Structural composition of a double backfold in a group over the bars on parallel bars, performed from various starting positions of the flight part

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Abstract

Objective of the study was to determine the structural composition of the studied gymnastic exercises.

Methods and structure of the study. In the course of scientific work, the following were carried out: video recording of exercises, computational models for analyzing the movements of biomechanical systems, system-structural analysis of motor actions. The subject of the study is the technique of gymnastic exercises in the unsupported and in the support periods based on the materials of optical registration of movements.

Results and conclusions. The sequence of changes in the phase composition in the studied gymnastic exercises is the same, and the parameters of biomechanical characteristics in the phases of movement are different. The division (differentiation) of the athlete's motor actions into separate components (periods, stages) is biomechanically justified by the motor tasks of the exercise, and its division into smaller structural parts (phases) is determined by the criterion of changing the unidirectional change in the angle in certain joints of the athlete. In complex gymnastic exercises, preparatory, basic and final actions can refer not only to the entire exercise as a whole, but also to its individual phases.

Keywords: *technique of gymnastic exercises, improvement of the structure of motor actions, period, stage, phase.*

Introduction. Coordinatingly complex exercises on gymnastic apparatus are rarely performed at official competitions, which makes it difficult to study their technique biomechanically [4-6]. Such exercises, rarely demonstrated at gymnastic tournaments, include the studied exercises:

Exercise 1. Decline from a handstand to a hang and a double back somersault in a tuck above the poles in an emphasis on the hands (performed by Honored Master of Sports of Russia M. Devyatovsky).

Exercise 2. Decline from the handstand to the emphasis on the hands and lifting forward with a swing forward double somersault back in the group over the poles in the emphasis on the hands (performed by the master of sports of Russia of international class N. Ignatiev).

Only in a few works is an attempt made to explain the deterministic relationship between the trajectory of the biomechanical system in the flight part of these exercises and the implementation of the motor skill under support conditions [1, 2, 3, 5]. The search for ways to improve the technique of the studied exercises requires an additional biomechanical study of the kinematic structure of the flight and support periods, which determines the relevance of the study.

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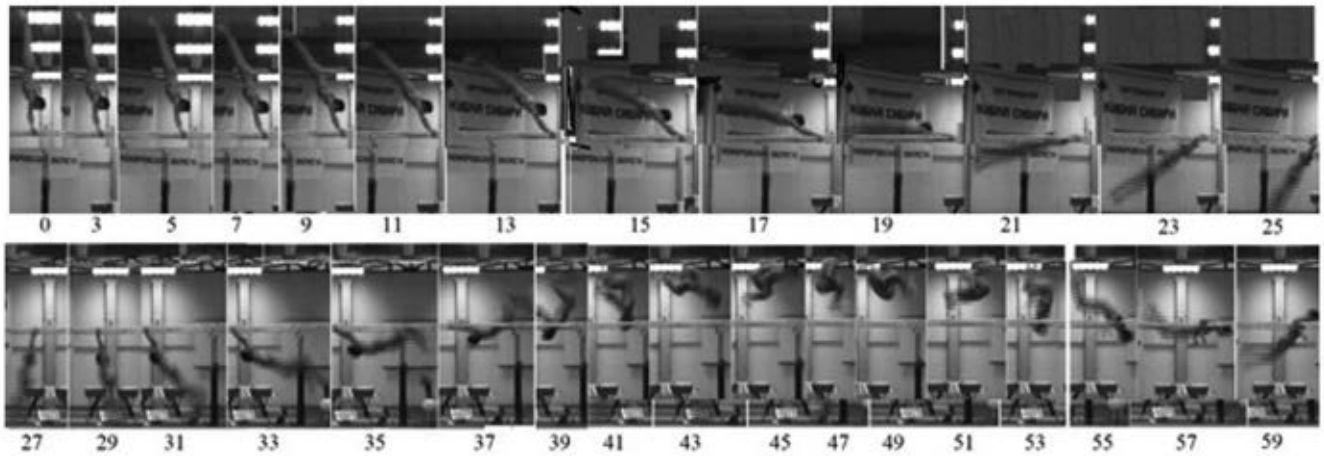

Figure 1. *Exercise 1. Decline from a handstand to a hang and a forward swing double back somersault in a group over the poles in emphasis on the hands (M. Devyatovsky)*

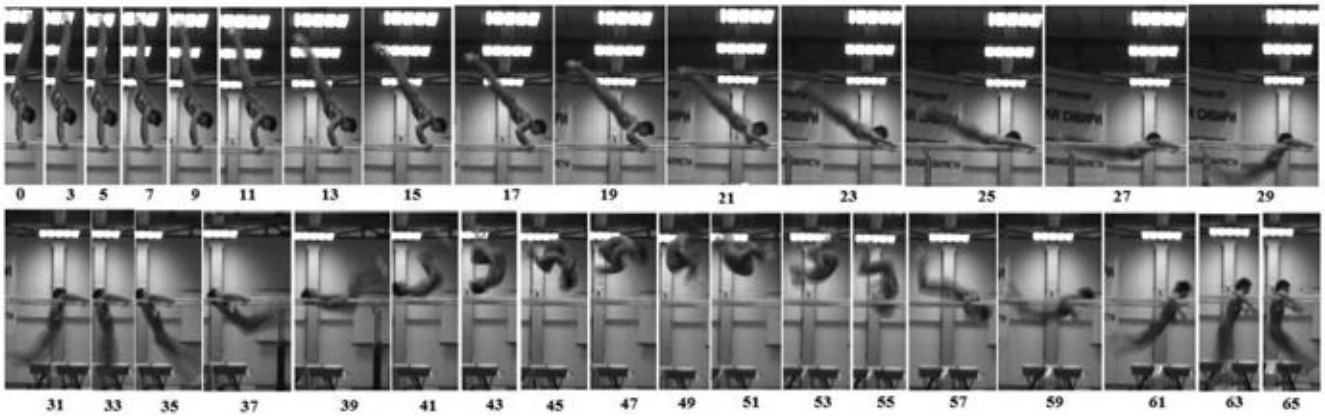

Figure 2. *Exercise 2. Decline from a handstand to an emphasis on the hands and a swing forward double back somersault in a tuck over the poles in an emphasis on the hands (N. Ignatiev)*

Results of the study and their discussion. Kinetograms of the studied exercises (Figure 1, 2).

Exercises start from the same starting position: handstand (Figure 1, Figure 2; frame 0). The exercise also ends with the same type of position: emphasis on the hands (Figure 1, frame 53; Figure 2, frame 55).

Exit from the reference position to the flight part of the exercise (the "Start" time point) is performed in the first exercise from the hanging position, and in the second exercise from the position of support on the hands, which causes different parameters of kinematic characteristics with the same phase composition of the flight part of the exercises.

Structural composition of exercises. In the structural composition of the exercises, periods, stages of the phase are distinguished (Figure 3).

Exercise periods include the following components: the first support period, the non-support period, the second support period.

Stages consist of elements: *accumulation, working* (the first reference period); *realizations* (benchmark period); *depreciation* (second reference period).

Phases: *bale* - flexion in the joints, *extension* - extension in the joints (accumulation stage); *throw* - the most accelerated decrease in the angle in the joints, *pre-start* (working stage); *grouping* - acceptance of grouping, *twist* - rotation with the most dense grouping, *extension* - extension in the joints (implementation stage); *emphasis* - arrival on the support with the shoulders, *dynamic posture* - the standard position of the emphasis on the hands (depreciation stage).

The sequence of changes in the phase composition in the studied exercises is the same, the parameters of biomechanical characteristics in the phases are different.

Parameters of biomechanical characteristics of the flight period of exercises. The resulting linear

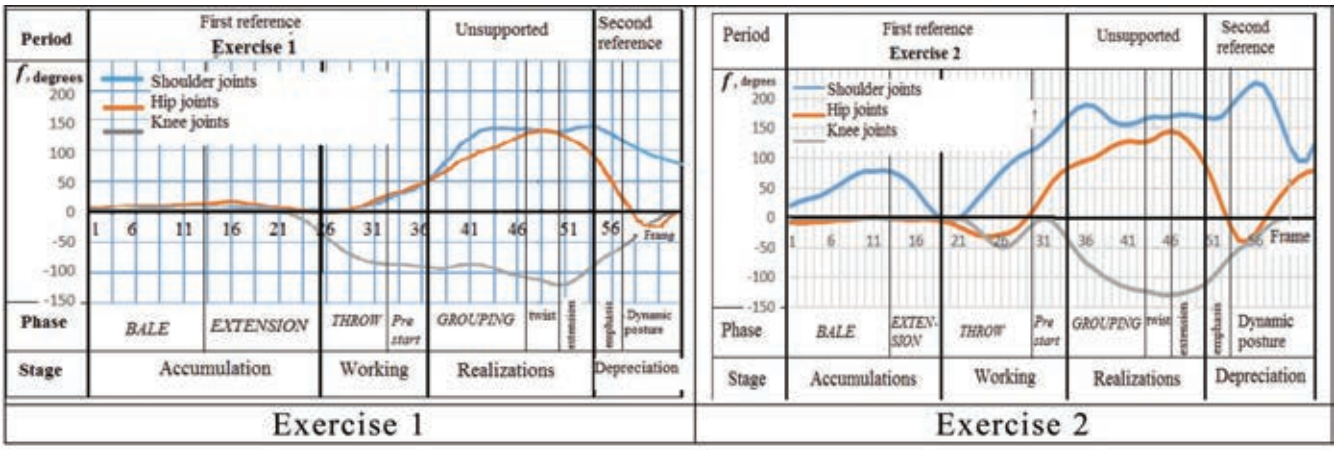

Figure 3. *Structural composition of the studied exercises: periods, stages, phases*

velocity of the general center of gravity (GCG) of the gymnast's body at the moment of time "Start" is 4.27 m/s, which is 17.56% more than the same velocity in the second exercise (Table 1, line 14).

The main share of the speed difference falls on the vertical component of the resulting linear velocity of the general center of gravity (GCG) of the gymnast's body - 19.71% (Table 1, line 13). A significantly smaller part of the speed difference falls on the horizontal component of the resulting linear velocity of the gymnast's body GCG - 4.92% (Table 1, line 12).

In the first exercise, the general center of gravity of the athlete moves vertically upwards by 0.86 m, in the second - by 0.55 m (table 1, line 9). The movement of the gymnast's GCG in the horizontal direction is -0.84 m and -0.78 m for the first and second exercises, respectively (Table 1, line 6). Consequently, a characteristic feature of the flight part of the exercises is a significantly larger amplitude of movement of the

Table 1. *Parameters of the biomechanical characteristics of the general center of gravity of the gymnast's body in the flight part of the exercises*

No. p/p	Biomechanical characteristics	Exercise Options 1	Exercise Options 2	Absolute difference	Relative difference
1	Total flight time	0,720 (c)	0,64 (c)	0,08 (c)	11,11 %
2	Time of flight to the maximum along the axis Oy	0,419 (c)	0,336 (c)	0,083 (c)	19,81 %
3	Decline time from maximum to coming to close range (on poles)	0,301 (c)	0,304 (c)	0,003	1,00 %
4	The initial position of the GCG along the Ox axis at the moment of time «Start»	0,94 (м)	-0,265 (м)	No comparison	
5	The final position of the GCG along the Ox axis at the moment of time «Finish»	0,10 (м)	-1,04 (м)	No comparison	
6	Flight on the Ox axis	-0,84 (м)	-0,78 (м)	-0,06 (м)	7,14 %
7	The initial position of the GCG along the Oy axis at the moment of time «Start»	-0,03 (м)	0,046 (м)	No comparison	
8	End position of the GCG along the Oy axis at the time «Finish»	0,38 (м)	0,17 (м)	No comparison	
9	Flight on the Oy axis	0,86 (м)	0,55 (м)	0,31 (м)	36,04 %
10	Maximum (max) on the Oy axis	0,83 (м)	0,60 (м)	0,23 (м)	27,71 %
11	The coordinate along the Ox axis at the moment of time «max» along the Oy axis	0,45 (м)	-0,68 (м)	No comparison	
Linear speed (V) at time «Start»					
12	V along the Ox axis	-1,16 (м/с)	-1,22 (м/с)	-0,06 (м/с)	4,92 %
13	V along the Oy axis	4,11 (м/с)	3,30 (м/с)	0,81 (м/с)	19,71 %
14	V resulting	4,27 (м/с)	3,52 (м/с)	0,75 (м/с)	17,56 %
15	Departure angle GCG - «Start» (Ox axis - radius vector GCG)	105,77 (град)	110,24 (град)	5,53 (град)	5,23 %

gymnast's GCG in the first exercise than in the second: horizontally by 7.14% (table 1, line 6) and vertically by 36.04% (table 1, line 9).).

Due to the existing difference in the vertical component of the resulting linear speed of the athlete's body GCG at the time "Start" (19.71%; Table 1, line 13), the different time to achieve, as the maximum lift height of the athlete's GCG (0.419 s - the first exercise, 0.366 s - the second exercise), and the total time the athlete was in a non-supported state (0.72 s - the first exercise, 0.64 s - the second exercise). The difference in time to reach the maximum take-off height of the gymnast's GCG is 0.083 s, or 19.81 % (Table 1, line 2).

The flight time of the body's GCG to the maximum vertically is 0.419 s for the first exercise, and 0.336 s for the second (Table 1, line 2). The time of Gymnast's body GCG decrease from the maximum take-off point to the point of emphasis (on the shoulder segments of the arms) is: for the first exercise - 0.301 s, for the second exercise - 0.304 s.

Conclusions. The sequence of changes in the phase composition in the studied gymnastic exercises is the same, and the parameters of biomechanical characteristics in the phases of movement are different. The division (differentiation) of the athlete's motor actions into separate components (periods, stages) is biomechanically justified by the motor tasks of the exercise, and its division into smaller structural parts (phases) is determined by the criterion of changing the unidirectional change in the angle in certain joints of the athlete. In complex gymnastic exercises, preparatory, basic and final actions can refer not only to the entire exercise as a whole, but also to its individual phases.

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