LOW SIDE-STEP KINEMATIC CHARACTERISTICS OF HANDBALL GOALKEEPER

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ABSTRACT
In order to recognize kinematic characteristics of the basic defensive movements of the handball goalkeeper's modern defensive technique, video recording of the three dimensional movements in the situational conditions has been done. The demonstrator was a top quality first league goalkeeper, having top defensive movement technique. One of the basic movements that dominantly participate in goalkeeper's situational activity was analyzed: low side-step. The analysis of kinematical parameters was realized using the 3D movement acquisition system developed in the Laboratory for the Biomechanics, FESB, Split. Low side-step analysis, which is movement applied during the defense of low shots from longer distances, showed relatively low speed of the lower leg in the initial and medium phases of the movement performance. In the final phase, we can notice a rapid velocity increase, what is caused by lower leg extension and the contraction of the muscles of the frontal side of the thigh.

KEY WORDS
Biomechanics, handball, kinematic characteristic, motion analysis

1. Introduction
Today in top handball dominates modern defense technique which was created as the response on evolution of handball game concerning the appearance of an extremely powerful short-distant shots. The basic determinants of this technique which in the modern handball terms shows the highest level of efficiency are possession of an optimal spot position, maximal rationalism of defensive movements and complete usage of body as a defensive surface.

The goalkeeper's playing does not contain many technical elements, but because of the specific function of this player who acts in an extreme conditions of time deficit (ball velocity is significantly higher than the velocity of the goalkeeper's defensive movements), the quality of motorical skills related to a superbly precise performance of technical elements is the top priority, which means that every single movement has to be performed correctly, rationaly, deliberately and precisely. Although the technique is mostly developed on ideally projected activity from the scientific and biomechanical aspect, minor deviations are allowed concerning adaptation to specific individual motorical and morphological determinants. A wide range and high quality appliance of technical elements enables the goalkeeper an optimal motorical response in different circumstantial conditions.

It seems that the defensive goalkeeper's movements technique is dominant for his circumstantial success. According to the common principle of setting up requiring goalkeeper's frontal plane to be perpendicular towards a shooting direction, it is pretty clear that the defensive movements have to be performed in frontal plane as well. Each abandonment of this plane from the peripheral parts of the body enlarges the amplitude on which the defensive movement operates and in this way decreases its efficiency. It is not hard to understand that the essence of the goalkeeper's game consists of adduction and abduction. As the natural motion of the human being is mainly orientated towards the sagittal plane, the group of muscles responsible for realisation of adduction and abduction movements is likely to be less developed. Also motion in frontal plane is more demanding because of a diminished possibility of the imbalance position correction, in contrast to the motion in sagittal plane.

Because of these reasons a significant attention has to be directed towards the technique and goalkeeper's technical preparation so we need a good quality analysis of goalkeeper's motional methods but most of all the analysis of their kinematical significations.

Present studies of the elements of the handball are predominantly focused on kinematics [1][2] or kinetics
[3][4] analysis of the players shooting technique. Analysis of the goalkeeper technique are based on empirical-qualitative [5][6][7][8] or theoretical-mathematical approach [9]. Improvements in acquisition of new knowledge based on the kinematics analysis of the goalkeeper’s technique in handball are possible using new technologies for the movement capturing and analysis [10][11].

2. Body of paper

2.1 Materials and Methods

The research is orientated towards recognising and analysing kinematical significations of goalkeeper's basic defensive movement as a leading strategy in discovering kinesiological parameters of the modern defensive technique. Kinematical parameters analysis contributes to a evaluation of defensive movements technical quality. Also, it enables diagnosis of errors which emerge during the performance so it has a deliberate appliance in goalkeeper's technical preparation. The aim of this research is to measure kinematical characteristics of the handball goalkeeper's modern technique such as low side-step.

The shots were digitized using a digital card of PC personal computer and the obtained referent points positions were filtered. Data interpolation was done and cameras were synchronized by software programming in order to achieve more precise information [10]. The coordinates were calculated in three dimensional space using Direct Linear Transformation (DLT) method.

Movement was repeated 4 times and the most significant movement was chosen for the analysis. Furthermore, the average velocity of the movement performance was calculated.
kg of weight, who according to the estimation of experts, have top defensive movement technique and domimative motorical potential.

2.2 Results and discussion

Low side-step technique is applied during the defence of low shots from longer distances.

In order to defend low shots it is necessary to perform, from the basic position, eccentrically take-off with the distant leg towards the ball, which is directed to as short as possible angle and in the direction of an expected connection with the ball.
The leg nearer to the ball at the same time performs lateral movement and exterior rotation of the thigh as side-step and weight is removed to the ball-reaching leg. The trunk is bended towards the connection point with the ball with exterior spinning around vertical trunk axes at the same time. Nearer arm is stretched and placed in front of ball-reaching leg, almost to the ground, while free arm is stretched and it is placed on the other side of the trunk in order to keep the balance.
Saggital axes of the foot of the ball-reaching leg is placed in frontal plane in a way that the foot is opened towards the ball with its interior side and it makes a large defensive area together with an opened palm and the forearm of the nearer arm.

In Figures 4. and 5, kinematical parameters for low side-step (3D coordinates and joint velocity of the chosen attempt) are showed.
The characteristic is relatively low velocity of the lower leg in an initial and medium phase of the movement performance. In initial phase in the first couple of segments, certain fluctuation of the distant part of the lower leg is noticed in relation to the x axis, which is the consequence of the preparation operations for the movement performance. In the final phase, we can notice a rapid velocity increase, what is caused by lower leg extension and the contraction of the muscles of the frontal side of the thigh. The average velocity of the movement is significantly lower in comparison with other movements already analysed [11][12]. Movement velocity results are shown in figures 6-8.

However, in an initial and medium phase, in the low side-step performance the abductor muscles and the exterior rotators of the thigh which as short muscles influence the peripheral part of the thigh bone, dominantly participate which means that they operate on short lever and a significant force and appropriate time is needed for the movement of relatively large mass of the leg.
The certain slowdown of this movement performance leads the attackers to shoot more often to the lower parts of the gate which are more difficult for the goalkeeper to reach than the medium or high parts, especially because the success of defensive movement performance with lower extremities is limited with their passive function in keeping the balance position in a basic goalkeeper's position.

3. Conclusion

According to the video recording in three dimensional space in situational conditions, kinematic significations of the basic defensive movement – low side-step of the establishing technique of handball goalkeeper are analysed.

The movement were performed by top first-league goalkeeper, member of the Croatian national team with possession of proper technique. The spatial coordinates were calculated in three referent points as well as the movement velocity.

During the performance of the low side-step movement, the lowest velocity of peripheral part in comparison with the other analysed movements is noticed. The velocity increases progressively and it reaches the highest value in the final stage of the movement during the explosive extension of the lower leg in frontal plane which is directed towards reaching the maximal amplitude of defensive movement.

The analysis of kinematic movements can significantly contribute to establishing a good-quality technique of the defensive movement performance, diagnosing the errors in movement performance and their effective elimination in relation to a technical preparation of the goalkeeper, but also in order to optimise the body position in the basic goalkeeper's poses.

References:


