

## An Illustrative Study on Wound Ballistics on the Human Body

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### Abstract

Penetrating injuries of the body are most commonly the result of firearm wounds which are often associated a range (distance) of fire. In every physical assault where firearms used to commit suicide or homicide, the injury led to death or not, the attacker had produced/left different types of ballistics wound in the victim's body that could be helpful to reconstruct the crime scene, distance of fire, type of firearm and also guide to determine the cause of death.

Through present study, we have illustrated examples of ballistics wounds found on the victim's body with our cases photos. These provide proper and illustrative images for the forensic community working in the field on wound ballistics and injury based analysis. All the images reported and examined in the study have been collected by the authors of the articles, from real crime scene cases. The injuries due to firearms explained and available in the literature are consistent with our reported illustrations.

**Keywords:** Injuries; Types of Ballistics Wounds and Digital Photography; Crime Scene Reconstruction

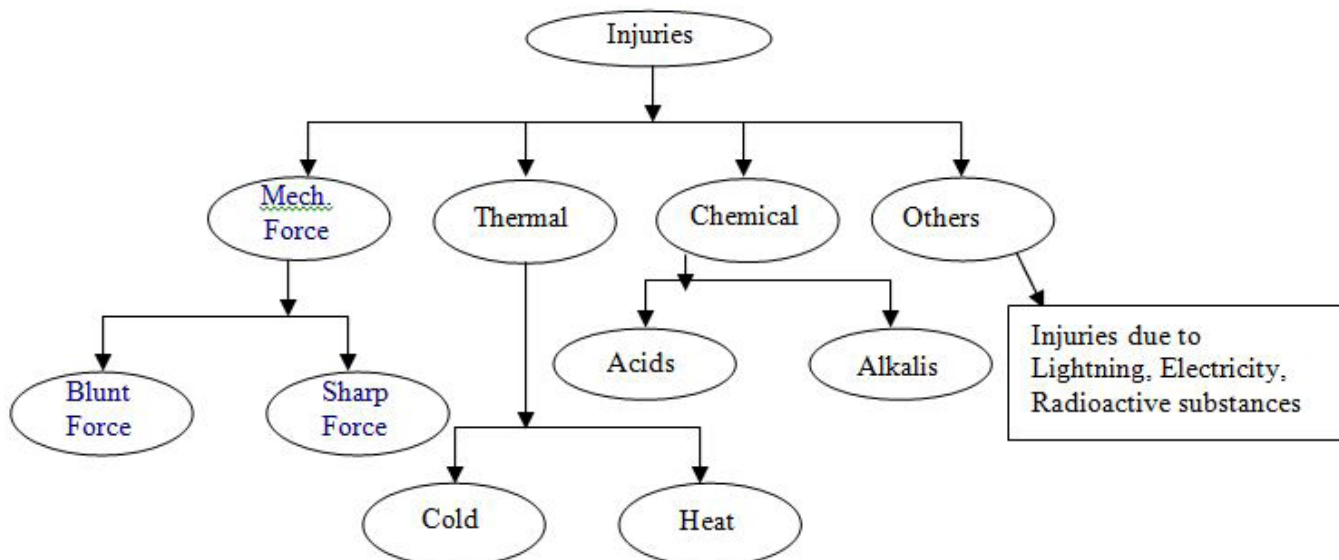
## Introduction

An injury is defined as any harm, whatever illegally caused to any person in body, mind, reputation or property as per Indian Penal Code (Sec. 44). In forensic science, the ballistic wounds are produced by physical violence using firearms, which break the natural continuity of any of the tissues of the living body [1-3]. Different types of injuries are summarized in Figure 1 and Figure 2. In Ballistics, as the distance up to which the momentum of missile drops to the level that human penetration is not possible. It is different from 'useful range', which is defined as the distance up to which the best results are achieved for penetration [4].

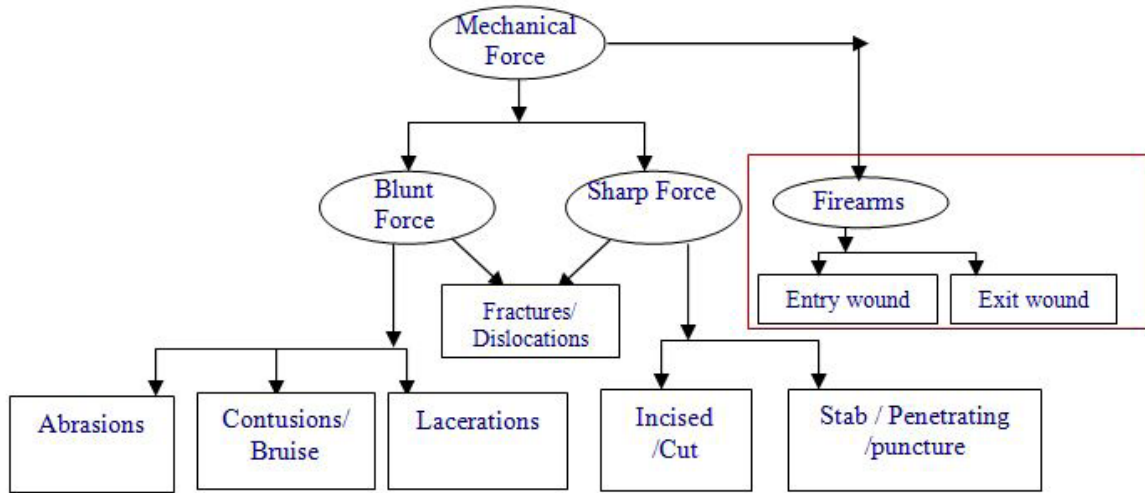
To understand how fire-arm injuries are caused, when a firearm is used at a crime scene, it leaves traces as following things: a) burning gases: When a firearm is used at a scene of occurrences it discharges, immediately a rush of gases at very high temperature leave the muzzle, sound of great amount is also produced. These gases are nitrogen, carbon dioxide, carbon monoxide, etc, some time flames also observed [5]. b) Gunshot Residue (GSR) Particles: Unburnt flakes of propellant material also come out from the firearm with gases, which may be deposited nearby matter contact with it, known as GSR, c) Powder tattooing: it is also a form of GSR, observed when the firearms used with as close or very near distance between the fired and the fire, and d) bullet: the lead pellets (bullet) come out from the firearm after burning of the gases and soot particles in the firearm. They travel a distance according to their make, model, groove of firearm, type of firearms and their momentum [5-7].

Accordingly, the entrance/exit wounds of the firearm are classified according to the distance between firearm (muzzle) and victim. The classification of the firearm wound has been reported in literature [8-11], we have summarized all the wound made by firearm in our Figure 3 with the flowchart. The classification of these ballistic wounds are explained with their definition and illustrations in our section discussion, with exemplified illustrations of our own cases. So the reader may have the concept of the injury with example in the same.

In the present paper, the authors have tried to exemplify the physical character of the ballistic wounds, which have been caused with the help of different instruments/weapons. In the paper, illustrative photos of different ballistic wounds are reported for ready use in forensic community to get proper direction in investigating agency.



**Figure 1:** Injuries due to physical violence, on the victim's body found generally at scene of crime



**Figure 2:** Mechanical injuries are classified with specifications, in the brown bracket the types of firearm injury has been clearly explained in the Figure 3

### Methods and Material

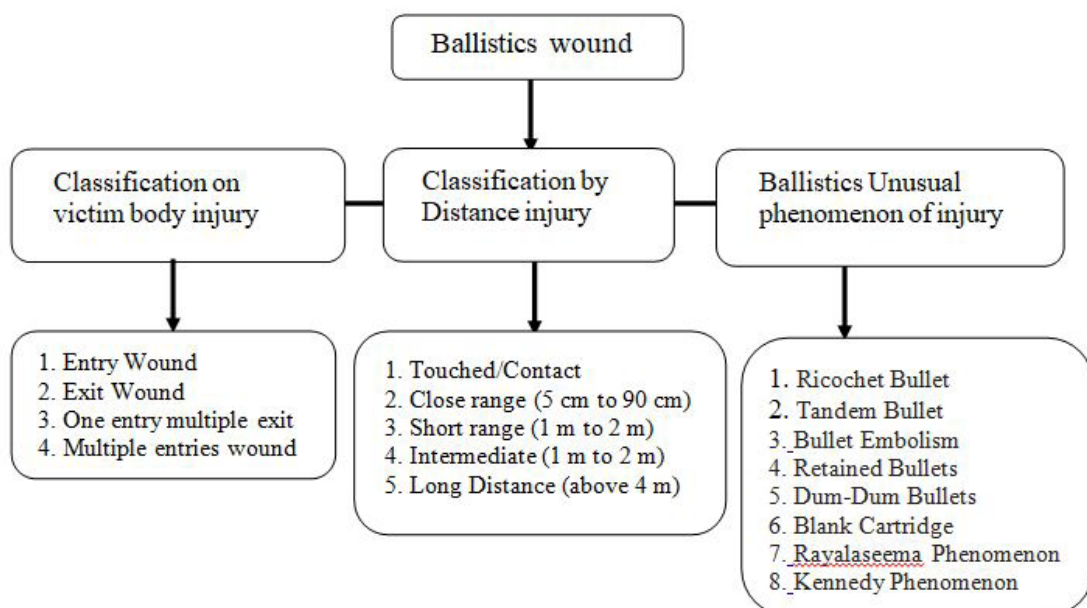
Firearms are usually recognized without difficulty, but due to negligence, avoidance and inexperience causes difficulty to recognize these. These injuries produced by firearms varies with the types of projectile, the muzzle velocity, distance, angle of firing, part of the body involved, surface, ricochet or tandem bullet and medico-legal negligence etc. [8].

These ballistics wound illustrated in Fig. 3 are subdivided, on the point of observations as define follow:

**Entry Wound:** When a bullet, passing through a body, produces a wound the point of entrance on the skin known as entry wound

**Exit Wound:** Another at the point of exit of the bullet known as exit wound.

These two broad wound are sufficient for a forensic expert to explain the scene of crime, but some study says data mislead or misguide due to lack of knowledge, investigation in wrong direction. In the lowest flowchart different unusual phenomenon report in Figure 3, common for all type of entry and exit wound



**Figure 3:** Classification of Firearm injury in illustrated for various factors

## Physical interpretation and observation of our statistical data for entry and exit wound

The Table 1, represent the terminology to differentiate the entry and exit wound made by the firearms are available in the literature [12,13], summarized here to provide the reader, full details of the injury made by firearms with our illustrative images. A reader can easily be able to separate the images as entry or exit wound by using the Table1, within the article.

| S. No. | Physical Properties and interpretation | Entry Wound   | Exit Wound   |
|--------|--|---|--|
|        | Size                                   | Smaller than the diameter of the bullet   | Bigger than the bullet   |
|        | Edges of the skin of the victim        | Inverted  | Everted or Torn  |
|        | Bruising/Abrasion/Contusion            | Present   | Absent   |
|        | Burning, singeing of the skin          | May be observed around the wound  | Absent   |
|        | Lead ring or metal ring                | May be seen while radiological examination                                      | Absent   |
|        | Bleeding                               | Less  | More   |
|        | Clothes of the victim, fibers          | May be detected   | Never  |
|        | Any gaseous or carbon monoxides        | Can be detected in May be present but high quantity. decreasing as track passes | Keeps on very less as compared to entry wound                  |
|        | Victim body fat                        | No protrusion except in contact shot  | May protrude   |
|        | Tissues within and around the wound    | May be cherry-red due to CO of explosive  | No colour change   |
|        | Digital X-rays Images                  | Less  | More detectable if bullet entangled with bone, surely observed |

### Illustration of the images:

The authors have a vast experience of crime scene visit in the investigation of firearm, and its related cases. On the basis of our experience in the field, analysis of injuries, sometimes helps at spot to the IO, get a proper direction of investigations. As per our Figure 3, we report and classified every images on basis of victim's wound and probable distance of fire.

Images 1, 2 and 3 are Contact firearm injury entry wounds without tattooing on the victim's body



In all three photos, one can easily observe all the featured characteristics of entry wound, with different angles. Images 1 to 3, are very explainable that these are related to closed firearm injury with entry wounds, these images are provide an example for the readers, so that no further study required.

Image 3, 4, and 5 are Close distance firearm injury entry wounds with tattooing on the victim's body. As we study, when the firearms used at a close distance, tattooing observed, these images illustrated the tattooing with image of bullet marks.



As all the three photos having tattooing and bullet impression, the forensic team can easily determine the distance, direction and type of firearm used, as the images depicts themselves.

Images 7, 8 and 9 are short distance firearm injury entry wounds, with a small distance like 1 foot to 4 feet, these images are illustrative as well as self explanatory for the reader of the forensic field community. These images provide a proper data base for wound ballistics.



Images 10, 11 and 12 are exit wounds of victim body as reported in table 1, all symptomatic characters are illustrated. The exits wound on the victim's body always create a doubt in the mind of the investigating agency and officer, what might proper observations. These illustrations provide a proper explanation of the types of wounds.



Also, all the exit wound injuries are consistent with the table 1, as featured characteristics of exit wounds are observed in all three images.

Images 14, 15 and 16 Images of victims injury locations with closed firearms used, all images are suicidal firearms injury, every images having burning and shrinking effects of firearms on the cloths. Suicidal nature of wounds is having different characteristics, which are available in the literature [13], reported here are same.



These images (1 to 15 images) are the library for the forensic ballistics community, which is not available in the literature, with the type of injury illustrations, through this article, we have tried to illustrate the injury of firearms made as entry or exit may lead the directions of investigation, sometime mislead if the opinion of the expert at the spot is not clear.

## Results and Discussion

Our study will be useful for the gunshot wound is very important especially to the forensic investigators in interpreting the gunshot injuries. This knowledge will be used in the process to recover firearm projectiles to recover firearm bullet from the victim's body, analysis and presentation in court without causing special utterances. Besides, differentiating a firearm entry wound from exit wound or vice versa and estimating the approximate range of shooting are always important factors to be determine at the spot of occurrences. Through the article and our observations on the wound, the investigation officer may lead to the proper direction of investigation.

Some time appearance of a ballistics wound may be mislead due to the following conditions these are mainly observed in India: a) moving of dead body, shooting and fly create of margins of the wound opening, b) environmental conditions of victim's body (stages of decomposition); c) internal resistivity of the victim's body and healing of the wound itself; d) negligence of medical officer medical personnel and inappropriate experiences of wound analysis; e) While doing autopsy or Surgical operation dos and don'ts are neglected; f) case may be affect by non-professional personnel at scene of crime; g) Negligence of the IO ate crime scene and h) Washing or cleaning of the wound after death [14].

From Point a) to h) are the most important aspect of scene of crime team, medico-legal team and police person to consider, while visiting or examining the death of scene, where firearm is involved.

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