TENSODYNAMOMETRIC AND SPATIAL-TEMPORAL CHARACTERISTICS OF DEFENSIVE MOVING REACTION OF A LAW-ENFORCEMENT OFFICER IN RESPONSE TO AN ATTACK OF AN ARMED ENEMY

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Annotation. *Purpose:* to examine the tensodynamometric and spatial-temporal characteristics of a law-enforcement officer's defensive movements in response to the moving attacking actions of an offender. To identify the efficient ways how to counter the attack of the enemy armed with the firearms. *Material:* It was surveyed 62 employees of practical units of law enforcement authorities. It was experimented with 15 cadets of Kyiv National Academy of Internal Affairs and 15 employees of Department of the State Guard of Ukraine. *Results:* As a result it was found out that the participants adapted to true-life armed conflicts with the offender. On the basis of the broadened knowledge about the outer indicators of the menace and spatial-temporal characteristics of the movements of the armed enemy it was created the moving behavior of the law-enforcement officer. *Conclusions:* In case of an armed enemy's attack it is recommended to carry out the defensive action lunging aside with the optimum cooperation of supporting reactions and action in response, shooting on account of "muscle memory" of the angle of the pointed gun and the projection of the straight line in accordance with the gun tube, the target and the spatial characteristics.
Key words: armed attack, firearms, armed enemy, law-enforcement officer.

Introduction

In main cases, law enforcement officer shall combat and arrest armed criminals. Specificity of professional functioning puts increased requirements to law enforcement officers' fitness [-2] [1, 3, 6, 7, 8-14].

One of elements of their professional fitness is ability to timely move aside from attack of armed adversary with simultaneous counter-attacking and restricting of adversary's motion potential [3].

Statistic data about deaths and wounds of officers, alongside with cases of their inadequate use of power means prove that there are problems in training of law enforcement officers [3].

The main problem is that future law enforcement officers, trained in compliance with existing program, remain to be not sufficiently adapted to actual armed fights. Absence of theoretical knowledge about external signs of threat in criminal's behavior, space-time characteristics of armed adversary and insufficient level of own motion skills bring to negative results.

Specialists note that extreme conditions of fighting with armed person are characterized by different level of danger and risk of death or health [4, 5, 7]. Conditions of fights with criminals show that it is necessary to have differentiated approach to degree of threat. Considering space-time parameters, psychological state of adversary, in some cases it is necessary to act in advance, using service gun[3], in other cases it is necessary to use martial arts' techniques or do not provoke aggressive actions and avoid combat [4, 15-22]. It is difficult to take decision owing to deficit of time.

Success in training of law enforcement officers for effective functioning in conditions of combat with armed and aggressive criminal depends on methodic of training. Methodic of training shall meet these requirements, be oriented, by sense and content, on acquiring of theoretical knowledge about external signs of threat in behavior of criminal, training of skills of timely physical response with simultaneous fulfillment of effective defense actions and acute gun shooting.

For working out of model of police officer's action it is necessary to carefully analyze peculiarities of movements of both criminal and law enforcement officer during attack and shooting in respond.

Purpose, tasks of the work, material and methods

The purpose of the work is studying of space-time and strain-dynamometric characteristics of law-enforcement officer's movements in respect to attacking movements of criminal.

The tasks:

1. To carry out questioning of officers of practical law enforcement departments, who had to fight with armed criminals.
2. To determine effective means of counter attack of adversary, who is armed with fire arms.
3. Analyze space-time and strain-dynamometric parameters of movements during shooting gun.

For researching of bio-mechanical and space-time characteristics of such kind of shooting we tested group of military cadets, who were trained by the worked out methodic with the help of patented invention.

Main experimental researches were carried out with cadets (n=30) of National academy of home affairs and with military officers of Administration of state security of Ukraine (Kyiv). Processing of data was fulfilled in

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[2] Brutscher B. Waffen und Einsatzmunition der Polizei / von B. Brutscher, C. Baum. – Auflage. – Hilden – 1998. – 360 S.

[3] Internationale Polizei Taktiken und Ausbildungen / von B. Siegfried, F. Hübner. – Auflage. – Stuttgart, 1995. – 238 S.

laboratory of bio-mechanics on the base of Chernigiv national pedagogic university, named after T.G. Shevchenko.

For researching of strain-dynamometric characteristics of responding to adversary's actions we used method of electric strain dynamography. This method helps to determine quantitative characteristics of supporting interactions of officer's body during shooting. With this method we registered efforts, which appear during interaction with support, videlicet value and vector of sportsmen's supporting responses in three inter-perpendicular planes.

Mathematical processing of results permitted to detect a number of indicators, which are characteristic for effective actions of officer.

Results of the researches

In order to find specificities of criminal's behavior, who is armed with fire arm and for researching of effective counter attack we conducted questioning of officers of practical law enforcement departments (n=62), who had experience of using of fire arms in fulfillment of service duties.

Questioning results showed that in fight with armed and aggressive person in 82.3% of situations, police officers did not manage to respond timely, explaining it by confusion and fear of arm.

In 17.7% of dangerous situations, police officers tried to resist attacker. With it, 5.3% of police officers tried to evade line of fire, come closer and use martial arts' techniques or improvised means, analyzing distance to attacker, position of his arm and his psychological state. 12.4% – responded by evading, retreating t6o shelter and using service gun.

In 64.7% of such cases attacker only threatened with arm without using it. In 35.3% criminal shot to police officer, trying to wound him. With it, most of shots were fulfilled without pointing.

Questioning showed that in 79.4% of situations started to use fire arm at distance from 5 to 11 meters; in; 7.2% - at distance from 3 to 5 meters; in 13.4% of situation they did it fat distance above 11 meters.

On the base of analysis of literature sources, questioning results we developed model of adversary's behavior. This model was characterized by combination of space-time and psycho-physical characteristics, which corresponded to parameters of actual criminal. In worked out model of criminal, armed with fire arm, indicator as on moment of using it and shooting was 1.2±0.2 in average that corresponds to adversary's response to appearance of police officer. With such time limits it is practically impossible to timely respond with attacking actions in advance. Only, is police officer first noticed appearance of criminal and determined direct threat to life, he can be ahead of adversary in actions.

Analysis of trajectory of bullets, shot to police officer, was made before researching effective counter-attacking means. On the base of conducted researches and comparative analysis of bullets scattering's (with quick shooting) analysis we determined, within certain period of time, more or less safe zones for police officer.

Considering these zones we established two the most effective means of defense against attack. The first method implies shooting "from belt" without pointing. This method of responding to criminal's armed attack has "preventive" characters, because there is no pointing and optimal angle of arm for acute shot. This method is possible when police officer and criminal noticed each other being with arms in hands. Time of pre-emption is in average 0.4 ±0.1 sec.

The second method of combat with armed adversary is connected with diving aside, creating by this, small target for adversary within safe zone and simultaneous shooting. In such situation deep left (right) side step is fulfilled by diagonal forward at distance of 0.80±0.1meters from initial position. In process of stepping body shall be grouped; it reduces size of "target". Head shall not be bent aside, but be vertically located in respect to criminal that is a compulsory condition of successful shot in answer.

Experienced police officers, who met with such situations, also affirm that the most effective is counter attack in advance or shoot with simultaneous step aside.

Many practices [2, 3] proved that acute shooting from pistol or revolver at short or even long distances is possible without pointing devices. Arm is pointed by space feeling of shooter.

In special literature it is mentioned that shooting without pointing is shooting without visual control with pointing devices. Pointing of arm is carried out at the account of muscular memory, which ensures one and the same position of arm in hand and position of hand in respect to forearm [3].

Psycho-physiological combination of two different by character actions, videlicet: defense with step aside and shot in answer require specially oriented trainings; first of one action and then actions' combination. For effective removal from fire line it is necessary to visually determine the angle of hand with pistol, to analyze and correct own actions.

Multiple repetitions of certain movement, which have one space-time parameters, facilitate formation coordination-muscular sense, which, in interaction with nervous processes, remain unchanged in the form of "muscular memory". Thus, on the base of worked out model of technical action, formation of motion skill takes place. With multiple repetition of movement (taking off pistol from holster), making it ready for shooting, and shooting "from the belt" within one space-time parameters, coordination-muscular senses are formed, which, in interaction with nervous processers, remain unchanged in the form of "muscular memory".

In work [4] authors say that in average time, pent by police officer for taking off pistol from holster, making it ready for shooting and shooting is 2.36 ± 0.19 sec. if officer is sufficiently trained.

Our own experiments showed that mean time for taking off pistol from holster, making it ready for shooting and shooting "from the belt" is reduced up to 1.3±0.17 sec. after multiple repetitions.

During training of shooting without pointing future police officer shall consider own sense during every shot,

analyze accuracy of shooting, insert coordination-power corrections and remember muscular senses with visual projection of straight line at moments of accurate shots; it will facilitate formation of required motion skills [2, 3, 5].

Ability of police officer to determine in due time degree of threat when meeting armed and aggressive person, in combination with skills of shooting without pointing facilitate advantageous position in conditions, preceding armed fight.

Application of method of electric strain dynamography permitted to register the following indicators of responses (see table 1) at moment of shooting without pointing, videlicet: indicator of optimal force of pushing off in respect to vertical axis (F_z max) – 690.6±11.18 N; optimal force in respect to sagittal (F_x max) and frontal (F_y max) axes – 28.2±1.85 N and 13.7±1.16 N accordingly; maximal value of vertical components of support responses, accordingly (F max) (resultant force) –811.7±11.56 N.

Table 1

Mean statistic indicators of support responses at moment of shooting pistol

Strain-dynamography, N	Способи захисних та контратакуючи дій	
	Shooting from the spot, (X±m)	Shooting with stepping aside, (X±m)
F_z max	690.6±11.18	902.3±16.07
F_x max	28.2±1.85	183±6.54
F_y max	13.7±1.16	191.4±5.75
F max	811.7±11.56	980.1±16.29

In case of shooting with step aside we found increase of force indicators (interaction of officer with platform), optimal were: F_z max – 902.3±16.07 N; F_x max and F_y max – 183±6.54 N and 191.4±5.75 N accordingly; F max (resultant) – 980.1±16.29 N.Increasing of these indicators is explained by peculiarities of technique of this action.

Motions, oriented on taking off pistol from holster), making it ready for shooting in average take 0.72±0.1 sec. Step aside before making shoot without pointing takes 1.1±0.14 sec. In general, time for stepping aside from adversary's shot and shooting in answer is in average 1.72±0.68 sec. In respect to adversary's actions police officer manages to step aside from his shot and shoot in answer without waiting for the second adversary's shot.

With shot in answer with stepping aside space-time parameters change in the following way:

- Right-forward step with right leg by 0.43±0.07 meter takes 0.36±0.06 sec. with support response by left leg Fz 902±16, Fy - 183±5.75
- Forward step with left leg by 0.63±0.07 m, left aside by 0.47±0.09 m with squatting takes 0.81±0.09 sec.; support response of right leg is - 980±16N. With exceeding of indicators, i.e. efforts during stepping aside, disorders balance and in general coordination of movements. Besides, reduced indicators of support responses' indicators hinders from defense in due time.

Squatting is characterized by shifting of body mass center, which influences on disordering of coordination. However multiple repetition of such action facilitates formation of skill of its fulfillment, while sharp shifting of body mass center disorders coordination of movements insignificantly.

Conclusions:

On the base of conducted researches we determined specificities of behavior of armed with fire arm criminal at the moment of facing police officer.

We have determined space-time and strain-dynamometric parameters at moment of shooting in answer, which shall be considered when working out model of police officer's technical action.

We have proved that effective means of counter action against adversary's fire attack are in some cases actions in advance, in other cases step aside with simultaneous taking off pistol from holster, and shooting in answer.Main characteristics: stepping aside in optimal regimes of support responses in required time, stable angle of pistol's pointing with the help of "muscles memory" and visual projection of strait line by barrel to target in dynamic of defensive actions.

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