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Trauma to the Skull: How to Differentiate Bullet Type From Bullet Wound

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Abstract

As a forensic anthropologist, it is important to understand varying types of skeletal trauma. Bullet trauma to the skull is an example of what forensic anthropologists can encounter when creating a biological profile of an unknown decedent. The purpose of this project is to analyze the effects of different weapons and the degree of trauma subjected to the skull. Domestic pig heads were used in this experiment due to the similarities in which they share with humans. They were evenly placed from the individual firing the weapon. The weapons used for this experiment include a 9mm Diamondback Compact Pistol, a .22 Marlin Long Rifle (LR), and a 12-gauge Harrington and Richardson shotgun. A comparison of trauma was observed on each of the skulls and then recorded. It was our belief that the shotgun would produce the most damaging effect, with the 9mm being next, and the .22 LR having the least effects on the skulls.

Introduction

Scholarly research and experimentation is limited in terms of testing the potential destruction that bullets from firearms have on skeletal remains. Due to this, our research team wanted to analyze and compare the amount of damage that can be caused from different types of firearms. For this experiment, *Sus scrofa domesticus* (domestic pig) heads were used due to the similar anatomy to humans. Before the start of our experiment, we recognized that several variables would influence the level of devastation to the domestic pig. We found that the nature and severity of a bullet wound depend on the characteristics of the bullet and of the tissues through which it travels. In addition to the mass and velocity of the bullet, its orientation and whether it fragments or deforms, affect the nature of the wound (Hollerman, Fackler, CoIdwell, Ben-Menachem, 1990). We also acknowledged that the distance from the target, as well as the accuracy of bullet placement (for comparison purposes) would also influence our results. Having decided to use a 12-gauge Harrington and Richardson Shotgun, a .22 Marlin Long Rifle (LR), and a 9mm Diamondback Compact Pistol, our research prior to our experiment showed that these three forms of firearms were all capable of doing a significant amount of damage. However, due to the amount of power and energy released by the 12-gauge Harrington and Richardson Shotgun (Molina, 2013), we hypothesized that this firearm would prove to inflict the most damage to the domestic pig.

Figure 1: 12-gauge Rounds

Figure 2: .22LR Rounds

Figure 3: 9mm Rounds

Materials and Methods

Materials: For this experiment, three *Sus scrofa domesticus* heads were ordered from Carlton Farms. The heads used still contained flesh and were thawed out prior to shooting. The guns used included: a 12-gauge Harrington and Richardson Shotgun, a .22 Marlin Long Rifle (LR), and a 9mm Diamondback Compact Pistol. The ammunition used included: Winchester 12-gauge rifled slug hollow point rounds, Federal Ammunition .22LR copper-plated hollow point rounds, and Federal Ammunition 9mm luger rounds (**Figures 1-3)**. A large storage container, a large stock pot, knives and dish soap were also used in this experiment.

Methods: To perform the shooting portion of this experiment, each head was placed one at a time, on its side on top of a log approximately 24 feet (7.315 meters) away from the shooter. The first gun fired was the shotgun, followed by the rifle, then the pistol. With each gun, the shooter placed the end of the barrels at approximately the same spot. This was done to keep the distance from which the bullet leaves the gun to the point of impact on the head as consistent as possible. The area the shooter was aiming for was the center of the top of the head. With the shotgun and rifle, the shooter was able to hit the right spot with one shot. However, with the pistol the bullet hit more down the nose. Due to this, it was decided to try and hit the same spot as the other guns, but the second shot ended up hitting very close to the first one.

Figure 4: 12-gauge Post Shooting

Figure 5: .22LR Post Shooting

Figure 6: 9mm Post Shooting

After the shooting portion of the experiment was completed, pictures of the impact from the bullets were taken **(Figures 4-6).** Then, pocket knives were used to remove the epidermis (outer layer) portion of the skin. After that layer was removed, the remaining muscles and tissues were removed as allowed without damaging the skull. Fractured bones that were no longer supported, were collected. After the initial skinning was completed, the heads were placed in a storage container and were covered with soap and water overnight, to assist in removing the remaining muscles and tissues.

The next day, the skulls were individually boiled in a large pot to help loosen the remaining tissues. After a period of boiling, some more of the tissues were removed using knives. This process was repeated two more times, and enough tissue was removed from around the bullet wound as need to conduct analysis. Photographs of the wounds were taken (**Figures 7-9)** and when possible measurements of the wounds were taken. Other observations of the wound type were also made.

Results

Brief descriptions of the wounds from each gun are shown in **Table 1**. The 9mm pistol left an entrance wound about 1.5 inches long by 5/8 inches wide. There was not an exit wound. The damaging effects left by the .22LR consisted of concentric fractures and a few fragmentary pieces from being shot. While de-fleshing the skull, the round was found lodged behind the right eye. The damage from the 12-gauge shotgun obliterated the occipital bone and created numerous fragmentary pieces.

Table 1: Wound Description for Each Gun Type

Gun Type	Wound Description
12-gauge Shotgun	Obliterated occipital bone, fragmentary pieces
9mm Pistol	1.5 in X 5/8 in, keyhole fracture
.22 Long Rifle	Concentric fractures, fragmentary pieces

Conclusions

Forensic anthropologists encounter varying scenarios that require more intimate knowledge, such as bullet wound analysis on skeletal remains. The results of this experiment for the 9mm pistol were consistent with other studies. The keyhole fracture produced from this bullet matched results from a case study done by Jackson (2LT Aaron M. Jackson USA, 2008). It was discovered that the 9mm pistol left a keyhole fracture that is consistent with other findings. The large entrance hole produced by the 9mm was due to shooting the skull twice in hopes of hitting the same spot as the other guns. Unfortunately, the second bullet hit so close to the first, that the bone between the holes broke making the wound seem bigger than expected. Finding specific information pertaining to each weapon type proved to be difficult, especially in the instance of the .22LR. However, the results observed from this gun were expected. Injuries were consistent with findings for the 12-gauge shotgun. The shotgun exhibited tendencies similar to what is expressed in a study by Breitenecker, in that the shotgun charge disseminated into individual pellets, in which were found lodged in the skull (Breitenekcer, 1969). In conclusion it was found that the 12-gauge shotgun produced the most severe damaging effects on a skull, with the 9mm pistol having the next most damaging effect and the .22LR being the least. In order to have a better understanding of the varying effects of bullet wounds on skulls, further studies need be conducted.

Figure 7: 12-gauge Results

Figure 8: .22LR Concentric Fractures

Figure 9: 9mm Keyhole Entrance

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