Technical training of young ski jumpers using simulation exercises

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Abstract

Objective of the study was to analyze the compliance of simulation exercises of young ski jumpers aged 12-14 with modern technical requirements.

Methods and structure of the study. A video recording of simulation exercises in sagittal and frontal projections was made during ground technical training of young ski jumpers aged 12-14 (n=44).

Results and conclusions. The biomechanical analysis of the imitation of jump elements showed that in the position of the acceleration stand, the value of the angle of inclination of the torso (11.59±3.99°) on a static support was statistically significantly ($p<0.005$) less than when simulating on a movable support in jumping boots (13.98±4.40°); the angular values of repulsion simulation on a movable support in jumping boots were closest to the model parameters of the competitive exercise; flight simulation on static and unstable supports had statistically significant differences ($p<0.05$) with the model values of the angles in the hip joint and the angle of inclination of the legs. It has been determined that during the ground technical training of young ski jumpers it is necessary to use training facilities that are close in terms of performance conditions to a competitive exercise (on a movable support and in jumping boots - for the acceleration and repulsion stand, on an unstable support - for flight). Each lesson should be accompanied by quality control of these exercises.

Keywords: *ski jumping, young ski jumpers, angular characteristics, fixed support, unstable support, movable support.*

Introduction. Ski jumping is a difficult sport to coordinate. The jump takes place under rapidly changing and extreme conditions, such as increasing speed, unsupported flight and the impact of landing. The take-off from the take-off table lasts 0.25-0.35 s, stable flight on sports power springboards lasts 2-2.5 s, the transition from flight to landing lasts 0.5-0.4 s [2]. All this requires the ski jumper to accurately and timely perform all the technical elements of the jump.

It is natural that the correct execution and automaticity of athletes' actions is achieved through careful technical training at all stages of long-term training, provided that the means used comply with modern requirements for ski jumping techniques [3].

Objective of the study was to analyze the compliance of simulation exercises of young ski jumpers used in Russia with modern technical requirements.

Methods and structure of the study. Video recording of simulation exercises was carried out during ground-based technical training of young ski-jumpers aged 12-14 years in sagittal and frontal projections. Athletes performed an imitation of the acceleration and take-off stance in three variants: on a stationary support in sneakers, in motion on a roller cart in sneakers and jumping boots. The flight simulation was performed on a fixed support (crossbar) and an unstable support (the athlete was supported by a coach). 44 young athletes from 10 regional teams of Russia took part in the study.

Video processing was carried out in DartFish Pro 10.0. The average values of angular values for the main positions of the skier-jumper were determined and their comparative analysis was carried out with modern model characteristics. Statistical data processing was performed in the RStudio program. The significance level of differences was calculated using the Dunn test with Bonferroni correction for multiple comparisons.

Results of the study and discussion. Analysis of the position of the acceleration stance made it possible to establish that during the exercise in sneakers on a fixed support, the angle of inclination of the shin was 53.95±4.39˚, and in sneakers on a movable support – 56.20±4.49˚. In the same exercise, but wearing jumping boots on a movable support, the athletes demonstrated a shin inclination of 55.48±4.56˚. Thus, minor differences in the technique of performing the acceleration stance under different conditions were determined (Table 1).

The angles in the knee and hip joints almost always exceeded the model values. The angle of inclination of the torso in the acceleration stance on a fixed support was statistically significantly less than in jumping boots on a rollerboard. This may be explained by the different distribution of body balance of athletes on static and moving supports.

Measurements of angular indicators in simulating repulsion from the take-off table were carried out at the first moment of the athlete's heels lifting off the support. A comparative analysis of the obtained measurement results and model values showed their significant differences (Table 2). Only in the position of the body when pushing off from a movable support did the average angular values correspond to the model indicators. It was also determined that the performance of repulsion on static and movable supports had statistically significant differences in all four measured parameters (Table 2). Moreover, the angular indicators determined in conditions of a movable support using jumping boots had the most approximate or corresponding values in relation to the model ones.

Therefore, it can be assumed that performing a take-off on a movable support allows not only to more accurately reproduce the conditions of a real springboard jump, but also to more accurately implement the take-off itself. The use of jumping boots by athletes helps to reduce the degrees of freedom in the ankle joints, which optimizes the take-off movement as a whole, making it similar to the action of a jumper on a springboard.

Analysis of flight simulation in two different versions showed that training of this position is carried out with deviations from the model requirements (Table 3). The angular values of all measured parameters, with the exception of the position of the torso on a static support, did not correspond to the recommended model characteristics. Statistically significant differences were also determined between the values of the angle of inclination of the torso and the angle in the hip joint

Table 1. *Average values of angular indicators in the main articular parts of the body of young ski jumpers, in the acceleration stance under various performance conditions (n=44), ($\dot{X} \pm \delta$), deg.*

Execution conditions	Ankle joint	Knee joint	Torso tilt**
In sneakers on a fixed support	53,95±4,39	69,15±5,91	11,59±3,99*
In sneakers with a movable support	56,20±4,49	71,13±6,75	13,47±4,17
In jumping boots with a movable support	55,48±4,56	70,19±6,08	13,98±4,40*
Angular model indicators	55-60	60-70	7-10

*Note: * – differences between execution conditions are statistically significant (p<0.005); ** – the inclination of the torso was determined in relation to the plane of support.*

Table 2. *Average values of angular indicators in the main articular parts of the body of young ski jumpers, in imitation of repulsion from the take-off table under various performance conditions (n=44), ($\dot{X} \pm \delta$), deg.*

Execution conditions	Shin tilt**	Knee joint	Torso tilt**	Take-off angle**
In sneakers on a fixed support	●48,96±4,078*	98,34±9,22♦	●14,11±7,48*	88,00±4,32*
In sneakers with a movable support	54,16±3,16*	100,96±10,47	23,44±6,78*	●92,19±4,05*
In jumping boots with a movable support	●54,44±3,46	105,81±13,86♦	●27,67±7,57	●87,73±4,75
Angular model indicators	67-72	120-135	20-30	85-87

Note: The differences between the execution conditions are statistically significant: * – (p≤0), ● – (p≤0), ♦ – (p<0.05); ** – the inclination of the body links was determined in relation to the support plane.

Table 3. *Average values of angular parameters in the main articular parts of the body of young ski-jumpers, in the flight position under various performance conditions (n=44), ($\dot{X} \pm \delta$), deg.*

Execution conditions	Torso tilt	Hip joint	Leg tilt
On a fixed support	3,23±7,92*	150,54±11,00*	32,40±10,41
On an unstable support	-4,95±11,67*	144,71±13,21*	31,46±10,94
Angular model indicators	0-10	155-162	20-30

*Note: * – differences between execution conditions are statistically significant (p<0.05).*

when simulating flight on stable and unstable supports. These discrepancies arise primarily due to difficulties associated with the conditions for performing simulation exercises.

According to the results of a previously conducted survey of coaches, less time is spent on practicing the flight phase in the technical training of young ski jumpers than on improving the acceleration stance and take-off phase, which naturally affects the quality of performance of this technical element [1].

Analysis of the video recording of the acceleration and take-off stance, taken in the frontal projection, revealed numerous technical errors associated with the asymmetrical position of the arms, shoulders, legs, and feet. Moreover, these shortcomings were observed in an unchanged form in specific athletes in all three variants of the simulation exercise. Reasons

These deviations could be due to the characteristics of the athletes' physical fitness, as well as the lack of target setting and proper control on the part of the coach.

Conclusions. A study of the means of ground-based technical training for young "flying skiers" showed that most of the angular characteristics of the acceleration, repulsion and flight imitation did not correspond to the model indicators, although they were close in value. In all three technical elements, statistically significant differences in the angular characteristics of simulation exercises under different conditions of their implementation were identified, which are of a fundamental nature.

In the technique of young ski jumpers, shortcomings have been identified, which together can be associated not only with improperly formed motor skills, but also with insufficient physical preparedness, as well as with the absence or incorrect coaching attitude and insufficient control over the quality of execution of motor actions.

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