

THE INFLUENCE OF A "PASSIVE DEFENDER" AND INCREASING FATIGUE ON THE KINEMATICS OF THE JUMP-SHOT IN TEAM HANDBALL

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INTRODUCTION

In the process of learning and perfecting a sport technique, coaches are looking for new ways which enable us to increase the difficulty of the task. They create new training exercises to improve movement performance. The main elements affecting the performance of movement in team handball are the opponent and increasing fatigue.

The quality of the jump-shot in team handball is influenced by a number of different factors, such as the level of movement abilities of the individual, the real situation during the match, physical conditions, etc. Some specific methods are used in training to improve the quality of the shooting. One of them is the "passive defender" which is simulated by a net over which the player's shot is executed. The main aim of this research was to investigate the influence of the fatigue on the quality of the jump-shot performed under the conditions with and without "passive defender."

MATERIAL AND METHODS

One of the first league team handball players was the subject of this research. The personal data of the player were: age - 18 years, height - 184 cm, body mass - 75 kg, experience in the sport - 5 years. Additionally, the following measurements were performed: $\text{VO}_2\text{max.} = 71.38 \text{ ml kg}^{-1} \text{ min}^{-1}$ and 15 s Wingate test: relative maximal power - 10.38 W/kg , power decrease index = 5%, time of maximal power = 5.59 s, relative total work - 136 kJ/kg . The athlete had to run the course until refusing to continue on; the 30 m running-path included specific technical elements: catch, dribbling, feint and throw. The main element of the running-path was the jump shot. The aim was to shoot to the upper left corner of the goal. The throw was performed alternately in two situations: (1) without the "passive defender," and (2) with a "passive defender" (net at the height of 2.5 m at a distance of 7.5 m from the goal).

After 3:43 min. of the test the player refused to continue the task due to fatigue. During the test the player performed 22 throws (11 with and 11

without "passive defender"). All the throws were recorded using two videocameras at an angle of 90 deg. and at a distance of 25 m from the throw point. The VIDANA system (sampling frequency of 50Hz) was used for 3D kinematic analysis. The evaluation of throw performance was done on the basis of 11 kinematic parameters (Fig. 1). These parameters were: maximal height of the center of mass (HCMmax), height of CM at the moment of ball release (HCMS), the decreasing index - the difference between maximal height of the CM and the height at which CM was at the moment of ball release (DI), the height of the ball while leaving the hand (HBS), horizontal translation of CM during the throw (XCM-N), the distance from the take-off to the movement of ball release (XS), horizontal velocity (VXB), final velocity of the throw (VAB), and angle between velocity vectors (AV) (Fig. 1). Time parameters were: time of take-off (TTO) and time of throwing phase (TTP). Acquired data was analyzed statistically using multiple analysis of variance (STATGRAPHICS).

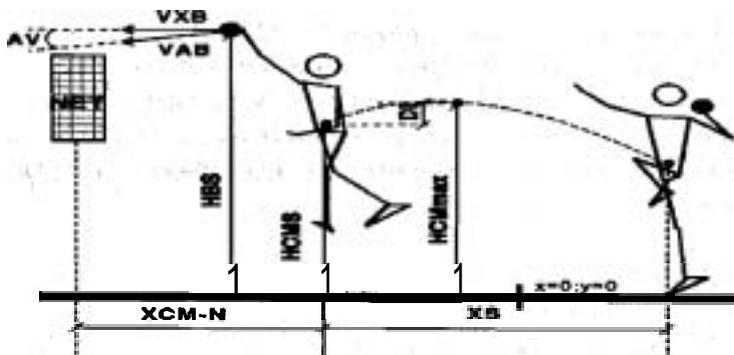


Figure 1. Analyzed parameters of the jump shot

RESULTS

We expected the existence of three relationships among the chosen parameters:

- a) Increasing fatigue and the "passive defender" influence the analyzed variables. The first type of change affects the HCMmax (Fig. 2), TTO, and HBS. As it was supposed, the HCMmax decreased with increasing fatigue. Simultaneously, the "passive defender" caused a significantly higher height of CM from the 5th throw until the end of the test. Similar changes have been found in the height of the ball at moment of throw (HBS).

- b) The changes of variables depend only upon one factor. The relationship between DI and growing fatigue was observed and this index increased significantly over time. The "passive defender" influenced three parameters: TTP, VXB and VAB. These velocities were significantly greater without the "passive defender" because the net disturbed the player (Fig. 3).
- c) The two factors (fatigue and "passive defender") do not influence measured variables. The fatigue and the "passive defender" have not influenced the following parameters: XCM-N, XS, and AV. The change in these variables was caused by the specificity of the movement task.

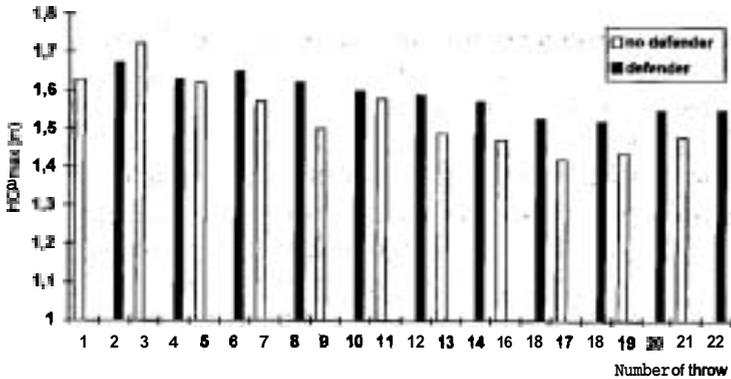


Figure 2. The height of CM at moment of throw

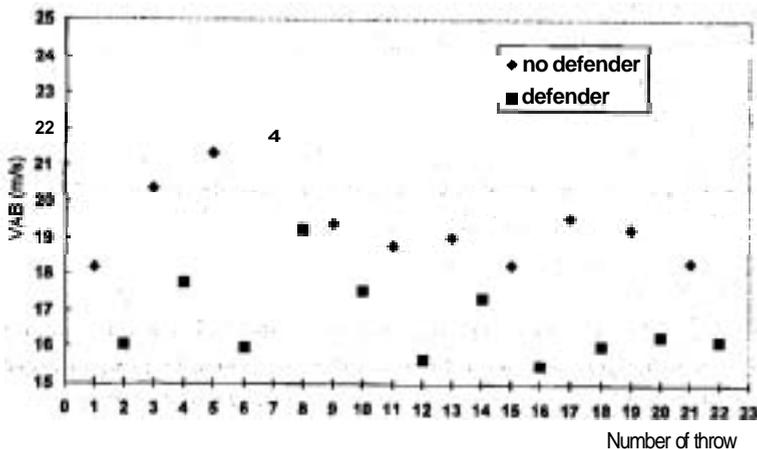


Figure 3. Absolute velocity in consecutive throws

DISCUSSION

The presumed decrease of height of CM supported the opinion of Zaciorski et al. (1984), that fatigue manifests itself by decreasing muscle strength, leading to lowering the impulse of the take-off strength. In this light, greater height of CM during the existence of "passive defender" indicates that using the more difficult condition of the throw in a phase of fatigue is positive for the training process. Furthermore, the velocity of the ball depended only upon the existence of the "passive defender" with no decrease except with increasing fatigue. Similar stability in ball velocity was evaluated in a volleyball experiment with increasing fatigue by Levczuk (1975). A greater engagement of the player was observed when the net was used, which means that he needed more time for take-off and the entire throw with minimal horizontal translation.

CONCLUSIONS

- * The parameters HCMmax, TTO, and HBS were found to be dependent both upon fatigue and "passive defender" (decreasing tendency). The "passive defender" caused a significantly higher height of HCMmax and HCMS from the 5th throw until the end of the test.
- * The variables TTP, VXB, and VAB were significantly influenced by the factor "passive defender" (these parameters were greater without "passive defender") and DI was influenced by the factor fatigue.
- * Only parameters XCM-N, XS and AV were not influenced by either of the two affecting factors (fatigue and "passive defender").
- * The application of the special exercise "passive defender" in the training has been proved to increase the quality of the take-off activity of the jump-shot in comparison with the situation "without passive defender" even during increasing fatigue. The difference between the quality of the throw with and without the "passive defender" indicates that incorporating the exercise "passive defender" into the training could improve the quality of shooting in actual play.

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