Forensic Examination of Ballistic Weapons: Indian Scenario

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Abstract: The identification of ballistic weapons, fired bullets and cartridges in respect of the weapons through which they have been fired is the most important work in forensic examination of firearms. The ballistic weapons and the recovered ammunition live and fired, should invariably examine in forensic science laboratory. The investigating officers known: the nature firearms evidence to be collected, firearm is found, firearms/ammunition sample is required, firearms is collected, packed and dispatched forensic labs.

Keywords: Ballistic Weapons, Forensic Examination.

Introduction

“Today, it may be set down as a scientific fact and a postwar discovery now first made public, that no two revolver or pistols ever leave precisely the same marks upon a bullet, and that it now is possible and practicable to link the bullet to the weapon in virtually every instance.”

.........W. S. Stout

Forensic ballistics is the examination of weapons, cartridges and bullets. Ballistic weapons which are used for crimes of violence can be categories into main types; smooth bore and rifled firearms. Between the two types there are various types of ballistic weapons, but suffice it to say here that a smooth bore firearm is the ordinary type of shotgun or shot-pistol, and the bullet used is the shot which consists of small lead balls or pellets. Ballistic weapons which are used for crimes of violence can be categories into main types; smooth bore and rifled firearms. Between the two types there are various types of ballistic weapons, but suffice it to say here that a smooth bore firearm is the ordinary type of shotgun or shot-pistol, and the bullet used is the shot which consists of small lead balls or pellets. The physical evidence related to ballistic weapons normally deals with the fired cartridges, empties, firearms etc. The nature of the examination in ballistic weapon cases is normally to find out whether the fired cartridge are fired from a particular firearm, nature and the type of the firearm, the direction of the firing, the distance of the firing, the range of firing of the firearm the time elapsed since the time of firing etc.

Scene Investigation of Firearms Cases

Challenges before a genuine investigator are manifold, generally of which are:

- Identification of location of crime.
- Visit the location and collection of physical evidence from scene of occurrence.
- Detection of firearm used in the crime.
- Collection of evidence from inputs.
- Supply of one or more missing link in a chain of evidence.
- Strengthening of a weak link or links in a chain of evidence.
- Clarification of doubts in the preliminary investigative stage, which may or may not be significant at a later stage.

The investigating agency has to get answer of many questions such as: (i) what kind of firearm used? (ii) Was the firearm working condition? (iii) What was the range and direction of fire? (iv) Did the specific firearm fire cartridge which was recovered from deceased’s body? (v) Did a particular person fire the firearm? Whether the case was an accident, homicide or suicide? This also includes examination of cartridge, cartridge cases, bullets, wads, firearm shot residues, etc.

The investigator can confine his studies to small ballistic weapons, i.e., guns, rifles, pistols, revolvers and magazine firearms. The constituent parts of all these firearms are the lock, the stock, the barrel and the accessories. If the barrel is long and the butt end of the stock transverse to it, so that, when fired, the firearm can be placed against the shoulder, it is called a gun or rifle. If the barrel is short and the stock curved down so that the firearm must be held in the hand when fired, it is a pistol or revolver. Any ballistic

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1 Lisa Steele, Ballistics, available at: http://apps.americanbar.org/abstore/products/books/abstracts/545 (last visited on July 26, 2016 ). W.S. Stout was a fingerprinting bullet in Saturday Evening Post (1925) in U.S.A.


4 Supra note 2 at 95.

5 Rukmani Krishnamurthy, Forensic Science in Crime Investigation 327(Selective & Scientific Books, New Delhi, 2011).


7 B.P. Maithi, Physical Evidence in Criminal Investigation & Trials 274 (Selective & Scientific Books, New Delhi, 2012).

weapon found at the spot of the crime should not be snatched up at once. It must be ascertained whether they have passed through anybody’s hands before they are collected. If any ballistic weapons found have not been touched by anybody, the investigator may find valuable fingerprints of the criminal on it. The investigator should note the number; make, etc., of the weapon found and carefully pack it up for expert examination.\textsuperscript{9}

The bullets, cartridge used in modern ballistic weapons contains three elements integrated inside the bullet. The elements are cartridges, propellant and primer. The cartridge is the actual projectile which will come outside the barrel after firing. It is made with different metals like brass, steel, aluminum and also with rubber and mood. Most of the bullets contain lead along with other metals for best performance and accuracy.\textsuperscript{10}

Whenever a ballistic weapon is used to carry out a design against anybody’s person, a very careful examination of the cartridge is of paramount importance, with particular reference to the nature of the crime, the marks and other features indicative of the make. The manufacturer’s name and other allied points have to be noted. A record of the results obtained in consequence of such scrutiny and test should be maintained for the assistance of the crime investigator.\textsuperscript{11}

The police investigator with a team consisting of firearms, medico-legal and a fingerprint expert along with a photographer should visit the scene of crime. The first and foremost duty should be to attend on the victim and arrange for necessary medical aid and recording of dying declaration.\textsuperscript{13}

\textbf{Firearm Evidentiary Clues}

The scene is the most important place for evidentiary clues. The investigating officer must locate, document (image, sketch and describe) and collect:

- The firearms, in suicides or accidental deaths, or their simulated versions. Its position and conditions vis-a-vis other evidence at the scene are extremely important.
- Fired cartridge cases, projectiles, wads and powders residues. The projectiles may be embedded in furniture, walls, trees, etc., smell of power charge burning.\textsuperscript{13}
- the location of the scene and the routes of ingress and egress, he sketches the scene to a scale and gets a video-film of the scene of occurrence prepared, covering all aspects of the scene, the time of arrival, the state of doors, windows, ventilators, taps etc.

\textbf{Mechanism of Firearms}

A ballistic weapon consists of two important parts: (1) the barrel and (2) the mechanical part which includes the chamber, breech face, firing pin, extractor, ejector and trigger. Barrels are of two types: (1) smooth bore and (2) rifling with lands and grooves. All barrels are manufactured from drilled solid steel pieces. The solid steel pieces are subjected to the drilling process from one end to the other with a uniform diameter. The inner side of the barrel will later bore with a reamer to produce a smooth surface. One of the scientific significance of barrel is that due to the drilling process, the inner surface of the barrel gets various scratches and scars which supplies the individually to that barrel.\textsuperscript{14}

Ballistic weapon examiners may be called upon to determine if weapons are operating properly or to conduct firearm powder shot pattern tests. In addition, examinations of questioned ammunition case may be assisting in ascertaining the type of firearm used in a crime. The bomb expert can analyze fragments of bombs to determine their original composition and possible sources of raw materials.\textsuperscript{15} The barrel is the metal tube in which the charge is placed ready for firing and in which it is exploded. This tube compresses the gases developed during combustion and gives the missile its proper direction. Now-a-days the barrel is always made of steel: formerly we find it constructed of iron and even bronze, copper, brass, and other metals.\textsuperscript{16}

\textbf{Evidence Collection}

The evidence available on ballistic weapons should be collected systematically: (i) Search and collect all the extraneous evidence like bloodstains, skin, flesh hair, paint or dust. Detach and pack them in separate small cellophane/plastic pouches, after drying, before the ballistic weapon is processed to fingerprints, (ii) Hold the ballistic weapons from place like the sling, ring, trigger guard or the corrugated surface on the butt where the possibility of fingerprints does not exist, (iii) Check the breech face, firing pin, extractor, ejector and trigger. Barrels are of two types: (1) smooth bore and (2) rifling with lands and grooves. The inner side of the barrel will later bore with a reamer to produce a smooth surface. One of the scientific significance of barrel is that due to the drilling process, the inner surface of the barrel gets various scratches and scars which supplies the individually to that barrel.\textsuperscript{14}

\textsuperscript{11} Anjani Madan Gaur, \textit{The Relating to Arms, Ammunition and Explosives} 13 (Eastern Book Company, Lucknow, 1970).
\textsuperscript{12} Kaushalendra Kumar, \textit{Forensic Ballistics in Criminal Justice} 250 (Eastern Book Company, Lucknow, 1987).
\textsuperscript{16} B.C. Jauhary and S.N. Gaur (eds.), \textit{Fire Arms, Forensic Ballistics, Forensic Chemistry And Criminal Jurisprudence} 6 (Delhi Law House, Delhi, 2009).
identification particulars (FIR No, with the date and name of the police-station) and the initials with the date of recovery of the firearm at the prominent parts like barrel, action block or stock of the ballistic weapon, (v) The position of the fired and live cartridges in the cylinder when revolver is involved, and (vi) The nature, quality and the quantity of the extraneous evidence, if any, observed and collected from the ballistic weapon.18

Before packaging the ballistic weapon, its serial number, make, model, calibre, etc. should always be recorded. The empty cartridge are often found at the crime scene, there position should be noted. Since, they may contain chamber, firing pin, and ejector marks, hence should be collected carefully. The ballistic weapon may contain live cartridge in the chamber or in the magazine. In such a situation, they should be recovered with taking extra care by an expert ballistic weapon handler only. If a firearm is involved, a thorough search should be made for pellets and wads at the crime scene. Cartridge may be found embedded in a wall, tree, and trunk. Doors, windows, etc. the material around the place of lodgement of the cartridge should first be removed to lose the cartridge and then it may be taken out carefully, so that extra scratch marks will not develop on its surface.19

Methods/Techniques of Examination of Ballistic Weapons

The bullets and the cartridges are cleaned before they are examined and compared. Dust and dirt is removed with a cotton-wool swab. The greasy surface is cleaned with petroleum either. Dilute acetic and dilute hydrochloric acid are also used to clean dull surfaces.20

Visual Examination

Visual examination allows quick eliminations and thus save a lot of time in case involving a large number of ballistic weapons. It gives the position, size and depth of the firing pin, breech face, extractor, ejector and chamber marks. Few times there may be gross characteristics indentations which permit quick identification or elimination of a suspected ballistic weapon in respect of a bullet case. Visual examination of cartridge indicates the caliber, the number of lands and grooves, their depth, width, direction and twist. Few ballistic weapons are easily eliminated by the visual examinations though positive identifications are rare through visual examinations.21

Comparison Microscopy

Stereomicroscopy is a simple, inexpensive and an extremely useful method. The test and the crime cartridges are placed side by side. They are properly illuminated by spot light. The light falls on the two bullet cases at the same angle. The examination of the cases is started with the lowest magnification of the microscope and progressively increased. At higher magnification, the bullets are examined in turn because photographs from both bullets are not seen in the field simultaneously. The relevant surface are examined through 360° and titled, if necessary.22

X-ray Examination

This method has been in extensive use, for conduct of qualitative and quantitative analysis of elements of firearm shot residue, which is convenient due to: (i) comparatively low price, (ii) simplicity in operation, and (iii) efficiency in results.23 The lead metal is opaque to X-rays. A soft X-ray radiograph of the hole reveals the radio opaque deposits around the hole in a characteristic pattern, indicative of a firearm shot fire.24

Gunshot Residues

The term ‘residue’ simply means something ‘left over.’ The term has several meanings as applicable to ballistic weapon residues. For example, the law enforcement agencies may be interested in the residues left on the hands of the suspect/assailant in ballistic weapon assaults, the firearm expert may be looking for the residues in the weapon itself and the doctor may be craving for the residues on the victim’s body in association with the firearm wounds upon the body.25

The polishing of the firearm and the amount of rust can be of some assistance in making distinction. Final confirmation that the victim has discharged the firearm can be made through firearm shot test. This method is consistent with the hypothesis that the firearm shot residues are formed by the condensation of vaporized particles from the cartridge and the priming materials that segregate into metallic and compound particles of lead, barium, antimony, copper, nickel and arsenic.26

Dry Method

Molten wax of suitable melting point is used to collect Gunshot Residues from hands. It is gently brushed over the hands till it acquires sufficient thickness (one to tw mm). It is allowed to set. When the wax is set, it is peeled off. It picks up the Gunshot

18 Ibid.
19 Supra note 7 at 299.
20 Id. at 200.
22 Supra note 17 at 201.
24 Supra note 21 at 484.
25 Supra note 111 at 246.
26 Supra note 7 at 308.
Residues particles from the hand.27 A solution of cellulose acetate is applied to the site bearing the gunshot residues. It is peeled off on drying. The cast picks up of the gunshot residues. Solution is sprayed on the site bearing the powder marks. The film formed is reinforced with nylon fibers. The reinforced film which picks up the powder residues is peeled off, on drying.28 It picks up the Gunshot Residues particles. The tape is kept in a vial with adhesive surface inside the vial, before and after the use. The tape is mounted on specimen stub for examination.29

Wet Methods

A filter paper is moistened with dilute acetic acid. It is pressed against the spot suspected to bear firearm shot residues. They are picked up by the filter paper. A piece of cotton cloth or a cotton swab is moistened with dilute hydrochloric acid (10%) or with nitric acid (5%) and the site bearing the firearm shot residues is swabbed with this piece of cloth or swab. It picks up firearm shot residue. The swabs from various parts of the hand are collected separately. 30

The hands are rinsed thoroughly in dilute nitric acid (fifty ml of one molar nitric acid is used) placed in a plastic bag. The solution thus obtained is freeze dried and is ready for testing purposes. The residues in the barrel are collected by washing the barrel with hot distilled water. The washings are tested for the constituents of the residues.31

Scanning Electron Microscopy (SEM)

Scanning electron microscopy is the most impressive and effective technique to evaluate the gunshot residues: (i) it images the powder residue particles at site. The specific shapes of the lead particles indicate firearm shot residue, (ii) it provides elemental analysis of the elements in the powder residues, (iii) the analysis is non-destructive in nature, and (iv) it gives the number of the particles per unit area.32

It scanning electronic microscopy a fine beam of electrons is focused on the material under study. The electron beam has the following effects: (i) it generates x-rays: the generated x-rays are used to find out the elements composition of the material with an x-ray analyzer as the x-rays are characteristic of the element, (ii) it gives cathode luminescence: when the electron beam falls on certain materials, it creates luminescence, specific of the elements involved. The spectral analysis of the light indicates the elements involved,33 (iii) it creates back-scatter: some electrons are reflected back (back-scatter). The photographs obtained from these electrons have three-dimensional effect which permit the topographic evaluations of the surface firearm shot residue particle in much better way, and (iv) it provides high magnifications/resolution: Scanning Electron Microscopy can give magnifications of the order of a hundred thousand times with high resolution and thus provides an excellent tool for the structural studies of the firearm shot residue particles on the surface.34

Dermal Nitrate Test

Dermal nitrate test was frequently used prior to 1950 to identify the shooter. The test is simple. The nitrates are picked up on a paraffin wax cast as described earlier. The residues on the cast are treated with diphenylamine dissolved in strong sulphuric acid. The formation of blue colour spots indicates nitrates. They are, in turn, indicative of the presence of the gunshot residues. As certain common materials give positive reaction with the above tests, the method is no longer used.35

Walker’s Test

Walker’s test is widely used even today. A desensitized glossy bromide paper is taken. It is treated with two naphthylamine 4:8 disulphonic acid (5%). The bromide paper is placed over a table with the treated surface upward. The cloth bearing the gunshot residues is placed over bromide paper. It is covered with a towel moistened with 20% acetic acid and the set-up is pressed with hot electronic iron for about five to ten minutes. Dark red spots on the bromide paper indicate gunshot residues.36

Paraffin Test

The method of detecting gunpowder residues in the hands of a suspect in a case of shooting is known as paraffin test and depends upon the fact that when a poorly constructed weapon is fired, the burnt/unburnt gunpowder residue escape through the rear and get deposited on the firing hand. If the hand is examined before it is washed, the products of combustion of propellant will be detected therein.37

Automated Firearm Identification

27 Supra note 21 at 481.
28 Ibid.
29 Ibid.
30 Supra note 17 at 237.
31 Ibid.
32 Supra note 21 at 485.
33 Ibid.
34 Id. at 486.
35 Id. at 484.
36 Supra note 17 at 239.
37 Supra note 12 at 152.
In the area of ballistic weapon identification, a number of automated comparison systems like landmark identification system, non-contact laser surface analysis, and laser profilometry are being developed at the international level. It is reported that in some countries, whenever firearm, bullets, or cartridge cases are discovered in a crime, an inter-comparison is made with the other crime cases to explore linkage, if any. This appears to be promising technique to keep a track of unsolved crime cases involving firearms.38

The Central Forensic Science Laboratory, Chandigarh is working on the development of automated ballistic weapons identification system and establishment of firearm and ammunition database for forensic investigation. The lab should extend its efforts to set up a national database for use by the entire forensic science lab and other law enforcement agencies in the India.39 Thus, the database will help in linking the previously unlink able crimes committed with the same ballistic weapons in different jurisdictions.40

National Integrated Ballistic Information Network (NIBIN)

NIBIN system is a sort of fingerprint bureau for the ‘thumbprint’ of ballistic weapons. The identifying data from all the licensed factory-made ballistic weapons, if generated and stored in the computers of the NIBIN before they are sold, they are sold, can be used to identify the offending ballistic weapons abused in a crime. The fired bullet, cartridges left at the scene can identify the ballistic weapon from the corresponding recorded data kept in the National Integrated Ballistic Information Network. The NIBIN system has many importance: (i) Comparison takes less time, (ii) Comparison and verification can be done at any designated match point place where the facilities for the work are installed, and (iii) the hurdle presented by the deformation of bullets is taken care of by the NIBIN system.41

Demerits of NIBIN system: (i) Non-registration of sale and purchase of ballistic weapons, (ii) change of identification characteristics of ballistic weapons, immediately on purchase, (iii) absence of sufficiency of clear marks, in certain cases for purpose of identification, and (iv) analysis of marks at the stage of initial data generation and for the purpose of comparison, not easily made.42

Presentation of Evidence

A ballistic weapon/bombs expert who has the rank of an Assistant Director, Deputy Director or a Director of a Forensic Science Laboratory is not required to give evidence in person. The report of the expert, alone, is considered sufficient as evidence. Others have to appear in person to prove their reports. The expert giving the evidence, establishes himself as an expert, identifies the exhibits prepared at the time of examination, gives experimental details, produces the data generated and presents the conclusions from the observations made by him. He illustrates his conclusion by images, illustrations, etc. if necessary.43

Expert Evidence

The person making examinations of physical evidence must have a background of training and experience in the field concerned. The ballistics expert must also be an expert backed by years of experience in the field of firearms.44

Expert evidence as regards the identification of instruments of crime is of forensic importance. It is an important link in the claim of circumstantial evidence as it confirms the guilt of its possessor. The wound reveals the nature of the weapon used. In criminology the main purpose of the science of forensic ballistics is to establish the use of a given bullet or cartridge of the weapon.

Expert evidence in shooting case has great importance because the evidence: (i) Is involved in heinous crime like murders, dacoities, suicides, attempted murders, accidents, etc. often resulting in loss of life, limb or serious wounds?, (ii) Provides definite linkage between the criminals and the crime, through the ballistic weapons and the fired cartridge, bullet. (iii) Permits the determination of the range of fire, direction of fire and differentiation between fake and real ballistic weapon wounds, (iv) Permits verification of versions: prosecution versions, defence versions, the correct versions, a real or fake suicide, murder or accident, a real or fake encounter, a real or fake crime scene? (v) Decides whether the occurrence is a case of suicide, an accident, a homicide, or a killing in self-defence. (vi) Indicates the pattern of events, for example, it can determine the number of shots fired, the number of firearm used, the sequence of firing and the events, the modus operandi of the culprit etc. and indicates the time of death, from the time of firing, etc.46


Ibid.


Supra note 17 at 212.


Supra note 21 at 521.


Supra note 13 at 239.
An expert appearing in the court states his qualifications, training and experience, both in related field and in actual firearm examination. The qualifications and experience are, thus, brought on record for the convenience of the court to decide whether the person giving evidence is an expert under Section 45 of the Indian Evidence Act or not. Section 45 of the Indian Evidence Act requires that only those persons can give expert evidence that are specially skilled in the art or science, in which they are expressing their opinions. The idea of placing the qualifications of the expert on record is therefore, to show that by education, training and experience the expert is specially qualified to express an opinion on the subject in hand.

Conclusion

Forensic ballistic is the science of investigation ballistic weapons usage in offenses, which includes investigating cartridge case, bullets, gun powders, ammunition etc. The ballistic weapons are used in offenses like, murders, robbery and also in police encounters and firings etc. The ballistic weapons evidence therefore is important in criminal investigation and trial proceedings. The smooth bore ballistic weapons are shotguns, the muzzle loading firearms, homemade firearms, pistols etc. The rifled bore ballistic weapons are pistols, revolvers, rifles, machine guns, sporting rifles and ammunition including firearm powder, cartridges, bullets and explosives/bombs. The ballistic weapon evidence helps to: difference between actual and false incidence, decide whether the given incidence is a case of murder, accident, killing in self-defense or suicide, determine the structure of events.

Section 45 of the Indian Evidence Act, 1872: Opinions of experts: When the Court has to form an opinion upon a point of foreign law or of science or art, or as to identity of handwriting [or finger impressions], the opinion upon that point of persons specially skilled in such foreign law, science or art, [or it questions as to identity of handwriting] [or finger impressions] are relevant facts. Such persons are called experts. Supra note 21 at 521.