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PROSPECTS FOR THE USE OF A NEW MODEL OF FIRE EXPERIMENTS USING THE COMPLEX "CLOTHING+NON-BIOLOGICAL SIMULATOR OF THE HUMAN BODY"

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Abstract

The practical work of forensic experts directly depends on a solid theoretical foundation, which is provided by scientists working in the field. One such field is forensic ballistics, which is based on the results of experiments, when trying to reproduce the various circumstances of the shot by conducting a series of shots. However, an incorrectly set experiment can distort the obtained data and, as a consequence, the work of practical experts. Therefore, the aim of our study was to search for new data on the organization of ballistic research and, in particular, the possibilities of conducting ballistic research using the complex "clothing+non-biological simulator of the human body" by analyzing literature sources. The results of the analysis showed that there is heterogeneity in the organization of ballistic research in different countries. In addition, the results of some studies indicate that with uniform shots separately into clothing and clothing adjacent to the simulator of the human body, there are different data on its gunshot damage. Thus, there is a need to revise the mechanism of ballistic experiments, namely the creation of a unified scheme that would eliminate the distortion of data in the experiment. The team of authors provides the most important recommendations for improving the organization of ballistic experiments.

Key words: "clothes + human body simulator" complex, experimental model, firearms.

Introduction

Firearms are becoming more common in the world. If before its use was limited to armed conflicts, now with the spread of non-lethal weapons, it has become available to civilians. Thus, in England and Wales from 1998 to 2007, 487 cases of firearms were recorded, which led to injuries. More than 90 % of all cases are recorded in cities and are committed by people aged about 30 years [4]. Sometimes even non-lethal use of firearms is fatal. Guenther T. and co-authors described in their study 39 cases where the use of non-lethal air gun resulted in death by heart injury [6]. Even in the center of a modern European city, there may be simultaneous mass use of firearms of various kinds, as happened in 2014 in Kyiv. In addition to examining fatalities, forensic experts encountered an influx of victims who had various types of injuries caused by combat and non-lethal firearms as well as explosives [9]. In addition, new types of firearms appear every year. All this burden falls on forensic experts, who are forced to use modern knowledge of ballistics to conduct reliable examinations. Replenishment of modern knowledge in this section of forensic medicine is possible only by conducting ballistic experiments. However, the ways of conducting a ballistic experiment are very diverse. Experiments aimed at studying the features of damage to clothing have become widespread [10]. Other studies have evaluated damage caused by simulators of the human body, such as ballistic gel (non-biological simulator of the human body (NBSHB)) [8] or animal corpses (biological simulator of the human body (BSHB)) [12]. However, the study of clothing separately from the imitator of the human body and

vice versa, cannot be objective. Such data can be reliably interpreted only in cases where there is gunshot damage to the naked body or clothing separately. The way out of this situation is to conduct experimental work where there is simultaneous damage to clothing and the imitator of the human body as one complex. However, even in this case it is necessary to take into account a number of other features of the ballistic experiment.

That is why the purpose of our study is to evaluate the methods of ballistic experiments and evaluate prospects for the use of a new model of fire experiments using the complex “clothing+non-biological simulator of the human body” (C+NBSHB).

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Materials and methods

The analysis of scientific literature sources from the databases of Google Academy, Scopus and Web of Science for 2011-2021 is carried out. Publications with clear sections of materials and methods, where research methods are described, as well as with highlighted research results were taken into account. If the section materials and methods was described inaccurately – this was the criterion for excluding the article from the analysis.

Results

In the analysis of literature sources, attention was paid to key points that may affect changes in the results of modeling gunshot wounds. Among such indicators are critical: the location of the experiment (open air or closed shooting range (CSR)), the presence of photo and video recording of the shot and the passage of the bullet through the object of study, information about the fixation of the weapon, data on the condition of the clip (last cartridge or not) as well as the object in which the shot was fired.

The final result of the review of literature sources is presented in table 1.

Publication	Object of study	Weapon fixation	Indication of the cartridge*	Venue	Photo, video recording
Bobkov P. et al 2019 [1]	cotton fabric	used	not conducted	CSR	not conducted
Bobkov PYu. et al 2019 [2]	leatherette	not used	not conducted	CSR	not conducted
Carr D. et al 2014 [3]	C+BShB	used	not conducted	CSR	used
Gunas V. et al 2021 [7]	C+NBSHB	used	not conducted	CSR	not conducted
Gunas VI. et al 2020 [8]	C+NBSHB	used	not conducted	CSR	not conducted
Scherbak BB. 2014 [10]	different types of fabrics	not used	not conducted	CSR	not conducted
Stevenson T. et al 2019 [12]	C+BShB	used	not conducted	CSR	used
Stevenson T. et al 2019 [13]	C+NBSHB	used	not conducted	CSR	used
Swain MV. et al 2014 [14]	gelatin	used	-**	CSR	not conducted
Tsiatis NE. 2021 [15]	gelatin	used	not conducted	CSR	used
von See C. et al 2011 [16]	gelatin	used	-**	CSR	used

Table 1. Methods of conducting ballistic experiments in the articles of the period 2011-2021

Notes: * – which cartridge was fired (last in the clip or not); ** – the design of the weapon did not provide for the presence of several ammunitions.

As can be seen from the table, there is a clear trend towards ballistic experiments in closed, specially adapted facilities (shooting range). In most cases, the object of study is rudder clothing, simulators of the human body, and only in rare cases, clothing and simulator are considered in the experiment as one complex. Weapon fixation in the vise and photo and video recording of shots are used in most studies. However, none of the studies indicated the degree of occupancy of the clip and what cartridge the shot was fired.

Discussion

The lack of a standardized mechanism for conducting ballistic experiments is still an unsolved problem. It is worth noting that for the most part, certain common features that researchers adhere to exist. So, for example, carrying out shootings in special closed rooms, or fixing of position of the weapon (that is not in hands of the person) [2, 3, 12, 13].

Photo and video recording of the shot has long been an integral part of the experiment, especially when it comes to shots through a transparent object (such as gelatin) [3, 13, 15, 16]. This greatly facilitates further calculation and understanding of the nature of the formation of temporary cavities formed during the shot.

But, of particular note are studies in which clothing and imitators of the human body are presented as one complex. Studies performed by Gunas V. [7, 8] showed that in cases of shooting at clothes fixed in the frame, and in cases where the shot is in the same clothes that are adjacent to the simulator of the human body – clothing damage has different properties and sizes. This finding showed that there is a need to revise previous studies that used the classical study scheme (if the study was not intended to examine clothing damage separately from humans).

In addition, it is important to consider the imitation of human skin in such experiments [5], even if the object is of both non-biological [7, 8] and biological origin, but is not represented by a layer of skin [3, 11].

The importance of which cartridge (last or not) with which the shot is fired has already been reported in some Ukrainian publications [7, 10]. This is due to the design features of some weapons, when during the last shot, there is a sharp change in the position of the shutter frame, which in turn affects the features of the damage, especially when it comes to a contact shot [7].

Conclusions

Based on the review of literature sources, it is proposed to unify the model of ballistic experiments as follows:

1. When setting up an experiment that involves the study of gunshot wounds to clothing and/or a simulator of the human body, it is necessary to study the above objects not only separately from each other but also as in the complex ie “clothing+simulator of the human body”. To increase the homogeneity of the results of the shots, the best simulator is non-biological (eg, ballistic gelatin).
2. The ballistic experiment should take into account which cartridge is fired – if the last in the clip, it should be reflected in the study. Shooting with the entire clip is not acceptable in the study.
3. Shots can be fired only if the weapon is in vice with due regard to the angle of the weapon. If possible, a photo or video recording of the shot and the passage of the bullet through the object under study should be performed.

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