

FUNCTIONAL AND TECHNOLOGICAL PROPERTIES OF THE SIMULATOR DESIGN OPTIMALLY SUITABLE FOR TRAINING THE HANDS OF SAMBO WRESTLERS AND JUDOISTS

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Abstract: The modern training process involves the use of various types of simulators. At the same time, the most effective are those simulators that allow you to create increased physical activity by simulating the real movements of an athlete, taking into account their trajectory and amplitude. In such types of martial arts as wrestling "sambo" and "judo" fights are conducted with the capture of the opponent's jackets, which requires strong muscles responsible for the work of the hands. The aim of the work is to create such a design of a wrist expander that would provide effective training of the hands of a "sambo wrestler", "judoist", taking into account the specifics of the movements performed by him with his hands during combats.

Keywords: wrist expander, simulator, sambo, judo, wrestling.

1 Introduction

The success of an athlete's performance in any sport is determined by his physical fitness, skills and abilities to perform certain technical actions.

N. A. Kislova (2017) notes that all people have different hands in shape and size. By the appearance of the hands, it is impossible to assume who will have a stronger hand and who will have a weaker one. The true strength of the hand does not depend on the size of the hand and the weight of a person, but on the training of the muscles and tendons of the forearm and on how well the strength in the ligaments of the hand and fingers is developed.

To improve the physical training of athletes, including increasing the strength of the hand, various types of simulators are widely used. Currently, there is a large variety of them, providing training for various muscle groups.

Among many types of simulators, a separate group stands out, aimed at strengthening the muscles of the hands and forearms of athletes. At the same time, the choice of a particular design is determined by the loads that the athlete experiences during training sessions. Examples of such loads can be the following cases:

- it is required to ensure the retention of a sports equipment clamped in the hand, for example, when performing an exercise consisting in spreading the arms to the sides with dumbbells clamped in them or when "pulling" a barbell;
- it is necessary to overcome great dynamic efforts, for example, in lawn tennis, striking a ball moving at high speed in the opposite direction with a racket in your hand;
- it is necessary to overcome static loads, for example, during push-ups, when the exercise is performed in a stand with support not on the palm, but on the fingers;
- it is required to strike with the hand with the fingers spread out on the ball, as for example, in volleyball;
- it is required to bend the wrist of the hand, while overcoming resistance from the opponent, such as in arm wrestling;
- and other situations.

Such a variety of training efforts led to the development of a large number of different specialized simulators for various muscle groups, including wrist expanders.

As A. O. Tsyganok (2020) notes the success of performing a particular technical action during a combat is determined by the interrelation of physiological processes occurring in the body due to a specific physical activity. At the same time, the higher the consistency of these processes, the lower the energy consumption and the greater the efficiency of the technical action carried out by the athlete. It is also noted in this work that the level of development of coordination and physical qualities

of an athlete as one of the most important factors affecting the accuracy of the execution of a technical action is largely determined by the spatial, temporal and power parameters of this action.

The peculiarity of such sports as "sambo" and "judo" is that many technical actions are associated with the necessity to bring the opponent out of balance by grabbing the opponent's jacket with one hand by the sleeve and the other by its lapel. At the same time, the athlete with one hand in which the sleeve of the opponent's jacket is captured makes a pulling force, and with the other hand with the captured lapel of the opponent's jacket, takes him out of balance, giving the desired trajectory of movement by twisting the lapel of the opponent's jacket on his fist and creating traction in the right direction.

Thus, for effective training of "sambo wrestlers" and "judoists" it is necessary to use simulators that provide training of the hands. At the same time, the fingers and the hand of one hand must ensure the capture of the opponent's jacket and its reliable retention in the grip, overcoming the resistance aimed at pulling the jacket out of the grip and creating a longitudinal thrust to shift the center of gravity of the opponent. The hand of the other hand must ensure the capture of the lapel of the opponent's jacket and its winding on the fist by turning the hand in the wrist, overcoming resistance from the opponent and at the same time providing a pulling force aimed at changing the center of gravity of the opponent with the hand with the lapel of the opponent's jacket wound on the wrist.

Based on the peculiarity of the technical actions of "sambo wrestlers" and "judoists" in the training process, it is required to use a wrist expander of such a design that would ensure the creation of loads close to the real situation when the hands experience different loads. One hand ensures the retention of the opponent's jacket clamped in her fingers, overcoming the effort to pull the jacket out of the grip, and the other makes a rotational movement in the wrist with the lapel of the opponent's jacket clamped in her fingers, overcoming the resistance to its rotation.

As the sports practice of monitoring the development of martial artists, including sambo wrestlers and judoists, shows, athletes are primarily required to improve speed and strength qualities, strength and functional endurance. Therefore, it is necessary to search for new methods and improve the technical means used in the preparation of athletes, which are aimed at the development of these physical qualities of athletes (Chevychev, 2013).

Due to a wide variety of simulators aimed at training the hands of athletes, taking into account specific power loads, the search for their optimal designs for specific conditions of the training process seems to be an urgent task. All the above-stated indicates the relevance of the topic of this article.

2 Literature Review

During the study of scientific and technical information regarding the designs of wrist expanders and the conditions of their use, information was collected that made it possible to classify known designs and establish the technical level of these devices and their functionality. Information was also studied regarding the peculiarities of the training of athletes of "sambo wrestlers" and "judoists", taking into account the peculiarities of their performance of technical actions during duels.

Zh. K. Kholodov and V. S. Kuznetsov (2003) note that the athlete's strength abilities begin to manifest when performing exercises with extreme (or near-limit) weights for the athlete. Such weights aimed at training certain muscle groups in the training process can be created by using specialized simulators.

At the same time, the improvement of strength abilities can be aimed at the development of maximum strength, the general

strengthening of a certain group of muscles, the formation of muscle relief (Shustin, 1975).

The training process of a wrestler consists of training both on the carpet and off the carpet. On the carpet, athletes practice techniques in general, and outside the carpet, parts of the techniques: approaches and preparation for throws, as well as grapples, strength and functional training.

According to the classification given by R. M. Baymukhametov and V. I. Petrova (2011), simulators are divided into weight simulators, work with which involve the movement of loads, and is aimed at strengthening general physical fitness and positional - specific devices that enable to take a certain body position from which movements are performed by an athlete. The use of positional simulators enables to strengthen those specific muscle groups that are involved in carrying out a certain technical action by an athlete.

Grip training can be trained using specialized simulators called expanders. They can be classified by design into the following groups:

- using rubber elastic elements;
- using spring elastic elements;
- gyroscopic;
- with adjustable force;
- with constant (not adjustable) force;
- installed on a portable or stationary platform;
- manual.

V. M. Zatsiorsky (1976) notes that the use of simulators with variable load resistance, in contrast to simulators with a constant load, enables to create a given amount of load during the exercise, providing such a shift in the emphasis of the manifestation of strength and speed of muscle contraction, which most corresponds to the successful solution of the training tasks.

Yu.A. Melnikov and Yu.T. Voroshilova (2019), all the design features of rubber expanders, as well as various exercises and muscle groups that these exercises are aimed at training, are considered in detail (pp. 8-15). It is noted that the advantages of using expanders include: "simplicity of classes, ease of mastering new workouts, the ability to practice anywhere (in the gym, at home, in transport, while walking)" (Melnikov & Voroshilova, 2019, pp. 10-11).

Choosing exercises with an expander, the degree of stretching and the number of repetitions, the athlete works out the muscles, develops joints and spine, and loads the heart, blood vessels and lungs (Rubber Expander, 2013). When practicing with an expander, the fingers and hand become stronger, the dexterity of the hand increases, the muscles of the forearm are pumped due to the fact that they also participate in palm compression.

E.V. Koshkin, R.A. Solonitsin, A.A. Smirnov, K.S. Kruchinina (2020) note that one of the promising ways to improve the physical capabilities of martial artists is the use of specialized simulators. The design of a throwing simulator device aimed at improving the level of technical and special training is described. This simulator is a mannequin with a sambo jacket on it and tightly tied with a wrestling belt from above and below. The mannequin is suspended on rubber shock absorbers between two pillars standing on the same line and a Swedish wall located at a distance behind the mannequin. Dosing of the load is carried out by tension and loosening of rubber shock absorbers.

N. S. Sverkunova, O. V. Vinogradov (2015) described a pedagogical experiment on training athletes "sambo wrestlers" to perform a throw "front footboard". The conduct of this experiment involved the use of rubber expanders through which the explosive force of hand traction was developed when performing a throw; individual elements of the technique of hand work and coordination of movements were fixed. This study showed that in the experimental group, in which hand expanders were used, among other things, the indicators of the technique of performing the "front footboard" throw were one

and a half times higher than in the control group, in which there was no use of hand expanders.

As the analysis of existing expander designs has shown, the vast majority of them are aimed at training only the compressive force of the fingers of the hand.

Among the expanders aimed at training the rotational movement of the hand, a number of designs were identified, for example, the following. Simulator (2020), which provides alternate rotation of the hands of a round handle, which, depending on the direction of rotation, rises or falls along the vertical rack. Another design of the simulator for training the muscles of the forearms (2013) provides for the presence of a crossbar mounted on racks, with the possibility of rotation, in the middle part of which there is a section for winding a cable with a load suspended at its free end. During training, the athlete simultaneously or alternately rotates the crossbar. At the same time, a cable is wound on the crossbar, at the free end of which a load is suspended. By changing the weight of the load, the athlete selects the optimal force of resistance to rotation for muscle training.

3 Research Methodological Framework

The purpose of the article is to search for such a design of a wrist expander that would provide effective training of the hands of a "sambo wrestler", "judoist", taking into account the specifics of the movements performed by his hands during combats.

Achieving this goal required solving a number of tasks:

- study of the peculiarities of the training process of "sambo wrestlers" and "judoists";
- study of the technical level of existing designs of simulators that provide training of fingers, hands and wrists;
- development of the design of the wrist expander, which ensures successful training of the hands of athletes of wrestlers, taking into account the specific movements performed by them during fights.

To achieve this goal, the method of functional-structural-technological analysis was used. According to this method, the object of research was selected and considered from various points of view: functional, structural, technological.

A wrist expander was chosen as the object of the study, which provides the creation of a load closest in nature to that experienced by a wrestler athlete ("sambo wrestler", "judoist") during a technical action with an opponent's jacket captured in the hands.

4 Results and Discussion

It is known that in order to increase the level of technical skill and successfully carry out technical actions during fights, all athletes, including wrestlers, need to develop those muscle groups that are necessary to perform techniques from their arsenal.

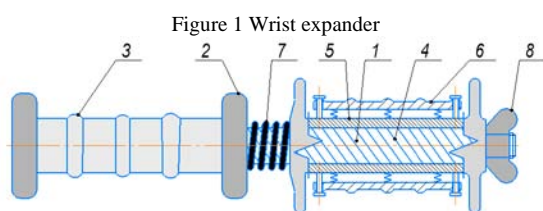
Analysis of known expander designs has shown that the vast majority of them are aimed at training the compressive force of the fingers. But such expanders enable to strengthen the grip strength of the opponent's jacket with your fingers, but do not provide training for the rotational movement of the hand when the athlete needs to overcome resistance from the opponent by twisting the armhole of the opponent's jacket on his fist to unbalance him.

During the patent information search, a number of simulator designs were found aimed at training the muscles of the arm, providing rotational movement of the hand. Technological analysis has shown that not all of them are convenient to use, since many structures are stationary and bulky, which makes them inconvenient when used at home and outside the sports ground on which they are mounted.

A functional analysis of the athlete's actions during the performance of a technical action with the capture of the opponent's jacket showed that the expander should provide simultaneous training of both hands of the athlete. At the same time, the fingers of the hand of one hand must firmly hold the object captured in it (without rotating the wrist), the muscles of the other hand must ensure the rotation of the wrist with the object clamped in its fingers.

During the structural analysis of known structures and the level of technology development, an original design of the wrist expander was developed, which has the required functional and technological properties.

The design of the wrist expander (see Figure 1) is a rod with a thrust step in the middle. The thrust stage serves to create a support surface for the compression spring, therefore it is made with an outer diameter exceeding the outer diameter of the compression spring. A handle is fixed on one side, which serves to grip it with the fingers of one hand. On the other side of it, a screw thread is made. A wrist grip with a similar screw thread is also installed here. Thanks to the screw thread, the movement of the wrist grip (when it rotates) along the side of the rod is ensured. The handle and wrist grip are equipped with spring-loaded clamping straps to increase the load on the fingers when gripping. A compression spring is installed between the end of the wrist grip and the thrust stage. The expander is equipped with an adjustment device that provides the ability to set the pre-compression force of the spring and thereby set the required effort in accordance with the athlete's power capabilities.



Notes: 1 - rod; 2 - thrust rung; 3 - handle; 4 - screw thread; 5 - hand grip; 6 - clamping straps; 7 - compression spring; 8 - adjusting device

Source: compiled by the author

In this design, a metal spring is used as a force elastic element, due to which the wrist expander has stable elastic properties and compact design. In addition, thanks to the possibility of setting the pre-compression of the spring, it is possible to adjust the training effort. Also, the training force can be set by replacing the spring with another one made of wire of a different diameter and a different stiffness characteristic.

5 Conclusion

Taking into account the comprehensive analysis of the object of research, the article proposes its design, which enables achieving the goal of effective training of the hands of athletes-wrestlers.

In this design, the training force is created due to the spring elasticity, which does not require the use of bulky and heavy loads, as with many analogues aimed at training the rotational movement of the brush. Thus, this design will be compact and lightweight, which will allow the athlete to carry it with him and use it not only in the training hall, but also in other places, for example, at home, in the countryside, on the outdoor sports field.

The wrist expander has an unpretentious design and is easy to manufacture. It has the ability to adjust the compression ratio of the spring, which will allow both beginners with a low level of physical fitness and professionals with a high level of physical fitness to use this simulator. In relation to this expander design, an application for a utility model patent was submitted to the Federal Institute of Industrial Property of the Russian Federation in 2021.

Another advantage of this expander is the approximation of the nature of the movement of the hands during training with it to

the movements of the athlete's hands during technical actions during training or a combat with an opponent, which will significantly increase the effectiveness of the training process of "sambo wrestlers", "judoists" and wrestlers of other sports performing technical actions with the capture of the opponent's jacket.

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