A181 Evidence to Consider When Evaluating Bullet Defects in Clothing for Characteristics of Entrance Versus Exit in Instances Where Distance Precludes Gunpowder Deposition

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After attending this presentation, attendees will learn about physical evidence characteristics that can help in determining whether a bullet hole in clothing worn by a person suffering a gunshot wound is an entrance defect or an exit defect when the clothing does not support gunpowder deposits in the area of damage.

This presentation will impact the forensic community by demonstrating that the comprehensive examination and analysis of the bullet damaged clothing being worn by a shooting victim in mid to long- range distance shootings can contribute significantly to the determination of entrance versus exit sites.

Clothing items with bullets holes recovered from persons injured in shootings can be carefully evaluated for firearm discharge generated evidence (including transfer of lead to fabric at the site of bullet perforation) and damage characteristics, and conclusions regarding the differentiation between bullet entrance holes (damage) and bullet exit holes (damage) are possible.

Typically, in shootings where people are injured by bullets passing completely through the body, medical doctors examine the victims to determine a course of medical treatment for those still living or to determine cause and manner of death in the case of fatal injuries. In cases where the victim lives it is very likely that the attending physician has little or no experience at determining gunshot wounds for entry and exit characteristics so that type of determination my depend solely on an evaluation of clothing items worn by the victim. In cases where a forensic pathologist conducts an autopsy there tends to be considerable reliance on the interpretation of the wounds for evidence of entry or exit by the autopsy surgeon, but those characteristics are not always clear cut and therefore confirmation may depend on an examination of clothing items.

When a live cartridge is fired, chemical compounds generated by the ignition of primer cap contents and gunpowder combine in a mixture of gases and particulate that produces a rapidly expanding pressure component behind the bullet, initially inside the cartridge case and eventually the chamber and barrel of the firearm, as the bullet is forced through the barrel of the firearm and out the muzzle. The bullet does not form a perfect seal inside the barrel of the firearm by any means and a significant amount of the expanding cloud of gases and particulate behind the bullet actually escapes past all sides of the bullet creating a coating of chemical residue on the exterior of the sides of the bullet. If the first target contacted by a fired bullet is clothing being worn by a person, then as the bullet passes through the clothing fabric, the chemical residue coating on the bullet transfers (at least partially) to the perimeter of the perforation damage in the clothing. This transfer is commonly referred to as “bullet wipe”. Bullet wipe has been found to generally contain lead in levels well above normal environmental conditions.

This presentation reports on the results of testing conducted thus far involving one 9mm semi-automatic pistol using nine different rounds of 9mm Luger ammunition representing seven manufacturers or brands.

In order to establish baseline information relating to the source of lead in bullet wipe patterns on clothing, the gunpowder, jacketed bullet and cartridge case of one round representing each of the seven manufacturers were tested using x-ray fluorescence spectrophotometry (XRF). All gun powders were found to contain lead ranging from 25 ppm to 180 ppm.

One each of the seven representative manufacturer’s cartridge cases with the live primer cap in place was fired in the 9mm pistol while aimed into white, 100% cotton t-shirt fabric at a muzzle to target distance of four inches. The resulting smoke and particulate deposit on the white cotton fabric was tested for lead using XRF. Lead content was noted in the range of from 7,000 parts per million (ppm) to 19,000 parts per million in the deposit. Copper, antimony, mercury and zinc were also noted in significant quantities.

The nine representative rounds of 9mm Luger ammunition were fired into 100% white cotton t-shirts, fitted over a device to approximate body torso thickness, at a muzzle to target distance of six feet (72 inches) in a manner that created an entrance hole in the front and an exit hole in the back of the t-shirt for each shot. All nine bullet entrance holes and exit holes were subjected to XRF analysis. Entrance hole residues ranged in lead concentration levels from 190 parts per million (ppm) to over 1,000 ppm while exit hole residue lead levels ranged from zero to 74 ppm. In all cases, entrance hole lead concentrations were at least six times higher than exit hole lead levels.

A second test firing was conducted where-in a white 100% cotton long sleeved shirt was place over a white 100% cotton t-shirt, which had been placed over a device as described above. Five rounds of different ammunition selected from the original group of nine 9mm rounds were fired into the shirts at a six foot muzzle to target distance such that entrance and exits holes were created in the front and back respectively for every shot. All five primary bullet entrance holes and all exit holes in the exterior white long sleeved shirt were subjected to XRF analysis, as were all five secondary entrance holes and exit holes in the t-shirt (undershirt). Primary entrance hole residues in the long sleeved (outer) shirt ranged in lead concentration levels

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from 114 parts per million (ppm) to nearly 500 ppm while exit hole residue lead levels ranged from zero ppm to 74 ppm. Secondary entrance holes in the t-shirt (undershirt) supported residues with lead levels ranging from 34 ppm to 250 ppm. The percentage of loss in lead levels identified in bullet hole residues between the primary entrance and secondary entrance sites ranged from a low of 36% and a high of 70%.

Damage characteristics exhibited at bullet perforation sites in clothing can also be an indicator for assessing the likelihood of entrance or exit. At an entrance site the clothing is usually supported by body mass and allows for a fairly well defined, circular hole while fabric at the exit site is often not supported and the exiting bullet tends to tear the fabric rather than create a clean hole. Bullet damage characteristics in clothing are best evaluated very cautiously and should always be considered in the context of other evidence.

Firearm discharge is a violent and powerful action and in some instances fragments separate from the fired bullet and can be lodged in the clothing near the bullet entry site. A careful microscopic search may reveal the presence of such particulate at the site of bullet entry.

When a fired bullet exits a person's body it will generally bring with it body tissue fragments and these fragments will be deposited as tissue bits, bone fragments and body fluid spatter on the next nearest target. When there is clothing covering the exit site the tissue/bone/fluid deposit pattern may be significant enough to help in the determination of entrance versus exit injuries. Tissue/bone/fluid deposit patterns must again be cautiously evaluated in the context of other areas of body fluid deposits, types and locations of other injuries, orientation of the significant deposits and evidence handling history.

Clothing items with bullets holes, body tissue deposits and bullet fragments as recovered from shooting victims can be examined and analyzed for the chemical content of their "bullet wipe" deposit patterns and other physical evidence characteristics to successfully identify which is an entrance and which is an exit defect.

Bullet Entrance, Bullet Exit, Clothing Examination

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