A53 Atypical Gunshot Wounds in a Controlled Experiment

Elizabeth A. Evangelou, MA, Vestal, NY 13850; Tessa Somogyi, MA*, Binghamton University, Binghamton, NY 13902; Kevin E. Sheridan, PhD, Binghamton University, Anthropology, Binghamton, NY 13902; Elizabeth A. DiGangi, PhD, Binghamton University, Binghamton, NY 13902*

Learning Overview: After attending this presentation, attendees will be aware of the variability in cranial gunshot entrance and exit wounds and fracture patterns resulting from a controlled experimental study.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by demonstrating the need for controlled ballistic trauma studies to further elucidate and understand factors that produce variability in cranial gunshot entrance and exit wounds.

The interpretation of gunshot trauma is a key aspect of forensic anthropology, but few studies have systematically tested the effect of gunshot trauma on the cranium. Recently, there has been a push for experimental gunshot studies under controlled conditions in order to expand our knowledge.

This study presents three examples of atypical gunshot fracture patterns that were drawn from a sample of 45 heads belonging to a larger experimental study focusing on gunshot fracture patterns. Prior to shooting, each head was placed atop a six-foot-high shooting stand and held in place using luggage straps. The heads were shot using a Smith and Wesson® model 438 J-frame revolver with a $1^{7}/_{8}$" barrel loaded with 0.38 caliber bullets each weighing 130 grains. Each head was shot once either anteriorly through the frontal bone or laterally through the temporal/parietal bone, using either a Full Metal Jacket (FMJ) bullet or a Jacketed Hollow Point (JHP) bullet. After shooting, the heads were macerated using standard processing techniques. Shot distance and bullet velocity were both controlled for, with each head being shot from three meters away and each bullet fired from the same weapon. Impact velocities ranged from 561f/s to 738f/s, which is considered low velocity. The three examples that follow are fracture patterns that were not expected, given the controlled conditions described above.

Example 1: Circumferential delamination around gunshot entrance wounds was observed in both FMJ and JHP bullets. It has been hypothesized that circumferential delamination only occurs in FMJ shots.[1] Presence of circumferential delamination by bullet construction was tested using a Pearson chi-square test with an alpha of .05 and was not significant (p=.682,) indicating that there is no relationship between the presence of circumferential delamination and bullet construction. These results suggest that the mechanism that causes circumferential delamination is not related to bullet construction. It was hypothesized that circumferential delamination may be related to impact velocity or shot distance, rather than bullet construction.

Example 2: A bone plug originating from a frontal entrance wound occurred once during the controlled study. Bone plugs are rarely described in ballistic trauma literature and are an uncommon finding. Additionally, when bone plugs are discovered, they are usually with exit wounds, not entrance wounds. The factors that cause bone plugs are not well understood, and it is thought that velocity plays a large role, with low-velocity gunshots more likely to produce cranial bone plugs. The impact velocity for the shot that produced the entrance wound bone plug was 676f/s, a low-velocity shot; although this was an average velocity for this sample. Further study into what factors of this shot are unique for this particular sample may provide more information about the factors that cause bone plug formation.

Example 3: Five of the 45 heads exhibited excessive fracturing or shattering of the cranial vault. For these five heads, the exit wounds did not display any characteristic evidence of normal external beveling. Rather, the observed fracturing appeared to resemble medium- or high-velocity gunshot trauma. Known impact velocities for these shots were average for the study and well within the low-velocity range. Additionally, these five heads had average bone density within the tested sample.

These examples are important to the study of gunshot trauma in forensic anthropology because they demonstrate unexpected results during a controlled experiment. These examples suggest that there is a need for more controlled studies to fully understand the variability of gunshot trauma.

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Reference(s):

1. Kimmerle, Erin H., and José Pablo Baraybar. *Skeletal Trauma: Identification of Injuries Resulting from Human Rights Abuse and Armed Conflict.* (Boca Raton: CRC press, 2008).

Forensic Anthropology, Gunshot Trauma, Controlled Experiment