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STUDY ON THE USE OF THE OPTOJUMP NEXT SYSTEM IN ASSESSING AND DIRECTING TRIPLE JUMP TRAINING

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Abstract

The triple jump, one of the most beautiful events in athletics, is a technical event that requires strength, speed, and coordination abilities. In the present research, we use OptoJump equipment for performance analysis, the analysis of the parameters measured by applying the tests integrated in the OptoJump Next system and aims at the specific components of skills and motor qualities: explosive and reactive force, power, contact and flight times, coordination and balance, so that feedback is obtained in real time. The parameters determined with this technology have an objective character, therefore we believe that the OptoJump system can be introduced in the training and evaluation of the training level of athletes specialized in the triple jump test, in order to increase the level of motor capacity, ultimately expressed through high performance, at world level. The aim of the research was to determine, analyse and interpret some parameters specific to the triple jump event, by applying 12 tests, integrated in the OptoJump Next optical system, to determine the aptitude level of the athletes in the male triple jump event, senior category. Following the application of the statistical analysis on the values of the parameters obtained by using the 12 tests carried out with the Opto Jump Next technology, on a group of athletes performing in the men's triple jump, senior category, carried out in this confirmatory research, we appreciate that the application of test 7 and 8, it is much more relevant to illustrate their level of training.

Keywords: Athletics, speed, triple jump.

Introduction

The OptoJump Next diagnostic research equipment belongs to the Interdisciplinary Research Laboratory "Dr. Alexandru Partheniu", from UNEFS Bucharest. To determine the power, explosive and reactive force of the athletes, we used the OptoJump Next optical system, using the tests integrated in this technology, which aim to measure the power, coordination, length and height of jumps. This system consists of two basic LED segments measuring 39.4 x 1.2 x 1.6 inches, to which segments of the same size can be added to measure longer distances, one of the bars is the receiver and the other is the transmitter, these two communicating permanently (http://www.optojump.com/What-is-Optojump.aspx). The LEDs on the transmit bar continuously communicate with those on the receive bar. The system detects any interruptions in the communication between the bars and calculates their duration. This makes it possible to measure contact and flight times during a series of jumps with an accuracy of 1/1000 of a second. Starting from this basic fundamental data, the dedicated software makes it possible to obtain a series of parameters connected to the athlete's performance, with maximum accuracy and in real time. (https://training.microgate.it/en/products/optojump-next).

The triple jump is one of the most difficult event in athletics from the point of view of the technique, the means used in preparation and the athlete's somatic activation capacity (Larion, 2007), (Gioftsidou et al., 2012).

Pure concentric or eccentric strength in field event athletes may also be developed via exercises in the weight room for example, concentric strength may be expressed in the quadriceps in the upward phase in the squat whereas eccentric strength would be expressed in the downward phase of the squat. (Dragomir et all, 2021), (Gribble, Hertel & Plisky, 2012). The difference between the two methods of developing concentric and eccentric strength lies in the time of force application. Again, squats develop the force component of power and the box jumps develop the velocity component of power. (Jacobs, Bobbert & Van Ingen Schenau, 1996), (Benns & Harvey, 2023).

Methods

The hypothesis of the research: the fitness level of the athletes in the triple jump test can be determined with the help of scientific technology, both during the training period and during the competitive period, later, by interpreting and analyzing the values of the parameters measured with the OptoJump system, both the values can be optimized motor qualities specific to the triple jump, as well as some aspects of the technique of the test.

The research methods in the paper were: bibliographic study method, Observation method, Measurement and recording method (optical motion analysis system, Optojump Next), Statistical-mathematical methods, IBM SPSS Statistics 25 and Microsoft Office Excel/Word 2021; the Shapiro-Wilk test, the One-Way ANOVA test, the Kruskal-Wallis H test.

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For the measurements in the set protocol for 10 tests, 6 meters of OptoJump bars were used, laid out in a square shape and connected to a laptop. For 2 other tests (Single Leg 3 Hops-test 7 and 8), 20m (2x10m) of OptoJump were used, the TX and RX bars being placed 1.5m apart and connected to a laptop. The test protocol was selected from the menu of predefined tests, once for the right leg and then for the left leg.

The 12 tests used are:

1. 5 successive jumps performed on the left leg, performed on the spot (5 Jumps Single Leg Left 2 D Drift);
2. 5 successive jumps performed on the left leg, performed with forward-backward movement (5 Jumps Single Leg Left Front/Back Drift);
3. 5 successive jumps performed on the left leg, performed with left-right drift (5 Jumps Single Leg Left Left/Right Drift);
4. 5 successive jumps performed on the right leg, performed on the spot (5 Jumps Single Leg Right 2 D Drift);
5. 5 successive jumps performed on the right leg, performed with forward-backward movement (5 Jumps Single Leg Right Front/Back Drift);
6. 5 successive jumps performed on the right leg, performed with left-right drift (5 Jumps Single Leg Right Left/Right Drift);
7. 3 successive jumps performed on the left leg, performed with forward movement (Single Leg 3 Hops Left Foot);
8. 3 successive jumps performed on the right leg, performed with forward movement (Single Leg 3 Hops Right Foot);
9. 5 successive jumps, from the semi-genuflexion position (90°), performed on both legs with hands on the hips, performed on the spot (Squat Jump 2 Legs 5 Jumps);
10. a vertical jump, from the semi-squat position (90°), performed on both legs, with hands on the hip (Squat Jump);
11. 5 jumps performed from the semi-squat position (90°), performed on the left leg, performed on the spot (Squat Jump Left Leg 5 Jumps);
12. 5 jumps from the semi-squat position (90°), performed on the right leg, performed on the spot (Squat Jump Right Leg 5 Jumps).

The test protocols were pre-set in the software of the device, it being sufficient only to introduce the athletes into the system, with the anthropometric data of the athletes (date of birth, height, weight), and to select the type of test to be used. The time of the start and end of the test are transmitted by the computer through a sound signal. The information was transmitted in real time to the computer, and then extracted in the form of xml documents.

Table 1. Research subjects

No.	Name and surname	Date of birth	Height (cm)	Weight (kg)	PB* (m)	SB 2024** (m)
1	G.R.C.	23.12.1999	185	76	16.82	16.48
2	B.C.N.	05.11.1994	179	74	16.37	15.83
3	C.D.	09.10.2000	188	74	15.80	15.80
4	P.M.	28.03.2000	189	74	15.48	15.27

*PB- personal best, *SB- season best

Following the statistical-mathematical analysis applied to this confirmatory research, we can draw the image of the somatic model of the triple jump jumper participating in this study and which, in fact, depicts the current portrait of the male triple jump event, at the level of the senior category, in Romania. The analysis and interpretation of the explosive and reactive force, of the specific power of the research subjects, was carried out by evaluating the level of the parameters measured within the protocol, with the help of the OptoJump Next system. (Rapotan, 2023). The tests described in this subchapter were chosen and used to measure and evaluate certain parameters specific to triple jumpers, but we emphasize that they can be introduced in the training of athletes as complementary means of training, to increase the level of training. The analysis and interpretation of the results obtained by each athlete, participating in the 12 evaluation tests, was carried out by comparing the results of the final testing (T2) with the initial testing (T1).

Results

In the *4th test***,** the athlete with the highest average power values, both at T1 and T2, is the B.C.N. athlete, with values close to the P.M. athlete, who is in an honorable 2nd place in the group ranking, emphasizing the fact that, the right limb is the kicking leg for both athletes (it also represents step 1 of the triple jump). The athlete B.C.N., at T2 shows a regression of the value of the average power parameter, of 4.83w/kg. For the parameter T flight, its value is higher in the initial test compared to the final test, as is the value of the parameter, the average height of the jumps, which is weaker in T2. The

mean of parameter value 5 and 6 are also regressed in T2. The athlete's right limb is step 1 in the triple jump, however, and for him the average strength of the right limb is weaker than that of the left limb.

Sportsman G.R.C. holds the 3rd value of the parameter average power, in fact, he remains constant, in the 3rd place within the group, in all parameters. We know that the right limb of the athlete G.R.C. is the one that suffered the rupture of the Achilles tendon, this being an explanation of the weaker parameters obtained by the athlete. We observe, however, an improvement in the value of the parameters in the final testing for this athlete. The right limb represents step 1 of the triple jump test for this athlete as well.

In the case of the athlete C.D., we emphasize his regression in the final testing against the initial testing, in terms of all the values of the analyzed parameters. We believe that he did not focus on the execution of this test, because the performance obtained does not recommend him as being so far from the parameters of the athlete B.C.N.

Sportsman P.M. presents a very good average of the power of the right leg, as well as having the best value of the average T flight parameter and the average height of the jumps, which leads us to think that this athlete would be more suitable to specialize in the long jump event.

(Test 11th): the initial testing, the average T contact parameter value is slightly in favor of the athlete P.M. (0.552sec.), being lower than the value of the athlete C.D., but perhaps the athlete C.D. (0.556sec.) is more loaded (tired), given the fact that we are in the preparatory period. At the final testing, the best value of the average T contact parameter was that of the athlete G.R.C. (0.473sec.), which reveals the fact that the athlete G.R.C. is on a good fitness curve during the competitive period (T2). We note, however, that in T2, the value of the average T contact, is in regression for the athlete C.D.

Referring to the average parameter T flight, the athlete G.R.C. shows a value improvement of 0.39sec., (increases flight time in T2). Athletes B.C.N., C.D. and P.M., we can state that they are stationary on this parameter, showing equal values at T1 and T2.

Introducing the average height parameter into the analysis, comparing the values of this parameter, we observe an improvement of it for the athlete G.R.C., with a progress of 4.4 cm between T1 and T2. The athlete B.C.N. shows a slight progress of 0.4cm between the 2 tests. The highest value of this parameter was obtained by the athlete C.D. (25.60cm) at T1, but we do not accept the regression of this parameter in T2 (-0.6cm). Incidentally, the athlete P.M. it regresses in T2 to this parameter by 0.2 cm. The normality was for the value of this parameter to increase in T2.

Very interesting is the value of the next parameter, namely, Average power of test no. 11. The athlete G.R.C. shows an increase of 4.81w/kg, between the 2 tests, while the athlete B.C.N. it increases its average power by only 1.28w/kg, so that the sportsman G.R.C. presents during the competitive period an average power of 24.18w/kg, and the athlete B.C.N. has an average power of 16.72w/kg. The explanation for the performance in 2024 could be attributed to the increase in the specific power of the G.R.C. athlete. against the athlete B.C.N. The athlete with the highest value of this parameter in T1 is the athlete C.D., but in T2, his value registers a regression of 0.92w/kg, which is not beneficial for obtaining better performances. The athlete P.M. is in third place in the group hierarchy, in the 2 tests.

Discussions

The following 2 parameters, pace and reactive power index (RSI), are favorable to the athlete G.R.C., both in the initial and final testing, compared to the athlete B.C.N. Sportsman C.D. shows slightly better values of these 2 parameters, compared to the athlete G.R.C., only in T1. Sportsman P.M. shows good parameter values in this test, ranking third in the group ranking.

Following the statistical analysis, applied to the target group that participated in the performance of the 12 tests, the values of the parameters were compared between the athletes in the initial testing (T1), in the final testing (T2), as well as the comparison of the values of the evolving parameters between T1 and T2.

For tests no. 1-6 and 9-12, the parameters compared were:

- T contact and T flight
- Average height
- Average power
- Peace
- RSI

Following the statistical analysis, we notice that the values of the parameters obtained by the athletes in tests 1-6 and 9-12 (in these tests, the efforts are of static strength), are not significantly different between the participants, both in T1 and in T2 , as well as the values of the evolving parameters between T1 and T2, except for the rhythm (Pace), the values recorded at T2 were significantly higher (1.27 ± 0.25), compared to the values at T1 (1.24 ± 0.22), the difference between the measurements was significant (0.031 ± 0.089, 95% C.I: 0.0007- 0.0615).

We consider the assessment to be correct, given the fact that during the competitive period, the athletes are in athletic shape and implicitly, the jumping pace is faster in T2 compared to T1, because the athletes become much faster. Comparing from this perspective, we appreciate that the participating athletes are about equal in value in tests 1-6 and 9-12.

Following the statistical analysis, applied to the target group that participated in the performance of the 12 tests, the values of the parameters were compared between the athletes in the initial testing (T1), in the final testing (T2), as well as the comparison of the values of the evolving parameters between T1 and T2.

For tests no. 7 and 8, the parameters compared were:

- T contact and T flight;
- Average height;
- Distance;
- Tilt angle;
- Propulsion phase;
- Average speed

After performing the statistical analysis, we notice that the values of the parameters obtained by the athletes in tests 7 and 8 (in these tests the efforts are of dynamic power), are not significantly different between the participants, both in T1 and in T2. In contrast, comparing the values of the evolving parameters between T1 and T2, presents certain specifications as follows:

- T contact values in evolution were not significantly different at T1 and T2, the differences between participants being insignificant;
- The values of T flight in evolution were significantly lower at T2 compared to the values at T1, the differences between the participants being significant;
- The values of the average height in evolution were significantly lower at T2 compared to the values at T1, the differences between the participants being significant;
- The values of the average distance in evolution were significantly higher at T2 compared to the values at T1, the differences between the participants being significant;
- The values of the angle of inclination in evolution were significantly lower at T2 compared to the values at T1, the differences between the participants being significant;
- The values of the evolving propulsion phase were not significantly different at T1 and T2, the differences between the participants being insignificant;
- The values of the mean speed in evolution were significantly higher at T2 compared to the values at T1, the differences between the participants being significant.

We consider the analysis to be correct, given the fact that during the competitive period (T2), the athletes are in athletic shape and implicitly, the average jump speed increased in T2, because the athletes become much faster.

Performing jumps at a higher speed in T2 causes the flight phase to be lower in T2 (fact confirmed by the analysis), the average height of the jumps to be lower in T2 (fact confirmed by the analysis) and the angle of the trunk to be lower in T2 (fact confirmed by the analysis). The contact T values and the propulsion phase values remain the same between the 2 tests, meaning that the athletes did not lose power, which we note is a good thing, all of these values twinned, leading to increased average distance values in T2, in fact, the goal pursued by the athlete and the coach, is for the distance parameter to be as high as possible in the testing during the competitive period.

Conclusions

In the confirmatory research, we performed measurements using the Optojump Next system, using a series of 12 tests that focused on specific power, power on each step of the technical structure, explosive and reactive force, as well as other measurements specific to the triple jump test.

We believe that the equipment we used provided us with objective data regarding the level of training of the athletes specialized in the triple jump event, both during the preparatory period and during the competitive period.

Through the analysis and interpretation of the results of the 2 tests, as well as the transmission of this data to the athletes in the test group and their coaches, the premise of working with specialized equipment was created, as well as the awareness of the positive aspects, but also of the deficiencies, that appeared in the training of the athletes in different periods of preparation.

The evaluation of the parameters determined with the help of the OptoJump Next system, the analysis and interpretation of their values, can lead to the rethinking and implementation of new means of training, of changing the contents of the training, both in terms of physical training and in the technical training of the athlete. (Dragomir et all, 2021)

The results obtained from the tests carried out provide clear information on certain parameters such as: the distance on each step in the jump, the height of the jump, the angle of inclination, the propulsion phase, the power exerted, the reactive and explosive force, the contact and flight times, being able to make an objective evaluation and diagnosis of the training level of the tested athletes.

Some of the presented tests do not only provide data on the level of training of the athletes, they can be introduced into the training program, by establishing a training protocol, aimed at increasing the motor capacity of the athletes practicing the triple jump test. We refer to the actuation and directing of proprioception and stability with the Optojump

Next system, through the Single leg left/right hops test, which also has a part of structural utility by being similar to the test technique, offering very important parameters, both about physical training and for the technical one.

As a final conclusion of the ascertainment research, we consider that the athletes B.C.N., C.D. and PM could have achieved a much better performance in the year 2024, taking into account that several parameters measured in the 12 tests are superior to the parameters of G.R.C.

From our point of view, it is extremely important, the dosage of the training, the sports performance obtained by the athlete in the competition, being also conditioned by the psychological factors, by the will and determination of the athletes participating in national and international sports events.

Following the application of the statistical analysis on the values of the parameters obtained by using the 12 tests carried out with the OptoJump Next technology, on a group of athletes performing in the men's triple jump, senior category, carried out in this confirmatory research, we appreciate that the application of test 7 and 8, it is much more relevant to illustrate their level of training.

This is primarily due to the fact that the 2 tests (7 and 8) also have some structural utility by being similar to the test technique, but also due to the causality that they provide valuable parameters, both about physical and technical preparation, of tested athletes.

Analyzing tests 7 and 8 statistically, they clearly and conclusively highlight the existence of significant differences between the participants, of the values of the parameters obtained during the 2 tests. Moreover, the comparison of the evolving parameter values between T1 and T2, measured in the analyzed tests, were significant, anticipating and actually explaining the performance achieved by each participating athlete in 2024.

To achieve international level performance, a carefully selected chain of all training factors is needed, of course without losing sight of the repercussions of injuries on performance. We do not have the information if the other three athletes had health problems that would affect their training during the period between the 2 tests.

Authors` contributions

All authors have equal rights in respect of publication and related measures arising from publication. All authors have read and agreed to the published version of the manuscript.

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