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Learning the Snatch Sports Technique Based on Biomechanical Criteria in Weightlifting

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Abstract

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This paper is meant to highlight the didactic technology of learning the sports technique of snatch procedure in weightlifting based on biomechanical criteria. This scientific approach led to a study conducted in "Rapid" Sports Club of Bucharest, Weightlifting Department. A number of 5 athletes aged 12 to 16 years participated in this study. The following methods of research were used: specialized bibliographic study; method of pedagogical observation; computerized video method, using Physics Toolkit biomechanical analysis program; statistical method of research data processing by means of KyPlot program. The study monitored the performances of junior weightlifters during training sessions in terms of learning and improving the sports technique of snatch lift. In the biomechanical analysis, there were identified, measured and evaluated the phases of snatch lift sports technique, there were highlighted the execution faults and the influence of the kinematic and dynamic characteristics on the technical execution. On the basis of the results obtained, there were developed algorithmic programs for the linear-branched learning of snatch lift, using the most efficient preparatory exercises for specific physical and technical training. The use of the video method of biomechanical analysis of snatch procedure in weightlifting contributed to the more efficient learning of sports technique and to the achievement of better performances in competition.

Keywords: Weightlifting; biomechanics; didactics; snatch; performance.

1. Introduction

The increase of performances in weightlifting, a phenomenon that we are continuously witnessing, is based on the improvement of technique and training methods (B.I., 2009).

The review of technique and technical training in weightlifting is highlighted by the following components (Ulareanu, 2014a: 86): technical elements (snatch and clean & jerk), technical procedure ("hockey" snatch or high pull, split in hockey, etc.), style and basic mechanism of technical procedure.

The relations between technical procedures and elements are not present in all sport branches, some of them having only technical procedures (weightlifting). Before starting to learn the technical exercises, the children should know a series of aiding exercises and execute them correctly, with load accessible for their age (Ulareanu, 2014b: 111).

Recently, the international sports arena and national competition countries have deteriorated sharply athletic competition, the weightlifters' fights becoming more acute and intense. In achieving victory, conditions can be based on non-traditional approaches to the formation of technical skills in athletes, as well as on research and development of technology implementation in competitive "jerk" and "push" exercises included in the biathlon (Kornilov, 2010: 28).

Weightlifting was usually studied in terms of kinematic and kinetic parameters by various researchers (Garhammer, 1985; Baumann et al., 1988; Lee, Huwang, & Tsuang, 1995; Gourgoulis et al., 2000; Ulareanu, Potop, & Timnea, 2013; Oleshko, 2014). During the lifting process, the feet become a supporting base to maintain balance and to facilitate the movement of the barbell as the forces applied on it by the weightlifter. Thus, an understanding of the feet reaction to the ground as well as the movement would be very valuable for coaches (Garhammer, 1984; Yu-Chuan & Wu-Chou, 2001).

Purpose of the paper: it is meant to highlight the didactic technology of learning the sports technique of snatch procedure in weightlifting based on biomechanical criteria.

Hypothesis of the paper. We considered that the use of the biomechanical analysis video method of snatch procedure in weightlifting would contribute to a more efficient learning of sports technique and to better performances in competition.

2. Materials and methods

This scientific approach led to a study conducted in "Rapid" Sports Club of Bucharest, Weightlifting Department. A number of 5 athletes aged 12 to 16 years participated in this study. The following methods of research were used: specialized bibliographic study; method of pedagogical observation; computerized video method, using Physics Toolkit biomechanical analysis program; statistical method of research data processing by means of KyPlot program. The study monitored the performances of junior weightlifters during training sessions in terms of learning and improving the sports technique of snatch lift.

The video recording was made with a Panasonic video camera, perpendicular to the plane of motion; the images were converted into AVI format (30 frames/sec, 1 frame = 0.033 sec) by means of Pinnacle studio video capture program. The measure of the angular features of movement phases in snatch style was performed by means of Kinovea program and focused on the angular positions between thigh and torso in the start position, straightening, end of snatch, getting under bar in squat; during the lifting from squat, we measured the angle between feet - GCG and barbell. We also analysed and assessed the kinematic and dynamic characteristics of movement phases in snatch style.

The technique of snatch style was learned by means of the linear-branched programming, in conformity with the model of professor V. Boloban (2013), adapted by us, using four levels of means for the correction of mistakes and improvement of the technique.

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3. Results

The video computerized analysis of snatch style in performance weightlifting identified, analysed and evaluated the characteristics of movement phases of sports technique in terms of start position (SP), straightening, flipping, getting under barbell in squat, lifting and barbell catch.

Table 1. Anthropometric indicators and weight in snatch style execution during workouts and competitions of junior weightlifters (n = 5)

No.	Name	Weight (kg)	Competition class (kg)	Height, (m)	Technical execution in workouts			Competition	Rel. workout Comp. – kg, %
					1	2	3		
1	T.M.	36	56	1.51	17	17	20	25	80.00
2	I.P.	62	62	1.55	30	35	40	60	66.67
3	I.C.	57	62	1.70	30	35	40	45	88.89
4	I.S.	55	56	1.60	40	45	50	70	71.43
5	M.D.	78	85	1.78	70	75	80	110	72.43
Mean		57.6	64.2	1.63	37.4	41.4	46.0	62.0	75.88
SEM		6.74	5.37	0.05	8.93	9.54	9.79	14.19	3.89

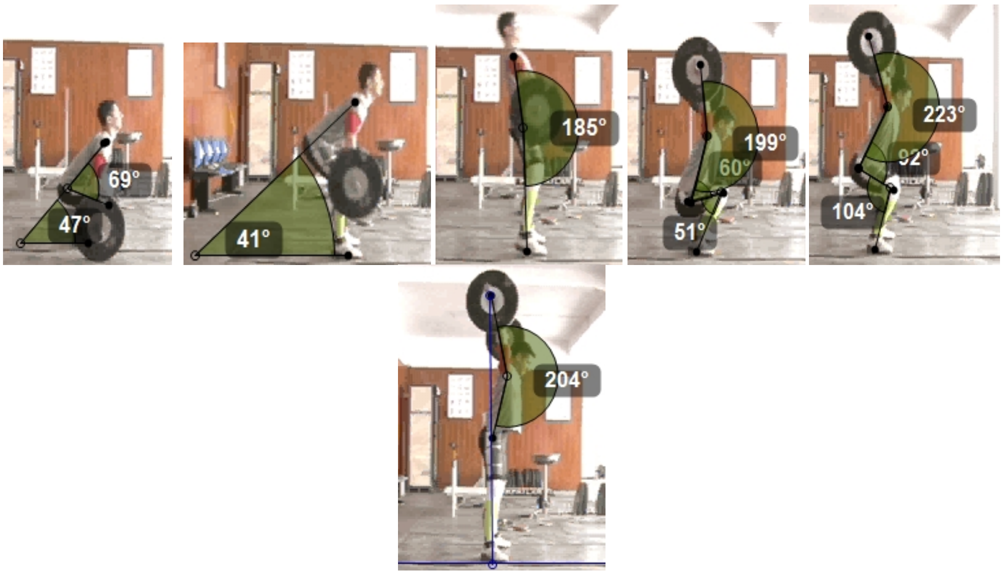
Table 1 shows the anthropometric indicators and the weight in snatch style execution during workouts and competitions.

Table 2 and Figure 1 show the angular characteristics of body segments during the phases of snatch style execution by junior weightlifters aged 12 to 16 in terms of barbell weight, angles of the start position, straightening, flipping, getting under barbell in squat, raising from squat and fixing the barbell.

Table 2. Angular characteristics of body segments in snatch style execution (n = 5)

	Barbell weight (kg)	SP (degrees)		Straight. (degrees)	Flipping, (degrees)	G.U.B. (degrees)			R.H. (degrees)			Catch, (degrees)
		1	2			1	2	3	1	2	3	
Mean		48.9	39.5	37.3	183.5	58.5	60.7	207.5	107.2	93.3	214.4	194.6
SEM		3.47	2.35	2.11	3.08	4.54	3.71	1.49	2.08	2.92	1.79	1.29
ANOVA		F=5.165; P<0.01				595.950; P<0.001			838.06; P<0.001			

Note: SP1 – angle between torso and hips; SP2 – angle between torso line and platform; Straight.- Straightening – angle between torso line and platform; G.U.B. - Getting under the barbell in squat: 1 – angle between hip and shank; 2 – angle between torso and hip and 3 – angle between torso and arms; RH – Lifting from "hockey" (semi-triple- extension) – 1-3 idem G.U.B.



Ph-I Ph-2 Ph-3 Ph-4 Ph-5 Ph-6

Fig. 1. Angular characteristics of snatch style phases (M.D.)

Table 3. Results of biomechanical indicators in snatch style (n = 5, mean ± SEM)

Movement phases	Statistical indicators	Position (m)		Velocity (m/s)			Force (N)		
		X	Y	V_x	V_y	V	F_x	F_y	F
SP – start	Mean	0.19	0.103	-0.41	5.588	5.615	-383.47	2622	2866
	SEM	0.01	0.02	0.2	0.68	0.69	550.15	138.79	166.03
Straightening	Mean	0.15	0.59	-0.52	6.78	6.90	1676	905.3	1990
	SEM	0.01	0.03	0.56	0.58	0.54	246.9	307.7	272.1
Flipping	Mean	0.204	0.95	1.92	8.01	8.26	-67.41	-58.19	1421.06
	SEM	0.03	0.05	0.34	0.45	0.47	538.3	530.4	260.78
GUB	Mean	0.14	1.22	-0.21	0.44	0.50	210.9	2013.6	2107.5
	SEM	0.07	0.08	0.12	0.17	0.19	256.4	396.9	371.9
Catch	Mean	0.13	1.94	-0.17	0.86	1.03	94.64	-1248.9	1329.2
	SEM	0.09	0.06	0.14	0.68	0.64	215.7	397.7	395.9

Phases of movement: SP –Start position and leaving the SP; GUB - Getting under barbell in squat; Raising and catching the barbell.

In Table 3, there are shown the results of the biomechanical characteristics of snatch style regarding the barbell trajectory (X, Y), velocity (V_x, V_y and V) and force (F_x, F_y and F) of the start position, straightening, flipping, getting under barbell in squat, raising from squat and barbell fixing.

Figure 2 presents the algorithmic diagram of the linear-branched programming in snatch style learning, highlighting the goal of learning, pedagogical tasks, aiding and preparatory exercises for learning snatch style, supplementary preparatory exercises, process of control, correction of learning and the results of learning.

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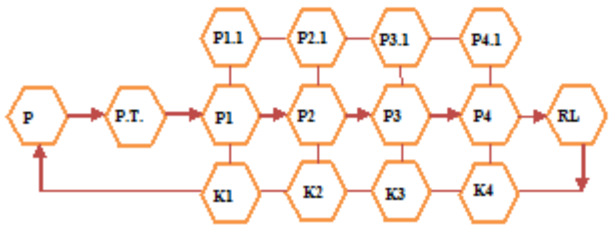

Fig. 2. Algorithmic diagram of linear-branched programming in snatch style learning

Note: P – purpose of exercise learning; PT – pedagogical tasks; P1-4 – aiding / preparatory exercises ; P1.1, 2.1, 3.1, 4.1 – supplementary exercises with aiding - preparatory character; K1, K2, K3, K4 – control, correction of learning process, RL – results of learning.

Methods to correct mistakes and to improve the phases of snatch style:

1. Insufficient pulling – execution of pulls during which the complete straightening, torso extension and head bending backwards are monitored; snatch without split; pulling from boxes of different heights, etc.

2. Getting under barbell in "hockey" position too early: pulls maintaining the barbell in the highest spot, etc.

3. Flipping is not executed from both legs: snatch from hanging; snatch from boxes; separate performance of the snatch, monitoring the tiptoeing and falling in squat, etc.

4. Lifting the barbell with the same speed: development of back and lower legs muscles; workout from hanging position; workout from boxes, etc.

4. Discussions and conclusions

The assessment of the technical training was performed by the method of movement postural orientation (Boloban, 2013), adapted by us to the specific features of snatch style, using the biomechanical analysis of the key elements of sports technique by means of the video computerized method.

The identification of the key elements of sports technique in snatch style was performed by means of a specialized program named Physical Toolkit, with a group of 5 junior athletes aged 12 to 16, monitoring - with Kinovea program - the angular characteristics of the snatch style in three attempts (Table 1).

The results of the anthropometric indicators and the weight in snatch style execution during workouts highlight an average body weight of 57.6 kg and an average height of 1.63 m; the barbell weight during the first attempt executions is 37.4 kg, at the second attempt is 41.4 kg, and at the third attempt is 46.0 kg, which represents 75.88 % of the maximum weight of 62.0 kg lifted in the event.

Regarding the angular characteristics of body segments we found out (Table 2) - in start posture – a mean of the torso – hip angle of 48.9° and 39.5° between torso line and the platform; at the end of the straightening phase, the mean of the angle between the torso line and the platform is 37.3°; the posture of the torso at the end of the flipping is 183.5°; in the phase of entering under the barbell in squat position, the angle shank-hip is 58.5°, hip-torso 60.7°, and torso-arms 207.5°; in the phase of lifting with split legs in semi-triple-extension of the shank-hip-torso, the angular values of these ones are of 107.2°-93.3°-214.4°.

The results of the angular characteristics of body segments between the phases of snatch style were obtained with the help of ANOVA test, revealing significant differences between the angles of the start posture and straightening at P< 0.01; the angular relation in the phases of getting under the barbell in squat position and lifting with split legs and fixing the barbell show significant differences at P< 0.001.

As for the results of the biomechanical characteristics in snatch style (Table 3), we notice in the flipping phase a value of barbell lifting at 0.95 m with a resultant of linear velocity of 8.26 m/s, and during the lifting from split leg position, the force resultant is 2107.5 N.

The assessment of technical execution level by means of the method of movement postural orientation led to the creation of an algorithmic diagram for correcting and learning the snatch style (Fig. 2).

The use of the video computerized method of biomechanical analysis of snatch style in weightlifting contributed to the more efficient learning of sports technique and to the achievement of better performances in competition.

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