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SOME PARAMETERS IN CROSSOVER PHASES SIGNIFICANT FOR THE RESULT IN PARTICULAR THROWING DISCIPLINES

(Professional paper)

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Abstract

Aims of this study which follow on the problem of the subject of the survey are: to explain kinematic and dynamic parameters of crossover acceleration of shot put, discus, javelin and hammer throw; to present anthropological characteristics of shot put, discus, hammer and javelin throwers.This survey tries to point to some problems during realization by phases, that is, during the release in certain athletic disciplines, especially those significant for the crossover phase. Length of a throw to a large extent depends on the approach run – turn phase, crossover phase and on the angle of a throw of a particular object. In order to eliminate some mistakes, we will try to give a small contribution to realization of length of a throw in throwing disciplines, through certain kinematic and dynamic parameters as well as through anthropological characteristics.

Keywords: *kinematic parameters, dynamic parameters, anthropological characteristics, shot put, discus throw, javelin throw, hammer throw, skeletal musculature, motor skills, functional abilities, cognitive and conative characteristics*

INTRODUCTION

The locomotor system enables humans to move in space. Elements of the locomotor system are bones, joints and muscles. Bones and joints are passive, whereas muscles are active elements as skeletal musculature which represents the only element of the system with its own ability of movement. While moving, human body is exposed to the activity of external forces (gravity) and internal forces our muscles use to act on bones they are tied to. Under the influence of these forces bones operate as levers. These levers are connected to the systems by joints. In order to apply mechanical laws to human locomotor system, it is necessary to be informed about the anatomy of the human locomotor system. Functional anatomy studies the locomotor system through the prism of its mechanics, appropriateness in different positions when some elements of the locomotor system move in space in relation to other elements of the same system as a difference from a normal body position. Biomechanical analysis of moving cannot be conducted without previous definition of size and direction of inner forces (muscular force). In order to get authentic data when analyzing recorded moving, filming must be performed under special regime. Rapid cine- camera is placed at particular distance from the space where the recorded object moves in such a way that the whole space which should be recorded is in take. Height of the object should match the height of the centre of gravity of the recorded object during movement. A plummet is positioned in the recorded space or lines defined by the plummet, which in the analysis help us define horizontal, that is, vertical line and also necessary gradients in particular moments of moving. There are some other ways of recording time intervals between adjacent takes, but the most practical is directly recorded time by recorded precise clock. In order to define optimal training for each thrower, all those things and every detail should be done and recorded for javelin throwers as well as for hammer, shot put and discus throwers. When certain elements are defined, common centre of gravity for each body part or the whole body can, by perceiving parallel forces or in some other way (analytically, graphically) be defined at all moments of moving. In order to calculate all the elements properly, it is necessary to know proportions and time intervals among adjacent takes where distance travelled and speed are calculated in particular unit of time.

Subject, problem and aim of the study

The subject of this study are kinematic and dynamic parameters of crossover acceleration in throwing disciplines. Starting from the structure of these athletic disciplines, analysis of spatial-time parameters are singled out within the subject of the survey. Short analyses of spatial, time and spatial-time characteristics during realization of technical-tactical tasks, as well as the analysis of forces developing in a thrower's muscles, are given for each discipline.

Problem of the survey

Within the scope of programming training in microcycles, especially in preparatory and before the competition periods for the athletes-throwers, knowledge about basic kinematic and kinetic parameters of movement from the initial measuring are important. The only possibility to make optimal choice of means for physical workout and to define training load (scope, intensity and relaxation intervals) is on the basis of these biomechanical data and results of testing of anthropological characteristics (morphological characteristics, motor skills, functional, cognitive and conative characteristics).

The aim of the survey

Aims of this study which follow on the problem of the subject of the survey are:

- To explain kinematic and dynamic parameters of crossover acceleration of shot put, discus, javelin and hammer throw,
- To present anthropological characteristics of shot put, discus, hammer and javelin throwers.

METHODS

Method of work is adapted to the subject, problem and tasks of the survey and it is based on one hand, on the synthesis of personal experience in sports and on the other hand, on expert and scientific literature as well as on suggestions by athletic trainers.

Kinematic and dynamic parameters of crossover acceleration in shot put

By structure of movement, shot put throw has cyclical character with specific rhythm in some phases. Distance of a shot put throw performed by the same athlete with optimal angle of a throw, depends first of all on speed defined for the shot put at the moment of a throw. Therefore, it is necessary to define the highest maximum initial speed of shot put at the moment of a throw. Crossover acceleration in shot put throw consists of four parts. Double support phase starts with turning of left foot toes, whereas the left arm goes forward in rotating movement and it ends at the moment when the right leg is detached from the ground. Single support phase starts with rotating movement of the right leg with smaller amplitude and shorter period of time than turning of a pelvis in direction of a discus throw. Chest and hand with a shot stay behind the leg movement. Non-support phase – characteristics of this acceleration is from the left to the right leg where the hand with the shot still stays behind, second single support part begins with touching the ground with the right foot near the centre of the shot.

Discus throw

Discus can be thrown from the standing position but throw with rotation can be much longer. Speed of a throw is 30m/s or more. Contemporary discus throwers start rotation standing with their back in direction of a throw and perform one and a half turn until the moment of throwing discus at about 540 degrees and a thrower goes through the following phases: double support – beginning, single support on the left leg, no support after jump off of the left leg, single support on the right leg – at the moment of landing into double support – final phase. Speed of turning can be increased by a degree of mastering throwing technique and by improving preparation of a thrower. At the end of resilience from the left leg, distance between thighs reaches the largest size of 90 degrees and more. At the moment of landing on the right foot, a thrower is in the position of a stride with a left leg behind, his/her shoulder zone is turned to the right side in comparison with the pelvis, right arm with the discus is above at the level of the shoulder zone, the body remains slightly leaning forward with the left arm next to the chest.

Jevelin throw

The task of the final part of the approach run is to enable the thrower to stop in the most natural position where he can use all his abilities in the throwing phase. Taking javelin away (crossover) by a thrower starts by taking away the hand which holds the javelin slowly backwards in the opposite direction from direction of throwing, arm which holds the javelin moves slower, that is, body of a thrower moves faster and crosses over the javelin. The javelin must keep the former direction of its vertical axis in direction of throwing independent from movements of a thrower because every deviation disrupts javelin flight and has a negative influence on the result.

Hammer throw

Turning of a thrower on both legs lasts until the body is turned to the left, in the first turn for about 90 degrees, and in the second and third up to 80 – 75 degrees in comparison with the initial position. At the same time with turning to the left, a thrower slightly stretches his/her legs in the knee zone. Body weight is transferred to the left leg when confronted with the burden of a device. In the first turn, wire of the hammer is transferred to the height of the shoulder zone on the left side of the starting position. In the second and third turns the wire is significantly above the shoulder zone. During transition to the phase of support on one leg, a thrower moves his body backwards in vertical position, with every turn making hammer taking away bigger. This is necessary in order to keep the balance so that central force of the hammer increases and reaches longer length which would change direction of pulling of the device.

It is possible, on the basis of results of some scientific research surveys, to make a number of hypotheses about the influence of some anthropological characteristics on efficacy in shot put, discus, hammer throw. Besides this, there are no reasons to suppose that there are differences in importance of certain dimensions between men and women. Majority of surveys on relations between motor skills and results in shot put confirmed information about the influence of the explosive strength factor.

Table 1. Estimation f importance of anthropological characteristics in relation to success in shot put, discus and hammer throw

Anthropological characteristics	
Longitudinal dimensionality of the skeleton	+5
Transversal dimensionality of body	+5
Body volume	+5
Subcutaneous fat tissue	-3
Coordination	+3
Precision	+3
Balance	+4
Flexibility	+2
Speed of alternative movements	+3
Basic body strength	+5
Explosive strength	+5
Maximum force of attempted movements	+5
Cognitive skills	3
Conative characteristics	3
Range of oxygen transport system	+1
Stability of oxygen transport system	+1
Anaerobic capacity	+4

DISCUSSION AND CONCLUSION

Knowledge in the field of sport is constantly increasing, as well as in the field of training practice. Thus we can determine structural, biomechanical and functional characteristics of athletes. Success of athletes in throwing disci-

plines is defined by level and structure of a large number of skills, knowledge and characteristics which they have on every developmental stage of a sports career. However, the most important are anthropological characteristics, specific skills, that is technical and tactical knowledge as well as situational efficacy realized on the basis of registration of events during competition. Perfection of movement in top sport reaches its limit when a trainer and athlete cannot estimate shortcomings in technical realization of movement on the basis of experience, so that techniques and methods of biomechanical analysis are used more and more, because they enable an objective and correct insight in the essence of movement. Data obtained by measuring can be used for estimation of sports technique efficiency, establishing reasons for sports injuries, programming of training process, etc. Biomechanical analysis of a throwing disciplines technique in its essence comes down to defining kinematic and kinetic parameters of movement. Kinematic structure represents mutual connection of movement in space and time with the basis in tempo of movement, speed and acceleration. This structure of movement is determined by kinematographic method, that is by recording the technique by cameras. Data about mutual influence of one object on another and their connection with external forces are obtained by establishing kinematic parameters.

On the basis of these kinematic and kinetic characteristics of movement, deviation of some movement in relation to the ideal model can be established simply. In this way we can obtain data about differences in main values, speed, acceleration, forces between movements performed by a particular thrower and the technique realized by a top athlete thrower. This is extremely important for correction of technical and tactical knowledge of throwers.

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