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Training motor actions for athletes using modelling method

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Abstract

The approaches to training athletes based on biomechanical analysis of movements allow us to identify the mechanisms of movement patterns, which determine the optimal performance of sport movement. In this paper we consider the basic motion skill of the basketball game and describe a biomechanical analysis of the hand movements while throwing. It is determined the athletes have motion stereotype with consistent involvement of all necessary anatomical links in the act of throwing; there is a correction and stabilization of motion presented by professional players, however, the unskilled athletes don not have it. It is concluded that the push is made by whole hand at once; there are no signs of motion decomposition into smaller tasks and their consistent implementation. The results confirm the need to develop an optimal scheme for training players, which is based not on practicing hits into the ring but on the formation of the general scheme of the throw. Therefore, the most reasonable approach is to design an optimal model of jump short based on a biomechanical analysis and skills formation based on information technology.

Keywords: Basketball, movement patterns, biomechanical analysis, motion tracking;

1. Introduction

Today, basketball is one of the most popular sports. In basketball, a crucial role is played by the athlete's ability to coordinate their movements well at a fast pace and a constant change of body position in space [4]. Training professional athletes requires fundamentally new approaches based on the use of modern technologies: the approach based on the biomechanical analysis of the implementation of the basic motion skills, identification of mechanisms of their formation and opportunities identification for improving an effective training [5].

The organization mechanisms of motion for beginners and experienced athletes have differences [6]. Beginners perform movements through the implementation of a set of independent movement stereotypes, which are poorly coordinated with each other. In the process of training independent movements are united, a single motion stereotype is formed with a coherent, coordinated system of its elements. The construction of such a stereotype ensures an optimal performance of the technique of motion actions and helps to achieve best results [3, 5].

Formation of movement patterns is based on the combination of two main factors: the creation of an optimal program of motion actions and improvement of the system of corrective actions based on reafference [1]. In particular, by regulating movements and adapting motion actions create accuracy of certain sport motions. Identification of the mechanisms of formation of basic motion skills allows us to determine at what stage of movement patterns the correction of its movement

may be made, and thus not only to help to increase the effectiveness of training, but also to accelerate the process of developing the necessary skills. With the help of digital technology it is possible to assess the biomechanical and physiological characteristics that ensure the success of the implementation of a sport motion [2]. This study examines the basic motion skills needed for a basketball game - jump shot, and it also carries out a biomechanical analysis of the movements of the hand during the throw.

2. Materials and methods

The experiment includes male students of TPU aged 19-23 years (right-handed). The main study group consists of 20 people who visit basketball classes, the control group consists of 20 people who have no the skill of ball throwing and are trained under the program of general physical education. Each throw is taken from the middle of the free-throw line. The study is conducted using the method of Motion Tracking. Digital high-speed camera "Vision Research Phantom Mire eX2" with a speed shooting of 200 frames per second is used. A biomechanical model of exercise is created and analysis of kinematic parameters is performed in the program StarTraceTracker 1.1 VideoMotion®. Statistical data processing is done in the program SPSS Statistics 17.0.

3. Results and discussion

Figure 1 shows a vertical and horizontal component of the velocity at the wrist, elbow and shoulder joints during a jump throw.

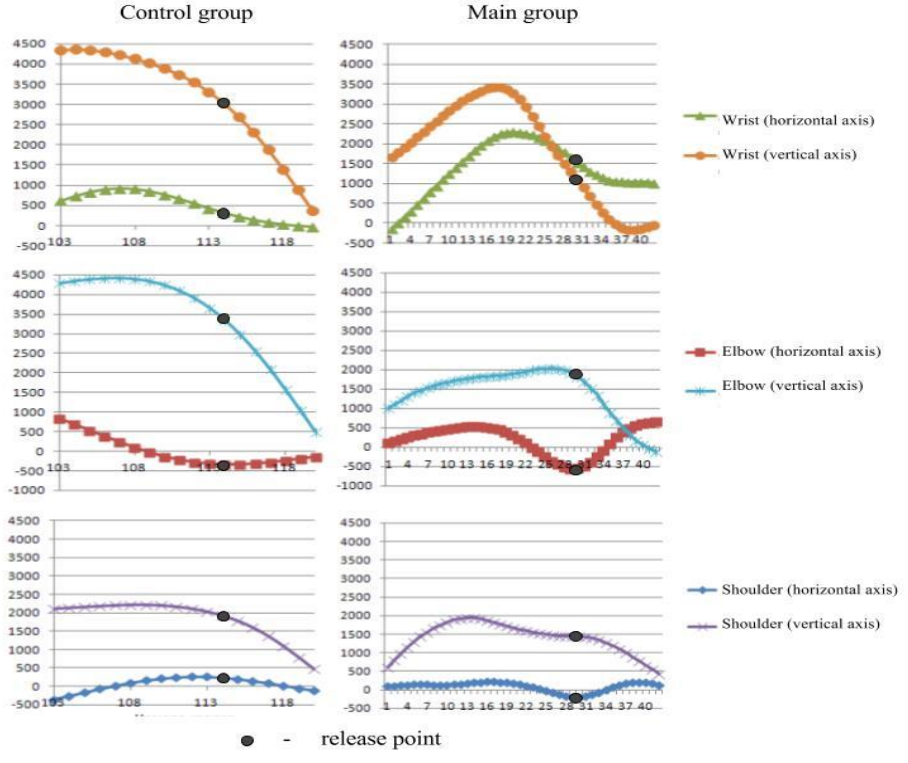

Fig.1. Velocity of the wrist, elbow and shoulder movement during a jump-throw (mm/s)

At all points the vertical component of velocity has a lower value compared with a control value in the main group, it indicates a more "saving" nature of athletes' movements. Athletes' wrist joint is the first that starts a ball push process. In the control group, there is a gradual decline in the value of the speed, but in the main group the rise of value is in both projections. After reaching a maximum value, the velocity drops and when the horizontal and vertical velocity components are nearly equal, there is the moment of a ball shoot. At this point the elbow velocity of the vertical axis reaches its maximum, and the horizontal axis, on the contrary, reaches its minimum, it means the elbow is actively involved in ball shooting, and it starts the sequence of movement patterns and stabilizes the position of the hands on a horizontal plane. The shoulder joint repeats the dynamics of the elbow one in some extent, giving the position correction and stabilization of a hand during the throw.

The estimation of the linear velocity at the release point (Table 1) shows that the value in the main group is significantly lower than it is in the control group at all three points. At the same time, the speed decrease of the wrist joint can be caused by the hand movement at the ball pushing process and coordinated by involving all necessary anatomical parts (wrist, elbow, shoulder) at the motion process. At the same time, participants of the controlled group produce a push by the whole hand simultaneously. Thus, there are no signs of decomposition of motion into several parts and there is a sequence of its movement.

Table 1. Linear velocity of wrist, elbow and shoulder movement during a jump-throw (mm/s)

Group	**Wrist**	**Elbow**	**Shoulder**
Control group	3112±385,644;	3491,5±571,337;	1576,75±286,346;
Main group	2284,417±80,732; $p<0,05$	2202,583±184,296; $p<0,05$	1156,917±196,686;

4. Conclusion

Athletes who have formed skills of the ball throw perform hand movement at a lower velocity, thus, they expend less efforts. Movement patterns are realized with consistent involvement of the wrist, elbow and shoulder in the act of shooting, and the elbow corrects and stabilizes the movement of the arm, the shoulder repeats the dynamics of the elbow, but amateur athletes do not show these skills.

The results show the necessity to develop an optimal scheme of training basketball players, based not on throwing the ball into the basket ring but the formation of the general scheme of the throw. Therefore, the most reasonable approach is to design an optimal jump shot model based on biomechanical analysis and skills formation using information technologies.

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