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PECULIARITIES OF ADDITIONAL SHOT FACTORS DEPOSITION WHEN FIRING FROM «FORT 9R» AND «FORT 17R» PISTOLS

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Summary. Additional factors of the shot are one of the key pieces of physical evidence that are investigated in the case of a gunshot injury in order to establish the distance and identify the weapon of the shot, as evidenced by the results of numerous scientific works. However, publications related to the study of non-lethal firearms are isolated cases and incomplete both in the world and in the domestic scientific literature.

The purpose of the work is to investigate the deposition of additional factors of the shot on different cover materials and bare blocks, which are imitating the tissues of the human body at different shot distances, using «Fort 9R» and «Fort 17R» pistols.

Material and methods. In order to achieve the goal, 120 gelatin blocks covered with different fabrics or left without a coating were fired. The shooting was carried out using «Fort 9R» and «Fort 17R» pistols. The fired blocks were examined for the presence of soot using a descriptive method and microscopic examination, and subsequently using a chromatographic-mass spectrometric method of examination and infrared microscopy on a combined IR-Fourier spectrometer in order to detect diphenylamine and centralite.

Results. When shooting from «Fort 9R» and «Fort 17R», the deposition of soot was observed at a distance of a shot at close range and 25 cm on all studied blocks, and also when shooting from «Fort 17R» on blocks covered with cotton fabric and in bare blocks, soot was detected microscopically on shot distance 50 cm; diphenylamine and centralite was observed when firing from «Fort 9R» in bare blocks (close and 25 cm) and blocks covered with leatherette (25 cm), while when firing from «Fort 17R» it was detected only at a shot distance of 25 cm on blocks covered with denim fabric.

Conclusions. The presence of clothing and the peculiarities of the material of its manufacture fundamentally change the macro, microscopic and laboratory picture of the deposition of additional factors of the shot at different distances, using the «Fort 9R» and «Fort 17R» pistols, with the exception of the soot deposition when firing from the «Fort 9R» pistol.

Keywords: forensic medical examination; gunshot injury; gunshot wounds; non-lethal weapons; soot; additional factors of the shot; firearm.

Introduction. The use of firearms is the cause of about 10,000 deaths in the United States and is the weapon most often used for murder (68% of murders) [1]. However, within Ukraine, the problem of firearms usage became a reality only in the last decade, which in its turn led to the intensification of scientific research in this direction by forensic experts [2, 3]. One of the key directions in the forensic medical examination of gunshot injuries remains the study of additional factors of the shot, which confidently occupy a central place in solving the key questions of the bodies of inquiry [4, 5]. At the same time, it is important to build the correct model of conducting a ballistic experiment, which will simulate the real situation with the firearms usage as best as possible. One of the factors that is definitely important and is not taken into account in most studies is conducting an experimental study of a human body simulator and clothes separately from each other and not in a complex [6]. Another understudied aspect of ballistics is still non-lethal firearms, which are becoming more and more common in Ukraine. Thus, there is a need to conduct an experimental study of non-lethal firearms on a complex consisting of a human body simulator and clothing samples.

The purpose of the work is to compare peculiarities of the soot deposition and constituent parts of gunpowder on trace-receiving objects represented by non-biological simulators of the human body, covered with different fabric at different shooting distances using «Fort 9R» and «Fort 17R» pistols.

Materials and methods. 120 blocks measuring 30x15x15 cm were produced, according to the Fackler and Malinowski method [7]. In order to comply with the method, a 10% solution of edible gelatin type A 270 Bloom (TM «Junca Gelatines SL», Spain) was used, which was kept for 2 days at a temperature of +4oC. To inhibit the microbial flora, propionic acid was added in the amount of 5 ml/l of the gelatin solution.

Subsequently, 60 blocks were shot with the «Fort 9R» pistol and the remaining 60 blocks with the «Fort 17R» pistol. From the 60 blocks in each firing group, subgroups of 15 units were formed according to the coating, namely: bare blocks, cotton-covered blocks, denim-covered blocks, and leatherette-covered blocks. In each subgroup, gelatin blocks were shot from three shot distances: close range, 25 and 50 cm (that is, 5 blocks for each shot distance). All blocks were covered with a film 200 μm thick to imitate human skin.

9 mm elastic bullets of traumatic effect were used for firing. All studies were conducted on the basis of the Vinnytsia Research Expert Forensic Center of the Ministry of Internal Affairs of Ukraine. Shootings were carried out in the shooting range within 30 minutes from the moment the blocks were removed from the refrigerating chamber with the prior fixing of the gun in the presses.

Blocks with covering material were photographed using a digital camera (camera «Alpha A6000 Sony») before and after the firing, with further examination of the soot deposition both with the unaided eye and by microscopic examination using a stereomicroscope MBS 10 under magnification from 4.8x to 56x. Microscopic examination was used only if the soot was not visible to the unaided eye.

The chromatographic-mass spectrometric research method on the Shimadzu GC-2010 Plus device and infrared microscopy on the combined IR-Fourier spectrometer Nicolet iN10 from «Thermo Fisher Scientific» were used to identify the components of nitrocellulose powder, nitroglycerin and stabilizers – diphenylamine and centralites.

The statistical analysis of the obtained results was carried out in the licensed statistical package «Statistica 6.0» using non-parametric estimation methods. The reliability of the difference in values between independent quantitative values was determined using the Mann-Whitney U-test, and between qualitative values – according to the Weber E. formula:

$$t = \frac{P_1 - P_2}{\sqrt{\frac{N_1P_1 + N_2P_2}{N_1 + N_2} \times \left(100 - \frac{N_1P_1 + N_2P_2}{N_1 + N_2}\right) \times \frac{N_1 + N_2}{N_1N_2}}},$$

where, P_1 and P_2 – the percentages with which one or another indicator met;
N_1 and N_2 – the number of indicators in the studied groups.

Research results and their discussion.

The analysis of *soot* deposition when shooting with *«Fort 9R»* pistol revealed the following features:

when fired *at close range*, both at bare block samples and at samples covered with cotton fabric, denim fabric, and leatherette in all cases, soot deposition was detected with the unaided eye (100% in all cases);

when fired from *a distance of 25 cm*, both at bare block samples and at samples covered with cotton fabric, denim fabric, and leatherette in all cases, soot deposition was detected only when applying a microscopic examination (100% in all cases);

when fired from *a distance of 50 cm*, both the bare block samples and the samples covered with cotton fabric, denim fabric, and leatherette in all cases soot deposition was not detected both macro- and microscopically (100% in all cases).

The analysis of *soot* deposition when shooting *«Fort 17R»* pistol revealed the following features:

when fired *at close range*, soot deposition was detected with the unaided eye on bare blocks and blocks covered with cotton fabric (100% in both cases), and when fired at denim fabric and leatherette, soot was detected in all cases only by microscopic examination (100% in both cases);

when fired from *a distance of 25 cm*, both at bare block samples and at samples covered with cotton fabric, denim fabric, and leatherette in all cases, soot deposition was detected only when applying a microscopic examination (100% in all cases);

when fired from *a distance of 50 cm*, soot deposition was not detected both macro- and microscopically in all cases when fired at denim fabric and leatherette (100% in both cases) and detected only microscopically when fired at bare blocks and blocks covered with cotton fabric (100% in both cases).

A comparison of the peculiarities of soot deposition when shooting with *«Fort 9R»* and *«Fort 17R»* pistols revealed microscopic soot deposition when fired at bare blocks and blocks covered with cotton fabric from *a distance of 50 cm* (100% and 0% in both cases) and denim and leatherette at close range shots (100% and 0% in both cases, accordingly).

An analysis of the indicators of *diphenylamine and centralite* detection when shooting with *«Fort 9R»* pistol revealed the following features:

when firing *at close range*, diphenylamine and centralite were detected in 100% on bare blocks. When firing at blocks covered with different fabrics, diphenylamine and centralite were not detected in any case (0% in all cases);

when fired from *a distance of 25 cm*, diphenylamine and centralite were detected in 100% on both bare blocks and blocks covered with leatherette. When firing at blocks covered with cotton or denim fabrics, diphenylamine and centralite were not detected in any case (0% in both cases);

when fired from *a distance of 50 cm,* diphenylamine and centralite were not detected in any of the fired blocks (0% in all cases);

An analysis of the indicators of *diphenylamine and centralite* detection when shooting with *«Fort 17R»* pistol revealed the following features:

when fired *at close range* and from *a distance of 50 cm,* diphenylamine and centralite were not detected in any of the fired blocks (0% in all cases);

when fired from *a distance of 25 cm*, diphenylamine and centralite were detected in 100% when fired at blocks covered with denim fabric. When firing at blocks covered with other types of fabrics and bare blocks, diphenylamine and centralite were not detected in any case (0% in all cases);

A comparison of the peculiarities of the indicators of *diphenylamine and centralite* detection when shooting with *«Fort 9R»* and *«Fort 17R»* pistols revealed reliably ($p<0.0070$ in all cases) more frequent detection of *diphenylamine and centralite* when fired from «Fort 9R» at close range and from a distance of 25 cm into bare blocks and blocks covered with leatherette at a distance of 25 cm in compare to «Fort 17R» (100% and 0% in all cases) and significantly ($p<0.0070$) more frequent detection of *diphenylamine and centralite* when firing from «Fort 17R» from a distance of 25 cm into blocks covered with denim fabric (100% and 0%, accordingly).

The peculiarities of soot deposition differ from one type of weapon to another and depending on the cartridges used in it. Thus, during the study of the shots using bullets, consisting compact lead cores and a special thick coating (the so-called plated bullet), the formation of a comet-like soot deposition was observed [8].

When shooting with «Fort-12RM» in an experiment with close-range shots at a clothed human torso simulator, the researchers discovered the soot deposition on the reverse side of the investigated fabric in the form of a drop or a candle flame [9].

If we are talking about the distance at which it is possible to determine the soot – then when shooting with «Fort-12RM» at a close range to the cotton fabric fixed in the frame, the deposition of additional factors of the shot around the incoming damage can be detected, but at distances of 25 cm

and 50 cm it is not possible [10]. If «Fort-12» is used under similar experimental conditions, soot is visually detected at a distance of up to 35 cm, but further (from 40 cm) soot is not detected [11].

The specificity of soot deposition on different clothing materials can be traced in other studies. Thus, when shooting with «Fort-17R» at a leatherette fixed in the frame, macroscopically, soot is detected when fired at close range, and at distances of 20 and 50 cm – only microscopically [12]. In this case, the peculiarities of soot deposition differ from those obtained by us in connection with the usage of a specific type of leatherette on a synthetic fabric basis, which is not used for the manufacture of clothing, by the authors of the above study.

Another factor that can fundamentally change the characteristics of soot deposition and must be taken into account during the examination is the use of devices to reduce the sound level of the shot [13].

Although the role of laboratory methods aimed at identifying the components of nitrocellulose (smokeless) gunpowder – diphenylamine and centralite – has decreased since the application of X-ray fluorescence spectroscopy, they are still constant companions of the forensic medical expert in solving forensic issues, which is confirmed by numerous modern publications in scientometric bases [14, 15].

Conclusions. When shooting with «Fort 9R» pistol, the soot deposition was observed at close range macroscopically and 25 cm microscopically, regardless of the block covering material. When shooting with «Fort 17R» pistol, at bare blocks and blocks covered with cotton fabric, soot was determined macroscopically when fired at close range and microscopically at a distance of 25 and 50 cm; when firing at blocks covered with denim fabric and leatherette, soot was detected microscopically when fired at close range and at a distance of 25 cm, it was not detected either by macro or microscopic examination when shooting at a distance of 50 cm.

Diphenylamine and centralite were detected in fired samples of bare blocks at close range and 25 cm firing distance and leatherette-covered blocks at 25 cm firing distance, using «Fort 9R», while when shooting with «Fort 17R» pistol it was detected only at the firing distance of 25 cm in samples covered with denim fabric. In all cases, the frequency of detection of the investigated substances was 100%.

Prospects for further research. In the future, it is planned to investigate the peculiarities of the layering of other additional factors of the shot on the surface of the tracer object, namely, metal microparticles.

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Література

1. Monuteaux MC, Lee LK, Hemenway D, Mannix R, Fleegler EW. Firearm Ownership and Violent Crime in the U.S.: An Ecologic Study. Am J Prev Med. 2015;49(2):207-14. doi: 10.1016/j.amepre.2015.02.008
2. Mishalov VD, Petroshak OYu, Hoholyeva TV, Gurina OO, Gunas VI. Forensic assessment of gunshot injuries in Maidan Nezalezhnosti protesters. Світ медицини та біології. 2019;3(69):118-22. doi: 10.26724/2079-8334-2019-3-69-118-122
3. Змієвська ЮГ, Савка ІГ. Особливості вітчизняного розвитку можливостей судово-медичної діагностики вогнепальних ушкоджень. Судово-медична експертиза. 2021;1:3-10. doi: 10.24061/2707-8728.1.2021.1
4. Mikhailenko OV, Roshchin HH, Dyadik OO, Irkin IV, Malisheva TA, Kostenko YeYa, et al. Efficiency of Determination of Elemental Composition of Metals and their Topography in Objects of Biological Origin Using Spectrometers. Indian J Forensic Med Toxicol. 2021;15(1):1278-84. doi: 10.37506/ijfmt.v15i1.13592
5. Bachinskyi VT, Vanchulyak OYa, Savka IG, Kozlov SV, Zubko MD. Forensic assessment of gunshot injuries using modern optical research methods. Світ медицини та біології. 2020;1(71):159-63. doi: 10.26724/2079-8334-2020-1-71-159-163

6. Гунас ВІ, Неприлюк РГ, Хомук НМ, Товбух ЛП, Рижак ЮВ. Особливості формування тимчасової пульсуючої порожнини при пострілі впритул з пістолета «Форт-12РМ» в одягнутий імітатор людського торса. Судово-медична експертиза. 2020;2:45-52. doi: 10.24061/2707-8728.2.2020.7
7. Fackler ML, Malinowski JA. The wound profile: a visual method for quantifying gunshot wound components. J Trauma. 1985;25(6):522-9.
8. Prahlow SP, Brown TT, Dye D, Poulos C, Prahlow JA. «Comet-tailing» associated with gunshot entrance wounds. J Forensic Sci. 2021;66(3):1154-60. doi: 10.1111/1556-4029.14670
9. Гунас ВІ, Бобков ПЮ, Плахотнюк ІМ, Ольховенко СА, Солоний ОВ. Особливості вогнепальних пошкоджень бавовняного одягу в разі пострілу впритул в імітатор людського торса з пістолета «Форт-12РМ». Теорія та практика судової експертизи і криміналістики. 2021;23(1):175-87. doi: 10.32353/khrife.1.2021.13
10. Bobkov P, Perebetiuk A, Gunas V. Peculiarities of gunshot injuries caused by shots Fort-12RM pistol using cartridges of calibre .45 Rubber. Fol Soc Med Leg Slov. 2019;9(1):44-8.
11. Щербак ВВ. Діагностичні ознаки пострілу із пістолета Форт-12 в межах близької дистанції. Судово-медична експертиза. 2015;1:47-50.
12. Бобков ПЮ, Лебедь МФ, Перебетюк АМ, Гунас ВІ. Судово-медична характеристика вогнепальних пошкоджень шкірозамінника при пострілах із пістолета «Форт-17Р». Буковинський медичний вісник. 2019;23(2):51-6. doi: 10.24061/2413-0737.XXIII.2.90.2019.33
13. Бондар ВС. Сліди близького пострілу з деяких зразків вогнепальної стрілецької зброї, оснащеної пристроями зниження рівня звуку пострілу. Часопис Академії адвокатури України. 2013;21(4):1-7.
14. Hofer R, Wyss P. The use of unburned propellant powder for shooting-distance determination. Part II: Diphenylamine reaction. Forensic Sci Int. 2017;278:24-31. doi: 10.1016/j.forsciint.2017.06.022
15. Kaur J, Sodhi GS. Forensic importance of gunshot residue analysis: A review. Int J Med Toxicol Leg Med. 2022;25(1-2):14-21. doi: 10.5958/0974-4614.2022.00004.3

References

1. Monuteaux MC, Lee LK, Hemenway D, Mannix R, Fleegler EW. Firearm Ownership and Violent Crime in the U.S.: An Ecologic Study. Am J Prev Med. 2015;49(2):207-14. doi: 10.1016/j.amepre.2015.02.008
2. Mishalov VD, Petroshak OYu, Hoholyeva TV, Gurina OO, Gunas VI. Forensic assessment of gunshot injuries in Maidan Nezalezhnosti protesters. Svit medytsyny ta biolohii. 2019;3(69):118-22. doi: 10.26724/2079-8334-2019-3-69-118-122
3. Zmiievs'ka YuH, Savka IH. Osoblyvosti vitchyznianoho rozvytku mozhlyvostei sudovo-medychnoi diahnostyky vohnepal'nykh ushkodzhen' [Features of the national development of possibilities forensic diagnostics of the gunshot injuries]. Sudovo-medychna ekspertyza. 2021;1:3-10. doi: 10.24061/2707-8728.1.2021.1 (in Ukrainian)
4. Mikhailenko OV, Roshchin HH, Dyadik OO, Irkin IV, Malisheva TA, Kostenko YeYa, et al. Efficiency of Determination of Elemental Composition of Metals and their Topography in Objects of Biological Origin Using Spectrometers. Indian J Forensic Med Toxicol. 2021;15(1):1278-84. doi: 10.37506/ijfmt.v15i1.13592
5. Bachinskyi VT, Vanchulyak OYa, Savka IG, Kozlov SV, Zubko MD. Forensic assessment of gunshot injuries using modern optical research methods. Svit medytsyny ta biolohii. 2020;1(71):159-63. doi: 10.26724/2079-8334-2020-1-71-159-163
6. Hunas VI, Nepryliuk RH, Khomuk NM, Tovbukh LP, Ryzhak Yu V. Osoblyvosti formuvannia tymchasovoi pul'suiuchoi porozhnyny pry postrili vprytul z pistoleta «Fort-12RM» v odiahnutyi

imitator liuds'koho torsa [Features of formation of a temporary pulsating cavity at a contact shot from the «Fort-12RM» pistol in the dressed simulator of a human torso]. Sudovo-medychna ekspertyza. 2020;2:45-52. doi: 10.24061/2707-8728.2.2020.7 (in Ukrainian)
7. Fackler ML, Malinowski JA. The wound profile: a visual method for quantifying gunshot wound components. J Trauma. 1985;25(6):522-9.
8. Prahlow SP, Brown TT, Dye D, Poulos C, Prahlow JA. «Comet-tailing» associated with gunshot entrance wounds. J Forensic Sci. 2021;66(3):1154-60. doi: 10.1111/1556-4029.14670
9. Hunas VI, Bobkov PIu, Plakhotniuk IM, Ol'khovenko SA, Solonyi OV. Osoblyvosti vohnepal'nykh poshkodzhen' bavovnianoho odiahu v razi postrilu vprytul v imitator liuds'koho torsa z pistoleta «Fort-12RM» [Specifics of fire damage to cotton clothing while shooting point-blank at a human torso simulator from a Fort-12RM pistol]. Teoriia ta praktyka sudovoi ekspertyzy i kryminalistyky. 2021;23(1):175-87. doi: 10.32353/khrife.1.2021.13 (in Ukrainian)
10. Bobkov P, Perebetiuk A, Gunas V. Peculiarities of gunshot injuries caused by shots Fort-12RM pistol using cartridges of calibre .45 Rubber. Fol Soc Med Leg Slov. 2019;9(1):44-8.
11. Scherbak VV. Diahnostychni oznaky postrilu iz pistoleta Fort-12 v mezhakh blyz'koi dystantsii [Diagnostic features of a shot from a Fort-12 pistol at close range]. Sudovo-medychna ekspertyza. 2015;1:47-50. (in Ukrainian)
12. Bobkov PIu, Lebed' MF, Perebetiuk AM, Hunas VI. Sudovo-medychna kharakterystyka vohnepal'nykh poshkodzhen' shkirozaminnyka pry postrilakh iz pistoleta «Fort-17R» [Forensic characteristics of damages to artificial leather caused by gunshots from a «FORT-17R» pistol]. Bukovyns'kyi medychnyi visnyk. 2019;23(2):51-6. doi: 10.24061/2413-0737.XXIII.2.90.2019.33 (in Ukrainian)
13. Bondar VS. Slidy blyz'koho postrilu z deiakykh zrazkiv vohnepal'noi strilets'koi zbroi, osnaschenoi prystroiamy znyzhennia rivnia zvuku postrilu [Short distance shoot's traces from some patterns of firearm fitted with instruments of reducing the level of shoot's sound]. Chasopys Akademii advokatury Ukrainy. 2013;21(4):1-7. (in Ukrainian)
14. Hofer R, Wyss P. The use of unburned propellant powder for shooting-distance determination. Part II: Diphenylamine reaction. Forensic Sci Int. 2017;278:24-31. doi: 10.1016/j.forsciint.2017.06.022
15. Kaur J, Sodhi GS. Forensic importance of gunshot residue analysis: A review. Int J Med Toxicol Leg Med. 2022;25(1-2):14-21. doi: 10.5958/0974-4614.2022.00004.3

ОСОБЛИВОСТІ ВІДКЛАДАННЯ ДОДАТКОВИХ ЧИННИКІВ ПОСТРІЛУ ПРИ ПОСТРІЛАХ З ПІСТОЛЕТІВ «ФОРТ 9Р» ТА «ФОРТ 17Р»

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Резюме. Додаткові чинники пострілу є одним з ключових речових доказів, які досліджують у випадку вогнепальної травми з метою встановлення відстані та ідентифікації знаряддя пострілу, що засвідчено результатами численних наукових робіт. Проте публікації, що стосуються дослідження нелетальної вогнепальної зброї, є одиночними і неповними як у світовій, так і у вітчизняній науковій літературі.

Мета роботи – дослідити відкладання додаткових чинників пострілу на різних матеріалах покриву та голих блоках, що імітують тканини тіла людини на різних відстанях пострілу при застосуванні пістолетів «Форт 9Р» та «Форт 17Р».

Матеріал і методи. З метою досягнення поставленої мети проведено відстріл 120 желатинових блоків, покритих різними видами тканин або залишені без покриття. Відстріл

проводили з застосуванням пістолетів «Форт 9Р» та «Форт 17Р». Відстріляні блоки досліджували на предмет наявності кіптяви з застосуванням описового методу та мікроскопічного дослідження і в подальшому з застосуванням хромато-мас-спектрометричного методу дослідження та інфрачервоної мікроскопії на суміщеному ІЧ-Фур'є спектрометрі з метою виявлення дифеніламіну та централіту.

Результати. При пострілах з «Форт 9Р» та «Форт 17Р» накладання кіптяви спостерігається на відстані пострілу впритул та 25 см на всіх досліджуваних блоках, а також тільки при пострілах з «Форт 17Р» у зразки, покриті бавовняною тканиною, та у голі блоки кіптяву виявляли мікроскопічно на відстані пострілу 50 см; дифеніламін та централіт спостерігався при пострілах з «Форт 9Р» у голі блоки (впритул та 25 см) та блоки, вкриті шкірозамінником (25 см), у той час, як при пострілах з «Форт 17Р» виявляли тільки на відстані пострілу 25 см на зразках, вкритих джинсовою тканиною.

Висновки. Наявність одягу та особливості матеріалу його виготовлення докорінно змінюють макро-, мікроскопічну та лабораторну картину відкладання додаткових чинників пострілу при різних відстанях пострілу з використанням пістолету «Форт 9Р» та «Форт 17Р», за винятком відкладання кіптяви при пострілах з пістолету «Форт 9Р».

Ключові слова: судово-медична експертиза; вогнепальна травма; вогнепальні ушкодження; нелетальна зброя; кіптява; додаткові чинники пострілу; вогнепальна зброя.

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