A46 A Comparison of Bullet Construction to the Area and Perimeter of Gunshot Entrance and Exit Wounds

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Learning Overview: After attending this presentation, attendees will gain awareness of: (1) how the sizes (area and perimeter) of entry and exit wounds on the human skull are affected by the bullet construction (full metal jacket vs. jacketed hollow point); and (2) the implications of the relationship between the size of entrance and exit wounds to bullet construction and how this can be utilized within a medicolegal setting.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by demonstrating and discussing how bullet construction affects the size of entry and exit wounds on the human skull.

The interpretation of gunshot wounds is a key element in skeletal trauma analysis. Many interpretations of gunshot and other types of skeletal trauma have been based on observations made during autopsies or observations from osteological materials recovered from archaeological contexts.[1] There has been a lack of controlled gunshot trauma experiments to add to these data from autopsy and archaeology. Controlled experiments are necessary to allow for detailed observations and interpretations of the interactions between intrinsic and extrinsic factors, both of which affect patterns of skeletal trauma.[1] Extrinsic factors include a wide variety of factors such as the type of firearm, bullet caliber, and bullet construction. Previous research has been able to reveal some patterns, allowing the prediction of bullet caliber or other bullet characteristics under controlled conditions, but much more research is needed in this area to allow for more complete interpretations. A controlled experimental approach is the best way to meet this need. Therefore, this project experimentally tested the effects of two different bullet constructions (full metal jacket and jacketed hollow point) on the size (area and perimeter) of entrance and exit wounds to the cranium. These bullet types were chosen because they are designed to do different things to human tissue (i.e., exit the body vs. not exit) and tend to be used in different contexts.

Forty-five human heads from donated individuals were sourced from an anatomical tissue supply company, specifically for the purpose of trauma research. Prior to shooting, each head was placed on a specialized stand set at the height of an average adult male. Each head was shot once either through the frontal or through the temporal or parietal bone using a Smith and Wesson® model 438 J-frame revolver with a $1^{7}/_{8}$-inch barrel loaded with .38 Special bullets. Bullet construction (jacketed hollow point vs. full metal jacket) was distributed randomly throughout the sample with equal numbers of each bullet construction used. Following the shooting, heads were autopsied and processed using standard maceration techniques.

The area and perimeter of the entrance and exit wounds were measured virtually using ImageJ, a freely available image processing program. To test the interaction between bullet construction and the area and perimeter of entrance and exit wounds, a series of independent sample *t*-tests were conducted with significance set at p=.05. Earlier research has indicated there is a relationship between entrance and exit wound sizes, with exit wounds almost always larger than their associated entrance wounds. The relationship between entrance and exit wound relative size (exit wound size divided by entrance wound size) and bullet construction was also tested here.

Preliminary data analysis revealed that there is a significant difference between bullet construction for the area and perimeter of the entrance wounds, where jacketed hollow points produce entrance wounds with larger areas and perimeters than those produced by full metal jackets (p=.001 for both). Preliminary results also reveal there is no significant difference between the two bullet types in the area and perimeter of exit wounds. The preliminary results analyzing entrance and exit wound relative size indicate that the exit wounds are consistently larger than their associated exit wounds; however, there is no statistically significant relationship between the ratio of the two wound sizes and bullet construction. This has implications for gunshot wound fracture analysis in that these results reveal bullet construction can significantly affect entrance wound morphology. Future research will include analysis of fracture pattern differences by bullet type and the interaction between bullet type and entrance wound location.

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Reference(s):

1. Berryman, Hugh E., Alicja K. Lanfear, and Natalie R. Shirley. The Biomechanics of Gunshot Trauma to Bone: Research Considerations Within the Present Judicial Climate. In *A Companion to Forensic Anthropology*, ed. Dennis Dirkmaat (John Wiley & Sons 2012):390-399.

Forensic Anthropology, Gunshot Trauma, Trauma Analysis