

BIOMECHANICAL CHARACTERIZATION DISMOUNT FROM BALANCE BEAM ON THE BASIS OF THE ANALYSIS OF KEY ELEMENTS OF SPORTS EQUIPMENTPotop V.A.¹, Rafal G.², Boloban V.N.³, Otsupok A.P.³Ecological University of Bucharest¹Józef Piłsudski University of Physical Education in Warsaw²National University of Physical Education and Sport of Ukraine³

Annotation. *Purpose.* Biomechanical analysis of sports performance technology with balance beam dismount. *Material, methods.* The study involved six young gymnasts aged 12 - 14 years old - the reserve team of Romania. *Results.* Identified nodal elements of sports equipment dismount from balance beam type flip off rondat and rondat - coup ago somersaults with twists caved at 360°, 540°, 720° and 900°. In the preparatory phase of the motor action performed dismount isolated and studied central element of sports equipment - starting posture of the body in the phase of the main motor action - animation body posture in the final phase of motor actions - the final posture of the body - Sustainable landing. *Conclusions.* The method of video - computer research dismount from balance beam type flip off rondat and rondat - coup ago, in conjunction with the method of postural orientation movements allow you to perform a detailed biomechanical analysis of the key elements of sports equipment, to develop advanced training programs.

Key words: biomechanics, gymnast, timber, dismount, posture, node phase.

Introduction

Exercises on BB is a kind of female gymnastic all round, which symbolize accuracy, elegance of female gymnasts' movements, perfect regulation of body posture. Modern exercise on BB are, by their essence, free style exercises, fulfilled on narrow support, including rather difficult acrobatic jumps with returning on support and dismounts in which, to-day, are the most difficult in exercises. Dismount from BB is a key element of every composition, which influence on final impression of referees and spectators. Completion of exercise on BB (dismount) shall be executed in compliance with difficulty of all composition and specific requirements of competitions, as it was noted by well known specialists in sport gymnastics V.M. Smolevskiy, Yu.K. Gaverdovskiy [9], N. Vieru [11].

Analysis of scientific-research literature witnesses about importance of studying of gymnastic acrobatic exercises' techniques and training of them, considering knowledge about body positions. In this connection, for studying of sport gymnastic exercises' techniques V.N. Boloban, Ye.V. Biriuk offered to use method of position reference marks. Method of positions' reference marks is the method of bio-mechanical studying of sport exercises by means of analyzing of preceding and following body positions, and their multiplications in phase structure of the fulfilled exercise, in order to know key elements of sport technique [1]. Realizing in our research method of positions' reference marks we should have measure, analyze and evaluate bio mechanical indicators of dismounts from BB, which were fulfilled by sportswomen of 12-14 years old age in competition conditions for studying of key elements of sport techniques.

Key element of sport technique is a signal position of movement, which pre-determines effectiveness of sportsman's movements. Method of positions' reference marks was developed at the end of seventies [1]. Then conception and methodology were improved as well as scientific-practical application in the works by V.N. Boloban [2,3], Ye. Sadvovskiy, T. Nizhnikovskiy, A. Mastalege, V. Vishniovskiy, M. Begaylo [8], V. Potop [5,6], N. Andreyeva [10], and other scientists, who studied regulation of sportsmen body's posture and system of bodies in gymnastics.

In researches of N.S. Romanov et al. [7] there are given recommendations how to use method of positions' training to track and field running. The authors mark out three positions: position of run, attack and coming from barrier; in high jumps – run position, position of pushing and position over bar; in long jumps: position of run (when running and flight in "scissors" manner), position of pushing and position of landing. Authors also underline that position of body and reproduction of positions shall be the subject of training. Researching of structural elements of track and field sportsmen's training V. Gamaliy, M. Ostrovskiy [4] write that the proves of formation and improvement of exercises' technique shall be based not on increasing of bio-mechanical characteristics' absolute values, but on studying and formation of mechanisms of their achievement in competition functioning.

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Purpose, tasks of the work, material and methods

The purpose of the research is to study bio-mechanical indicators of dismounts from BB on the base of analysis of key elements of sport technique with realization of method of positions' reference marks, which were fulfilled by sportswomen of 12-14 years old age.

The tasks of the research:

1. Identify key elements of sport techniques in phase structure of dismounts from BB, fulfilled by sportswomen of 12-14 years old age.
2. Carry out bio-mechanical analysis and evaluate indicators of kinematic and dynamic structures of key elements of dismounts from BB, fulfilled by sportswomen of 12-14 years old age.
3. Evaluate degree of connection of sport techniques' key elements structures' bio-mechanical indicators of dismounts from BB, fulfilled by sportswomen of 12-14 years old age, with evaluation for performances in individual all round and final at championship, Rumania 2012.

Methodology and methods of the research:

1. Analysis of scientific-methodic literature. 2. Method of positions' reference marks of movements [1] – analysis of body positions, their multiplications on support and without support in phase structure of dismounts from BB for identification of key elements of sport technique and their bio-mechanical analysis. 3. Video-registration of dismounts from BB of somersault from RO, RO – back turnover type was fulfilled with camera Panasonic mini DV, which was located perpendicular to the plane of movement (sagittal plane). For converting video-records in AVI format we used program Pinnacle Studio, speed of video recording was 30 shots per second; preparation of individual shots of movements for bio-mechanical analysis. 4. Application of computer program «Kinovea» for measuring of joint angles of female gymnasts' bodies. 5. Bio-mechanical analysis of dismounts from BB with the help of program «Physics ToolKit» for obtaining kinematic and dynamic characteristics of movements of sportswomen's bodies, angle speed of ankle, knee, shoulder, wrist joints and GMC. 6. Mathematical statistics was carried out with computer program «KyPlot».

In table 1 we present anthropometrical indicators and bio-mechanical data of fulfilled dismounts from BB of junior female gymnasts of 12-14 years old age, which were intended for analyzing of sport techniques' key elements with program Physics ToolKit.

Table 1

Anthropometrical indicators and bio-mechanical data of dismounts from BB, fulfilled by sportswomen of 12-14 years old age, and intended for analyzing of sport techniques' key elements (n = 6)

	Mass (kg)	Height, (m)	Height with raised arms (m)	IR (kgm ²)	RM /GMC, (m)			
					A.FL	A.BL	Sh.	Wrist
Mean	36.32	1.48	1.88	129.12	0.896	0.894	0.494	0.672
SEM	1.29	0.01	0.02	6.29	0.02	0.02	0.02	0.04
SD	3.18	0.04	0.04	15.43	0.06	0.04	0.04	0.09

Legend: –A – ankle joint, FL- front leg; BL – back leg when pushing from beam; Sh.- shoulder joint; wrist – wrist joint; IR – inertia of rotation (height with raised arms); RM – radius of movement; GMC – general mass center. Mean – mean arithmetic; SEM –error of mean arithmetic; SD – square deviation.

In research 6 female gymnasts took place, who fulfilled competition exercises on beam. All they were reserve of combined team of Rumania in sport gymnastics. The research was carried out in period from 16 to 18 of November, 2012 in Oneshty town at championship of Rumania on individual all round and finals on apparatuses. In our article we presented results of studies of sport techniques' key elements of dismounts from BB: RO-somersault, bending, with turn by 360° (ROSS360°), RO-somersault, bending, with turn by 540° (ROSS540°), RO-somersault, bending, with turn by 720° (ROSS720°), RO-somersault, bending, with turn by 900° (ROSS900°); RO – backward turnover - somersault, bending, with turn by 720° (ROBTSS720°), RO – backward turnover - somersault, bending, with turn by 900° (ROBTSS 900°).

Results of the research

On the base of bio-mechanical analysis of dismounts from BB of type somersault from RO and RO – backward turnover we indentified the following key elements of sport technique: in phase of preparatory movements – starting position of body (SP) – position of gymnast's body in narrow stance, legs – parted, right (left) leg on beam before pushing into somersault; in phase of main movements – multiplication of body position (MP) of somersault's fulfillment, after pushing from edge of beam (ROSS360°, ROSS540°, ROSS720° ROSS900°, ROBTSS720°, ROBTSS 900°); in phase of finalizing movements – final body position (FP) – firm landing (key element, which characterize firm landing with dismounts – semi-squat with forward semi-bent of torso, in narrow stance, legs – apart, arms – forward and aside; depending on quantity of fulfilled pirouettes in dismounts, landing was carried out either facing apparatus or with back to it.

In table 2 and in fig.1 there are presented indicators of space-time characteristics of sport techniques' key elements; They are elements of dismounts from BB of types: somersault from RO (a) and RO –backward turnover (b) by data of joints' trajectories of junior, 12-14 years old female gymnasts.

Table 2.

Comparative indicators of space-time characteristics of key elements of dismounts from BB of types: somersault from RO and RO- backward turnover by data of joints' trajectories of junior, 12-14 years old female gymnasts (n = 6)

KE	Initials	Dismounts	TKE (sec)	GMC(m)		A.FL (m)		A.BL (m)		Sh. (m)		Wrist. (m)	
				x	y	x	y	x	y	x	y	x	y
SP	R.M.	ROSS 360°	0.067	0.31	1.07	0.43	0.08	0.21	0.08	-0.09	1.51	-0.35	1.92
	D.D.	ROSS 540°	0.033	0.29	0.93	0.34	0.19	0.17	0.11	-0.17	1.37	-0.57	1.62
	T.P.	ROSS 720°	0.067	0.23	1.12	0.36	0.13	0.11	0.11	-0.13	1.58	-0.36	1.96
	Z.S.	ROSS 900°	0.033	0.56	0.92	0.66	0.06	0.43	0.11	0.3	1.41	0.26	1.78
	V.K.	ROBTSS 720°	0.067	0.46	1.2	0.74	0.25	0.56	0.25	0.00	1.58	-0.16	2.01
	S.Sh.	ROBTSS 900°	0.067	0.29	1.16	0.56	0.13	0.32	0.11	-0.08	1.52	-0.30	1.92
MP, mhf	R.M.	ROSS 360°	0.2	-0.29	1.41	0.77	1.26	0.83	1.24	-0.48	1.41	-0.69	1.26
	D.D.	ROSS 540°	0.167	-0.09	1.31	0.68	0.8	0.70	0.8	-0.4	1.24	-0.49	1.16
	T.P.	ROSS 720°	0.267	-0.46	1.43	0.55	1.47	0.53	1.49	-0.88	1.49	-0.71	1.43
	Z.S.	ROSS 900°	0.2	0.11	1.42	0.94	1.26	0.92	1.24	-0.47	1.33	-0.32	1.26
	V.K.	ROBTSS 720°	0.233	-0.12	1.49	0.87	1.37	0.89	1.39	-0.6	1.41	-0.43	1.29
	S.Sh.	ROBTSS 900°	0.267	-0.27	1.48	0.61	1.83	0.63	1.84	-0.65	1.27	-0.57	1.18
FP	R.M.	ROSS 360°	0.8	-1.99	-0.27	-2.19	-1.18	-2.19	-1.23	-1.51	0.12	-1.10	-0.19
	D.D.	ROSS 540°	0.767	-1.56	-0.51	-1.68	-1.19	-1.68	-1.19	-1.43	-0.09	-1.79	-0.11
	T.P.	ROSS 720°	0.8	-2.25	-0.25	-2.38	-1.14	-2.40	-1.18	-1.68	-0.08	-1.72	-0.32
	Z.S.	ROSS 900°	0.8	-1.67	-0.26	-1.91	-1.18	-1.93	-1.16	-1.44	-0.04	-1.29	-0.22
	V.K.	ROBTSS 720°	0.8	-1.94	-0.37	-2.19	-1.14	-2.01	-1.18	-1.53	-0.12	-1.43	-0.54
	S.Sh.	ROBTSS 900°	0.8	-1.71	-0.39	-2.02	-1.18	-2.12	-1.16	-1.50	0.11	-2.03	0.04

Legend:

x –horizontal movement,

y –vertical movement,

SP- starting position of body,

MP – multiplication of body position,

mhf – maximal height of flight in dismount,

FP final position of body (landing),

KE – key element,

TKE – time of fulfillment of key elements,

A- ankle joint,

FL - front leg,

BL – back leg in pushing from beam,

Sh – shoulder joint,

Wrist – wrist joint.

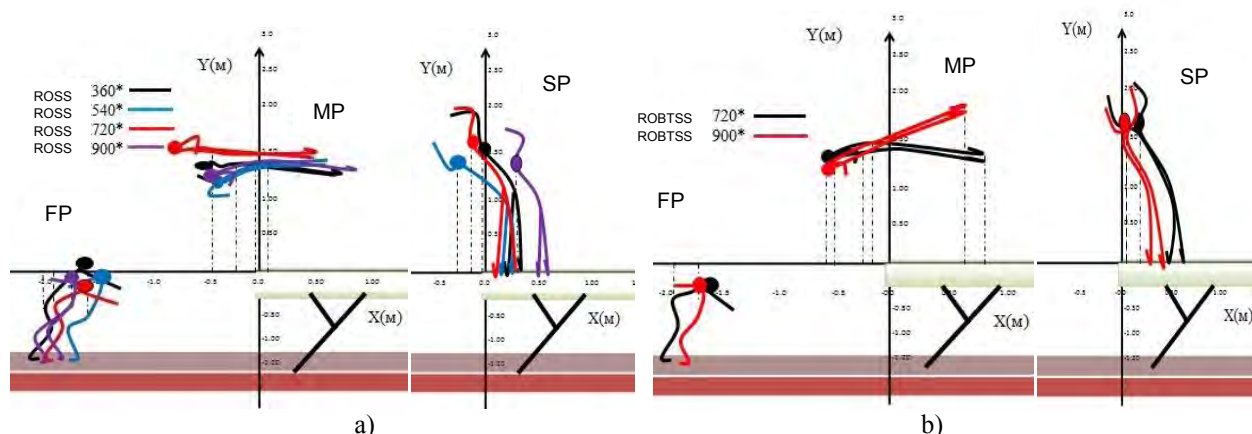


Fig.1. Key elements of dismounts from BB, fulfilled by junior, 12-14 years old female gymnasts, finalists of championship in Rumania, in exercises on beam:

SP- starting position of body – narrow stance, legs – apart with right (left leg on beam before pushing for somersault; MP – multiplication of body position – main phase of exercise, pirouette positions of body in maximal height of flight; FP – final position of body (landing).

Legend: a) dismounts from RO; b) dismounts from RO-backward turnover. Detail explanations of dismounts' names are given in section "Methodology and methods of research".

Analysis of comparative indicators of space-time characteristics of dismounts' key elements (dismounts – somersault from RO and RO – backward turnover by data of trajectories of joints' movements of junior, 12-14 years old female gymnasts, showed that from 6 gymnasts 4 fulfilled the following dismounts: ROSS 360°, ROSS 540°, ROSS 720°, ROSS 900°, and 2 - ROBTSS 720°, ROBTSS 900°. Time of dismounts, which we analyzed, was in average 0.8 ± 0.033 sec.; time of SP fulfillment in dismounts ROSS 360°, ROSS 540°, ROSS 720°, ROSS 900°, was in average 0.033sec., while time of SP fulfillment in dismounts ROSS 360°, ROSS 720°, ROBTSS 720°, ROBTSS 900° was in average 0.067sec. Longer time of SP in dismounts ROSS 360°, ROSS 720°, ROSS 900°, is connected with some technical mistakes, such as: insufficiently spring-firm landing on beam after RO, RO – backward turnover; this makes SP for moving to somersault slower, pushing is fulfilled with half-bent legs with torso's unbending backward from vertical axis (owing to the fact that back deviation of body from vertical axis with fulfillment of ROSS 360° is 41°, ROSS 720°, - 54°, ROBTSS 720°, - 37°, ROBTSS 900° - 35°); and to fast beginning of body rotation around longitudinal axis. In dismounts ROSS 900°, ROSS 900°, sportswomen fix SP farther from beam edge (by 0.56-0.74 m) and legs are parted on support by (0.18-0.24m), angle thigh – torso is 209° - 217°, this is witnessed by shots given in fig.1 (a. b). Analysis of starting body positions in all dismounts witnesses that junior gymnasts are not sufficiently skillful in short-term fixation of body position close to vertical axis for effective flight in somersault.

In the phase of main movements (start of pushing – rotation in somersault – preparation to landing), time of multiplication of body position (MP) in all dismounts is in interval $0.1 - 0.733 \pm 0.033$ sec. In dismount ROSS 360°, during pushing, position of body is deviated backward and bent by 221°, maximal height of GMC flight by 1.41m, feet position from beam edge - 0.29 m. At the end of pirouette sportswoman straightens position of body. In dismount ROSS 540° body is deviated backward and bent by 220°, maximal height of GMC flight by 1.31m, feet position from beam edge - 0.09 m and not high flight of GMC was registered. In dismount ROSS 720° body is deviated backward and bent by 234°, maximal height of GMC flight by 1.43m, feet position from beam edge - 0.46 m that characterizes higher flight of GMC and possible firm landing; distance between feet in this stance is 0.23 m. In dismount ROSS 900° body is deviated backward and bent by 209°, maximal height of GMC flight by 1.42 m, feet position from beam edge - 0.27 m. In dismount ROBTSS 720° body is deviated backward and bent by 217°, maximal height of GMC flight by 1.49 m, feet position from beam edge - 0.12 m. In dismount ROBTSS 900° body is deviated backward and bent by 215°, maximal height of GMC flight by 1.48 m, feet position from beam edge - 0.27 m.). Main technical mistakes, determined by fulfilled bio-mechanical analysis of MP, is that in all dismounts junior female gymnasts fix lower part of body at the moment of rotation above beam (see fig. 1 a) b)) but not shifted upward-backward behind the edge of beam. All these witness that pushing shall be fulfilled with narrowly located feet on beam, at the edge of beam, with fixation of spring-firm straightened SP of body.

In finalizing phase of dismounts final position of body is a key element (FP) – firm landing; it is characterized by half-squat and forward torso half-bent, in narrow stance with legs apart, arms forward – upward – aside; depending on quantity of pirouettes in dismount landing body position can be with face or back to apparatus. There were 3 firm landings in dismounts with final exercises. Unstable landings (they were also 3) were characterized by such technical mistakes as: ROSS 540° - short forward jump; ROSS 720° - too deep squat with forward torso bent; ROBTSS 900° - unfinished rotation in pirouette and wide step. The length of landing in dismounts from beam is as follows: ROSS 360° -2.19 m; ROSS 540° 1.68 m; ROSS 720° - 2.40 m; ROSS 900° -1.93m; ROBTSS 720° - 2.01 m and ROBTSS 900° -

2.12 m. Sportswomen make more technical mistakes when landing with back to beam (not divisible pirouettes). Thus, we fixed confident influence of technical mistakes in key elements in phase structure of dismounts on quality of landing.

In fig. 2 and 3 there are presented indicators of resulting GMC force, angle speed of body links of female gymnasts in dismounts from BB by type somersault from RO and RO – backward turnover.

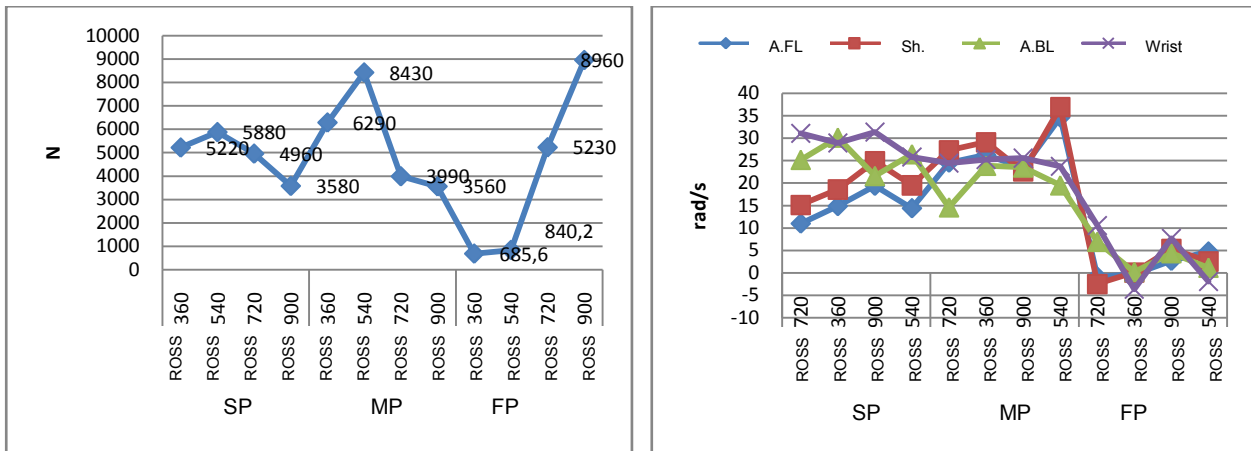


Fig.2. Comparative indicators of resulting GMC force, angle speed of body links of 12-14 years old female gymnasts in dismounts from BB of somersault from RO type.

Legend: see tables 1, 2, fig.1.

Bio-mechanical analysis of resulting GMC force's (N) indicators, angle speed (rad/s) of 12-14 years old female gymnasts in dismounts from BB of somersault from RO type, witnesses that in phase of preparatory actions in SP the highest resulting force of GMC - 5880N was registered in dismount ROSS 540°, fulfilled by gymnast D.D. Gymnast Z.S. showed greater angle speed in ankle joints (19.5 - 24.9 rad/s), less angle speed in shoulder joints (21.6 rad/s) and higher angle speed in wrist joints (31.4 rad/s) in dismount ROSS 900°. In main phase of movements, fulfilled by female gymnast D.D. MP of body was characterized by the highest resulting force of GMC in maximal height of flight in dismount ROSS 540°, which was 8430N. It is complied with angle speed in ankle and shoulder joints, which was accordingly 22.6 – 23.4 rad/s and 23.5 rad/s. The highest angle speed in wrist joints in dismount ROSS 900° was shown by female gymnast Z.S. - 25.6 rad/s. In finalizing phase of movements – FP – we registered the highest resulting force of GMC in dismount ROSS 900° - 8990N; the highest angle speed in ankle joints in dismounts ROSS 540° and ROSS 900° (4.7 – 5.4 rad/s), that do not facilitate effective control of landing. At the same time, high angle speed in shoulder joints (6.9 rad/s), wrist joints (10.6 rad/s) in dismount ROSS 720°, fulfilled by female gymnast T.P. was a result of weak pushing in SP (10.9 -15.1 rad/s) – that reduces quality of finalizing actions during rotation with taking convenient FP of body for landing (forward torso and shoulder bent – lower than technical standard, determined by FIG).

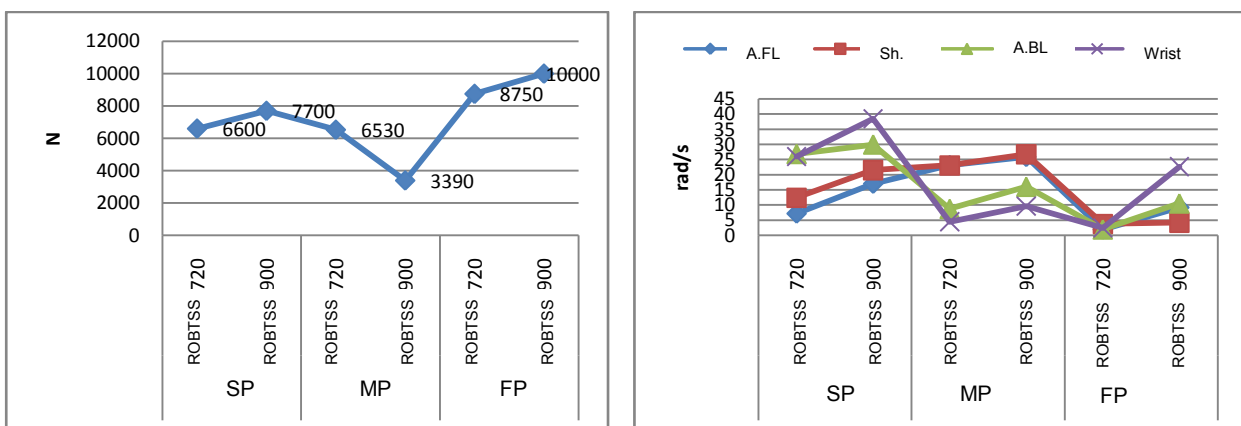


Fig.3. Comparative indicators of resulting GMC force, angle speed of body links of 12-14 years old female gymnasts in dismounts from BB of somersault from RO –backward turnover type.

Legend: see tables 1, 2, fig.1.

In phase of preparatory actions when fulfilling dismounts somersault from RO – backward turnover (see fig.3) in SP of female gymnast S.Sh. there were registered: higher resulting GMC force in dismount ROBTSS 900° - 7700N; higher angle speed in ankle joints - 17.1 – 21.5 rad/s, shoulder joints 29.9 m/s and wrist joints - 38.4 rad/s. In phase of main movements, when fulfilling of MP of body, female gymnast S.Sh. showed at maximal height of flight in dismount ROBTSS 900° low resulting force - 3390N, high angle speed in ankle joints.9 – 26.7 rad/s, in shoulder joints - 16.1 rad/s and in wrist joints 9.6 rad/s. In finalizing phase of movements – FP- we registered high resulting force of GMC in dismount ROBTSS 900° - 9580N, and high angle speed in ankle (9.2 – 4.2 rad/s), shoulder (10.6 rad/s) and wrist (22.6 rad/s) joints that facilitate effective completion of pirouette rotation with taking of convenient FP of body for landing with back to beam.

Results of performances of junior, 12-14 years old, female gymnasts on BB at championship in Rumania 2012 in individual all round and finals on apparatuses are presented in table 3.

Table 3.

Results of performances of junior, 12-14 years old, female gymnasts on BB at championship in Rumania 2012 (n = 6)

№	Initials	Dismount	Individual all round			Finals, apparatuses	
			Dif.	Ex.	FE	Result	Place
1	R.M.	ROSS 360°	5.200	8.600	13.800	13.950	4
2	D.D.	ROSS 540°	5.200	8.925	14.125	12.935	7
3	T.P.	ROSS 720°	5.500	8.700	14.200	13.350	6
4	Z.S.	ROSS 900°	5.700	8.650	14.350	13.885	5
5	V.K.	ROBTSS 720°	5.300	8.275	13.575	12.750	8
6	S.Sh.	ROBTSS 900°	5.600	8.525	14.125	14.535	3
Mean			5.42	8.61	14.03	13.57	
SEM			0.09	0.09	0.12	0.28	
SD			0.21	0.21	0.29	0.68	

Legend: see tables 1 and 2; Dif. – difficulty of jump; Ex. - evaluation of execution; FE – final evaluation.

Results of performances of junior, 12-14 years old, female gymnasts on BB at championship in Rumania 2012 witness that from 8 finalists, our tested gymnasts (6 persons) executed 4 dismounts of type” somersault from RO and 2 – from RO – backward turnover. In individual all round on beam mean mark for difficulty of exercise is - 5.42 points (content and construction of exercise, requirements to composition and pluses for combinations); for execution female gymnasts received in average– 8.61 points (discounts for artistry and choreography, specific discounts on beam); final mark was 14.03 points (sum of marks, given by referee’s group D. and I.). In final, by beams, the tested received for performances in average 13.57 points (see table 3).

Table 4.

Degree of connection of indicators of kinematic and dynamic key elements; structures of dismounts from BB, fulfilled by 12-14 years old female gymnasts with marks for performances in individual all round and final on beam at championship in Rumania, 2012. (n = 6)

Statistical indicators*	IAR (points)	FA (points)	SP		MP		FP	
			F (N)	Omega (rad/s)	F (N)	Omega (rad/s)	F (N)	Omega (rad/s)
IAR(points)		0.42;>0.05	-	-	-	-	-	3.26;
			3.36;<0.05	3.36;<0.05	3.36;<0.05	2.42;>0.05	3.36;<0.05	<0.05
FA (points)			-	-	-	-	-	3.04;<0.05
			3.36;<0.05	3.36;<0.05	3.36;<0.05	2.41;>0.05	3.36;<0.05	
SP	F (N)			3.36;<0.05	0.10;>0.05	3.36;<0.05	-	3.36;<0.05
	Omega (rad/s)				-	2.31;>0.05	2.41;>0.05	3.36;<0.05
MP	F (N)					3.36;<0.05	-	3.36;<0.05
	Omega (rad/s)						2.31;>0.05	3.15;<0.05
FP	F (N)							3.36;<0.05
	Omega (rad/s)							

Legend: see tables 1 and 2. * Nonparametric Multiple Comparisons; F – resulting force of GMC; Omega – angle speed of shoulder joint; IAR results of individual all round; FA – results of final on apparatuses.

In table 4 we show degree of connection of indicators of kinematic and dynamic key elements; structures of dismounts from BB, fulfilled by 12-14 years old female gymnasts with marks for performances in individual all round and final on beam at championship in Rumania, 2012.

Results of analysis of degree of connection of kinematic and dynamic key elements' structures' indicators of dismounts from BB, which were fulfilled by 12-14 years old female gymnasts with marks for individual all round and in final on apparatuses at championship of Rumania 2012, were obtained with the help of method «Nonparametric Multiple Comparisons» (see table 4). We determined different correlation connections of key elements structures' indicators of dismounts from BB, which were fulfilled by 12-14 years old female gymnasts at championship of Rumania, 2012.

Conclusions:

1. Method of video-computer analysis of dismounts from BB of types: somersault from RO and RO – backward turnover in combination with method of positions' reference marks of movements permitted to specify and identify key elements, the studying of which makes deeper understanding of gymnastics' sport techniques and permits to develop modern programs of their training.

2. Key elements of dismounts from BB of types somersault from RO and RO – backward turnover are: in preparatory phase – starting position of body – SP – position of body in narrow stance with legs apart and with right (left) leg on beam, ready for pushing for flight in somersault; in main phase – multiplication of body position (MP) – fulfillment of somersault after pushing from beam (somersault, bending with turn by 360°, 540°, 720° and 900°); in finalizing phase – final position of body – FP – firm landing.

3. Key elements, studied by us with the help of up to date methods of research in phase structure of dismounts from BB by RO and RO-backward turnover, fulfilled by junior female gymnasts – reserve of combined team of Rumania in sport gymnastics, and their objective indicators were the ground for measuring, analysis and evaluation of kinematic and dynamic structures and other exercises of gymnastics' all round in order to develop training programs for preceding and following next positions of body, bio-mechanical rational transmitting of optimal power, space, time and other abilities, parameters and indicators of movements in phase structure of gymnastic exercise.

4. We registered correlation connection of different degree of kinematic and dynamic structures' key elements' indicators of dismounts from balance beam, fulfilled by 12-14 years old female gymnasts with marks for performances in individual all round and final at championship of Rumania, 2012.

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