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Fatal gunshot trauma from a homemade weapon: case report

Deyana Velkova

Department of General and Clinic Pathology, Forensic Medicine and Deontology Medical University – Varna

* Corresponding author e-mail: deyana.velkova@mu-varna.bg

Injuries from homemade firearms are extremely rare in forensic practice and they present some difficulties due to the variety of injuries that can be observed on the victim's body. This paper presents a forensic case of suicide involving a 46-year-old male. Adjacent to the body was found an object resembling a firearm. During the external examination of the corpse, two deep slit-like wounds were observed at the corners of the mouth and communicated with the oral cavity. In the area of the soft palate, an irregularly shaped defect was noted. Tracing the defect revealed a wound tract extending into the cranial cavity with several damaged structures. The wound tract terminated within the occipital bone, where a metallic projectile was discovered. This forensic case underscores that homemade firearms can be as dangerous as factory-manufactured ones and the characteristics of the injuries they cause are of significant importance to all forensic practitioners.

Key words: homemade firearm, gunshot, suicide

Introduction

Injuries from homemade firearms are extremely rare in forensic practice. These cases present some difficulties for both ballistics specialists and forensic pathologists, due to the variety of injuries that can be observed on the victim's body. In most cases, injuries from homemade weapons significantly differ from those of typical, factory-made firearms [11, 12].

Injuries caused by firearms depend on a number of factors – the type of weapon (including factory-made, modified, homemade, etc.), the ammunition used and its characteristics, the distance of the shot, the materials through which the bullet passes and the location of the gunshot wound on the body itself, etc. In general, firearm injuries can be divided into three groups: blind injury, in which there is an entrance wound

and a wound tract, at the bottom of which the projectile settles; penetrating injury, in which there is an entrance wound, a wound tract and an exit wound; tangential injury, in which the projectile passes along the surface of the body without penetrating deep [1, 2, 9, 11, 12, 20].

Usually, the characteristics of the entrance wound, as well as the presence/absence of the associated products of the firearm discharge (and their effect on the tissues), are of essential importance for an approximate determination of the distance of the shot. In most cases of firearm injury caused by a manufactured weapon, the entrance gunshot wound is round or oval in shape, with a lack of tissue in the center, and often has an abrasion ring on the edges, which is the result of the skin being stretched by the projectile while simultaneously rubbing the edges of the wound. At close-range and contact shots, components such as soot, unburned gunpowder and metal particles, as well as other accompanying products, are usually found around or in the entrance wound. In contrast, at long-range shots, there is no deposition or effect of the associated products, and only the projectile damages the tissues [1, 2, 9].

The associated products of the shot (flame, explosive gases, soot, unburned gunpowder, metal particles and other residues) have an additional mechanical, thermal, and chemical effect on the tissues. For example, the gases released during the shot (for contact or close-range distance) can have a mechanical effect on the entry wound, leading to lacerations at its edges, especially when there is bone under the skin. In the case of a gunshot wound with a muzzle placed in the mouth, similar lacerations of the soft tissues of the oral cavity are commonly observed [11,12].

Another factor that plays a significant role in tissue damage is the phenomenon of the temporary (pulsative) cavity. When the projectile reaches the contact surface (skin) and penetrates into the depth, part of its kinetic energy is transferred to the surrounding tissues in the vicinity of the permanent cavity, thus obtaining a temporary cavity, characterized by a rapid change from positive to negative pressure. This, in turn, also leads to additional damage (destruction) to the tissues surrounding the projectile tract [1, 2, 20].

Homemade firearms can also cause injuries that have the elements of a firearm (an entrance wound with a defect with a lack of tissue and an abrasion ring, a permanent cavity (wound channel) and destructive changes from the temporary cavity, etc.), but they can often cause changes that resemble other types of trauma, such as injuries from hard, blunt objects. In this sense, a thorough forensic examination plays a leading role in the investigation of the incident [11, 12].

Case Description: This paper presents a forensic case of suicide involving a 46-year-old male discovered deceased in his residence. Adjacent to the body was found an object resembling a firearm. Closer examination revealed that the object consisted of a wooden board with an attached metal tube. The tube exhibited a wide opening with a diameter of approximately 1.5 cm at one end and a narrower opening measuring 2–3 mm in diameter at the opposite end. Additionally, empty matchboxes were located in the immediate vicinity of the corpse.

The body was found seated on a bed with the back resting against the wall, the head bent forward, and the lower limbs flexed at the hip and knee joints with the feet in contact with the floor. The upper limbs were positioned in a relaxed state alongside the torso, with a lighter observed in the right hand. The skin on the left hand exhibited extensive staining with soot. Blood staining was prominently noted on the anterior surface of the

clothing, originating from the facial region. Examination of the mouth and nose revealed significant deformation of the soft tissues and substantial blood staining**.**

The body of the deceased was transported to the Clinic of Forensic Medicine at the Saint Marina University Hospital – Varna for a forensic autopsy. Before the examination of the corpse was initiated, forensic specialists from the police department collected and documented all trace evidence from the clothing and body for ballistic testing and took standard photographs of all evidence. Autopsies at the Saint Marina University Hospital – Varna, including the present forensic case, are performed in accordance with the guidelines outlined in Recommendation No R(99)3 of the Council of Europe Committee of Ministers [13]. In cases of gunshot injuries, special attention is given to the following aspects: detailed description and localization of each wound according to the main anatomical points and their location in relation to the lowest point of the legs; morphological description of the injuries, noting the presence/absence of the characteristic elements of the gunshot wound (shape, presence of a defect with lack of tissue, abrasion ring, bullet wipe, muzzle mark, etc.); description of the presence/absence of associated products of the firearm discharge and assistance to the forensic experts in taking the relevant samples; layer-by-layer dissection of the tissues underlying the gunshot wounds along the wound tract to determine its direction and identification of traumatic changes in the affected tissues.

In the present case, during the external examination of the corpse, two deep slit-like wounds with irregular edges were observed at the corners of the mouth. These wounds extended to and communicated with the oral cavity. Additional, smaller wounds of similar appearance were identified on both the skin and mucosal surfaces of the lips. The oral cavity was filled with blood, and the mucous membranes exhibited extensive staining with soot. The tongue also displayed soot and exhibited multiple slit-like lacerations on its anterior portion, some of which penetrated its entire thickness. The edges of these lacerations were uneven, bruised and covered with soot. In the area of the soft palate, an irregularly shaped defect was noted, characterized by tissue loss with dimensions around 1.1×1.5 cm (after slight stretching of the tissue) and extensive hemorrhagic bruising in the surrounding tissue with a diameter around 3.5 cm. Some parts of the edges of the defect were irregularly abraded and markedly bruised, and were covered with soot.

During the internal examination of the corpse, multiple traumatic injuries were identified in the head region. Both the upper and lower jaws were fractured into several fragments with significant displacement of the bone pieces. Tracing the defect through the soft palate revealed a wound tract (permanent cavity) extending into the cranial cavity. The tract traversed several critical structures, including: the clivus of the occipital bone with an irregular defect measuring approximately 1.8×2.5 cm on the outer bone plate and around 1mm larger on the inner plate (only on a part of the defect) and a corresponding rupture of the adjacent dura mater (**Fig. 1)**; irregular damage to the brain structures – the pons and medulla oblongata, the fourth cerebral ventricle, and the cerebellar vermis with destruction of the brain substance and severe hemorrhages on the walls of the permanent cavity **(Fig. 2).** The tract terminated medially within the occipital bone, slightly above the protuberantia occipitalis interna. At this site, an irregularly shaped fracture of the inner bone plate with mild depression was observed, while the outer plate remained intact. This fracture was with dimensions around 3.5/4 cm. Within this area, a metallic projectile was discovered. The object was

cylindrical in shape, measuring approximately 3 cm in length and 1.5 cm in diameter **(Fig. 3).** No additional traumatic injuries were observed elsewhere on the body, and no pathological changes were identified in other organs. The cause of death was determined to be extensive brain damage resulting from a gunshot wound to the head. This injury was deemed incompatible with life due to the destruction of vital brain structures along the projectile's trajectory.

Fig. 1. The defect on the clivus of the occipital bone.

Fig. 2. The injury of the brain structures – pons, medulla oblongata, fourth cerebral ventricle, cerebellar vermis.

Fig. 3. The metallic projectile discovered in the area of the occipital bone.

Discussion

Under the Law On Weapons, Ammunition, Explosives and Pyrotechnic Articles in force in the Republic of Bulgaria, firearms are defined as weapons capable of discharging a bullet or projectile through the action of an explosive substance [6]. The literature describes numerous cases of injuries caused by weapons that mimic the effects of firearms [5, 7, 16, 19]. Air weapons (pneumatic weapons) occupy a special place in this context. Despite lacking the use of explosive substances, these weapons can produce injuries that closely resemble those inflicted by factory-manufactured firearms [10,14,18]. Homemade weapons can also be classified as firearms if they meet the legal criteria specified in the legislation. In the present case, the homemade weapon discharged a projectile – a piece of metal – through the ignition of an explosive substance, likely derived from matches.

Such improvised weapons often use metal tubes to serve as barrels, typically constructed as short-barreled firearms regardless of the type of ammunition intended for use. While factory ammunition may serve as projectiles, random objects such as nails or metal fragments are frequently utilized. The incendiary material can vary widely, including substances such as gunpowder or the flammable material from matches, as suggested in this case [8,11,12,15]. In factory-made weapons, the ignition of gunpowder is of primary importance in the mechanism of producing a shot. As a result, a significant amount of gases and heat is released, which creates a large pressure, through which kinetic energy is imparted to the projectile. Usually, the heads of matches contain a mixture of fuel, oxidizer and binding components. When rubbed or heated (additional ignition), a rapid exothermic reaction occurs with the release of a large amount of heat and gases. When this reaction occurs in a closed and small volume space, an explosive effect is created, similar to that of gunpowder [2, 11, 12, 17]. In the present case, the empty matchbox found next to the victim's body suggests that matches were probably used as the incendiary substance, and they were probably placed at one end of the tube, behind the projectile. The lighter found in the victim's hand suggests that they were ignited by it.

The functioning of a homemade firearm depends on two key factors: the materials used in its construction and the knowledge and skills of the individual fabricating it [21]. These weapons pose a significant risk not only to the intended target but also to the shooter. The materials used are often unstable and may fail to withstand the pressure generated during firing, leading to the potential explosion of the barrel and the release of shrapnel. This inherent instability necessitates extreme caution during ballistic testing of such weapons. Test firings must be conducted with robust safety measures in place to mitigate the risk of injury [3, 8, 21].

The combustion of the explosive substance during the discharge of a homemade weapon is typically incomplete, leading to the release of large quantities of unburned particles along with the projectile. This phenomenon is primarily attributed to two factors: the inherent properties of the explosive material and the frequent mismatch between the diameters of the barrel and the projectile. As a result, unburned particles tend to deposit at greater distances compared to those from factory-made firearms. This is often accompanied by pronounced gunpowder tattooing, observed on the skin of the shooter's hands and around the entrance wound [4, 8, 15]. In the present case, similar

findings were noted, including abundant soot on the left hand of the shooter and within the oral cavity, which also contained the entrance wound.

The kinetic energy of projectiles fired from homemade weapons is generally low, sometimes rendering the injuries ineffective. Consequently, such injuries are often blind, with the projectile remaining lodged within the body. Lethal injuries from homemade firearms are typically observed only at close-range, most often at point-blank range [4, 8]. The characteristic features of entrance gunshot wounds caused by homemade weapons – such as tissue loss, abrasion rings - may be absent or poorly defined, complicating forensic evaluation. Unlike the typically round entrance wounds caused by factory-made firearms, those from homemade firearms can vary significantly in shape. Even when a factory-manufactured projectile is used, lateral penetration can result in non-circular wound patterns. At point-blank range, the imprint of the muzzle may sometimes be found on the skin surrounding the entrance wound, enabling a comparative analysis with the suspected weapon [11, 12, 15]. In this case, the entrance wound was located in the soft palate and presented as an irregularly shaped defect with tissue loss, but the abrasion ring was not well presented. The slit-like wounds in the oral area, on the other hand, are a common finding when the muzzle of the firearm is placed in the mouth. They most likely resulted from rapid expansion of gases under high pressure in the oral cavity, one of the vicinity effects associated with the firearm discharge.

The wound channel created by the projectile's penetration into the body can also exhibit characteristics distinct from those typically observed in factory-manufactured firearms. These differences depend on the projectile itself and its kinetic energy. In most cases, the wound channel ends blindly within the tissues without forming an exit wound. Occasionally, the projectile may fragment upon entry, resulting in additional wound channels [11, 12, 15]. In the present case, the wound channel ended blindly in the occipital bone, where the projectile was extracted. The channel crossed soft tissues and bone structures, forming a permanent cavity with destruction of the structures along its course, which indicates that the projectile possessed significant kinetic energy. This is also confirmed by the morphological changes in the tissues surrounding the wound tract, which are the result of the effect of the temporary cavity (lacerations of the tissues of the oral cavity, fracturing of bone structures, etc.).

Although rare, injuries caused by homemade firearms can result in exit wounds, which may vary greatly in size and shape. In some instances, fragmentation of the projectile or the displacement of bone fragments along the wound channel can lead to multiple exit wounds. [15] In the case presented, the kinetic energy of the projectile was insufficient to produce an exit wound. However, an irregularly shaped fracture of the inner plate of the occipital bone was observed, highlighting the destructive potential of the projectile even in the absence of an exit wound.

Conclusion

This forensic case underscores that homemade firearms can be as dangerous as factory-manufactured ones. Understanding the mechanisms of these weapons and the injuries they cause is of significant importance to forensic medical practitioners and ballistics specialists.

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