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An Overview of Firearms Identification Evidence for Attorneys. I: Salient Features of Firearms Evidence

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ABSTRACT: This article attempts to broaden the perspective of attorneys, but it should be of value to all forensic scientists. Although the subject matter is directed to attorneys, it nevertheless is applicable to the professional understanding of members of all professional disciplines. It covers some of the salient features of firearms evidence, and the scientific articles referenced should enable the reader to find a base from which to begin additional research.

KEYWORDS: jurisprudence, ballistics

This paper is designed to assist attorneys in the elementary understanding and evaluation of firearms-related cases. It is intended only to be an initial source of reference for trial preparation. The material relating to firearms is purposely oversimplified and will be of little value to the experienced criminalist. However, the material is intended to be of some value to all forensic scientists, even if used for no purpose other than review.

For further study on the technical aspects of firearms evidence, Bradford's chapter on "Firearms Evidence" [*1*] was prepared especially for attorneys and provides depth to the salient features as discussed in this paper. References at the end of that chapter recommend sources for further reading, as do additional references throughout this paper.

General Principles

Although revolvers and pistols are more commonly used in the commission of felonies in urban areas and rifles and shotguns are more likely to be used in rural areas, the presumption should not be that this is universally the case [*2*].

What is important is that following discharge every breech-loading firearm leaves physical evidence in the form of a bullet, a cartridge case, and, occasionally, firearms residue and a shot pattern. All of these may be available to the police investigators [*3*].

Bullets are of technical importance because they can frequently be identified with the guns from which they were fired [*4*]. Consequently, a test bullet may be fired through a gun obtained at a scene, and the bullet extracted in such fashion may be microscopically compared with a bullet found at the scene. When test-firing the weapon, the examiner must be careful so that no damage occurs to the test bullet. Firing into a water tank is the best way to do this [*5,6*].

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Questions that must always be present in every examiner's mind include:

1. Can it be determined at what distance from the victim the gun was fired?
2. By examination of a suspect's hand or cheek, can it be determined whether or not he fired the gun?
3. Could the gun that has been confiscated have been discharged accidentally?
4. What kind of gun fired the bullet recovered at the scene?
5. Was the bullet recovered at the scene mutilated?

The classic method of identifying a bullet from a particular gun involves test-firing bullets from the gun in question so that two consecutive test bullets are recovered from a water tank. These bullets should be marked on their noses before the test-firing; these marks should be related to the barrel at the 12 o'clock position before firing. These marks are called "index marks," "witness marks," or "reference marks." After being fired, these bullets are recovered and examined in a comparison microscope so that the optical images of both bullets are juxtaposed. The indexed areas on each test bullet should be aligned to determine whether or not the gun reproduces microscopic striae of an identifying nature. In .22-caliber guns, approximately 80% of replicate test firings cannot be identified with each other and, consequently, identification with an evidence projectile cannot be expected. In larger calibers, however, about 80% of the guns examined produce replicate identification.

Having completed this preliminary examination of the test bullets, the examiner should then proceed to the comparison microscope method in an attempt to make a comparison match between the test-fired bullets and the questioned bullet obtained from the scene or victim. If a determinative identification is made, a microscopic index mark should be made on the questioned bullet so that reexamination can be made rapidly by simply lining up the index marks on the bullets being compared. The information concerning this relocation data should be kept in the case notes of the examiner and be readily available whenever needed or requested. An absence of such relocation data or case notes should make any expressed conclusion of the firearms examiner suspect and open to review.

Comparison identifications are of three types: (1) both objects are determined to be related to the same source, (2) they are determined to be unrelated to the same source, and (3) a determination is not possible from this type of examination. *There should be no conclusions couched in terms of probability.* All same-source identifications should be recorded photographically to document proof of fact.

In addition, a cartridge case recovered from a fired weapon may frequently be linked to the gun that fired it. This can be done in more than one way. A comparison of photomicrographs of firing pin impressions in the primers of the questioned and test cartridge cases may result in identification. A firing pin sometimes leaves individual characteristics on the primer because the firing pin is driven with great force into the primer as the hammer falls. The primer, in response, is pressed with force against the firing pin by powder pressure in the cartridge. This causes surface irregularities in the pin to be impressed onto the primer metal. The impression of the breechblock marks of the rifle or handgun on the head of a cartridge fired in a weapon is also the result of the same type of mechanism.

Firearms Muzzle Residue

Muzzle residue permits the estimation of the distance from the subject at which a gun was fired if the discharge occurred at close range. Unburned and partially burned powder granules as well as other residues are distributed by the firing of the gun. The size and nature of the powder residue pattern may provide a basis for an estimation of the distance from the gun to the object struck. There are certain techniques that also may be used on clothing to determine the pattern of the partially burned and unburned powder granules [*7–31*].

Individual Characteristics in Firearms Evidence

Legal counsel should be aware of the differentiation between "class" and "individual" characteristics involved in the comparison of bullets and cartridges. Gun barrel class characteristics refer to gross properties such as the caliber, the number of lands and grooves, and the direction of twist of rifling of the barrel of the gun.

On the other hand, barrel individual characteristics printed on bullets when fired normally relate to the marks from burrs in the barrel, particularly at the muzzle. When a bullet is fired through a weapon the number of lands and grooves and the direction of the twist of the rifling can be determined by examining the fired bullet. The individual burrs in the barrel transfer striations to the fired bullet. The individual characteristics are essential to the matching of the fired bullet to the weapon that purportedly fired the bullet. This is what is known as a determinative identification.

A completely reliable determination of the muzzle-to-target distance can be obtained only when the gun obtained at the scene is test-fired with the same batch of ammunition as was used in the specific case involved.

On occasions the Walker H-acid test is used to detect nitrous powder residue on clothing. The disadvantage of this test is that it alters the evidence and destroys the possibility of a follow-up examination. In lieu of the chemical identification of nitrate residues resulting from the combustion of gunpowder, powder residue may be detected with infrared photography, "soft" X-rays, and sophisticated scanning electron microscopy coupled with energy-dispersive X-ray analysis.

All bullet entry wounds have a peripheral black ring that results from the carbonaceous products of combustion. When a gun is fired with the muzzle pressed against a clothed part of the body, or against the flesh of the body itself, it is not uncommon to find the bullet hole surrounded by a black ring that closely corresponds to the profile of the muzzle of the weapon used. Sometimes, because pressure causes expansion of the entry wound, a stellate wound results with little ring residue. When hot gases from the powder touch synthetic fabrics, the ends of these fibers frequently melt.

In close-contact wounds, it is not uncommon to find that the high pressure developed in the target following discharge may cause blood, hair, and other substances, particularly fragments of tissue or bone or fabric, to be blown back into the barrel of the gun itself.

The rule of thumb to remember is that as the muzzle-to-target distance decreases the scattering of particles will decrease, thus increasing the density of the particulate matter dispersed on the target. The length of the barrel of a gun and the ammunition used, as well as other manufacturing characteristics, may create different patterns of powder residue at different distances. The same gun will produce different patterns with the varying gunpowder peculiarities created during the manufacturing of the ammunition. It is essential, therefore, to know what company manufactured the particular ammunition being used, the lot of ammunition that was used, and the type of gun being used to fire the particular bullet in question [*32–37*].

Terms of importance connected with gunpowder and primer residue include tattooing, powder stippling, and powder burn. Each is frequently used to describe the dispersed residues of powder charge that may be located at the site of a bullet wound or the point of impact.

Flight Path

The direction in which a bullet is fired may be determined to some degree by studying the relationship of entrance and exit wounds. However, caution is urged because the bullet may deflect as it strikes a bone. The same ricochet effect may occur in the flight path of a bullet outside the body within a given area. Gunpowder residues on the skin and more on one side of the bullet wound than the other indicate that the bullet struck the body at an angle. The

same rule applies to outer garments and may well be applied to elliptical bullet holes found in wood or other materials.

Abrasions located on fabric, wood, or human skin may be evidence of the direction of the bullet flight path. When a bullet strikes an object perpendicularly the abrasion should be circular and uniform in width. However, when the bullet strikes an object angularly the hole itself may be round but the marginal abrasion should be oval because of the scraping or abrasion caused by the increase in width as the bullet enters from an angle. The actual abrasion and its width depend on the angle at which the bullet struck the object.

Frequently, lubricants used within the barrel of the gun, or combustion products accumulating within the barrel itself, may be deposited on the bullet as it exits from the barrel. These substances constitute the black ring deposited on the edges of the entrance hole. This observation may be made with both lead and copper-jacketed bullets. The abrasion, in such instances, should be found surrounding the black ring.

The frayed edges of a bullet hole in cloth may indicate the direction of the bullet path. Furthermore, pieces of fabric frequently are carried into the wound track and may be found some distance from the entrance wound.

When a bullet strikes a body, it is common that the entry wound is smaller than the caliber of the bullet and the exit wound is considerably larger. This latter phenomenon is created by the overstretching of the skin as the bullet pushes material outwardly in front of it. Any conclusion concerning the caliber of a bullet based on the diameter of either an entrance or an exit wound is highly speculative. A deformed or a ricocheting bullet striking an object also creates holes that cannot be related to the caliber of the bullet. In addition, bullets may fragment and, as a result, create bizarre penetrating holes. In copper-jacketed bullets, the core may separate from the jacket and create two different directional pathways. It is important to obtain copper-jacketed fragments as well as the lead portion of the bullet when metal is removed from a wound.

In differentiating between homicide, suicide, and accidental death, it is important to determine the distance from the muzzle to the body struck, the type of firearm used, and whether or not there are firearm residues on the hand of the individual suspected either of committing suicide or of firing a gun that killed another human being. Because different firearms deposit residue in different ways, it is important that laboratory examinations be made. The index finger, thumb, and connecting web area of a shooting hand are most likely to be contaminated with the residue of the firing processes; residue may be found on both hands, particularly when both hands have been used in the firing process. There are determinative methods for ascertaining whether or not such residue is located in these areas. However, caution should be exercised in making quick judgments when such deposits are absent. Absence of residue will not eliminate the possibility that the person may have committed suicide, nor does it indicate that the gun was fired by another person.

No one can predict the flight path of a bullet in advance. Experiments have shown that bullet flight paths can be determined only in retrospect, that is, by determining where the bullet came to rest and then tracing the various telltale marks it left during the course of its flight, taking into consideration marks on walls, wood, and the object struck. When a bullet ricochets, it is quite frequently deformed. The deformity will be related to the type of bullet, the consistency of the object struck (such as metal, wood, or plaster), and the angle of the impact of the bullet on the object struck.

Studies have shown that the angle of ricochet of a bullet is totally unpredictable except under controlled conditions on the surface of a body of water. When tests are performed under such controlled circumstances, the angle of reflection will equal the angle of incidence, much like that of a basketball bounced onto the floor.

Characteristics of Ammunition

The attorney involved in any prosecution or defense in which firearms evidence is to be used should be familiar with the type of ammunition as well as the type of gun suspected of being

used in the commission of the crime. This is particularly true because of the many types of ammunition now available. Ammunition will range from lead bullets to copper-jacketed bullets, to plastic bullets, Teflon®-coated tungsten-alloyed bullets, frangible bullets, bird shot, and others.

A tandem bullet does occur on occasion and results from the discharge of a second bullet while the first bullet is stuck within the barrel of the gun. Consequently, one bullet will ride piggyback upon the other. The second fired bullet, when pushed into the rear of the other, creates a double impact when compared to ordinary bullets of the same caliber. Usually a piggyback bullet is caused by faulty ammunition or a defective firearm.

Blank cartridges use a primer, gunpowder, and wadding, but have no bullet. The propellant in blanks burns faster than the propellant used in an ordinary cartridge of the same caliber. Blank cartridges when fired at very close distance can be very dangerous.

Stud guns, used in the building trades, are used for firing metal studs or nails into steel, wood, concrete, or other materials. Stud guns may be devastating when fired at the human body.

Photomicrographs

Photomicrographs are made so that the identification made under the comparison microscope can be documented and used for both notes of reference and for demonstrations. It should be mandatory that enlarged photographs be made to document the evidence to be presented before court and jury. Whenever this is not done, the trier of the case should be skeptical concerning the credibility of the identification allegedly made.

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