

Increase in power striking characteristics via intensive functional training in crossfit.

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Abstract: The study is devoted to the scientific substantiation of the training methods for the athletes and officers of the security forces to improve the effectiveness of kicks. Nevertheless, the analysis of the scientific literature showed that the existing methods of sports training of boxers kick boxers, etc. does not allow you to achieve the necessary impact force. The authors recommend using different methods of intensive functional training based on crossfit to increase the impact strength. The conducted researches have shown that the use of crossfit means allows to increase the force of kicks significantly and reliably performed by hands and legs by the cadets studying in the educational organizations of the Ministry of Internal Affairs of Russia. We determined that the strength of a direct kick with the right and left hand to the head increased significantly. A significant increase in the strength of the kick is noted when performing a side kick with the right leg to the head. Meanwhile, the authors recommend using the methods of intensive functional training crossfit in the training activities of the athletes practicing the martial arts, police and military servicemen.

Key words: combat sports; boxing; strike technique; kicks; power characteristics; training of the officers of the law enforcement agencies; crossfit.

Introduction

It would be unfair not to mention the fact that different types of martial arts: boxing, kickboxing, mixed martial arts, judo, etc. are widely popular in many countries of the world and have millions of fans. Most combat sports are used today not only for training combatants with combat skills but also as effective means of increasing the level of health and physical preparedness of various groups of the population (Chyu, 2010). Moreover martial arts (hand-to-hand combat, combat sambo) are an obligatory component of the special training of police and military specialists (Bakayev, 2015). The wide use of martial arts in various health, applied, sports and other purposes determines the search for new, modern scientific methods of training athletes, law enforcement personnel, military specialists and coaches in combat sports. Besides, the new scientific research should help specialists cope with a number of significant problems present in combat sports. The scientists consider such problems: high traumatism of those who participated, controversial decisions of the judges in competitive fights, poor quality of sports equipment, various aspects of training athletes for competitive fights, etc.

Besides, the problem of frequent injuries in combat sports takes a leading place in research. It is known that the sportsmen of strike sports, first of all are the professional boxers who are the most susceptible sportsmen to the chronic traumatic encephalopathy (Bernick, & Banks, 2013). These neurological consequences of the cumulative brain injury are due to a large number of kicks in the head missed by the athletes in sparring and match for many years of the sports career. The scientists claim the need for comprehensive scientific research on the health of professional fighters of shock style (boxers, kickboxers, representatives of the mixed martial arts). The experts believe that modern professional fighters will necessarily face the risk of developing diseases such as Alzheimer's disease and Parkinson's disease (Bernick, Banks, Phillips, et al., 2013). Despite the fact that numerous admirers of mixed martial arts argue that MMA classes are safer than boxing, athletes risk fractures, muscle and ligament sprains and other injuries. There is a high risk of getting and subdural hematoma which is the most common cause of injury in boxing and kickboxing (White, 2007). However, it is proven that the risk of injury is the greatest among the representatives of classical martial arts and primarily boxers (Pappas, 2007). The

specialists attribute this to the fact that due to the changes in the rules of the competition in amateur boxing, the boxing matches are held in high-speed mode with a lot of dense kicks (Martsiv, 2014).

According to the analysis of the scientific literature reveals a large number of works related to the study and problems of judicial bias and engagement in combat sports (Myers, Balmer, Nevill, et al., 2006). However, the problems of insufficient qualification of the judiciary or erroneous refereeing are observed in almost all types of martial arts. This is due to A. Osipov's opinion, both to the low level of qualifications of judges, to the lack of quality training programs for the judiciary and to the dynamically changing competition rules (Osipov, Kudryavtsev, Iermakov, et al., 2017). Sometimes the changes in the rules are so significant that it is difficult not only for the athletes but also for the judges to adapt to them in a short time.

What is more in the scientific literature there are also studies devoted to the problem of matching sports equipment for kick sports (helmets, gloves, kappas) to the specifics of the modern competitive fights. According to an analysis of the scientific literature reveals a large number of works related to need for research on the development of protective devices for the boxers in order to protect them from perioral injuries which is indicated by A. El-Ashker (El-Ashker & El-Ashker, 2015).

At the same time, it was revealed that the modern martial sports are quite dynamic and intense activities that require a high level of preparedness, special skills and tactical schemes of the athletes to achieve superiority over the enemy. One of the opportunities for the organization of quality training of the athletes is the knowledge of the combat capabilities of an athlete (Silva, Del Vecchio, Picango, et al., 2011). Moreover the studies of physical, physiological and psychological characteristics are associated with age, gender and level of training of athletes specializing in kick sports which are necessary to enrich the current knowledge and create the most effective training programs for the athletes (Slimani, Chaabene, Miarka, et al., 2017).

It is important to note that the research, the authors of the article decided to draw attention to the possibility of purposeful development of the force of kicks being brought against the representatives of combat combatants and servicemen of the law enforcement agencies having clashes with the armed criminals. It is proposed to use the methods of intensive functional training - crossfit to achieve this goal in the training process of training athletes. This type of functional training is quickly gained wide popularity and today is one of the most popular types of physical activity in the population in many countries of the world (Sprey, Ferreira, et al., 2016). Crossfit is the performance of physical exercise complexes of various orientations: running exercises, gymnastics, weightlifting and ballistic exercises. Besides, an important point is that these exercises should be carried out dynamically in the certain series with a limited time allocated for the recovery of the body after each of the series (Glassman, 2007). Individuals who are regularly engaged in cross-training have shown good rates of the muscle growth (Eremin, Volkov, & Seluyanov, 2014). These observations can serve as a basis for the use of cross-training techniques in the process of targeted development of the force of kicks of the athletes practicing in martial sports. Also, the intensive cardio-strength training methods are used today in military and specialized universities of the Russian Federation to improve the quality of physical training for the officers and servicemen of security agencies (Voloskov, & Voloskova, 2014). It is believed that the successful solution of the professional tasks by the law enforcement officers will be based on the level of their physical and special preparedness to counter criminals including the armed. The effectiveness of the performance of duties will determine the professional competence of police officers and other servicemen of special units (Crawley, Sherman, et al., 2016). According to the opinions of some experts, the system of high-intensity is multifunctional exercises - crossfit (Galimova, Kudryavtsev, Glubokiy, et al., 2017) will contribute to raising the level of physical preparedness of officers and servicemen of the security services.

Material & methods

It is clear from these observations that the studies were conducted on the basis of the East Siberian Institute of the Ministry of Internal Affairs of the Russian Federation in 2014–2015. The contingent of the participants of the research is 2 groups of cadets (n=40) 18-19 years old who are studying at the second year course of the university. The participants in the research were selected on the results of passing the control standards for general physical training. The experimental (n=20) and control (n=20) groups were cadets who demonstrated an approximately identical level of development of basic physical qualities. The cadets of the control group (group number 1) had physical training on the basis of a traditional training program. This program included classes for physical and special training (4 lessons per week for 90 minutes) which include combat fighting techniques (2 lessons) and general physical training classes (2 lessons). The cadets of the experimental group (group 2) studied combat techniques in conjunction with the cadets of group 1 and physical training sessions were conducted using the intensive functional training technique - crossfit. Recent scientific research shows that functional training methods are well suited for training athletes practicing in different types of martial arts (Osipov, Kudryavtsev, Gatilov, et al., 2017). The program of crossfit-training of the cadets included strength exercises: the movement with cargo (weights from 16 to 32 kg), transfer of cargo (rubber tires weighing 10 kg, wrestling mannequins weighing 16 kg); the circular training with the use of the weight of your own body (pull-ups, push-ups, jumps, lunges, etc.); the complexes of strength exercises with a barbell and

dumbbells (deadlift, lifting the bar to the chest, standing bar press, squats with a bar, etc. The weight of the shells varied from 20 to 80% of the possible maximum). The time of training by cross-training was 50–60 minutes. The exercises were performed in series of 3–4 exercises in each with a minimum rest interval between them (60–90 seconds).

It would be unfair not to mention the fact that the registration of the force characteristics of the kicks with hands, elbows, knees and legs was carried out with the help of the training complex dynamometer which is a traditional boxing bag which includes an electronic device that allows measuring the basic characteristics of the "EDU KICKTEST 100" developed in the laboratory of sports equipment "Ray Sports Electro". The dynamic characteristics of kick movements were recorded on an electronic board built into the dynamometer. The cadets of both groups carried out strikes from the fighting post with the maximum speed and strength. All cadets used boxing gloves weighing 300 grams each. Each participant selected a convenient distance for the attacks and after the command "Kick" he began striking. To qualitatively determine the force characteristics of the kicks to the participants were given three attempts to apply each type of kick. It should be noted that kicks on the boxing bag are one of the main exercises in the testing of the boxers and other representatives of shock martial arts (Gaskov, & Kuzmin, 2011). Such tests allow specialists to determine a number of characteristics of athletes from the speed-strength indicators of the athletes to the level of development of their general and special endurance (Osipov, Nizhegorodtsev, Ostanin, et al., 2013). The specialists note that boxing bags equipped with electronic sensors for measuring the strength and speed of various impacts are a good diagnostic tool in martial arts (Busko, Staniak, et al., 2016).

Another good thing in our studies is that the statistical analysis of the results of the study was carried out using the program SPSS20. The reliability of differences in the results of the mean values in two interrelated samples was determined using Student's t-test.

Results

One should note here that the results of test tests of the force of direct impact with the right hand to the head, at the beginning of the studies were approximately the same for the cadets of both groups. There were no statistically significant differences between the indices. At the end of the studies, the cadets of the experimental group demonstrated significantly ($P<0,01$) large values of impact strength indicators than the cadets of the control group. At the same time, it should be noted that the cadets of both groups increased the indicators of the force of a direct kick with the right hand to the head in comparison with the beginning of the research. The cadets of group 1 increased the impact force by an average 9 kg and the cadets of group 2 on average 19 kg.

It is well-known facts that testing the strength of the side impact with the right hand to the head at the beginning of the studies did not allow revealing the significant differences between the cadets of the experimental and control groups. At the end of the studies the cadets of group 2 showed a high ($P<0,001$) impact strength values than their peers from group No.1. On average, during the studies the cadets of group No. 1 increased the lateral impact by a right hand to the head by 4 kg and their peers from group No. 2 by 23 kg.

Perhaps we should point out the fact that in our studies the values of the power of the right-hand elbow to the head at the beginning of the studies were only slightly different for the cadets of both groups. After a year of research, the cadets of group No. 2 showed significantly higher ($P<0,001$) elbow impact than group 1 of the cadets. During the year, the cadets of the control group increased their elbow-to-head impact by an average 3 kg and their peers from the experimental group by 18 kg.

Doubtless, the tests to determine the force of a direct impact of the right knee in the body carried out by the authors of the article at the beginning of the research did not allow revealing significant differences in the values of the impact force in the cadets of the study groups. At the end of the research, significant ($P<0,01$) differences in the impact strength in favor of the cadets of group 2 were found. On average, during the year of studies the cadets of the controlled group increased the force of a direct kick by the right knee by 2 kg and the cadets of the experimental group by 16 kg.

Furthermore, when the right leg was struck directly into the body the cadets of both groups did not show any significant differences in the impact strength at the beginning of the study. At the end of the studies, the cadets of group 2 showed significantly higher ($P<0,01$) impact strength than their peers from group No.1. During the research, the strength of a direct impact from the right leg to the body increased by an average on 8 kg in the control group of the athletes and by 17 kg in the athletes of the experimental group.

Besides, at the beginning of the studies the performance by the cadets of a side impact with the right leg to the head did not reveal significant differences in the impact strength in the experimental and control groups. At the end of the study, a significant ($P<0,01$) difference in the impact force in favor of the cadets of the experimental group was found. On average, the cadets of group 1 increased the side impact force by 6 kg and the cadets of group 2 by 14 kg.

The test to determine the strength of a side impact by the right leg to the body, carried out at the beginning of the research, did not show any significant differences in the impact strengths of the cadets of both groups. At the end of the studies, a significant ($P<0,01$) advantage in the impact strength of cadets in group 2

was found. The increase in the impact force during the year averaged 2 kg for the cadets of the control group and 7 kg for the cadets of the experimental group.

The basic statistical values of the impact force of the cadets are shown in Table 1.

Table 1. The force values of the right hand and foot attacks of the cadets at the beginning and at the end of the studies.

Type of kick	On-study	Impact strength (kg)		Criterion	Certainty
		Group №1	Group № 2	t	p
Direct kick to the head	start	197,86±0,63	198,92±0,36	1,47	>0,05
	ending	209,37±2,33	218,54±2,81	2,69	<0,01
Hook by hand to the head	start	205,91±0,37	206,43±0,24	1,81	>0,05
	ending	209,07±2,97	229,61±2,95	5,01	<0,001
Hook by elbow to the head	start	210,47±0,54	211,47±0,37	1,58	>0,05
	ending	213,74±2,24	229,61±2,72	4,51	<0,001
Direct kick by knee to the body	start	269,87±0,29	270,41±0,27	1,38	>0,05
	ending	271,93±3,04	286,32±2,06	2,09	<0,01
Direct kick by leg to the body	start	210,87±0,45	211,92±0,41	1,07	>0,05
	ending	213,31±11,2	224,31±10,6	2,07	<0,01
Hook by leg to the head	start	188,67±0,12	188,93±0,09	1,07	>0,05
	ending	192,39±3,03	205,41±3,51	2,07	<0,01
Hook by leg to the body	start	292,63±0,53	293,78±0,44	1,69	>0,05
	ending	294,41±1,43	301,34±1,37	3,06	<0,01

One must admit that the results of tests to determine the strength of a direct blow with the left hand to the head were practically the same for the cadets of both groups at the beginning of the studies. There were no statistically significant differences in the results. At the end of the studies the cadets of group No. 2 showed significantly higher ($P<0,001$) impact strength than their peers from group No.1. On average, the force of direct impact with the left hand to the head increased for a year by 7 kg in the cadets of the control group and by 18 kg in the cadets of the experimental group.

It should be noted that the tests to determine the strength of a lateral impact with the left hand to the head did not reveal significant differences in the strengths of this impact in the experimental and control groups studied at the beginning of the study. At the end of the studies, a significant ($P<0,01$) advantage in the strength of this impact was found for the cadets of group 2. During the year of research, the indicators of the strength of the side impact by the left hand to the head of the cadets of the control group remained practically unchanged. The impact strength of the cadets of the experimental group increased on average on 4 kg.

The indicators of the lateral impact strength of the left elbow in the head were almost the same for all participants at the beginning of the studies. At the end of the year of research, a significant ($P<0,001$) advantage in the strength of this impact was found for the cadets of group 2. On the average, the indicators of the side impact force with an elbow to the head increased by 3 kg for the cadets of group 1 and for 11 kg for the cadets of group No. 2.

The indices of the force of direct impact by the left knee in the body at the cadets did not vary significantly at the beginning of the studies. At the end of the studies, the cadets of group 2 showed significantly higher ($P<0,01$) impact strengths than their peers from group No.1. It should be noted that the cadets of both groups showed a fairly significant increase in the strength of this strike at the end of the studies. The impact strength increased on average on 52 kg for the cadets of group 1 and 61 kg for the cadets of group No. 2.

Testing the strength of a direct impact of the left leg in the body carried out by the authors did not reveal any significant differences in the strength of this impact among the cadets of both groups at the beginning of the research. After a year of research, the cadets of the experimental group showed significantly higher ($P<0,001$) impact strengths than their peers from the controlled group. On average, during the year of research, the impact force increased on 6 kg for the cadets of group 1 and for 19 kg for cadets of group No. 2.

The indicators of the strength of a side impact by the left leg to the head of the cadets of the experimental and control groups were practically the same at the beginning of the studies. At the end of the studies, the cadets of the experimental group significantly ($P<0,01$) increased the strength of this impact. During the year of research, the cadets of the experimental group increased the impact force by an average on 3 kg and the cadets of the control group could not significantly increase the strength of this strike.

Tests that determine the strength of a side impact of the left leg in the body showed the presence of some advantage ($P<0,05$) in the power characteristics of the cadets of group 2 at the beginning of the research. At the end of the studies, the reliability of the differences in the impact strength parameters increased even more ($P<0,01$). On average, the cadets of group No. 1 increased the force of this strike on 4 kg and the cadets of group No. 2 on 11 kg.

The statistical values of the difference in the impact strength of the cadets are presented in Table 2.

Table 2. The force values of the left hand and leg strikes of the cadets at the beginning and at the end of the studies.

Type of kick	On-study	Impact strength (kg)		Criterion	Certainty
		Group №1	Group №2	t	p
Direct kick to the head	start	156,8±1,09	160,82±1,21	1,37	>0,05
	ending	164,9±2,31	180,37±2,69	4,36	<0,001
Hook by hand to the head	start	179,5±0,75	181,41±0,64	1,42	>0,05
	ending	179,6±0,97	185,39±0,98	4,14	<0,01
Hook by elbow to the head	start	168,9±0,43	169,32±0,41	1,02	>0,05
	ending	170,2±2,02	181,41±2,03	3,46	<0,001
Direct kick by knee to the body	start	183,4±0,91	185,62±0,89	1,27	>0,05
	ending	235,6±2,08	246,06±2,07	2,09	<0,01
Direct kick by leg to the body	start	193,9±0,43	192,08±0,44	1,08	>0,05
	ending	198,4±2,09	209,07±2,06	3,09	<0,001
Hook by leg to the head	start	175,2±0,05	176,21±0,48	1,46	>0,05
	ending	176,4±0,54	179,14±0,51	3,08	<0,01
Hook by leg to the body	start	233,6±1,75	236,08±1,48	1,39	<0,05
	ending	237,2±2,39	247,07±2,88	2,08	<0,01

Discussion

Furthermore, boxing is one of the oldest fighting sports with a lot of scientific research devoted to various aspects of training of the highly professional fighters. The scientists have found that elite boxers should have a high level of cardiorespiratory fitness and well-developed muscle strength both upper and lower extremities. The development of muscle strength of the upper and lower extremities is necessary for boxers to apply a large number of quick and short kicks (Chaabene, Tabben, Mkaouer, et al., 2015). The analysis of the profile of the winners and losers of the athletes in amateur boxing shows that the winners throw an average of 18±11 kicks more than the losing boxers for 3 rounds (Davis, Wittekind, & Beneke, 2013). On average, for one round of combat the boxer throws out 50–70 blows. The most commonly used kicks are direct hits from both hands and

hooks from the front of the boxer (Siska & Brodani, 2016). According to R. Davis, the strategy of achieving victory in modern boxing must necessarily include the imposition of a large number of direct hits from both hands with the highest possible precision and strength (Davis, Connorton, Driver, et al., 2017). In general, the ability of athletes to the maximum number of movements during the conduct of competitive fights is one of the most important indicators necessary to predict their success in various types of martial arts (Podrigalo, Iermakov, et al., 2017). At the same time, there is a shortage of effective technologies for improving the shock action of boxers and representatives of other types of shock martial arts that can help qualitatively evaluate the measurements of various biodynamic characteristics of athletes when they perform shock actions in real time. The specialists propose using electronic dynamic devices to solve this problem (Yakupov, & Stepanov, 2014) in the process of training drummers. According to the scientists researches, all studies related to determining the quantitative and qualitative characteristics of the reaction of various athlete's body systems to loads that somehow model different conditions of competitive activity in boxing are of undoubted scientific interest (Kiprich, & Berinchik, 2015). Studying, analyzing and evaluating the adaptive potential of athletes are essential components of the effectiveness of sports selection and predicting success in sports (Podrigalo, Volodchenko, Rovnaya O, et al., 2017).

Unfortunately, it should be noted that many trainers are not interested in data from the latest scientific research or simply ignore them. A number of specialists build a training process for the training of athletes using either traditional (i.e. obsolete) methods of training or based on one's own preferences (sometimes quite subjective). Only a few elite coaches understand the need for additional research in the field of sports science and the importance of the rapid dissemination of research results in specialized journals (Williams, & Kendall, 2007).

It was revealed that at the present stage of the development of shock martial arts, first of all in boxing, the styles of conducting competitive fights were determined. One of them is the force suppression of enemy resistance due to the strength and power of the strikes being struck. Another style is characterized by a high rate of combat during the entire time of the fight. The experts argue that to achieve high sports results the athletes must combine both styles of fighting (Aksutin, Korobeynikov, 2014) therefore for successful competitive activity the athletes need to increase the strength and power of their strikes.

From these facts, the experts may conclude that the effectiveness of boxing matches depends on the components of power and the speed of blows of boxers. If the boxer is not able to inflict a powerful power kick then the effectiveness of his attacks will be greatly reduced (Ramirez Garcia, Harasymovich, et al., 2010). Using the methods of cross-training will allow those engaged to increase the performance of muscle strength. The studies conducted with the representatives of different types of mixed martial arts (synthesis of kick and throw technique) showed that the use of intensive cardio-strength training contributes to a significant increase in muscle strength and strength endurance (Podrigalo, Iermakov, et al., 2016). It is known that the impact force is significantly increased due to the tension of the muscles of the body participating in the motor action when performing various kicks (Neupokoev, Kapilevich, & Pavlov, 2013). The development of the force of the strikes is an important aspect of the process of qualitative training of the cadets of the MIA universities - future police officers and special unit personnel. It is noted that the curriculum for cadets and officers currently practicing in the educational institutions of the Ministry of the Internal Affairs of Russia for the implementation of combat methods of the combat consists of training in kick activities in the rack (Osipov, Kudryavtsev, Galimova, et al., 2017). This is done to increase the level of special preparedness of the servicemen of law enforcement agencies and special units to confront offenders and criminals actively who are often armed.

It should be specially noted that the use of intensive cardio-strength training methods was carried out by the authors in accordance with scientific recommendations restricting the use of cross-training in the training process. The scientists believe that cross-training should not be used in daily training and it is advisable to allocate special days for this training (Mullins, 2015). At the same time, some specialists conduct classes on the system of cross-training 5–6 days a week or daily (Voloskov, & Voloskova, 2014). In this issue there is some contradiction which will be resolved in the course of further scientific research by the opinion of the authors.

Conclusions

Sum up the scientific research shows that in combat sports primarily in the single combat there are a number of serious problems that limit their development. High level of injuries, conservatism and reluctance of many trainers to use modern scientific developments in the training process of fighters, lack of effective computer technologies used in training athletes adversely affect the sports results and health of individuals engaged in various types of martial arts. However, the solution of these problems will be promoted by research on the use of electronic technological devices that allow assessing the parameters of various biodynamic characteristics of athletes in the training activity of representatives of combat sports quickly and accurately. In addition to, it is also necessary to apply various methods of high-intensity cardio-strength training (crossfit) for a significant increase in the level of the development of muscular strength and special endurance of athletes. Besides, the use of such techniques makes it possible to significantly increase the force of the applied strikes

performed by both hands and legs in a relatively short time period. To draw the conclusion one can say that the authors recommend the use of cross-training in the training activities of sportsmen-representatives of combat sports and in the process of physical and special training of the cadets of the Ministry of Internal Affairs and servicemen of the law enforcement agencies.

Conflicts of interest - If the authors have any conflicts of interest to declare.

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