Sport Biomechanics Research on the Key Technique of Race-Walking Athletes in China

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Abstract: The literature research and sports biomechanics analysis are used to analyze the key technologies of race-walking athletes in China. The purpose of the study is to standardize the time and space characteristics of the key technologies of race-walking athletes in China according to the technical standards of definition of race-walking made by the IAAF; to correct the traditional technology stereotypes of "small stride, fast stride frequency, straight leg smashing", and to establish a new technical stereotypes recognized by international race-walking judges.

1. Questions raised

The race-walking competition is the only competition event with special requirements in track and field events, and it is the key and advantageous item of track and field events in China.

In 1996, the IAAF made significant changes to the definition and rules of race-walking in the athletics rules. Race-walking athletes were fined multiple times in international competitions. The modification of the definition and rules has impacted the technical characteristics of "small stride, fast stride frequency, straight leg smashing" formed by Chinese athletes for many years. Chinese athletes are small in size and small in stride length, which can easily give the foreign referee the illusion of fouls and is also easy to be punished. The main problems are focused on the technology of race-walking. Race-walking competitions must follow the definition of race-walking made by the IAAF to standardize their technical actions. Anyone who violate definition of race-walking made by the IAAF will be disqualified.

2. Analysis of key technology and biomechanics

2.1 Biomechanics analysis of stride length and stride frequency

The speed of race-walking is stride length by stride frequency. Stride length and stride frequency are the main factors to determine the performance of race-walking, and they are also important indicators to reflect the athletes' sports technical style and efficiency. A reasonable and stable stride length is one of the key techniques of race-walking. Stride frequency is the number of repetitions with reasonable and stable stride length. Under the condition of reasonable and stable stride length, stride frequency will not change the structure of the right technical action of race-walking, but change the number of repetitions of the right technical action. Therefore, the development direction of modern race-walking technique is to fix reasonable and stable stride length and speed up stride frequency. At present, the stride length of athletes in the world level is between 115-125, and the stride frequency is controlled around 3.33 strides / s. Compared with foreign athletes, the stride frequency of Chinese athletes is higher. It is an urgent problem for Chinese athletes that there exists the phenomenon that their stride frequency will not go up after their stride length is improved. Therefore, the next stride for techniques of race-walking athletes in China needs to improve the stride frequency on the basis of stable stride length to achieve the best combination of stride length and stride frequency.

2.2 Biomechanics analysis of the time of single step and the vertical displacement of the body center

Today, with continuous improvement of race-walking performance, it is inevitable that the race-walking athletes will cause flight fault. Under the camera, we can clearly see the flight fault of race-walking athletes, and the double support phase disappears for a short time. Therefore, in 1996, the IAAF amended Article 191 in the track and field rules, which means that the phenomenon of flight fault that can be seen by the naked eye of the human body is not allowed. The so-called airlift visible to the naked eye means that the airlift action of the athlete when walking away remains imaged in the eyes of referees. According to physiological experiments, the time limit for eye imaging takes 1 / 24s. Our research on technique of race-walking also confirms that a reasonable flight time limit is less than 42ms (that is, 1 / 24s), a fuzzy time limit of 42-67ms, and a flight time limit of more than 70ms, fuzzy time limit is 42-67ms, and flight time limit is more than 70ms. If the walking technique is coherent, coordinated, and relaxed, it is not easy to be punished for "flying" technology fouls; if the walking technology is disconnected, nervous, or laborious, it is easy to be punished for "flying" technology fouls. Therefore, controlling reasonable flying time and playing coherent, coordinated, and relaxed movement techniques are another key technique for the training of race-walking athletes. By consulting the data, it is found that the control of flying time of Chinese athletes is not much different from that of foreign players, and the control of flying time is better.

The vertical displacement of body center is an important technical index in race-walking competition, which is closely related to the technical foul of "flying" and reflects the economy of race-walking competition. The distance between the ups and downs of the body center that the referee can't observe clearly with his eyes should be less than 5cm. From the literature, it is found that the body ups and downs of Chinese race-walking athletes are large, which is easy to cause fouls. Therefore, we should reduce the ups and downs of the whole body in training, and keep the stability of the whole body moving in the horizontal direction.

2.3 Biomechanics analysis of trunk angle

The trunk is the main body of human body movement. In the race-walking, the back of the trunk makes the head lift up, the front of the trunk makes the head move down, causing the head to fluctuate up and down. And the head fluctuation up and down is an important sign of the referee's ruling "flying". If the torso is tilted forward too much, it will result in the technical shape of the run. The longitudinal axis of the trunk of Chinese elite race-walkers is always controlled before and after the vertical line to keep the trunk in a straight state, meeting the normal angle of forward and backward and the technical specifications of the definition of race-walking. The trunk should be kept upright as much as possible during the whole walking process, but should be leaned forward slightly at the moment when the body is off the ground.

2.4 Biomechanics analysis of the landing angle

In a multi-step cycle, when the foot is off the ground, the instantaneous displacement speed is the highest, and when the current supporting ground transitions to the vertical phase, the instantaneous displacement speed is the smallest. The speed loss rate in this period can be an important technical index, and the main factor affecting the speed loss rate is the size of the landing angle. A larger landing angle can produce less braking, and the speed loss rate is relatively small. However, if the landing angle is too large, the landing point will be too close to the projection point of body center, which will affect the stride length. Of course, if the landing angle is too small, the horizontal speed drops too much, and the energy consumption is too large. After the heels lead to the ground, the falling motion of the feet is performed as the body center moves forward. At the moment when the projection line of the body center is vertical to the ground, the heel gradually rolls to the full foot, and the body center moves smoothly forward. The research results show that the landing angle of excellent race-walking athletes is more suitable, which maintains good horizontal speed and gives the referee a long and reasonable time to observe leg movements.

2.5 Biomechanics analysis of knee joint angle

The new definition of race-walking stipulates that the forefoot should be straight from the

moment of landing to the vertical phase (that is, the knee joint must not be bent). The definition before 1996 was that the support leg must be straight at least once in the vertical position. The angle of the knee joint when the support leg is off the ground is important for the referee to judge the flight. The smaller angle of the knee joint will give people the feeling of throwing the calf. This is one of the differences between running and walking, which will give the referees a bad impression and affect their decision. From the results of the study, the forefoot of outstanding race-walkers is straight from the moment of landing to the vertical stage. Although some athletes do not reach 180 ° when their support legs reach the ground, their knee joint angle is greater than 180 ° for about 120ms. The referee can see that the supporting leg is fully straight from the ground to the vertical stage clearly, meeting the technical specifications of the new definition of race-walking.

3. Conclusions and suggestions

(1) The horizontal displacement of the body center of elite race-walking athletes in China is synchronous with the step length and step frequency, which proves that their step length and step frequency are correct, reasonable and accurate. Literature review shows that the "small step" in the "small step high frequency" technology of our elite race-walking athletes has been improved, especially for male athletes, we have been emphasizing that the increase of stride has been gradually implemented. However, it is an urgent problem for our athletes to solve that the step frequency will not go up due to the increase of stride length. Therefore, the next step for techniques of race-walking athletes needs to improve the step frequency on the basis of stable step length to achieve the best combination of step length and step frequency.

(2) There is not much difference between Chinese athletes and foreign athletes in the control of the takeoff time. The one-step takeoff time of Chinese elite competitors is all in the fuzzy takeoff time limit. The race-walking technology is coherent, coordinated and relaxed. The referee can hardly see the takeoff with the naked eye, but the body center fluctuates greatly (> 5cm).

(3) The longitudinal axis of the trunk of Chinese elite race-walkers is always controlled before and after the vertical line, keeping the trunk in a straight state, meeting the normal angle of forward and backward pitch (< 5 °) and the technical specifications of the definition of race-walking.

(4) If the landing angle is too small, the phenomenon of leg bending and small stride may occur. The landing angle of excellent walking athletes in China is more appropriate, and it can keep a good horizontal speed and give the referee a long and reasonable time to observe the leg movement. But compared with the world's outstanding athletes, it is still insufficient. We should pay more attention to strengthen the technique of foot touch and the training of controlling the angle of foot touch.

(5) In the process of swinging, the angle of the knee joint of the swinging leg is one of the main indexes to determine the swinging effect. A larger angle of the knee joint is conducive to maximizing the swinging effect and straight leg support. The time when the angle of knee joint of supporting leg is more than 180 ° is within the visible time limit (> 42ms). The referee can clearly see the moment of landing of front leg until the knee joint is fully straightened in the vertical stage, which fully conforms to the new definition of race-walking.

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