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Increasing Efficiency of Semifond Running by Improving Technical Aspects

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Abstract

Our analysis attempts to highlight some technical aspects that we believe can be exploited to increase the effectiveness of re-systematic injuries by detecting the non-synchronizations that occur between the body segments during effort on a fatigue background.

We refer here to the different power released by the lower limbs, which generates deviations of the impulse vectors and which ultimately result in a lesser capitalization of the mechanical work actually performed.

The level at which the performance in the 1500 m running on the world scale could be greatly improved by discovering those small details that could still be corrected.

High-frequency video analyzes can serve this purpose, but the biomechanics of body movements must be properly controlled to know what we are reporting.

The novelty consists in the fact that through this research we want to identify the technical faults occurring in the run distance competitions, in order to subsequently develop an intervention program with the main purpose of improving the frequently encountered technical errors. For this, we will use monitoring and video analysis, then interpreting the results with a program called Kinovea.

Kinovea is a video analysis software that allows you to capture and play at different speeds a video recording with the ability to analyze kinematic parameters.

Keywords: *technical; resistance; fatigue; performance; video analysis.*

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1. Introduction

No matter how "curious" or less credible, the high performance in running can also depend (in particular) on the technical correctness of running dynamics.

Sports performance represents the area with the highest level of interest in terms of the dynamics of international scientific research in the field of sports. Studies in this direction have enabled researchers to exhibit different approaches.

According to Manno R. [5], training is "a complex intervention process, whose aim is learning and improving the technique, under a simple or chained form, for an individual, a group or a team and aimed at developing physical-psychic abilities allowing achieving maximum sports performance, taking into account the specific characteristics of the subject, group, or team".

Athletes do not develop overnight, and the coaches can't work miracles. There are no shortcuts, which explains that "adapting to your training is the sum of transformations caused by repeated, systematic exercise." [1: 18].

The technique is important, primarily through the economy of movements and their effectiveness and as such it should not be understood in isolation, since it is subject to a large extent to the level of development of the conditional and coordination abilities, being closely related to the tactics, psychological, theoretical and artistic training, in the fields of sport that require this [7].

The role of technique in middle-distance and long-distance track running trials has become more and more important and consists in allowing the runners to accomplish effectiveness and ease in movement, which will allow crossing the distance at a higher speed.

In middle-distance track running, the physiological requirements influence the running technique

We aim to analyze running techniques based on video recording, performed with high-performance cameras, with high frequency of video frames, to make it possible to detect the smallest errors with which the movements of body segments during the run are achieved.

2. Problem Statement

The changes that have occurred over the years in the structure of the competition calendar, as well as the results of a series of high-value athletes,

have gradually led to the idea that many athletes fail to obtain a sportive level plateau to achieve results close to the maximum at objective competitions.

It has also been noticed that in the last few years the number of junior athletes passing through the seniors is very low and the percentage of those who reach the world elite is steadily decreasing. The analysis of current scientific and methodological literature as well as the generalization of sports practice in this field has demonstrated that there have not been crystallized directions and basic orientations regarding the importance of technical training in the economics of dosing effort in run distance athletic category [3], [6].

The topicality of the theme refers to the deficitary level of technical preparation for the 1500 m. and 3000 m. running trials and the urge for a modern intervention methodology in the training in order to objectively detect and correct the technical errors. We mention that the literature presents less information and conceptual ideas of athletic training to argue and scientifically implement a structure of the approaching process of the athletics techniques researched by us.

By applying an accurate biomechanics of the technical skills, the mechanical efficiency is determined, which contributes to increasing the flow in the athletic training and consequently high performance in competitions.

Within the research of the current paper, the kinematic parameters of the athletic trial are determined, in order to obtain scientific information about the level of acquisition of a reasonable technique, bound to be known in correcting mistakes ever since junior years.

The novelty consists in the fact that through this research we want to identify the technical faults occurring in the run distance competitions, in order to subsequently develop an intervention program with the main purpose of improving the frequently encountered technical errors. For this, we will use monitoring and video analysis, then interpreting the results with a program called Kinovea. Kinovea is a video analysis software that allows you to capture and play at different speeds a video recording with the ability to analyze kinematic parameters. Kinovea was specifically designed to analyze movements in various sports to improve sports performance [2],[4].

3. Research Questions/Aims of the research

The purpose of the preliminary research is to determine the best methods and means that we can use to analyze the most important moments of run distance, with which we can improve the technique so as to achieve a

more efficient dosing of the effort during racing by removing unnecessary movements occurring with installing fatigue.

All efforts are directed towards correcting technical deficiencies, which is the ultimate goal of this work.

4. Research Methods

The research methods used in devising the scientific research shall be:

- ***the documentary method***

Scientific research regarding specific training of athletes has allowed the comprehension of the training concept regarding the effort characteristics and the relations that are established among these and fatigue, performance ability, stress and technical preparation.

The research of the literature, the publications written on the thesis issue, the information obtained from analysing them will represent the background of the research premises and establish other methods and investigation techniques,

- ***the investigation method***

The investigation method shall be used in the form of a conversation with the coaches and sportsmen involved in the experiment. The conversation will be based on subjective and objective aspects of the training effort effects, of the influences on the fatigue and other imbalances caused by fatigue in the running technique. This method allows the coach to acknowledge the runners' subjective perception regarding the dimension of the effort induced by the methods, methodological procedures and training means. The subjects will be asked to convey their training state, their level of fatigue, the difficulty/ease of the training, the desire and pleasure to train. This information, together with the data collected through the methods: timing, heart rate, breathing rate and observation, will allow a better classification of the effort in the desired strength areas.

- ***the observation technique***

The observation will be oriented towards the biological and psychical effects of the effort during training.

This method allows the assessment of the biological use determined by effort, through observing the changes: the complexion, breathing rate, the motrical behaviour: the efficiency of movements, the occurrence of technical errors due to fatigue, etc.

- ***tests and measurements method***

Measuring heart rate – this method offers information regarding the functional parameter and adapting the cardiovascular system to effort. The following indicators will be used: heart rate after warm-up, heart rate during training (do-overs, pauses, etc)

- ***biochemical tests***

Blood tests providing information about: establishing the speed of the training (locating the anaerobic threshold), establishing progress in training, diagnosing the weaknesses of the training programme, as well as the degree of fatigue and rebound during the training represent the basis of the effort guide and the adaptability of the body.

The following indicators will be determined through blood samples: lactic acid level, CPK, TGO, glucosis, calcium, albumin, magnesium, potassium, uric acid, transaminase, adaptation protein.

The urine samples used in the experiment will be: density and PH in base and after training. The effort tests used throughout the research period shall be: VO₂, T30.

- ***experimental method***

The experimental method is a complex system of acknowledging the reality characterized by using the experimental reason, which processes both facts from other research methods and from the experiment. The experimental method or the experiment lies in devising experiments to control or verify the value of an experimental idea. Our research will be a longitudinal experimental one, objectified, analysed and interpreted through case studies.

- ***graphical method***

Graphical representation of the results of the experiment emphasize the essential characteristics of the data collected and also the directions in which the practical conclusions drawn during the training may be applied.

By using graphical representations, the dynamics of the parameters evolution in different stages of the training is emphasized as well and at the same time, the comprehension of the informational volume is facilitated.

The targeted group of the project consists of 8 juniors from the athletics department of the Sports Highschool in Galați and Brăila, trained directly by the undersigned.

The project team consists of the scientific coordinator, prof. Mereuță Claudiu, doctoral student, Dobre Andreea-Georgiana.

5. Findings

5.1. Structure

The first test was carried out at the "Danube" stadium in Galați with the video recording of the 1500 m race with a "GOPRO" camera and a Phantom 3 Professional drone, on 5 subjects.

At the same stadium, the subjects used a Garmin Forerunner 230 watch during the testing. Following the use of the watch, a number of interesting parameters were obtained that revealed data that can not be detected with "the naked eye". All the data were then interpreted and quantified instantly by its programs. If we were focusing on a perfect technique, we would think of a series of movements based on biomechanical laws that are appropriate to the purpose of the action in category and contribute to the achievement of high sporting results.

For the examination of run distance technique, we must take into account:

- the movement of the whole body mass or only of its segments in space and time;
- the movement of the body or its segments is characterized by: the motion trajectory which has direction, length and shape, the speed of movement.

Neglecting technical training can turn into a handicap for runners at any time.

The cyclical unit of the running is the running pace, namely the simple running pace and the double running pace.

In conclusion, depending on the damping phase, the moment of the vertical and the pulse phase of the double running pace we will also interpret and we will analyze graphically, for each of the competitors involved in the preliminary experiment, the following aspects:

- the duration of the damping phase;
- the horizontal velocity of the three joints studied (ankle, knee, hip);
- the hip trajectory at the moment of the vertical;
- the horizontal speed of the hip;
- the active pulse of the pulse phase;
- the variation of thigh-throat angle during each phase (damping, vertical moment and pulse);
- the variation of the horizontal speeds according to the angle of the calf;
- the pulse width.

In this article we will only discuss the horizontal speed of the three joints (ankle, knee, hip) for two of the five athletes involved in the experiment.

5.2. Tables

Analysis of horizontal speed variation in the damping phase for each athlete participant in the preliminary experiment

Table 1. Duration of the damping phase and relative deviation

No.	Experiment Participant	Duration of the dumping phase (ms)	Relative deviation
1	Runner 1	133	-20.16%
2	Runner 2	167	0.24%
3	Runner 3	133	-20.16%
4	Runner 4	133	-20.16%
5	Runner 5	267	60.26%
	Average	166.6	-

In this phase the contact with the ground takes place. Ground response has a negative influence on running speed, hindering the continuity of running.

At the moment of impact with the ground, the lower segment bends and cushions the shock, and the horizontal speed is reduced.

The joints that make up the damping are: knee and hip joints. The ankle joint should not participate in this damping.

Chart 1. Variation of horizontal speed during damping phase for 1-st runner

Figure 1 a
1-st runner at the onset of the
damping phase

Figure 1 b
1-st runner at the end of the
damping phase

Each diagram is analyzed, drawing on the conclusion of the specialists that in the case of a correct running technique, at this stage the horizontal speed of the hip and knee should decrease and the ankle speed not.

In case of the 1-st runner, the duration of the damping phase is 133 ms. Horizontal speed at this stage for hip joint varies between 0.45 m / s and 0.47 m / s. The knee joint speed is similar to the diagram, but between 0.39 m/s - 0.42 m / s. In both cases there is a slight increase, which indicates that a poor running technique is installed, as the speeds for these joints, in the damping phase, should have a downward, not ascending trajectory.

The horizontal speed of the ankle joint in the damping phase behaves differently from the speed of the other two joints in the sense that it decreases throughout this step so it reaches 0.23 m/s from 865 ms. at 0.15 m/s at the time 1000 ms. In the case of this joint, the horizontal speed should not decrease if we talk about a correct technique.

Starting from the conclusion of the specialists that in the case of a correct running technique at this stage, the horizontal speed of the hip and knee should decrease, and the ankle speed not, we notice that the horizontal speeds of the 1-st runner's joints behave in reverse, so the treadmill be improved.

The damping phase for 2nd runner takes 167 ms and the horizontal hip joint speed decreases considerably from 27 m/s at 800 ms. to 15 m/s at 970 ms.

Chart 2. Variation of horizontal speed during the damping phase for 2nd runner

Regarding the knee joint horizontal speed, it decreases, much less, from 47 m / s to 45 m/s throughout the damping time.

The ankle joint horizontal speed for 2nd runner insignificantly increases from 44 to 46 between 800 ms. and 970 ms.

Figure 2a
2nd runner at the onset of the damping phase

Figure 2b
2nd Runner at the onset of the damping phase

The horizontal speeds of the 2nd runner's hinges behave, according to the opinions of the specialists, that is, that of the hip and knee decrease at this stage, while that of the ankle does not.

The only one who registers a significant decrease is the horizontal speed of the hip joint, the other values being insignificant, which indicates that there is also the possibility of improving the running technique.

5.3. Discussion and conclusions

Following the analysis, according to the records for preliminary testing, the essential condition was and it is the correction of the technical errors and the removal of their causes, especially at the junior age as a prerequisite for the basic research.

We have concluded that:

The contact with the ground denotes automatism and highlights many technical mistakes from the onset of damping.

The duration of the contact with the ground can be improved by reducing damping and pulse time.

The variation in the horizontal speed of the hip and knee joints in the damping phase of the runners participating in the experiment increases, rather than having a downward path. In this phase, the contact with the ground takes place. Ground response has a negative influence on running speed, hindering the continuity of running

At the moment of the impact with the ground, the lower segment bends and damps the shock, and the horizontal speed is reduced. In terms of horizontal speeds for the three joints, improvements can be made for all participants in the preliminary experiment.

Recommendations following the preliminary investigation

It is recommended that the athletes be monitored and evaluated constantly in order to observe the damping phase, the moment of the vertical and the pulse in the attempt to observe the duration of each phase, the contact with the ground, the impulse angle, the horizontal speeds of the three articulations studied: hip, knee, ankle.

Periodic use of kinematic records processed on Kinovea software is recommended, subject of study and analysis of the coach and the athlete in order to find solutions for optimizing and improving performance at this junior age.

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