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**Forensic Medical Peculiarities of Skin Damage Caused by a Large-Caliber Bullet Cartridge of Traumatic (Non-Lethal) Action “Teren-12P”**

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**Keywords:** gunshot wound; a device for shooting bullets filled with elastic kinetic-energy projectiles of traumatic (non-lethal) action; “Teren-12P” cartridge; elastic bullet of traumatic (non-lethal) action; morphological features of bodily injuries; specific ring-shaped bruise

**Abstract.**

The limitation of the database on the properties of the bullet cartridge of traumatic (non-lethal) action 12-gauge “Teren-12P” as well as the nature and peculiarities of injuries caused by it can lead to certain difficulties in the conduction of the complex forensic examinations when investigating their wide-scale use. Using pig skin and ballistic clay experimental shots from shotgun “Fort-500M” using bullet cartridge “Teren-12P” from a distance of 15 m were carried out. The obtained data were compared with the available clinical and morphological data when observing the course of damage to the human hip formed under the same conditions. During the experimental studies morphological features of typical skin damage caused by the action of elastic “Teren-12P” bullet cartridges as well as the features of the process of wound healing were established. It is of great relevance for both forensic experts and medical personnel of healthcare facilities, as detailed and qualitative description of the nature of these damages in medical records allows obtaining more complete forensic information when conducting forensic examinations.

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**Problem statement and analysis of the recent research**

The use of the devices for shooting bullets filled with elastic kinetic-energy projectiles of traumatic (non-lethal) action by the law enforcement agencies particularly when terminating group violations of public order, or mass disorders, usually causes a wide resonance in the society. Although the kinetic non-lethal weapons are a valid alternative to classic firearms, bullets of traumatic action in some cases can lead to serious injury, disability or even death. The increase in the number of such cases leads to further escalation of the conflict with the relevant socio-political consequences.

Different countries use more than 75 types of large-caliber projectiles of traumatic (non-lethal) action. Depending on the design features and shape of the contact surface of the bullet, shooting distance, muzzle velocity and angular velocity of the bullet, anatomical location of the injured bodily area, layers of clothing and its features, etc., quite specific (pathognomonic) damage to the skin integument can develop.

A number of foreign experts, who examined the victims being damaged by various kinds of large-caliber bullets of traumatic (non-lethal) action during clashes with the police, reported the presence of specific skin injuries. If the main part of the bullet hit the body – ring-shaped or circular abrasions with contour bruise (intradermal hemorrhage) at the periphery were formed; if the lateral portion of the bullet surface hit the body - abrasions and bruises reflecting the imprint of the lateral projection of the bullet were formed [1-5]. French scientists, who have studied the features of skin injuries caused by shots with soft 44 mm rubber bullets Flash-Ball® (Verney-Carron, France), noted that upon contacting the skin the bullet forms a typical “cockade” bruise [6, 7].

The mechanism of formation of specific damage due to the effects of elastic bullets of traumatic (non-lethal) action has been studied in detail in the specialized scientific works of Ukrainian and foreign researchers [8-10].

Currently, the law enforcement authorities of Ukraine use the pump action smoothbore shotgun of 12/76 mm caliber "Fort-500" to carry out service and combat missions. The only certified bullet cartridges of traumatic action intended for shooting from the above mentioned and other smooth-bore shotguns, are 12-gauge cartridges “Teren-12P” (TC U 29.6-19485052-014-2002), which are manufactured by RPE “Ekolog” (Kyiv). Although these cartridges are in service of the law enforcement agencies for quite a long time, the limitations of the corresponding database on the properties of their bullets, and the nature and characteristics of injuries they may cause, can lead to certain difficulties in the conduction of complex forensic examinations at a high scientific level when investigating their wide-scale use.

The objective of the research was to determine the morphological features of typical skin damage caused by the action of elastic "Teren-12P" bullet cartridges with shots from 12-gauge shotgun "Fort-500M".

**Materials and methods**

Cartridge “Teren-12P” has a length of 6.4±0.1 cm and a diameter of 2.3±0.2 cm. The cartridge is loaded with elastic pulley-shaped bullet, a felt wad, two cardboard spacers, powder charge and primer, which are connected to one unit via the shell. Shell body is made of a polymeric material of white colour; its base is made of steel coated with yellow brass attracted by a magnet. Elastic bullet having a mass of 8.46±0.13 g is made of polymeric material - copolymer on the basis of polypropylene (containing Cl, Ca, Sc, Zn, Sr, Zr, Pd, Sn as impurities) plasticized with phthalates (dioctylphthalate) with addition of aluminum powder (4-6% of its mass). The density of the bullet material is 1.256 g/cm³. Marking symbol “TEREN P” is in the front face circumferentially. Bullet is a pulley-shaped axially symmetric body of gray colour with a dull silver sheen. The bullet length is of 3.5±0.1 cm, diameter of its cylindrical portion is 1.8±0.1 cm. Bullet has steadying bands, which
are located on the main and cylindrical portions. The front (main) part of the bullet has a disk-like shape, which is attached to the cylindrical portion via a cylindrical shaped transition section in the form of truncated cone. General view of the cartridge of traumatic (non-lethal) action 12-gauge “Teren-12P” and elements of its equipment is presented in Fig. 1.

According to the manufacturer the bullet velocity at a distance of 3.5 m from the muzzle of the gun is 140±20 m/s.

![General view of the cartridge of traumatic (non-lethal) action 12-gauge “Teren-12P” and elements of its equipment](image)

To determine the damaging properties of the bullets of these cartridges experimental shots from pump shotgun “Fort-500M” at a right angle from a distance of 15 m using targets in the form of pig (the large white) skin fragments with subcutaneous fat being about 22×16 cm in diameter and 1.8-2.8 cm in thickness. Fragments were secured on blocks of ballistic clay “Beschussmasse, 6287156” (Carl Weible KG, Germany) certified by the European Committee for Standardization of ballistic studies (ISO 14876-2:1999). The skin had been previously treated with hot steam and the bristles were removed, which allowed eliminating their impact on the mechanism of damage formation. The obtained data were compared with the available clinical and morphological data when observing the course of damage to the human hip caused by the shot of the shotgun “Fort-500M1” using bullet cartridge “Teren-12P” at an angle close to right, from a distance of about 15 m. This distance was chosen as “limited” to the minimum range for firing these bullets allowed by the manufacturer - 20 m. Any therapeutic measures aimed at accelerating the healing of damaged hip (local therapy et al.) were not performed.

**Results and discussion**

In experimental shots from a distance of 15 m on the pig skin damage in the form of a stamp impression was formed with further formation of disc-shaped indentation of the skin having a diameter of 2.1-2.2 cm and a depth of 0.7-1.0 cm at the bottom of which there was detected a round portion 1.8 cm in diameter with relatively smooth ring-shaped contour in the form of linear skin disruption arranged circularly to the subcutaneous fat having a width of 0.1-0.2 cm and a depth of 0.5-0.7 cm the outer epidermis of which was stratified. On the background of this area there were observed multidirectional skin tears having predominantly linear shape, a depth of 0.3 cm (Fig. 2, 3). In a living person immediately after firing with bullet cartridge “Teren-12P” from a distance of about 15 m in the outer surface of the thigh at the level of the upper third coated with a thin layer of fabric made from cotton close-meshed jersey, injures in the form of stamp impression were observed with further formation of round blue and purple bruise 1.8 cm in diameter, on the

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background of which, predominantly on the right, superficial oval and linear wounds with relatively smooth edges appeared, which sometimes merged together.

Fig. 2. Nature of damage to pig skin when fired from a distance of 15 m

Fig. 3. Nature of damage to pig skin when fired from a distance of 15 m (Mg 8x0.6x)

The outer contour of the stamp impression visually represented a superficial ring-shaped bleeding wound 0.1-0.2 cm in width with relatively smooth edges. At a distance of 0.9 cm from the top and on the left from the ring-shaped wound there was an additional damage in the form of surface arc-shaped wound turning its concave surface toward the outer contour of the above-mentioned ring-shaped wound 1.2 cm in length and 0.3 cm in width with relatively smooth edges and wet surface (Fig. 4). When examining the injuries 24 hours after their formation, it was found that the surface of the wound was covered with dark and light brown crusts, which were slightly below the level of the skin and bruise which was at the center of the stamp impression, changed its colour to light pink. However, outward from the stamp impression a ring-shaped bruise was formed that circularly consisted of three zones (layers) of skin colouration: directly around the ring-shaped wound there was observed the area of light pink colour having a width of 0.7-1.2 cm with a relatively smooth external contour; outwards from it there was the second area of purple red colour having non-uniform width of 0.7-3.0 cm with predominantly radially arranged subcutaneous linear and band-like hemorrhages sometimes blending with each other; at the periphery there was located the third zone of light purple colour having a width of 0.5-1.0 cm with wavy, sometimes in the form of "radial radiance" outer contour. The ring-shaped bruise was weakly expressed on the right (Fig. 5).

When examining the injuries 5 days after their formation, it was found that wound surface was covered with dense dark and light brown crusts that were above the level of the skin with whitish areas of epidermis detachment and ring-shaped pink skin colouration peripherally. The ring-shaped bruise around the print impression spread and changed its colour: the area immediately around the wound changed colour from light pink to light yellow and spread to 1.5-2.0 cm, and the areas outwards from it became more sparse, their uneven nature, however, preserved. On the background of light yellow skin colouration in the area of irregular round form 11x10 cm in size with weak blurred contour, light red and light red-purple colouration was observed inside and intermitting areas of light purple colour were observed outside. The inner edge of the ring-shaped bruise remained relatively smooth, and the outer one was wavy (Fig. 6).
Subsequent dynamic inspections revealed that on the 6\textsuperscript{th}-7\textsuperscript{th} days yellow colour was observed only at the periphery of the ring-shaped bruise, which at that time consisted of three zones changing circularly from the center to the periphery having light red, light purple and light yellow colour, respectively.

The area located directly around the stamp impression had normal skin colouration, spread gradually and on the 9\textsuperscript{th}-10\textsuperscript{th} days was 10.0-10.5 cm in diameter; the bruise zones outside were slightly light yellow and red up to 2 cm in width with irregular blurred inner and outer contours. On the 13\textsuperscript{th}-14\textsuperscript{th} days the ring-shaped bruise consisted of single foci of light red and yellow skin colouration being arranged peripherally from the center of the ring-shaped wound. On the 15\textsuperscript{th}-16\textsuperscript{th} days the ring-shaped bruise was not defined. The crusts covering the stamp impression fully exfoliated on the 24\textsuperscript{th} day after injury formation. When examining the injuries on the 70\textsuperscript{th} day after formation of skin injury there were detected two round and arc-shaped scars being formed in the areas of wound healing. Scars were pink, soft and movable, not sealed to the underlying tissues, had a smooth brilliant surface with whitish scales of epidermis detachment and relatively smooth contours. Moreover, round scar had more intense red colour in the area of the outer ring-shaped contour (Fig. 7).
The results of the above-mentioned studies have shown that when firing from a distance of 15 m at a right angle bullet cartridge "Teren-12P" upon contacting the skin forms specific damage in the form of the stamp impression with the ring-shaped bruise at the periphery. Flat front face of the main part of the bullet affects the skin like the end of the cylinder, i.e., round stamp. The formation of superficial wounds on the background of the stamp impression in the thigh of a living person in this case is likely to be caused by a slight deflection of the main part of the bullet from the vector trajectory. As a result, predominantly right lower part of bullet front face contacted the skin surface of the thigh. In further deflection of the bullet to the left and upwards the rib of the cylindrical portion of the bullet contacted the skin surface resulting in additional damage in the form of surface arc-shaped wound.

**Conclusions**

1. The obtained results are consistent with those obtained by foreign experts concerning the possibility of the formation of specific damage to skin surface caused by elastic large-caliber bullets of traumatic (non-lethal) action. In combination with other expert researches it allows us to establish the fact of using weapons (devices) of traumatic (non-lethal) action, shooting distance, as well as to identify the bullet type etc.

2. Morphological features of injuries that may be caused during clashes with the police are of great relevance for both forensic experts and medical personnel of healthcare facilities (surgeons, trauma specialists). A detailed and qualitative description of the nature of these damages, their localization, size, etc., in medical records allows obtaining more complete forensic
information when conducting forensic examinations in criminal proceedings or civil actions for police officer’s actions.

3. During the initial medical examination of victims when providing medical care, conducting forensic examinations, etc., it is advisable to take pictures or video with any available equipment, as well as to use a ruler or colour scale and in their absence – to apply small items of standard size being widely used in everyday life (coins, a box of matches, etc.) in order to get visual information on the nature of injuries, their features and dimensions.

4. During the examination and treatment of victims being damaged during social conflicts, medical personnel of any healthcare facility should take all possible measures for the preservation of bullet shells, clothing, shoes, etc., which can be used during the investigation as material evidence.

References