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Aspects of Biomechanical Research Related to the Techniques Used by Jumping Athletes for Performance Improvement

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Abstract

All over the world, jumping athletes (male and female) use two techniques in triple jumping events, that are known under the names of plate technique (balanced technique) and high technique (hop dominant technique), which can be influenced biomechanically by Ergosim simulator training.
The content of this research tries to provide some information about several aspects of this modern technique that can be used to increase the efficiency of a triple jumper's training. The originality of this device is represented by its capacity to analyze the movement parameters obtained by working at the desired speed, in an accelerating movement, achievable at all levels, at a variety of angles, with the ideal amplitude without forced recovery effect, as it was the case with traditional devices such as chain, ribbon, tourniquet. The Ergosim simulator used in the triple jumpers' training reveals that each athlete has a maximum optimal speed, and a minimum active time which influences mechanical work and maximum power with perfect amplitude.

Keywords: biomechanics, triple jump, performance

1. Introduction

The optimization of the jumping athletes' training involves the identification of the biomechanical particularities with positive influences on triple jump technique. In the last years there has been a growing interest of specialists in biomechanical analysis for athletic events. Thus, the biomechanical research of the technique tends to become one way to improve performance in direct relation with the psycho-motor and biological aspects.

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Scientific knowledge thus acquired with recording techniques and biomechanical analysis, allows the possibility to generate information about techniques, adapting the technique to the optimum model, depending on the somatic and motor particularities of athletes (IAAF, 2005).

Biomechanical analyses on athletics competitions are performed with the help of high performance recording techniques using synchronized video cameras:

- Camera 1 shoots the last two strides before the take off board;
- Camera 2, 3 and 4 focus on the three phases of the triple jump;
- Camera 5 analyses the horizontal and vertical speed for each step of the triple jump (hop, step, jump), it indicates a high level regarding the grade of objectivity of the information, with practical applicability (Bruggemann and Avampatzis, 1997).

This information creates the premises of valuable analyses with concrete relevance for training, regarding the evaluation of the following parameters:

- official distances and effective distances,
- total losses at the take-off board,
- effective distances of the phase and their report,
- length of the last two strides and the horizontal speed,
- the horizontal and vertical speed of each phase,
- angles at the jumping and landing phases (Bruggemann and Avampatzis, 1997).

2. Aim

We shall try to correlate some aspects from the biomechanics of triple jump events with work in special conditions, to increase the efficiency of training of triple jumpers which lead to a mechanical work and mostly to a higher execution power.

By promoting this research we continue a case study of four Romanian triple jumpers, using analysis and data recorded on the Ergosim simulator (CNCPS, 2006). The Ergosim simulator is computer-assisted, adjusting the desired speed of execution, number of repetitions and brake component. The program has capacity for analysis and synthesis, allowing the recording of the Active time (At - ms), the Active work (Aw - cm), the Mechanical work (Mw - j), Active power (Ap - w) and Active speed (As - cm / s), guided by the computer required speed (S - m / sec).

The computer imagines each repetition of the above mentioned parameters, allowing an objective analysis (Hay, 2002). It can compare the evolutions over a cycle of training, aiming at performance constancy at a specific speed. It can determine the optimal speed and the athletes can also showcase their psychophysical qualities at the highest level. Thus, it can create an optimal model, viewed by the athlete, which is then repeated until overlap.

3. Research methods

- Method of bibliographic study, regarding the topic of the research,
- Method of observing, analysis of the athletes enrolled in the research, the main methods and means used, and devices and installations used,
- Method of biomechanics analyses using the Ergosim simulator,
- Graphical method, drafting tables and graphs for each athlete.

4. Subjects

- P.I.- World junior champion and European youth champion,

- G.A.- European youth champion, bronze medalist at youth E.C., youth W.C. and U.W.C.
- S.M.- World and European vice champion in the youth category, bronze medalist at U.W.C.
- B.M.- European youth champion.

5. Hypothesis

The development of proprioceptive memory through the stereotyping of specific triple jump movements, with direct effect on obtaining superior techniques, can be achieved by biomechanical analysis on the Ergosim simulator.

Both techniques can be biomechanically influenced by Ergosim simulator training.

6. Research organization

The priority for the biomechanical analysis of our four subjects is the comparative analysis of some parameters resulting from the most valuable executions - power, mechanical work, active work, active speed - for each leg, using the Ergosim simulator (CNCPS, 2006) (Figures 1 and 2).

Training on the Ergosim simulator can lead to awareness of the maximum optimal speed, a high mechanical work, performed with necessary amplitude for a standard technique. In this way training can be performed following the maximally optimal individualized model.

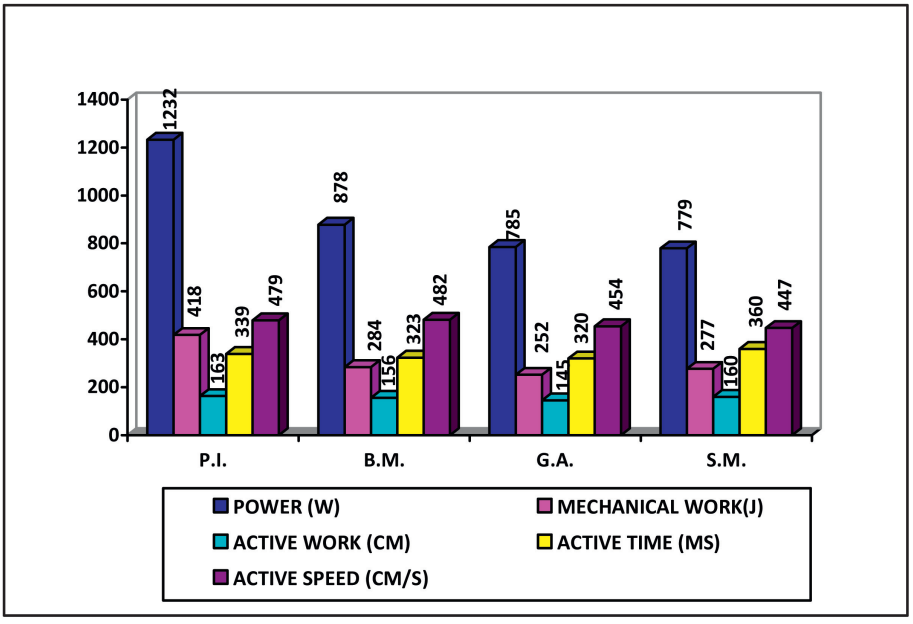

Fig. 1. Comparative chart of individual parameters - Executions right leg, device speed 5.5 m/s

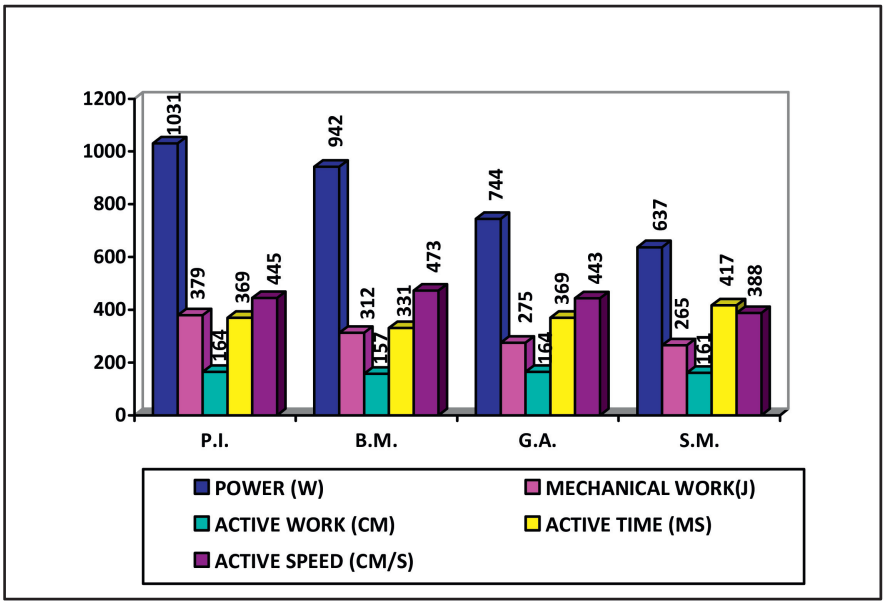

Fig. 2. Comparative chart of individual parameters - Execution left leg, device speed 5.5 m/s

7. Conclusions

At the athletic training level, on the basis of some biomechanical analyses, using modern devices, specialists try to create technical models which reflect the basic parameters, leading to a decisive influence on performance.

In our country, triple jump athletes (male and female) use both jumping techniques - balanced and hop dominant, all trying to jump with a maximum optimal speed, but without affecting complexity, which can lead to damaging the technique and decreasing performance.

An important element of analysis in the triple jump technique is the rhythm, the personal mark put on the technique. Rhythm depends on the morphological and functional particularities of the triple jump athlete.

Vertical speed is variable depending on the jumping phases with some values in first phase being influenced by the jumper's style and by the horizontal speed developed in the last stride. These values decrease in the second phase, and then they increase again in the third phase to a level which exceeds the level in the first phase.

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