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STUDY ON THE IMPACT OF THE ANALYSIS OF THE KINEMATIC PARAMETERS OF THE MIDDLE-DISTANCE RUNNER STEP IN THE IMPROVEMENT OF THE JUNIOR TECHNIQUE

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Abstract: *The relevance of the theme refers to the deficient level of the technical training in the 1500 m races and the necessity of a modern methodology of intervention in training by the objective detection and correction of the technical errors. The aim of the research in this paper is to determine the kinematic parameters of the athletic endurance courses in order to obtain scientific information about the level of learning of a rational technique, necessary to be known in correcting mistakes from the junior level.*

Key words: *technique, running trials, video analysis*

1. Introduction

The continuous development of the sports activity, the increase in the number of sports competitions, the pursuit of favourable sports results and the emulation created by the financial reward of the new records obtained have multiplied the theoretical and methodological concerns regarding the training of those involved in the performance sport.

Athletes do not develop overnight, and coaches can't do wonders. There are no shortcuts, which explains that "adaptation to training is the sum of the transformations caused by repeated and systematic exercise" [1].

During the preparation process, over several years, the physical and mental qualities of the athlete are constantly being improved and the conditions for increasing the technical and tactical mastery are created. Therefore, the improvement of the technique must be a permanent concern, pursuing an even greater economy of the movements, seeking that they become as rational, as natural and without unnecessary contractions.

2. The Hypotheses and the Purpose of the Research

It is known that the level at which the

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performances have reached, within the sports competitions, lately, is due to the improvement of the specific techniques by:

– the studying of the most intimate/hidden aspects of the running technique that ensures the knowledge of the level of influence of the muscle chains involved in each phase of the movement;
– the knowledge of the biomechanical details that can allow the improvement of the technique of running, in general, and the departures from the start.

The hypotheses are:

a. The technologies of investigation of the kinematics of the human movement, can offer data acquisitions that highlight some relevant indicators in the technique of running in the 1500 m race.
b. The kinematic data that characterize the running in the run distance races by the objectification of some biomechanical parameters may represent an individualized source for approaching the sport training process.

The final aim of the research is given by the efforts that are aimed at correcting the technical deficiencies, by means of the video monitoring systems and the systematic and continuous kinematic analysis by using the Kinovea software for obtaining data of major interest with which the intervention program was elaborated.

3. Methods used in Research

The methods used to achieve the research objectives are the following:

- the study of the specialized literature;
- the comparative method;
- the method of pedagogical experiment and case study;
- the method of pedagogical observation;
- statistical and mathematical methods of data processing and interpretation;
- the method of graphical analysis of the research results;
- the test method.

4. Conducting the Experiment

The research was carried out within the Research Center of the "Low Danube" University in Galați, represented by Ph. D. Claudiu Mereuță, in collaboration with teacher and trainer Marlena Chițu.

The location of the research was within the Danube sports base, the athletics stadium.

Following the analysis and correlation of the tracked parameters and the technical execution kinematic recorded and processed with the help of the Kinovea software, it was observed that through a program of proprioceptive training made individually according to the needs of each sportsman, applied between March-June 2018 an improvement was achieved of the technical execution on the subjects involved in the research.

Three athletes, junior, were involved in the basic research, each with national results.

This paper presents the evolution of two participants.

The subjects involved in this research project participated in the training and national competitions dedicated to the junior and young people.

The athletes were aware of the advantages of improving the technique of the middle-distance races and cooperated according to the requirements of the experimental research.

5. Description of the Software used in Research for Kinematic Analysis of Running Biomechanics

Kinovea is a video analysis software that allows the capture and playback, at different speeds, of a video recording with the possibility to analyse the kinematic parameters. It was created specifically for the analysis of movements in different sports in order to improve sports performance [2], [4].

6. Establishing the Parameters Analyzed using the KINOVEA Software

In the present research, the study is based on a kinematic analysis of the recorded spatial and temporal parameters.

Several components of biomechanics were measured according to the stages of the double quick-march step for each athlete involved in the experiment:

– the duration of the damping phase;
– horizontal speed of the three studied joints (ankle, knee, hip);
– horizontal velocity of the hip;
– the active duration of the impulse phase;
– the pulse angle

Being a large study, in this paper we will present only the first two parameters.

7. Proposed Training Program for the Technical Training of the Athletes involved in theResearch

The experiment had continuity after identifying, finding and interpreting the kinematic parameters with the monitoring and evaluation of the results that allowed us to detect the errors of technique and of physical training in order to adopt measures/programs to correct them. To this end, it was concluded that an adequate motor program for monitoring and evaluating the technical training for the middle-distance race junior runners should be developed.

In order to make our work easier, we have created a register of technical errors in which to specify their reasons at the age of the juniors, taking into account that at this age we are laying the foundations of an individualized technique that must aim to ease the way to the high performance at the level of senior level.

The training program included specific and non-specific training.

Specific training

- technical means from the basic competition
- analytical technical means
- technical means in difficult conditions (over obstacles, with dumbbells in hands)
- technical means in time trial
- combined technical means in the applied trial run
- technical means made under endurance conditions.

Non-specific training

Speed development under various conditions (starts from different positions, with handicap, with performing motor acts in a confined space, performing tasks against time, etc.)

The development of reach (force-speed) through:

– combinations of spot jumps and on the move (with or without motric ladders)
– jumps with elastic cord

– jumps in the circuit
– jumps in physical skills tracks
– jumps inserted into the relay races
– exercises with elastic bands, with medicinal balls, with dumbbells, with a partner.

Endurance development through endurance exercises:

- fartlek, repetitions, treadmill use;

- use of elliptical bike, use of the ergonomic bike.

7.1. Analysis of the horizontal velocity variation in the damping phase

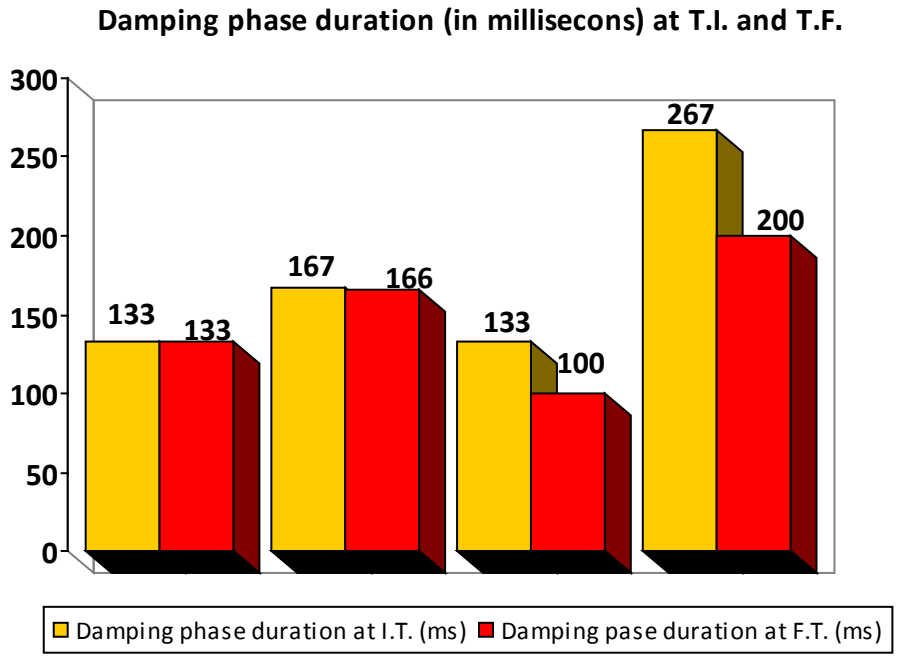
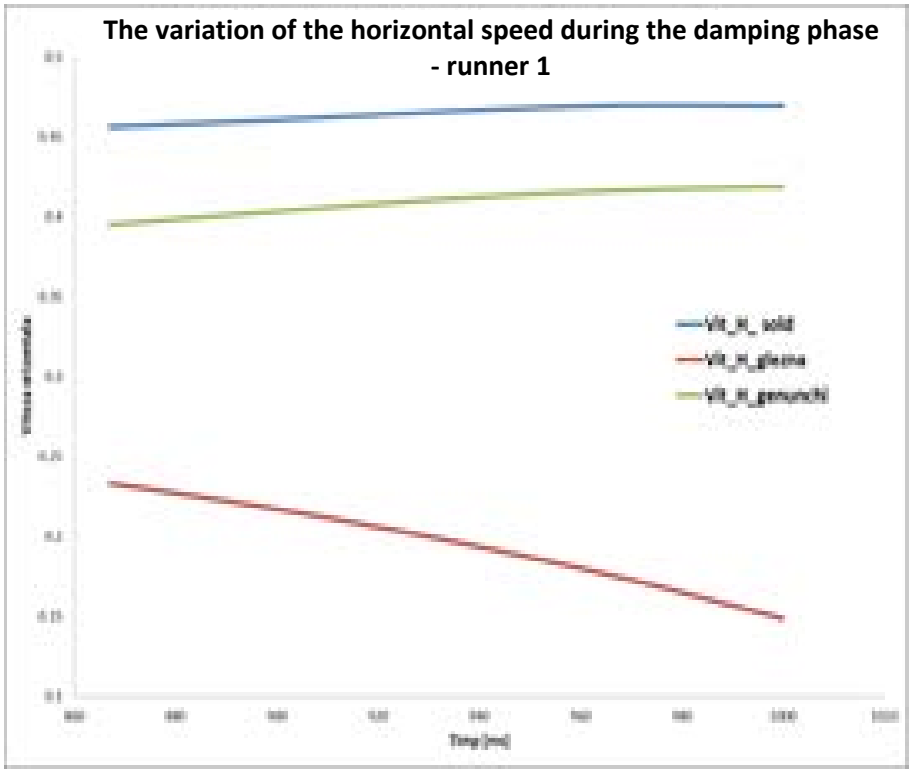


Chart 1. *Duration of the attenuation phase in milliseconds (ms.) at the initial and final testing*

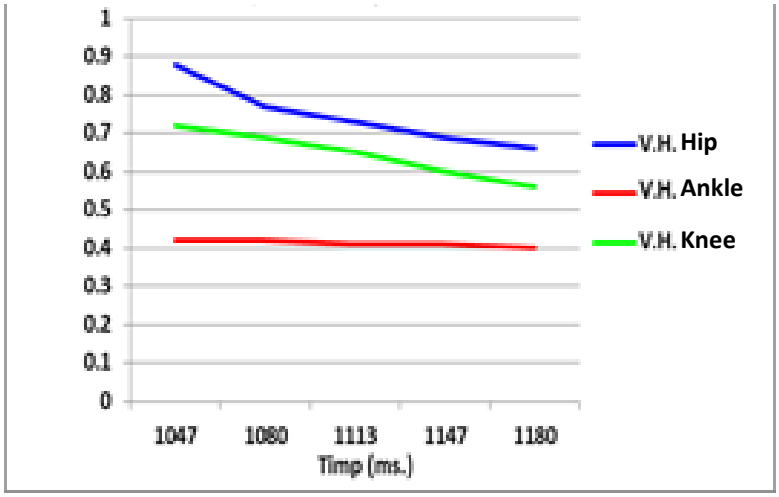
In this phase, contact with the soil takes place. The soil reaction has a negative influence on the running speed, impeding the running continuity.

At the moment of impact with the ground the lower segment bends and dampens the shock, and the horizontal speed is reduced. The joints that perform the cushioning are: the joints of the knee and of the hip. The ankle joint must not participate in this cushioning.

The graphs will be analyzed, starting from the conclusion of the specialists that, in the case of a correct running technique, for the cushioning phase, the horizontal velocity of the hip and knee should decrease, and the ankle speed, not, being indicated to remain constant.



Graph 2a. *Variation of horizontal speed during the damping phase for first runner at initial testing*



Graph 2b. *Horizontal speed variation during the damping phase for first runner at the final test*

Fig. 1a. *First runner at the beginning of the damping phase at I.T.*

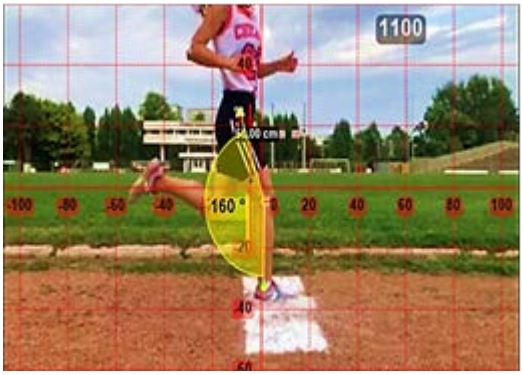


Fig. 1b. *First runner at the end of the damping phase at I.T.*

Fig. 1c. *First runner at the beginning of the damping phase at F.T.*

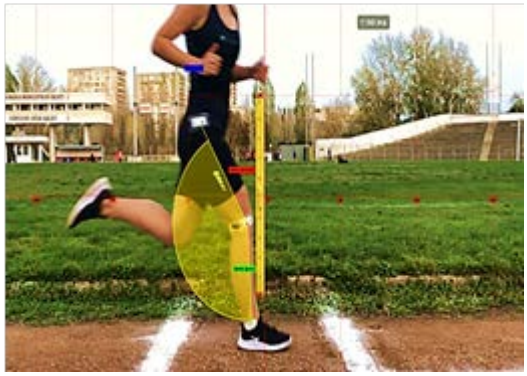


Fig. 1d. *First runner at the beginning of the damping phase at F.T.*

In the case of the first runner, the duration of the damping phase is 133 ms. both at the initial and final testing.

The horizontal velocity of the hip joint at this stage varies between 0.45 m/s and 0.47 m/s at initial testing, and at the final test it varies between 0.88 m/s and 0.66 m/s.

The knee joint velocity is also shown on the graph, but between values 0.39 m/s - 0.42 m/s., regarding the initial testing, and at the final one we have values between 0.72 m/s and 0.56 m/s.

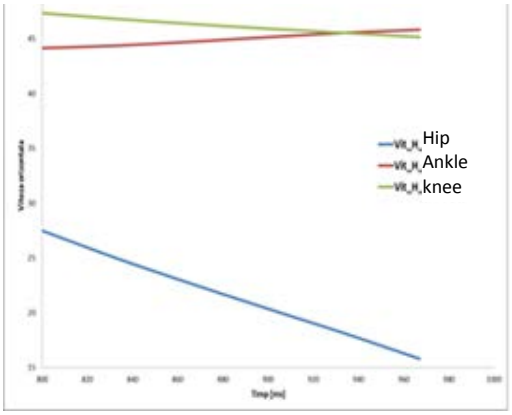
If at the initial test an increase of this speed is observed for the hip and knee joint, at the final test we notice a decrease in both joints (hip and knee), which is indicated by the specialists for the damping phase.

The horizontal speed of the ankle joint during the damping phase behaves differently from the speed of the other 2 joints, in that it records a decrease throughout this stage so that it reaches from 0.23 m/s to 865 ms. at 0.15 m/s at 1000 ms time at initial testing**.**

The horizontal speed of the ankle joint should not decrease. Ideally, it should be constant throughout the amortization in the case of a correct technique.

After completing the training program, it can be seen on graph 2b that the horizontal speed of the first runner's ankle joint does not change during the damping at the final test. It has a value of 0.41 m/s.

Taking into account what the specialists say, that in the case of a correct technique of running at this stage the horizontal velocity of the hip and the knee should decrease, and the ankle speed does not, we notice that the horizontal speeds of the joints of the first runner behaved inversely to the initial, the running technique being deficient. At the final test, the horizontal velocity of the studied joints is shown as indicated for the damping phase of the middle-distance race runner's step.



Graph 3a. *Variation of horizontal speed during the damping phase for runner 2 upon initial testing*

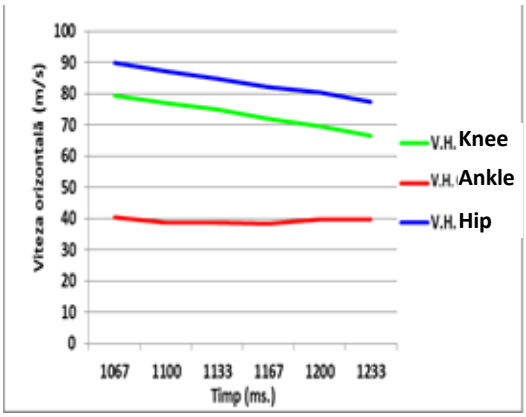


Chart 3b. *Variation of horizontal speed during the damping phase for runner 2 upon final testing*

Fig. 2a
Second runner at the beginning of the damping phase at I.T.

Fig. 2b
Runner 2 at the end of the damping phase at I.T.

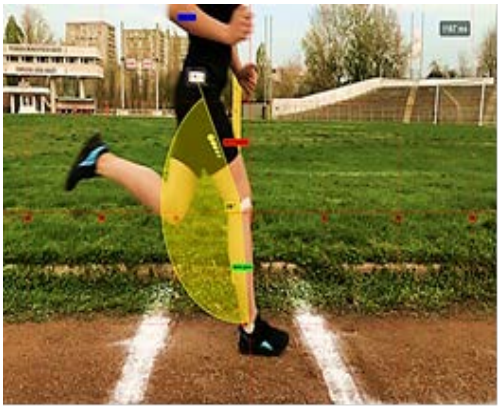


Fig. 2c.
Runner 2 at the beginning of the damping phase at F.T.

Fig. 2d.
Second runner at the beginning of the damping phase at F.T.

The damping phase for second runner takes 167 ms. initially and 166 ms. at the final recording, and the horizontal velocity of the hip joint decreases considerably (from 47.34 m/s at 800 ms. to 45.15 m/s at 970 ms at the first test). At the final test it has much higher values, but it has the same trajectory, falling from 89.93 ms to 77.56 m/s.

The horizontal velocity of the knee joint is reduced from 47.15 m/s to 45.82 m/s throughout the deceleration at initial testing. At the final, the same speed has a downward path between the values of 79.35 m/s and 66.7 m/s. The decrease of the horizontal speed of the knee joint is much more pronounced at the final test.

The horizontal speed of the ankle joint increases insignificantly from 44 m /s to 46 m/s between 800 ms. and 970 ms. upon initial testing.

At the final test, the same speed is shown as indicated for this stage, i.e. it remains constant between the values of 40.44 m/s at the beginning of the damping and 39.72 m/s at the end of it.

The horizontal speeds of the second runner joints behave in the end according to the experts' opinions, that is: the one of the hip and the knee decreases, while that of the ankle.

Improvements of the middle-distance race runner's step technique for the damping phase can also be seen here, where the horizontal speeds follow the route indicated by the specialists for increasing the efficiency of the run in this stage.

8. Conclusions from Basic Research

Following the experiment based on the results obtained and by their scientific interpretation we can draw the following conclusions:

1. The documentation made for the scientific basis of the research approach has highlighted the fact that there are some methods and techniques for evaluating biomechanics, which are not used at national level in the evaluation and monitoring of the kinematic

parameters of the middle-distance race runner's step, in the technical preparation of this category of athletes, although their effects are beneficial at least in the awareness of the athlete on their own performances.

2. The hypothesis that the study of the kinematic parameters of the middle-distance race runner's step in the training process by means of new generation video analysis programs will lead to the improvement of the running technique and implicitly to improve the performances obtained in the 1500 m race.
3. The video recording method is successfully applied and used in the training process as an observational tool, but also as a correction tool for the technical errors of the middle-distance race runner's step, in order to obtain the superior sports performance.
4. The use of the software "KINOVEA, represents a good step towards the use of advanced and modern technologies for measuring and analyzing the kinematic parameters of the middle-distance race runner's step, in order to monitor them in the different stages of training.

9. Recommendations following Basic Research

Following the research, the results and conclusions of the experiment, as well as based on my personal experience, both as a professional athlete and as a technical specialist in the researched trials, I consider the following practical recommendations necessary:

1. The preparation and performance objectives for the junior (girls) middle-distance runners are set at the beginning of the training period in September - October, when it is advisable to start the training of the new competition season.
2. In the planning and programming of the content of the training, the data provided by the analysis of the previous achievements of each runner should be taken into account, both in terms of the main effort indicators, as well as the volume of the training methods and means.
3. The preparation methods and means will be selected to ensure the development of the dominant physical quality, the resistance, without neglecting the speed of movement and the specific force.
4. We recommend the correction of the execution errors based on the determination of the kinematic recorded causes, analyzed and objectively identified, which achieves the optimization of the middle-runner's step technique.
5. We recommend the introduction of the proprioceptive training, in the development and completion of the technical execution, from the junior age.

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