Research on the Training of Relaxed Running Techniques for Middle School Sprinters

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Abstract: Enhancing the study of relaxed running technique training for middle school sprinters holds significant importance for improving the athletes' sprint performance. Relaxed running elucidates the physiological mechanisms by which relaxation techniques affect sprint performance from the perspectives of exercise biomechanics and exercise physiology. By conducting objective analyses of the various components of sprint relaxation techniques and integrating the formation mechanism of these techniques, teachers can provide targeted training for middle school sprinters, which can facilitate the development of their relaxed running techniques. Furthermore, employing rational and effective methods can enhance the ability of sprinters to run with relaxation.

Keywords: Relaxation Running Techniques, Sprinting, Training Methods

1. Introduction

With the continuous advancement and innovation of modern sprint training techniques, the technology of sprinting has become more scientific and systematic, reflecting economy and practicality at every turn. The study of sprint relaxation techniques using principles from anatomy, physiology, and biomechanics is increasingly gaining the attention of coaches.

2. Concept and Significance of Sprint Relaxation Techniques

Sprinting is a cyclic high-intensity anaerobic metabolic event that requires the human body to utilize ATP for energy supply under hypoxic conditions. The speed of sprinting depends on stride length and frequency, characterized by high frequency, large amplitude, and coordinated muscle relaxation. Sprint relaxation technique refers to the ability of athletes to reasonably coordinate the contraction and relaxation of muscles during the sprint process, meaning that the muscles necessary for completing the running action participate in the contraction and work, while other muscles not involved in the action are effectively and timely relaxed.

In the daily training of athletes, many coaches often focus too much on the training of athletes' explosive power, while neglecting the cultivation of athletes' coordinated relaxation ability. This leads to some athletes having tense muscles and stiff movements during the run, thereby increasing internal resistance, excessively consuming energy, and causing the sprint performance to stagnate. However, it is not known that the coordinated relaxation ability of muscles is also a main factor in determining sprint performance, directly affecting stride frequency and length. Good coordinated relaxation ability can make the central nervous system better control the active muscles to achieve high frequency. At the same time, it can make the antagonistic muscles relax during the completion of technical movements, reducing the resistance of the antagonistic muscles encountered during muscle contraction, increasing the range of motion of the joints, and making the completion of technical movements more economical and energy-saving, thus achieving better sprint performance.

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3. The Physiological Mechanism by Which Relaxation Techniques Affect Sprint Performance

3.1. The Impact of Sprint Relaxation Techniques on Skill Acquisition

The formation of motor skills is a process that evolves from generalization, through differentiation, to consolidation, enhancement, and automation, all under the direction of the cerebral cortex, which coordinates the operation of different muscles. In other words, it is the brain's ability to precisely control muscle contraction at the right time and in the right space. In the early stages of establishing conditioned reflexes in the brain, the spread of the central nervous system's excitation and inhibition processes, which is the generalization phase, can easily lead to tension in the body and mind due to unfamiliarity with the movement. This can cause muscle stiffness, uncoordinated movements, disrupted running rhythm, and the emergence of additional unnecessary actions. A strong relaxation ability can make the timing and spatial transition of muscle contraction and relaxation more precise, more efficient, and better coordinated among muscle groups, reducing the resistance caused by muscle tension. This facilitates a faster entry into the differentiation phase of movement, establishing more accurate motor conditioned reflexes, excluding irrelevant stimuli, and thus more rapidly mastering technical movements.

3.2. The Impact of Sprint Relaxation Techniques on Energy Expenditure

Sprinting relies on the decomposition of high-energy phosphorus compounds in muscles, adenosine triphosphate (ATP) and creatine phosphate (CP), for energy supply in anaerobic metabolic sports. The energy supply at maximum power through CP decomposition can only be maintained for about 6 to 8 seconds. During intense exercise, the content of CP drops rapidly, but ATP does not change much. Its characteristic is that the total energy supply is small, the duration is short, the output power is the fastest, it does not require oxygen, and does not produce substances such as lactic acid. Sports such as sprinting, throwing, and jumping mainly rely on this energy supply system. The storage of ATP in human muscle is limited, and it will be consumed in the first few seconds after starting, and the consumption rate is far greater than the aerobic synthesis ability of ATP. Therefore, to maintain a high sprinting speed, it is necessary to enhance the replenishment ability of ATP and improve the speed of ATP re-synthesis. The speed of ATP re-synthesis is closely related to the degree of muscle relaxation, blood flow speed, and oxygen supply. In a relaxed state, blood flow increases, and oxygen supply is relatively sufficient, which is beneficial to improve the speed of ATP re-synthesis. If the muscles are tense, it will not only consume too much energy but also delay the re-synthesis of energy substances. The tense and contracted muscles compress the blood vessels in the muscles, affecting blood flow. Once the muscles are relaxed, it will greatly improve the conditions of blood circulation, and the blood flow will increase more than ten times compared to when the muscles are tense, and it can also reduce the content of blood lactic acid, reducing the degree of muscle fatigue.

Therefore, in the sprinting process, accelerating the relaxation speed of muscles and emphasizing the coordinated relaxation of movements can reduce the work done by additional muscles, maintain a reasonable distribution of physical strength, promote the effectiveness and economy of physical strength consumption, and are conducive to fully adjusting the reasonable speed structure of individuals.

3.3. The Impact of Sprint Relaxation Techniques on Stride Length and Frequency

In sprinting, the magnitude of stride length mainly depends on the enhancement of lower limb strength and the flexibility of the hip joints. Good muscle relaxation ability can improve the flexibility and pliability of muscles and ligaments around the joints, thereby increasing the range of motion of the joints and increasing stride length. The flexibility of the joints is an important guarantee and prerequisite for the full play of the muscle's ability to do work. In a good relaxed state, the extensibility of the muscles and ligaments around the joints is enhanced, which is conducive to maintaining an appropriate length of muscle fibers before contraction, thereby increasing the contraction speed and strength of the joint's prime mover muscle fibers.

During the sprinting process, muscle strength comes from the combined force of various muscle groups when completing movements, and the coordination between muscle groups is the main factor affecting muscle strength. If the antagonistic muscles do not relax, the power of the agonist muscles will be partially

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or completely offset by the antagonistic muscles. Adequate relaxation of the antagonistic muscles can improve the contraction speed of the agonist muscles, increase muscle strength, and further enhance the flexibility and pliability of the hip joints. The rhythm of muscle contraction and relaxation is coordinated, making the pace more light and powerful, thus creating conditions for better utilization of human sports potential and improving running speed.

3.4. The Impact of Sprint Relaxation Techniques on the Flexibility of the Central Nervous System

Exercise physiology indicates that the stride length and frequency in sprinting are largely dependent on the flexibility of the nervous system's excitation and inhibition conversion. The ability to relax muscles helps to improve the speed and flexibility of the central nervous system's excitation and inhibition conversion, allowing for better release of speed potential. The capacity for muscle movement is closely related to the rate and flexibility of the nervous system's excitation and inhibition conversion, especially the role of the central nervous system's flexibility, which is mainly reflected in the improvement of the coordination mechanism between the agonist and antagonist muscles, as well as the enhancement of the coordinated transition ability between muscle contraction and relaxation. Additionally, the rate of excitation and inhibition conversion of the nervous system is also related to the tolerance of the nervous system to high-frequency neural impulses. Blindly pursuing high frequency and neglecting the coordinated relaxation ability of muscles during running will inevitably lead to muscle tension. During the sprinting process, the nervous system is continuously stimulated by high frequencies, in a state of high excitement, and the central nervous system has the basic laws of diffusion and concentration, and mutual induction. After a period of high excitement, it will inevitably lead to a decrease in the tolerance of the cerebral cortex, resulting in a negative induction phenomenon, and the nervous system gradually enters an inhibited state.

4. Training methods for muscle relaxation techniques in sprinting

Mastering relaxation techniques is an important aspect of improving sprint performance. In sprint training, it is essential to raise students' awareness of the importance of relaxation techniques and guide them to earnestly master these techniques. This will enable middle school athletes to more economically and effectively utilize their potential during the sprint process, achieving excellent results. The main methods for training muscle relaxation techniques include the following.

4.1. Inertia Running

Utilizing short-distance variable-speed running, start by having athletes sprint quickly, and then transition to inertia running after covering a certain distance. For instance, athletes can accelerate for 30 to 50 meters and then cease active muscle effort, allowing the body to relax and run with inertia for 20 to 30 meters. A training session can be structured with 4 to 5 repetitions as a set. Rest periods between sets can be controlled at 5 to 7 minutes, and the interval time between each repetition should be kept within 25 seconds. The characteristic of this exercise is that after reaching a certain running speed, athletes can naturally enter a state of inertial relaxation, which strengthens the athletes' sense of muscle relaxation during high-speed running. Emphasis should be placed on athletes paying attention to technical coordination and relaxation during practice.

4.2. Towed Running

Utilize an elastic tape of about 8 meters in length to apply a forward pulling force to the athlete through the external force of another person, enabling the one being towed to run forward in a relaxed and lively manner. During the run, focus on the experience of maintaining a high posture, high center of gravity, hip extension, knee extension, and the action of pushing off with the back leg, as well as the sensation of muscle relaxation and effort. At the start, two individuals should position themselves one in front and one behind, with the faster athlete leading, and start simultaneously upon the signal, controlling the running rhythm between them. As the person providing the pull also experiences a pulling force from behind, this can be very effective in strengthening the calf muscles.

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4.3. Downhill Running

Select a slope that is 60 to 100 meters long with a gradient of 20° to 30° based on the actual conditions. Athletes should run forward with the downhill momentum while correctly grasping the running technique, focusing on a moderate step frequency and feeling the sensation of relaxed muscles.

For the first time in downhill running training, help athletes overcome the psychological tension and fear. Coaches should instruct athletes to land on the balls of their feet, with a slightly faster cadence and shorter stride length. Athletes are required to have a light and quick step, resembling the touch of a dragonfly on water.

In the process of downhill running, it is crucial to maintain the correct posture. Athletes should adhere to the following: ① Slightly lean the body's center of gravity forward; ② Land on the forefoot; ③ Keep the entire body's muscles in a relatively relaxed state, reducing the active control of the muscles as much as possible. By following these guidelines, the level of physical fatigue will be alleviated.

4.4. Relaxed Stride Running

The relaxed long-stride running is ideally suited for distances of 60 to 100 meters. When practicing, focus should be placed on the fluid coordination of the lifting of the swinging leg and the extension of the kicking leg, with arms moving naturally and relaxed, and at a suitable frequency. The intensity of the training should be maintained at 70% to 80%. A training session can be planned with 10 to 15 sets, with a rest interval of 50 to 60 seconds between each set. After each set, athletes may jog back to the starting point while performing muscle shaking and relaxation exercises. This medium-speed running is advantageous for enhancing muscle relaxation capabilities and fostering a sense of relaxed running. The movements should be expansive, coordinated, and springy, with full hip movement and an appropriate frequency.

4.5. Fartlek Training

Place an acceleration point on each straightaway of the track, requiring athletes to jog to this point and then engage in a 30 to 40 meter sprint, followed by a relaxed inertial run of approximately 20 meters, and then jog to the corresponding position on the other straightaway, repeating the aforementioned sprint, relaxed inertial run, and jog. Taking a 400-meter track as an example, typically 5 laps make up one set, and a training session can include 2 to 3 sets. This exercise not only develops the athletes' ability to accelerate and enhances their sense of muscle relaxation but also effectively improves their speed endurance.

4.6. Mental Relaxation Running

Psychological suggestions can exert a strengthening or weakening influence on an individual's physiological functions and observable behaviors. Positive suggestions can improve and enhance psychological states, behaviors, and physiological capabilities, whereas negative suggestions may impede and disrupt cognitive processes.

Coaches should enhance their guidance on psychological relaxation training for athletes, employing techniques such as adjusting the rhythm of breathing, self-language suggestions, and meditation to regulate emotions, enter a state of relaxed consciousness, and achieve the objectives of muscle relaxation, stress relief, fatigue reduction, and the accumulation of physiological and psychological energy. In sprint training, mental relaxation techniques can be utilized, where athletes can consciously visualize the natural sensation of muscles relaxing through the process of alternating contraction and relaxation with the aid of positive verbal cues, thus further enhancing their muscle relaxation capabilities.

4.7. Arm Swing Technique Drills

In training, guide students to perform arm swing relaxation exercises, ensuring the shoulders are relaxed, with the upper arm leading the forearm in a natural back-and-forth motion, and the fingers and wrists are relaxed. The arms should swing rhythmically, alternating between fast and slow movements, avoiding shoulder hunching, teeth gritting, neck stiffening, shoulder joint rigidity, or excessively tight fist clenching.

Analyzing from both the biomechanics and physiology of sports, relaxation techniques during sprinting significantly impact the economical use of energy, the enhancement of muscle strength, and the

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improvement of stride length and frequency, which has a very practical significance for enhancing sprint performance.

Grassroots coaches should focus on cultivating relaxation techniques and abilities in young athletes, capturing the critical period when the sprint techniques of young athletes are being perfected and their sports perception abilities are rapidly developing. In training, they should integrate the characteristics of the initial training stage for young athletes, emphasize the diversity, scientific nature, and variability of training methods, and focus on the steady increase or decrease of training loads, shifting away from an overemphasis on training intensity and exercise load. Adhering to the principle of comprehensive physical fitness development, establishing the correct technical concepts, and through various means and methods, conducting muscle relaxation running technique training, thereby improving sprint performance.

5. Conclusion

Relaxation training for sprint athletes is a crucial element in enhancing sports performance. Coaches at the grassroots level should be fully aware of this and implement diverse and scientific training approaches in the training of young athletes, emphasizing the accuracy of technical concepts and the rational adjustment of training loads. By employing these comprehensive training methods, the sprint relaxation techniques of young athletes can be effectively improved, which in turn can elevate their sprint performance and establish a robust foundation for their athletic development.

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