

# Differentiated use of auxiliary projectiles in the preparation of high-class javelin throwers based on the consideration of biomechanical features of the implementation of the final effort

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## Abstract

**Objective of the study** was to substantiate and experimentally test the methodological conditions for the shared use of auxiliary projectiles in the preparation of high-class javelin throwers.

**Methods and structure of the study.** In the presented work, the methodological conditions in the preparation of javelin throwers using the sloop throwing technique and the rebound throwing technique are determined. The classification of auxiliary projectiles has been carried out.

**Results and conclusions.** Managing the training of throwers using sloop throwing technique involves the organization of pedagogical influence aimed at developing the athlete's mechanisms for the manifestation of force in the links of the kinematic chain of the motor apparatus. The main methodological condition for the shared use of auxiliary projectiles in the group of athletes using the rebound throwing technique was the use of weighted projectiles, lightweight projectiles thrown at the wall, and lightweight projectiles thrown at a distance, in a ratio of 20% -50% -30%. This made it possible to achieve an increase in the speed of angular movements in the kinematic chains of the motor apparatus in two athletes of the rank of CMS and one - MS, in addition, in the master of sports and one candidate for the master of sports to achieve an increase in the results of throwing the main projectile, and in the honored master of sports to maintain high rates of speed potential of the kinematic chain.

**Keywords:** *javelin throwing technique, kinematic characteristics of javelin throwing, final effort, final effort realization phases, thrower's tasks.*

**Introduction.** The study of the kinematic order of the generation of the speed of angular displacements in the kinematic chains of the motor apparatus of high-class athletes when performing javelin throw, carried out by us in previous studies [2], allows us to establish two ways to perform the final effort. These are the technique of performing the final effort with a rebound and the technique of performing the final effort with a sloop. Each method is characterized by its own system-forming factors, its own cause-and-effect relationships and risks. Rebound throwing allows more efficient use of the speed run-up potential, which is mainly determined by the mechanisms of coordination of the control of the speed of angular movements in the links of the kinematic chain of a motor athlete. Leap throwing allows more efficient use of the athlete's speed-

strength capabilities, which is mainly determined by the work of the mechanisms that determine the manifestation of force in the links of the kinematic chain of the motor athlete.

The prevalence of any throwing method in an athlete is determined by the dominance of the coordination or speed-strength components in the physical condition of the athlete. Such an individual feature causes different approaches to the management of the training process of athletes using one of the types of throwing [3].

**Objective of the study** was to substantiate and experimentally test the methodological conditions for the shared use of auxiliary projectiles in the preparation of high-class javelin throwers.

**Methods and structure of the study.** In the framework of this study, the basis for managing the



sports training of throwers is the idea of using auxiliary projectiles, based on the biomechanical features of the throwing method formed by the athlete. It was assumed that the process of training athletes using the technique of rebound throwing, which is based on the ability to control the high speed of angular movements in the kinematic chain of the motor apparatus, should be based on the predominant use of lightweight auxiliary projectiles. In turn, the process of training athletes using sloop throwing technique, which is based on the ability to manifest force in the kinematic chains of the motor apparatus, should be based on the centralized use of weighted projectiles.

This assumption was tested experimentally. A group of throwers was selected, including athletes of the Candidate Master of Sports (CMS), Master of Sports (MS), Honored Master of Sports (HMS) level, whose biomechanical characteristics of the final effort technique were established based on the use of an optical system for video analysis of movements, which made it possible to establish a method for its implementation. The first group included throwers using the rebound throwing method, and the second group included throwers using the sloop throwing method. To increase the reliability, each subject had 10 attempts. The formative experiment was carried out in the preparatory period of sports training. During the training process, both groups were faced with the task of ensuring the acquisition of biomechanical parameters that characterize the improvement of sports form. To ensure a positive effect, special exercises for throwing light and heavy auxiliary projectiles were included in the training process of each group based on the principle of shared use. To implement this principle, when compiling individual programs, auxiliary projectiles were divided into three groups:

- 1) weighted auxiliary projectiles, the use of which is aimed at developing the power potential of the thrower;
- 2) lightweight auxiliary projectiles designed for wall throwing and used to develop the thrower's coordination abilities;
- 3) lightweight auxiliary projectiles designed for throwing at a distance and helping to develop the speed abilities of the thrower.

In order to verify the results reliably, the following share ratio of exercises with the use of auxiliary equipment for athletes using different throwing methods was proposed:

1) for athletes using the bouncing technique, the proportion of exercises using weighted projectiles was 20%, the share of exercises using lightweight projectiles thrown at the wall was 50%, and the share of exercises using lightweight projectiles thrown at a distance was 30%;

2) for athletes using the sloop throwing technique, the share of exercises using weighted projectiles was

30%, the share of exercises using lightweight projectiles thrown at the wall was 20%, and the share of exercises using lightweight projectiles thrown at a distance was 50%.

Throwing a competitive projectile was planned independently. When analyzing individual plans developed on the basis of the principle of shared use of auxiliary exercises, it was possible to establish that the participants in the experiment did not throw the competitive apparatus more than 1-2 times a week, the rest of the time was devoted to throwing auxiliary apparatus. At the same time, each athlete led the preparation process in accordance with an individual program. Innovations in the field of management of the training process concerned only the share ratio of the use of auxiliary projectiles. The duration of the experiment was three months. The definition of the kinematic characteristics of throwing was implemented on the basis of the optical system of three-dimensional video analysis of motions of the company "Biosoft" [1]. Processing of the results of the experiment was carried out in the laboratory of ergonomic biomechanics of the Adyge State University.

**Results of the study and their discussion.** To determine the criteria for evaluating the effectiveness of the application of building individual plans based on the share ratio of the use of auxiliary projectiles in athletes using various throwing methods, indicators of the speed of angular movements in the links of the kinematic chain of the motor apparatus were selected, which have high values determined by using a system of three-dimensional video analysis of human movements. Five indicators were taken as the most significant for the athletes of both groups (see table).

The introduction of the principle of shared use of an auxiliary projectile into the process of managing the training process in a group of athletes using the sloop throwing technique made it possible to achieve an increase in the speed of angular movements in the kinematic chains of the motor apparatus in three athletes, and in two athletes to achieve an increase in the results of throwing the main projectile and maintain high rates of speed potential kinematic chain of an athlete with the title of HMS. These results allow us to speak about the effectiveness of introducing the principle of shared use of an auxiliary projectile into the process of managing the training process of javelin throwers.

The study of similar data in the group of athletes using the bounce throwing technique made it possible to establish the implementation of the principle of shared use of an auxiliary projectile in the process of managing the training process in the group of athletes using the bounce throwing technique. The introduction of this principle, in particular, made it possible to achieve an increase in the speed of angular movements in the kinematic chains of the motor apparatus



*Indicators of the speed of angular displacements in the kinematic chains of the motor apparatus of athletes.*

Members experiment	The speed of angular displacements in the kinematic chains of the propulsion apparatus (°/c - degrees per second)									
	Speed of extension in the ankle joint in the phase of taking the final position		Speed extension at the knee joint in the final position phase		The speed of extension in the hip joint in the phase of the final actions		Speed of extension in the shoulder joint in the phase of performing the final actions		The speed of extension in the elbow joint in the phase of the execution of the final actions	
	Before experiment	After experiment	Before experiment	After experiment	Before experiment	After experiment	Before experiment	After experiment	Before experiment	After experiment
<b>Using the technique of throwing a rush</b>										
Cr-----z (KMS)	122±18	*182±22	201±17	183±25	165±11	163±5	209±22	216±31	142±21	*404±43
Pu-----a (KMS)	201±23	224±19	76±8	*145±19	158±18	148±12	203±31	198±25	235±34	*368±25
Ab-----a (HMS)	362±14	352±11	91±9	103±24	142±14	146±9	211±12	242±9	429±23	578±32
Pi-----s (MS)	327±18	355±25	54±14	*113±25	110±25	105±35	276±19	341±42	418±34	*674±71
<b>Using the rebound throwing technique</b>										
To-----n (HMS)	365±24	387±35	187±14	225±25	170±12	183±16	251±14	275±18	731±57	831±77
To-----n (KMS)	249±27	241±29	10±2	*51±15	57±14	79±11	250±24	*311±21	280±41	*411±31
Ща-----н (MC)	383±31	371±32	29±5	*85±17	31±11	54±14	251±31	271±29	350±32	*451±12
Zo-----v (MS)	131±35	*243±27	111±12	84±17	41±14	52±10	197±28	221±35	195±32	*276±43

\* Significance of data differences before and after the experiment,  $p < 0,05$ .

in three athletes, and in two - to achieve an increase in the results of throwing the main projectile. Such results allow us to conclude that the principle of shared use of an auxiliary projectile is effective in managing the training process of javelin throwers.

**Conclusions.** Managing the training of throwers using the technique of rebound throwing mainly requires the formation of mechanisms for coordinating the manifestation of the speed of angular movements in the links of the kinematic chain of the motor apparatus in the athlete. Managing the training of throwers using sloop throwing technique involves the organization of pedagogical influence aimed at developing the athlete's mechanisms for the manifestation of force in the links of the kinematic chain of the motor apparatus.

The main methodological condition for the shared use of auxiliary projectiles in the group of athletes using the rebound throwing technique was the use of weighted projectiles, lightweight projectiles thrown at the wall, and lightweight projectiles thrown at a distance, in a ratio of 20% -50% -30%. This made it possible to achieve an increase in the speed of angular movements in the kinematic chains of the locomotor apparatus in two athletes of the rank of CMS and one - MS, in addition, in the master of sports and one candidate for the master of sports to achieve an increase in the results of throwing the main projectile, and in the honored master of sports to maintain high performance speed potential of the kinematic chain.

The main methodological condition for the shared use of auxiliary projectiles in the group of athletes using the sloop throwing technique was the use of

weighted projectiles, lightweight projectiles thrown at the wall, and lightweight projectiles thrown at a distance, in a ratio of 30% -20% -50%. This also made it possible to achieve an increase in the speed of angular movements in the kinematic chains of the locomotor apparatus in two athletes of the CMS rank and one - MS, in addition, in the master of sports and one candidate for the master of sports to achieve an increase in the results of throwing the main projectile, and in the honored master of sports to maintain high indicators of the speed potential of the kinematic chain.

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