

An Autopsy Case of the Decomposed Body with Kronlein's Shot and the Importance of Skull Reconstruction

Abstract

In forensic medicine, firearm-related fatalities are regular. The range and velocity of the bullet, the characteristics of the wounds, and the probability of recovery are vital components of forensic analyses. While examining gunshot wounds to the skull, focus on the critical difference between bullet entry and exit points and the distance between the muzzle and the bullet entrance is vital. Determining bullet injury in cases of extreme decay has been a difficult challenge. The police send a corpse in the later stages of decomposition for re-postmortem examination, with a history of severe blunt force injuries to the head in our case report. Following the reconstruction of the skull, it is determined that some regions are bone deficient. A bullet entry wound is present on the left side's upper border of the defect, formed like an arc (representing the upper 1/3rd of a circle), and a corresponding exit wound was discovered on the right side's lower border of the defect, shaped like an arc (representing the lower 1/3rd of a circle). The bullet passed left to right backward and downward. It is noteworthy that in cases of advanced decomposition, where identifying the characteristics of a bullet wound is nearly impossible, fully skeletonizing the body and reconstructing it will provide critical hints to establishing the cause of death.

Keywords: *Bullet entry, bullet exit, decomposition, Kronlein's shot, reconstruction*

Introduction

In forensic medicine, deaths involving firearms are common. The use of arms and ammunition in homicides, suicides, and injuries provides a distinctive legal and medical connotation. Measurements of the distance and trajectory of the projectile, wound characteristics, and the possibility of the victims' recovery are critical attributes of forensic examinations. The distinction between the causes of death by suicide and homicide would dictate how the investigation proceeds.^[1]

In the standard practice of forensic autopsy, the emphasis is on the clear distinction between bullet entry and exit and the distance between the muzzle and the bullet entrance while analyzing gunshot wounds to the skull. In cases of severe decomposition or skeletonization, the determination of damage caused by a bullet has been a challenging task.^[2] Autopsies of gunshot wounds can be complicated by decay because changes in skin pigmentation alter gunshot wound characteristics such as soot deposition and

stippling pattern, used to calculate the range of fire. Furthermore, slippage of the skin due to decomposition can lead to the destruction of gunshot wound characteristics.^[3]

In our case study, the police sent a body in advanced stages of decomposition for re-postmortem examination with a history of heavy blunt force trauma to the head. We conducted the autopsy in our department and established the cause of death only after the reconstruction of the skull pieces.

Case Report

In October 2018, the police discovered a 45-year-old male deceased in the hilly areas of the district Sonbhadra, Uttar Pradesh, India. A preliminary postmortem was conducted there, but they could not conclude the cause of death. Four days past the first autopsy, the police then sent the body to our department at the Institute of Medical Sciences, Banaras Hindu University, Varanasi, for a re-postmortem examination.

Postmortem examination

We received a decomposing body of a male with the scalp avulsed and the skull

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fragmented with brain matter missing. The skin is rubbery and darkens to a brownish-black color throughout the body. Maggot larvae are present in the mandibular, neck, and pelvic region and within the oral cavity. In addition, the anterior and posterior abdominal walls are missing, and the viscera are found liquefied [Figure 1]. A blown-out fracture of the skull is present, combined with laceration of the overlying skin, resulted in a large and continuous defect, extending from the left parietal and temporal region to the right parietal and temporal region, involving the frontal area and both orbits in the process. The breach is approximately 10 cm × 6.5 cm in size. The lower margin is in contact with the nose's root, while the upper margin is in touch with the vertex. The right margin is 3 cm from the pinna of the right ear, and the left margin is 5 cm above the left tragus [Figure 1]. The postmortem interval is estimated to be between 7 and 14 days. We retained the body for skeletonization to examine bony injuries in greater detail. After the skeletonization process, we reconfigured the skull and analyzed the bone for detailed damages.

Examination of the skull

The 12 pieces of the skull bones are present. They are numbered and manually reconstructed from these pieces. Following reconstruction, the following areas are identified as bone deficient [Figure 2]:

1. A portion of the left temporal, parietal, frontal, zygomatic, and maxillary bones are missing, resulting in a defect measuring 12.4 cm × 7 cm on the left side of the skull
2. A portion of the frontal bone measuring 7.5 cm × 3.7 cm along and to the left of the midline is missing
3. A portion of the right temporal and parietal bone is missing, resulting in a defect on the right side of the skull measuring 11 cm × 5 cm
4. On the left side, a portion of the sphenoid and the orbital bones are missing, resulting in a 3 cm × 4.5 cm defect in the middle and anterior cranial fossa
5. Furthermore, upon careful examination of the skull, a



Figure 1: Body in advanced stages of decomposition

bullet entry wound is discovered on the left side's upper border of the defect, 7 cm above the tip of the left mastoid process and 6 cm posterior to the left orbital margin. The entry wound is shaped like an arc (forming the upper 1/3rd of a circle), with a smooth outer table and beveled inner table. In addition, a fracture line is observed originating from the entrance wound and extending backward between pieces 3 and 5. On the right side, the exit wound is present at the lower border of the defect. It is shaped like an arc (representing the lower 1/3rd of a circle), with a smooth inner table and beveling on the outer table. It is positioned 4 cm upward and back from the tip of the right mastoid process and 8 cm posterior to the right orbital margin. In addition, a fracture line is visible in piece number 1 that originates from the exit wound and extends backward and downward. After aligning the entry and exit with a probe [Figure 3], it is evident that the bullet traveled backward and downward from left to right.

Discussion

In this case study, the head suffers the damage resulting from a homicidal near contact shot (Kronlein's shot), and decomposition was a significant complication in assessing gunshot wound characteristics. Still, as a study limitation, it should be noted that complications will arise when an imperfect skull is getting examined, as described above. Even though the conclusions, in this case, were unusual, they were compatible with previous research.

Rudolf Ulrich Kronlein was a very well German surgeon who lived from 1847 to 1910. Prof. Kronlein described the brain evisceration of a bullet wound to the head by a military rifle in his publication *Beitrag zur Lehre der SchadelHirn-Schusse aus unmittelbarer Nahe mittels des schweizerischen Repetier-Gewehrs Model 1889* in 1899.^[4] This phenomenon has been identified in the context of gunshot wounds to the head during wartime. The violent expansion of muzzle gases in the skull cavity



Figure 2: Pre-reconstruction images of all the skull bone fragments

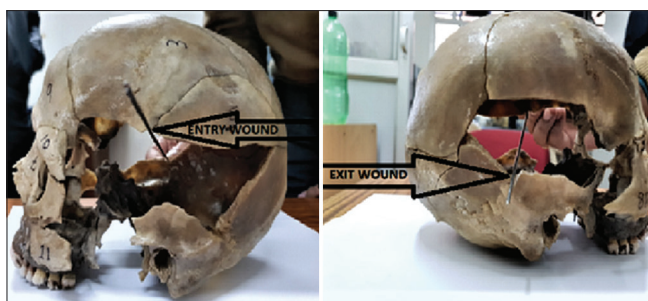


Figure 3: Entry and exit wounds aligned via probe

explains Kronlein's shot.^[5] When analyzing gunshot wound characteristics, including soot deposition and stippling pattern, decomposition is a significant complication. Interestingly, there are published studies on the impact of decomposition on the traits of gunshot wounds.^[2] In Canada, MacAulay *et al.* used a pig to investigate the effects of decomposition in moderate and cold temperatures.^[6,7]

According to Peterson, the entrance and exit wounds in perforating bullet wounds to the head have a distinctive feature called beveling that helps distinguish them. Beveling is a type of bone erosion in the direction of the bullet path through the cranial vault in the shape of a cone. Entrance wounds may be circular, oval, or stellate in shape, with a beveled interior (erosion of bone in the inner part of the bony table).^[8] Bonaccorso *et al.* stated that exit wounds are ordinarily irregular and have a beveling (bone erosion) on the outer part of the bony table. Bone fragments fly through the cranial vault in the same direction as bullets. Owing to the increasingly rising pressure as the bullet passes through the skull, gunshot wounds in the skull often result in multiple fractures.^[9]

In high-velocity projectile wounds to the brain during close-range shooting, Kronlein's shot reveals a prolapse of both intact brain hemispheres.^[10] In cases of Kronlein's shot, where a high-velocity bullet fragments the skull, a complete evisceration of the brain occurs.^[11] According to Pankratz and Fischer, a Krönlein's shot (brain evisceration) is a specific type of skull fracture caused by a high-velocity bullet. A wide opening of the skull with laceration of the dura mater is observed in this type of low-range shot wound.^[12] Spitz's study has shown that the amount of gas generated by a high-powered firearm's blast is so massive that a shot fired with the weapon in head contact causes significant damage. When a high-powered firearm is fired into the mouth, the soft tissues of the head expand dramatically, resulting in severe skull fractures.^[13] As Gautam (2015) mentioned in the textbook, Krönlein's shot is a relatively uncommon skull fracture caused by a high-velocity bullet. The skull bursts, and the dura mater is lacerated, resulting in the complete evisceration of the brain in this proximity shot.^[14] However, book by Agarwal has also stated that the residual brain in the cranial cavity is pulpified after large parts of the skull and brain are blown

away (Kronlein's shot). Shearing off pieces of the scalp is a possibility. Extensive comminuted fractures can be seen in the skull.^[15] Another result that contradicts our statement is research by Quatrehomme and Işcan, which demonstrates that the direction of external beveling in exit wounds is unrelated to shooting direction. As a consequence, this property is inefficient for determining the direction of fire.^[16]

In the cases of advanced decomposition, where it is almost impossible to find the characters of a gunshot wound, completely skeletonizing the body combined with reconstruction can provide vital clues to determine the cause of death. The present case, on the further police investigation, was established as a case of near-contact shot (Kronlein's shot) firearm injury to the head, based on wound ballistics testing, cadaver examination, and skull reconstruction with the evidence of the bursting fracture with entry and exit wounds on the skull.

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Conflicts of interest

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