Comparative analysis of snap techniques in young weightathleters at the initial and training stages of sports training

UDC 796.012

Dr. Hab., Professor **A.A. Shalmanov**[1]
PhD, Professor **V.F. Skotnikov**[1]
[1]The Russian University of Sport «GTSOLIFK», Moscow

Corresponding author: shalmanov_bio@bk.ru

Received by the editorial office on 03.09.2023

Abstract

Objective of the study was to compare general and specific criteria for snatch technique among young weightlifters at the initial (26 people aged 9-12 years) and training (129 people aged 13-17 years) stages of sports training.

Methods and structure of the study. The technical skill of the athletes was assessed during official competitions using bilateral video recording. The kinematic and dynamic characteristics of the movement of the CM of the barbell were calculated, on the basis of which the criteria for the technical skill of the athletes were determined.

Results and conclusions. It was shown that only five athletes at the initial stage of preparation and eight athletes at the training stage corresponded to the criteria of technique corresponding to the values of the rational way of performing this exercise. The remaining athletes had two or more technical errors. From this we can conclude that coaches do not pay enough attention to developing the correct snatch technique.

Keywords: *criteria of rationality and effectiveness of sports equipment, biomechanics of weightlifting exercises, biomechanical control.*

Introduction. The problem of technical skill of athletes in the early stages of training is one of the most important, since as the skill of competitive exercises is formed and automated, the difficulties in eliminating errors in the technique of performing them increase. Formation and improvement of the technical skills of weightlifters presupposes knowledge of the requirements and criteria for the rational technique of classical exercises, based on which it is possible to formulate recommendations for their correct implementation, taking into account the individual characteristics and level of preparedness of the athletes [1, 2]. This is especially important for weightlifters at the initial and training stages of sports training.

Our research in this direction, conducted on highly qualified weightlifters [3], when comparing athletes of light and heavy weight categories [5], men and women [10], allowed us to identify the following criteria [3, 6]:

– CE1 – coefficient of implementation efficiency of the snatch technique (generalized criterion). This criterion is determined by the difference between the result shown in the competition and the theoretical result, calculated by regression equations between the maximum vertical power in the snatch and the actual result. Positive coefficient values indicate a more effective technique, and negative coefficients indicate a less effective technique. The higher the coefficients, the higher the level of technical skill of the athlete.

– H1 – height of the CM of the bar at the beginning of the final acceleration phase relative to the athlete's height. At this time, the athlete performs "knocking" the barbell. The greater the height at the beginning of the "kick," the more technical the athlete.

– H3 – maximum height of the CM of the barbell after the lift relative to the athlete's height. The lower the height, the more technical the athlete.

– Y3 – horizontal coordinate of the highest point of the trajectory of the CM of the barbell in the unsupported phase of the squat. Positive values of this indicator indicate that the bar is moving in the "up and back" direction, and negative values "up and forward". The more the position of the point deviates from the vertical towards the athlete's body, the closer the trajectory of the CM of the barbell is to the rational one.

– Vv – maximum vertical speed in the final acceleration phase. The value of this speed should be optimal

for each athlete, but the lower it is, the more technical the athlete.

– dVv – decrease in vertical velocity in the transition phase. The less speed loss, the more technical the athlete.

– Vg – maximum horizontal speed in the final acceleration phase. Its value must be optimal and correlate with the correct direction of lifting the projectile.

Objective of the study was to compare the listed criteria for the snatch technique among athletes at the initial and training stages of sports training and to identify the most common errors in the technique of performing this exercise.

Methods and structure of the study. The assessment of the technical skill of athletes was carried out on the basis of recording the kinematic and dynamic characteristics of the movement of the barbell during official competitions.

At the initial stage of sports training, young weightlifters (26 boys and girls) of different weight categories, who competed at the "Olympic Hopes" competition at the Olympic Reserve School No. 2 in Moscow, took part in the experiment. The average age of the athletes is 11.9±1.0 years, body weight is 44.9±11.5 kg and body length is 153±10.6 cm.

Bilateral video recording was carried out with Cannon-EOS80D cameras at a frequency of 50 frames per second. Video cameras were located on both sides of the weightlifting platform at a height of 1.1 m. Markers were attached to the ends of the barbell, on the basis of which the kinematic and dynamic characteristics of the movement of the center of mass (CM) of the barbell were calculated.

A similar experiment was carried out on young athletes during the training stage of preparation, in which significantly more athletes participated (129 boys and girls: 96 athletes aged 13-15 years and 33 athletes aged 16-17 years) of different weight categories competing in 2022 at competitions: "Olympic hopes"; Moscow Cup; Moscow Championships (in October and December of this year) and the Moscow Championships, which took place at the Olympic Reserve School No. 2 in Moscow. The average age of the athletes was 14.7±1.3 years, body weight was 63.8±15.8 kg and body length was 167±9.2 cm. Bilateral video recording was carried out with Cannon-EOS90D cameras at a frequency of 100 frames per second. Video cameras were located on both sides of the weightlifting platform at a height of 1.2 m.

Since the main criterion for the technical skill of athletes, determined by the method of regression residuals, is not the sports result, but the degree to which the athlete uses his speed-strength capabilities, we considered it possible in both cases to combine boys and girls into one sample of subjects.

Results of the study and discussion. To assess the technical skill of weightlifters, generalized and specific criteria for the effectiveness of technique were determined during the initial training period (I) and during the training period (II), the average values of which for the snatch are presented in Table 1.

The generalized criterion for the implementation efficiency of a technique for athletes was determined by regression equations between the maximum vertical power that athletes develop in the final acceleration phase and the result in the snatch. For athletes at the initial stage of preparation, the correlation coefficient between the discussed indicators is 0.95, and for athletes at the training stage - 0.87.

The corresponding regression equations are:

at the first stage – $Rt=3.40+0.030\times Pz$;

at the second stage – $Rt=8.59+0.033\times Pz$, где

Rt – theoretical result in snatch; Pz – maximum vertical power in the final acceleration.

In most cases, the average values and variability indicators do not differ statistically significantly among athletes at different stages of training. The exception is the relative horizontal alternation of the highest point of the lifting trajectory of the bar (shown in bold in the table) and the maximum vertical speed of the bar, the average values of which are statistically significantly different from each other ($p<0.01$ and $p<0.001$, respectively). The negative value of the highest point of the trajectory indicates that athletes at the training stage lift the barbell "up and forward" to a greater extent, which is less rational. In addition, these athletes accelerate the barbell to high vertical speeds and lift the barbell to a large relative height ($p<0.01$), which is also irrational. Let us note that athletes at the training stage of preparation are distinguished by large interindividual variability of the generalized criterion of the jerk technique of maximum horizontal speed in the final acceleration phase, as evidenced by statistically significantly large standard deviations of these indicators among athletes at the training stage of preparation ($p<0.01$).

Analysis of the correlation dependencies of particular criteria with the general criterion of the implementation efficiency of a technique suggests that technical athletes are distinguished by more economical execution of exercises (Table 2). This is evidenced by the negative correlation between the maximum lifting height of the bar after the lift (-0.63 and -0.39) and the maximum vertical speed of the bar at the end of the final acceleration (-0.80 and -0.68) among athletes of the initial and training stages, respectively. Unlike athletes at the initial stage of preparation, athletes at the training stage are distinguished by a statistically significant correlation of the relative height of the barbell at the beginning of the final acceleration (0.48)

Table 1. *Generalized and specific criteria for the effectiveness of the technique in the snatch during the initial preparation period (I) and during the training period (II)*

Criterion name	Stages preparation	Average arithmetic	Standard deviation
Equipment sales efficiency coefficients (kg) – CE1	I II	-0,09 0,05	±4,49 ±9,91
Relative height of the CM of the barbell at the beginning of the final acceleration phase (%) – H1	I II	33,3 34,9	±4,2 ±4,2
Relative maximum height of the CM of the barbell after detonation (%) – H3	I II	67,9 70,0	±3,85 ±4,0
Relative horizontal movement of the highest point of the CM of the barbell trajectory (%) – Y3	I II	2,47 -0,38	±5,41 ±4,57
Maximum vertical speed in the final acceleration phase (m/s) – Vv	I II	1,94 2,08	±0,16 ±0,15
Decrease in vertical speed in the transition phase (m/s) – dVv	I II	0,12 0,09	±0,22 ±0,25
Maximum horizontal speed in the final acceleration phase (m/s) – Vg	I II	0,67 0,57	±0,21 ±0,57

with the general criterion for the effectiveness of the snatch technique, which meets the requirements for the rational technique of this exercise.

A common feature of the technique of young weightlifters is that in the final phase of the snatch, athletes accelerate the barbell to greater than required vertical speed values (Vv) and lift the projectile to a greater height (H3), that is, many athletes tear the barbell in a half-squat position, which is irrational.

Analysis of the individual values of the considered criteria for the snatch technique shows that according to the generalized criterion at the initial stage of preparation, only five athletes out of 26 (19.2%) demonstrate an "excellent" level of technical skill, and in the group of athletes at the training stage of preparation this percentage is even lower - 17 athletes out of 129 (13.2%).

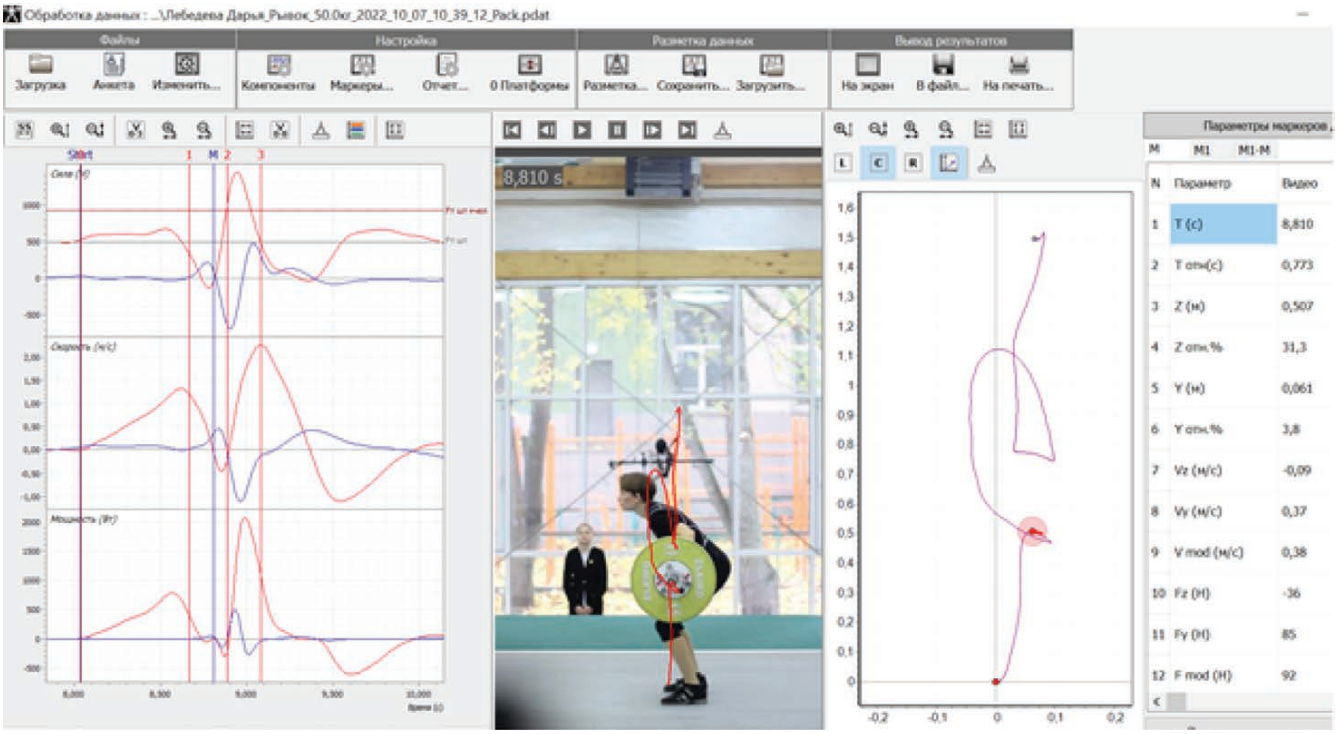
As for private criteria, in the initial training group and in the training stage group, respectively, the percentage of athletes with "excellent" technique is as follows: the relative height of the barbell at the beginning of the final acceleration is 26.8% and 29.1%; relative maximum boom height – 24.7% and 10.9%; relative horizontal movement of the rod at maximum lifting height – 30.4% and 26.4%; – maximum vertical speed in the final acceleration – 28.5% and 19.4%; decrease in vertical speed in the transition phase – 69.2% and 77.5%; the maximum horizontal speed in the transition phase is 39.3% and 17.8%.

Note that only five weightlifters at the initial stage and eight athletes at the training stage demonstrated a snatch technique close to the rational version; the remaining athletes had two or more errors in the technique.

As an example, we present the results of processing video data from athlete L-voy (16 years old, snatch result of 50 kg), whose technique can be assessed as "very poor" (see figure). The general criterion for the implementation efficiency of equipment is -20 kg. In the preliminary acceleration, the athlete imparts a vertical speed to the barbell of 1.32 m/s; in the transition phase, this speed drops to zero and even the barbell moves downward for some time. The decrease in speed is caused by the fact that the athlete sits under

Table 2. *Correlation coefficients of the result in the snatch and the general efficiency coefficient of the snatch technique with particular criteria for the effectiveness of the technique in young weightlifters*

Criterion name	Stages reparation	CE1
Relative height of the barbell at the beginning of the final acceleration	I II	-0,09 0,48
Relative maximum height of the barbell	I II	-0,63 -0,39
Relative horizontal movement of the bar at the maximum lifting height	I II	0,33 0,11
Maximum vertical speed in final acceleration	I II	-0,80 -0,68
Reduction of vertical speed in the transition phase	I II	-0,55 -0,24
Maximum horizontal speed in the transition phase	I II	0,15 -0,28



Results of processing data from video recording of athlete L-voy. The athlete's posture corresponds to the moment the barbell moves down in the middle of the transition phase

the barbell and bends her arms at the elbow joints, as a result of which the speed drops by 1.78 m/s. At the beginning of the final acceleration phase, the CM of the barbell is at a height of 47.8 cm (29.5% of the body length), which is irrational.

In the final acceleration phase, the athlete accelerates the projectile to 2.25 m/s and lifts it to a height of 1.12 m (69.2%), while the maximum horizontal speed of the bar reaches 1.11 m/s. The direction of lifting the barbell is predominantly upward.

Thus, all the values of the criteria for the snatch technique considered by us for this athlete do not correspond to rational values, and this case is far from isolated.

Conclusions. The results of a comparative analysis show that coaches pay insufficient attention to the technical training of weightlifters at the initial and training stages of sports training. Many athletes make mistakes in the snatch technique, the correction of which is difficult and sometimes simply impossible at subsequent stages of sports training.

References

1. Shalmanov A.A. Osnovnyye trebovaniya k ratsionalnoy tekhnike podyema shtangi v klassicheskikh tyazheloatleticheskikh uprazhneniyakh. Innovatsionnyye tekhnologii v podgotovke sportsmenov. Proceedings national scientific-practical conference, November 30-December 2, 2016. Moscow. pp. 90-96.
2. Shalmanov A.A. Individualnyye metodicheskiye rekomendatsii po vypolneniyu trebovaniy k tekhnicheskoy i skorostno-silovoy podgotovlennosti tyazheloatletov. Uchenyye zapiski universiteta im. P.F. Lesgafta. 2021. No. 3 (193). pp. 484-489.
3. Shalmanov A.A. Biomekhanika dvizheniya shtangi v ryvke i tolchke u sportsmenov vysokoy kvalifikatsii. Moscow: Torgovyy dom «Sovetskiy sport» publ., 2022. 197 p.
4. Shalmanov A.A., Skotnikov V.F., Atlas A.A., Bagmet P.N. Sravnitelnyy analiz kinematicheskikh pokazateley dvizheniya shtangi v ryvke u muzhchin i zhenshchin. Trudy kafedry biomekhaniki universiteta im. P.F. Lesgafta. St. Petersburg, 2017. Vypusk 11. pp. 59-68.
5. Shalmanov A.A., Skotnikov V.F., Atlas A.A. Sravnitelnyy analiz kinematicheskikh pokazateley dvizheniya shtangi v ryvke i tolchke u sportsmenov legkikh i tyazhelykh vesovykh kategoriy. Trudy kafedry biomekhaniki universiteta im. P.F. Lesgafta. St. Petersburg, 2016. Vypusk 10. pp. 50-61.
6. Shalmanov A.A., Lukunina E.A. Obobshchennyye i chastnyye kriterii tekhniki ryvka i podyema shtangi na grud v tolchke. Biomekhanika dvigatelnykh deystviy i biomekhanicheskiy kontrol v sporte. Proceedings national scientific-practical conference with international participation, October 29-30, 2020. pp. 194-199.