Kinematic characteristics of the movement technique of highly qualified biathletes

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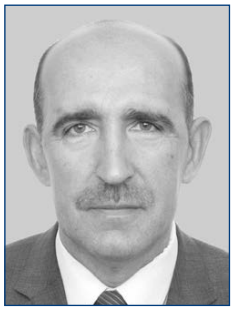

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Abstract

Objective of the study was to identify the features of the use of tactical techniques and differences in the kinematic parameters of the movement technique of biathletes with a simultaneous two-step skating move and a simultaneous one-step skating move in conditions of competitive activity.

Methods and structure of the study. The article examines the kinematic and dynamic indicators when moving with simultaneous two-step and simultaneous one-step skating moves (ODKH and OOKH) of highly qualified biathletes during the races of the Russian Championship 2023 in Khanty-Mansiysk.

Results and conclusions. The analysis made it possible to establish that leaders, when covering a competitive distance, change the ratio of the length and frequency of steps and the amount of effort when pushing off. The first lap of the distance is overcome by climbing with great rolling and a relatively low frequency of movements, the second lap is completed by increasing the frequency of the cycle and minimizing effort. On the third circle, an increase in speed is achieved by increasing the cycle frequency and cycle length relative to the 2nd circle. For athletes who did not make it into the top ten of the final protocol, the limiting factor in maintaining a high speed of completing a distance with a simultaneous one-step skating stroke is power potential.

Keywords: *technical and tactical training, kinematic parameters of movement technique, simultaneously two-step skating, simultaneously one-step skating, cycle phase filmogram, frequency, linear length of the skate, coefficient of running activity (KBA indicator).*

Introduction. Improving technical and tactical preparedness at the stage of maximum realization of the athlete's capabilities becomes a priority [2, 4]. Moving along the distance with the most rational technique, choosing the optimal way of movement on various sections of the track, using individual strategies and tactical techniques can increase competitive speed without increasing the intensity of movement [1, 2]. The ability of athletes to adapt the kinematic and dynamic structure of skiing to competitive conditions in order to maximize the realization of motor potential is one of the reserves for improving the results of Russian biathletes [3, 4].

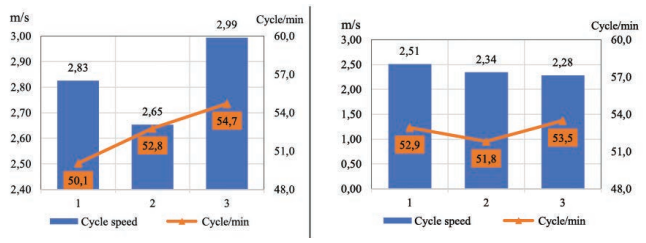
The purpose of the study is to identify the features of the use of tactical techniques and differences in the kinematic parameters of the movement technique of biathletes of the ODKH and OOKH in conditions of competitive activity.

Methodology and organization of the study. The scientific work was carried out at the Russian Biathlon Championship in Khanty–Mansiysk on 27.03 – 02.04.2023. To analyze the technique of the moves, Sony HDR-AX53 cameras were used and installed perpendicular to the ski track, sideways, motionless in various sections of the distance. The frame was scaled relative to the track and the kinematic param-

eters of the athletes' movement were measured using the Kinovea computer program. In the course of the study, a comparative analysis of kinematic and dynamic indicators was carried out when moving OOKH and ODKH in 13 biathletes competing at the Russian championship, and indicators of the coefficient of running activity (KBA) were also compared between the race leaders and outsiders. It was assumed that the best athletes in terms of speed, competing at the Russian Biathlon Championship, more effectively realize their potential and maintain a high speed of movement over a distance by varying the kinematic parameters of movement techniques in different sections and circles of the competitive distance.

The results of the study and their discussion. The fixation of the time parameters of linear advancement in the ODKH was carried out in two phases: in the first – from the moment of pushing off with the "main" hand and the moment of complete setting of the ski of the supporting leg to the separation of the heel from the ski at the moment of leaving the supporting leg; and in the second phase - from the moment of the end of the first phase at the moment of leaving the supporting leg to the moment of setting the sticks of the "main" hand.

When passing the competitive distance, the cycle speed on the 1st, 2nd and 3rd laps of the leaders is 2.83 m/s; 2.65 m/s and 2.99 m/s, respectively. The leaders on the second lap have a decrease in speed and linear cycle length, and the number of cycles per minute (step frequency) increases with each subsequent lap – 50.1, 52.8 and 54.7, respectively (Fig. 1A and 2A).

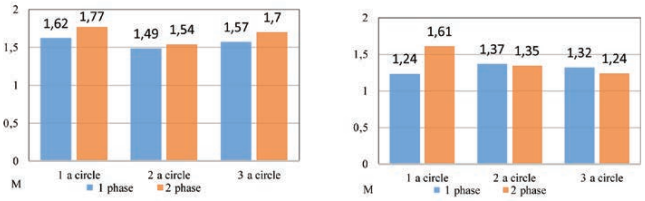


A B

Fig. 1. Dynamics of the speed and frequency of cycles in the leaders (A) and other athletes (B) during the movement of the CSTO

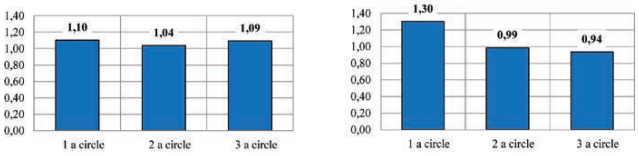
At the same time, the length of the linear advance on the 2nd lap is reduced for the leaders in both the 1st and 2nd phases of the cycle (Fig. 2A).

For the leaders, the speed decrease occurs due to a change in the repulsive forces, since the coefficient of running activity on all three laps is greater than one (1.1; 1.04; 1.09) (Fig. 3A). Thus, when passing a competitive distance, the leaders change the ratio of the length and frequency of steps and the amount of effort when pushing off. The first round of the race is overcome by climbing with a large roll and a relatively low frequency of movements, the second round is passed, increasing the cycle frequency and minimizing effort, the third round – increasing the cycle frequency and cycle length relative to the 2nd circle.



A B

Fig. 2. Dynamics of the linear length of the rental of the leaders (A) and the rest of the athletes (B) during the movement of the CEC



A B

Fig. 3. The coefficient of running activity of the leaders (A) and the rest of the athletes (B) during the movement of the housing and communal services.

The average movement parameters of the CEC biathletes, who are not leaders, are characterized by a slight change in the number of cycles per minute on the 1st, 2nd, 3rd laps of the distance and are 53, 52 and 53.5, respectively (Fig. 1B). At the same time, the cycle speed decreases on the ascent (1 lap – 2.51 m/s, 2 lap – 2.34 m/s, 2.28 m/s), and the cycle length decreases on each subsequent lap (2.85 m; 2.72 m and 2.56 m) (Fig.2B).

For athletes who are not leaders, maintaining speed on the finish lap is more due to the pace of movement, rather than due to strength potential. Confirmation is the linear length of the rolled product in the 2nd phase, which decreases from the second round relative to the linear length of the rolled product in the 1st phase (Fig.2B). The coefficient of running activity is less than "1" from the second round (1st - 1.30; 2nd – 0.99; 3rd – 0.94) (Fig. 3B).

In the analysis of the OOCS of biathletes, time and distance (linear advance) were recorded when pushing

off with hands and foot as a reaction to support (from the beginning of the moment of setting the sticks in the phase of pushing off from the "attacking" position until the moment of heel separation in the final phase of pushing off with the foot); time and distance (linear advance) in the rolling phase – from the moment of separation the heels are in the final phase of pushing off with the foot until the sticks are placed in the "attacking" position of the beginning of pushing off with the hands. The athlete, who took 2nd place in speed, overcomes this section with a fairly high pace (71.4; 73.1; 73.1 cycles per minute), but with the shortest repulsion time (the average for 3 laps is 0.38 seconds) and with an average rolling length of 1.56 m. The athlete, who took 3rd place in speed, maintains high speed due to a lower pace (68.1; 68.18; 68.2 cycles per minute), but with the longest linear roll (average for 3 laps is 1.58 m), while the average repulsion time is 0.4 s.

The athlete with the best speed on the ski track shows the highest average cycle speed – 3.65 m/s, increasing the pace on each subsequent lap (62.5; 68.2; 75 cycles per minute). The time of repulsion on 3 laps of the distance also varies: 1 lap – 0.38 s; 2 lap – 0.44 s; 3 lap – 0.36 s. The leader's largest rental was recorded on the 1st lap - 2.13 m. On the 2nd and 3rd lap, the length of the rolling is 1.55 and 1.65 m, respectively. We assume that the leader of the race varies by the force of repulsion, rolling and pace of movements throughout the competitive distance, overcoming the 1st lap with a large roll and a short "impulse" repulsion. On the 2nd lap, the leader increases the pace of movement, but reduces the repulsive force, as evidenced by a reduction in the time of repulsion and the athlete's ride. The leader passes the 3rd lap of the competition distance with the least repulsion in time (0.36 s) and the highest power relative to the power on the first two laps, developing a maximum cycle speed of 3.89 m/s.

Considering the KBA indicator (the ratio of reaction to support for hire), we note that the race leaders have this indicator greater than "1", which indicates a more effective realization of the power potential in the technique of movement of athletes in this section of the distance. We note that the athlete, who took 16th place in the "clean" time of the race, has a fairly high pace of movement during 3 laps (75; 71.4; 71.4 cycles per minute), however, the indicators of the length of the roll and the speed of the cycle are lower than those of the leaders, while the KBA on the second and third laps is less "1".

Conclusions. The leaders of the race are able to vary the force of repulsion, the length of the roll and the pace of movements throughout the competitive distance. The best athletes in terms of distance travel time overcome the 1st lap with a large roll and a short "impulse" repulsion, while on the 2nd lap increasing the pace of movement and reducing the repulsion force, as evidenced by a reduction in the time of repulsion and the length of the roll. The leaders complete the 3rd lap of the competition distance with the shortest repulsion time (0.36 s), and the highest power relative to the power on the other two laps, developing a maximum cycle speed of 3.89 m/s.

The best athletes in terms of speed have a more effective realization of their power potential in the technique of movement, as evidenced by the KBA indicator equal to more than one. The athletes who did not make it into the top ten of the final protocol have a KBA of less than one, and, as a result, the limiting factor in the ability to maintain a high speed of passing the OOKH distance is the power potential.

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