

# Catching a Bullet: Gunshot Wound Trajectory Analysis Used to Establish Body Position

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There is little published in the peer-reviewed forensic literature on gunshot wound trajectory analysis with regard to the body position of the victim when the shooting occurred. More often than not, unwitnessed shootings with multiple projectiles and a dynamic scene make such interpretations difficult. However, it is not uncommon for forensic pathologists to be asked to testify about the body position of the decedent in civil and criminal cases (1). The case presented exemplifies six gunshot wound defects delineating two trajectories and the interpretations that can be made from the injuries found at autopsy in the context of ancillary evidence.

In July 2003, an estranged but still married couple visited their previously shared house with an appraiser to evaluate the property for division in their upcoming divorce. Immediately after the conclusion of the meeting, as they were leaving the residence, the appraiser heard a gunshot behind him and turned to see the hus-

band holding a gun in the driveway and the 35-year-old wife collapsed, with gunshot wounds to her neck. The appraiser called the police and the husband retreated into the house; a single gunshot was heard by law enforcement from the house soon after they arrived at the scene. The husband was found in the residence with a single self-inflicted gunshot wound of the head, and a pistol by his side. The wife was declared dead at the scene. Police gathered two expended casings from the driveway, which were found within a few feet of the wife's head.

Autopsy findings in the homicide victim were significant for six gunshot wound defects (**Image 1**). One gunshot wound entered the left chin, exited the right side of the neck (B), re-entered at the right inner upper shoulder, and exited the right upper arm (D). No fouling or stippling of the adjacent skin was identified at the initial entrance wound, indicating she was shot



**Image 1:** Gunshot wounds from the first bullet trajectory and contusions on the right shoulder.



from a distant range. After entering the left side of the chin, the projectile perforated the skin and soft tissue of the lip, entered the oral cavity, and sequentially perforated the lower left premolar, mandible, and soft tissues of the neck without deflection. In association with the exit wound at the right side of the neck (B), there was soft tissue hemorrhage of the right sternocleidomastoid muscle and right supraclavicular musculature. The projectile then re-entered at the right upper shoulder and traveled through the superficial soft tissue and muscle of the right shoulder and arm, fracturing the coracoid process of the right scapula and the head of the humerus.

A strap-shaped contusion was noted extending from behind the right shoulder to the outer upper right arm (**Image 2**). This contusion was consistent in width with the strap of a purse that accompanied her body, suggesting that she was manipulating her purse strap over her arm as the first gunshot was fired. After exiting the right upper arm (D), the projectile entered her left ring finger and lodged at the base of the middle finger at the metacarpal-phalangeal joint. This accounts for the slight abrasion rim at D, indicating a shored exit wound and the “caught” bullet in the left hand radiograph (**Image 3**). The first bullet trajectory is delineated using two probes (**Image 4**) and in an accompanying animation (**Figure 1**). Based on the direction of fire and the reported positions of the husband and wife in the driveway as they were exiting the house, the decedent was standing in an upright position as the first gunshot was fired.

A video animation illustrating this bullet path and in alignment with the decedent’s likely position was generated to account for the wounds. The three-dimensional (3D) model of the gunshot wound path was generated using Autodesk’s 3D Studio MAX software. The software was run on a 24-core DELL XEON PC with 64 GB of RAM running the Windows 7 operating system. The autopsy report, photographs, and radiography of her left hand provided the basis for the victim’s height and the specific location of each entry, exit, and the bullet lodgment location. As the report described internal skeletal structures involved in the wound path, a 3D skeleton was scaled to match

her 63-inch height and provided a spatial and visual reference for the illustration of the bullet path.

A second gunshot wound trajectory entered at the right occipital scalp via a circular defect without a margin of abrasion. The projectile exited the skull to the right of the foramen magnum, while penetrating the soft tissues of the upper neck and glottis, creating contusion and hemorrhage at the right piriform recess and larynx and lodging at the base of the right tongue. No fouling



**Image 2:** Close-up of right shoulder contusion, indicating that it corresponds in size to the strap of her handbag.



**Image 3:** Radiograph of the decedent's left hand with the bullet lodged in the base of the left ring finger at the metacarpal-phalangeal joint.



**Image 4:** First bullet trajectory delineated using two probes.





**Figure 1:** Animation of the decedent showing the trajectory of the first gunshot wound.



**Image 5:** Radiograph of decedent's skull showing second bullet point of lodgment.



**Image 6:** Trajectory rod depicting the second bullet's course through base of skull.

or stippling of the adjacent skin was identified at the entrance wound. The decedent had thick black hair and was not wearing a hat. There was grossly visible fouling of the outer table of the skull and dura described in the autopsy report, but this was not photographed. The inwardly beveled oval entrance defect in the skull had radiating fractures to the right posterior cranial fossa and the bullet track completely transected the pontomedullary junction. A radiograph of the skull showing where the bullet lodged is shown in **Image 5** and an autopsy photo with a rod depicting the trajectory through the base of the brain is shown in **Image 6**.

The gunshot wound trajectory through the chin and shoulder must have occurred first because the victim would have had to have been upright at the time the first shot was fired due to the distant range of fire combined with her body position: the shooter and the victim were both witnessed to be standing prior to the shots being fired and the projectile from the first gun-

shot wound defect entered her left chin from a distance and went downward through her body as she secured her purse on her shoulder – an action that requires intent and an intact nervous system. The projectile from the first gunshot did not penetrate the brain or spinal cord and would not have caused immediate incapacitation. Therefore, the shooter would have had to shoot her again to kill her.

The second, occipital scalp gunshot wound was at close range, as evidenced by the grossly visible soot within the wound. This trajectory went through the pontomedullary junction of the brain stem, indicating that after the first, nonfatal shot, the shooter closed the distance between them. Among many factors, the range at which a gun is shot determines the energy imparted to the target and thus, the extent of tissue injury (2). At any range, however, ballistic damage to pontomedullary junction is instantaneously lethal (1). Following the second gunshot, she would have

been immediately incapacitated. Stopping power, or the ability to generate enough damage to immediately incapacitate the victim, is predominantly determined by bullet placement (3, 4). In this case, laceration of the brainstem would have caused immediate incapacitation and likely dropped her to the ground (4).

Had the close range shot through the brain stem been first, there would have been no need for the distant, nonfatal shot and her body position (left hand holding a purse over her right shoulder to “catch” the bullet) would have been impossible. While it is certainly possible that the deceased could have been on the ground, partially collapsed or kneeling rather than standing for the second occipital shot, in the absence of an incapacitating gunshot wound or abrasions on her knees indicating such a partial collapse, this posture would be speculative, especially given the characteristics of the driveway and the decedent’s clothing: she was wearing a thin summer skirt and sandals with no stockings, exposing her bare knees.

In some gunshot wound cases, such as this one, one can elucidate the sequence and trajectory of gunshot

wounds by interpreting the injuries found at autopsy in the context of ancillary evidence. This evidence includes, but is not limited to witness statements, the distance and number of casings, scene topography, and patterned injuries on the body that may correspond to articles of clothing, evidence, or the surfaces at the crime scene. Experience with gunshot wound trajectory analysis may be crucial in establishing a likely body position in cases where there are no witnesses or if there are conflicting witness statements about the death.

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