoris, vastus lateralis and biceps femoris are the primary thigh muscles. These powerful thigh muscles provide power support for leg movements and generate vital propulsive force in swimming. During kicking actions in different swimming strokes, the thigh muscle groups continuously contract and relax to drive the lower limbs to push and beat the water, which directly determines the propulsion efficiency of swimmers. Weighted full squats and half squats can be applied to train the thigh muscle groups, effectively enhancing muscle strength, explosive power and muscle endurance of thighs, so as to stabilize the kicking movements and improve swimming propulsion.

3.5. Lumbar muscle group training

Lumbar muscles play an important role in coordination and stabilization for maintaining balance and controlling movement coordination during swimming. They serve as the foundation for swimmers to control their bodies. Therefore, strengthening lumbar muscle training is the prerequisite for mastering swimming movements. Lumbar muscles can be trained by means of Swiss ball exercises, weighted sit-ups and barbell twists.

4. Application of core strength in swimming training

4.1. Scientific scheduling of training time

In today's international swimming community, training for swimmers adopts a high-tempo and short-cycle mode. Accordingly, core strength training for athletes requires reasonable time arrangement to achieve optimal training effects. Training can be divided into general muscle training and local muscle training according to muscle locations. General muscle strength training can be appropriately combined with dryland strength training to achieve balanced physical development. When carrying out local muscle strength exercises, swimmers should complete adequate warm-up activities before practicing stabilizing strength. Only after acquiring satisfactory body stability on land can athletes better conduct stability training in water.

4.2. Rational selection of training movements

From the perspective of core strength training theories, swimming training modes can be divided into two categories. The first category mainly includes backstroke and freestyle, while the second category covers breaststroke and butterfly stroke. There are differences in the focus of core strength development between these two training modes. For the first category, athletes' core strength should maintain balance and stability, emphasizing a tight, flat and straight body posture, which belongs to static strength training. For the second category, the core region experiences continuous variation and undulation, requiring simultaneous force exertion of limbs, which is dynamic strength training. Nevertheless, in practical training, these two training modes should be applied alternately to help athletes conduct core strength training more effectively and reduce physical fatigue.

4.3. Combination with practical conditions

There are differences in physical fitness among individual athletes, which lead to great disparities in the stability of core strength and training demands. Consequently, a uniform training program cannot be adopted for all athletes in practical training; otherwise, ideal training effects can hardly be achieved. Coaches should formulate tailored training programs in accordance with each athlete's physical characteristics and implement training progressively. Only in this way can athletes' overall capabilities be effectively improved.

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5. Conclusion

Core strength is an indispensable component of swimmers' physical quality. It delivers supporting functions for swimming techniques, improves athletes' neuromuscular coordination, acts as the transmission hub of kinetic chains and lowers the risk of sports injuries. Targeted core training covering forearm, upper arm, chest-shoulder-back, thigh and lumbar muscle groups can strengthen athletes' muscular foundation. In swimming practice, coaches should arrange training time scientifically, select movements rationally according to stroke types, and design individualized progressive training schemes based on athletes' physical conditions. The integration of static and dynamic core training helps swimmers stabilize body posture, improve power transmission efficiency and optimize competitive performance.

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