H59 Bullet Wipe on Bone: Production and Detection

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After attending this presentation, attendees will understand the influence, if any, of caliber, range, angle, and bullet design on the production of bullet wipe; to determine the effect of maceration on the detection bullet wipe; to find whether proton-induced X-ray emission (PIXE) analysis may be used to detect non-visible bullet wipe.

This presentation will impact the forensic community and/or humanity by codifying much that had been believed to be true, but had not been examined by any previous study. The issue of cross-contamination in maceration is addressed for the first time.

Most bullets in civilian use are made of lead hardened with tin or antimony. Lead is a soft, dense metal with a low melting point (Fahrenheit 621). When it passes through bone, it often leaves traces in the form of small fragments in the hole or on the surface of the bone itself. These radio-opaque traces are called bullet wipe. In the absence of a well-defined entrance or exit wound, bullet wipe is a useful indicator of gunshot. This study was undertaken to determine what factors influence the production and detection of bullet wipe.

A total of 345 gunshot wounds were produced in 69 pig crania and postcrania. Two revolvers were used: a 1909 Model Army Colt in .38 Special and a North American Arms Black Widow mini-revolver in .22 Long Rifle and .22 Magnum. The pig bones were shot five times each, at ranges of ten feet and hard contact, at angles of ~90 degrees and ~180 degrees, with a variety of ammunition (full-metal jacket, jacketed soft point, hollowpoint, and unjacketed lead). After being shot, the specimens were radiographed. They were macerated for a minimum of 24 hours, cleaned, and radiographed again. The presence of bullet wipe on each specimen was scored before and after maceration on a scale from 0 (no traces present) to 3 (large traces present). Proton-induced X-ray emission (PIXE) analysis was used to search for bullet wipe on bones for which no wipe was observable.

Conclusions

1) The presence of bullet wipe on bone is determined by bullet design. Bullet wipe may be separated into two distinct types. Direct bullet wipe is produced by physical contact between the primary mass of the bullet and bone, and is found on the margin of a gunshot wound. Indirect bullet wipe is produced by fragments shed by the bullet. The presence and nature of bullet wipe on bone is determined by bullet design. The study found range and angle to be irrelevant to the production of bullet wipe.

2) Full-metal-jacket, unjacketed, soft-point, and hollow-point bullets cause different patterns of bullet wipe. Bullets with a full metal jacket, which have no exposed lead, typically produce no visible wipe at all. In the extremely unlikely event that any wipe is present, it is indirect. Unjacketed bullets produce both direct and indirect wipe in ample amounts. Soft-nosed bullets produce direct and indirect wipe, but much less of each than unjacketed bullets, and hollowpoints produce indirect wipe and little direct wipe. Because .22 caliber rounds are open at the base, these generalizations do not hold for small-caliber ammunition.

3) Maceration can affect the presence of bullet wipe and result in cross-contamination. Direct bullet wipe does not appear to be affected by maceration. Indirect bullet wipe, however, can be reduced or eliminated. Small particles of indirect wipe may transfer from one specimen to another if the specimens are macerated together. Pre-maceration radiography is essential to guard against such cross-contamination.

4) PIXE analysis is a useful tool in analysis of bullet wipe, particularly when reconstruction of trauma is difficult.

Bullet Wipe, Gun Shot, PIXE

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