Introduction to Wounding Mechanism

When a projectile strikes the human body, it depresses and compresses the skin, flesh and bone underneath. The sustained pressure stretches them beyond the elastic limits and a hole is produced. The stretched skin recuperates its normal state after the hole is created and the bullet has entered inside. The diameter of the hole on the skin therefore appears, on the non-stretched skin to some extent lesser than the size of the projectile which generated the wound, when it was stretched. The minimum velocity necessary to penetrate the human skin has been found to be 40 to 50 metres per second. The threshold velocity for the penetration of a bone is found to be 60 meter per second. The projectile continues it's onwards advancement till it leaves the body through an exit hole, or, till its energy is consumed before, in overcoming the resistance. The projectile may be found wedged at the end of the path of the wound in several cases.

Forensic Significance

The projectiles fired by firearm have certain shapes, velocities and kinetic energies which vary from most of the other agents causing injuries. The shapes of wound, the destructive effect on the tissues, presence of foreign bodies (of specific shapes and composition) and the projectile trajectory help to ascertain whether the given injury is a firearm injury or not. The evaluation of the injuries elucidate if the given injury is-

- A firearm injury or not
- An entrance wound or an exit wound
- Post- mortem or ante-mortem injury
- Fired from the alleged firearm or not
- Lethal or not
- Caused from purported distance

The evaluation of injuries can also point out of the alleged number of shots fired or the number of firearms used.

Classification of Gunshot Injuries

Gunshot wounds are either penetrating or perforating. Penetrating wounds occur when a bullet enters an object and does not exit. In perforating wounds, the bullet passes completely through the object. A wound, however, can be both penetrating and perforating. A bullet hitting the head may pass through the cranium and brain before impending to rest under the scalp, consequently creating a penetrating injury of the head, but a puncturing wound of the skull and brain.

Gunshot wounds can be divided into four broad categories, depending on the range from the muzzle to target: Contact, Near- contact, Intermediate- Range and Distant.

1. CONTACT INJURIES

In contact wounds, the muzzle of the firearm is held against the surface of the body at the while of discharge. Contact wounds may be hard, loose, angled, or incomplete (a variation of angled).

1.1 Hard- Contact Wounds: In hard-contact wounds, the muzzle of the firearm is crammed "hard" against the skin, depressing it, so that the skin encases the muzzle. In hard contact wounds, the direct edges of the entrance are scorched by the burning gases of ignition and blackened by the soot. This soot is entrenched in the scorched skin and cannot be entirely removed either by washing or by forceful brushing of the wound.

1.2 Loose- Contact Wounds: In the loose-contact wounds, the muzzle while in broadly contacted with the skin is held casually against it, the gas moving previous to the bullet, as well as the bullet itself, indents the skin, producing a temporary gap between the skin and the muzzle through which gas can leak. In a area around the entrance, the soot is deposited which was carried by the gas. This soot can be cleaned away with no concern. A small number of unburnt grains of powder may also leak out this gap and deposited on the skin in the region of soot.

1.3 Angled- Contact Wounds: In the angled-contact wounds, the barrel is held at an acute angle to the skin, so that the entire circumference of the muzzle is not in the connection with the surface of the skin

1.4 Incomplete - Contact Wounds: Incomplete-contact wounds are a variation of angled-contact wounds. In these, the muzzle of the weapon is held against the skin, but, because the body surface is not completely flat, there is an opening between the muzzle and the skin.

2. NEAR CONTACT INJURIES

Near contact injuries lie in a gray zone between contact and intermediate range wounds. There is an overlap between the appearances of near- and loose-contact injuries making it challenging to distinguish the two. In near contact wounds, the muzzle of the weapon is not in connection with the skin, being held a short distance away. The distance, however, is so minor that the powder grains emerging from the muzzle do not have a chance to scatter and mark the skin, generating the powder tattooing that is the requirement of intermediate-range wounds.

In near-contact wounds, there is an entrance wound, enclosed by a wide zone of powder soot covering scorched, blackened skin. The zone of scorching is wider than that seen in a loose contact wound.

3. INTERMEDIATE RANGE INJURIES

An intermediate-range gunshot injury is one in which the muzzle of the weapon is held away from the body at the time of discharge yet is satisfactorily close so that powder grains ejected from the muzzle along with the bullet create “powder tattooing” of the skin. These patterns are the prerequisite of intermediate-range gunshot wounds. In intermediate range wounds microscopic sections of the entrance should display grains of powder embedded in the skin adjacent to the entrance hole.

4. DISTANT INJURIES

In distant wounds, the only marks on the target are those made by the mechanical action of the bullet in puncturing the skin. Distant gunshot wounds in head may have a stellate or asymmetrical appearance simulating a contact wound. This phenomenon is seen with both handguns and rifled bullets.

Common Terminologies in Gunshot Injuries

1. Entrance Wound

Entrance Wound is the opening from where the projectile has entered the body. Entrance wounds are generally smaller and quite regular in contrast to the exit wounds, which can occasionally be ragged with skin, tissue, and muscle and bone damage. Entrance wounds are frequently ringed with the residue of gunpowder.

2. Exit Wound

Exit Wounds are produced by the penetration of bullet travelled through the body and moving out of it. Exit wounds are generally larger than the entrance wound and this is because as the round moves through the body of the victim it decelerates and shatters within the tissue and surrounding muscle. This slowing down of the projectile means that as it reaches the end of its trajectory it has to force harder to thrust through. This associates to the exit wound normally looking larger and significantly more destructive than the entrance wound.

3. Pink Coloration

If a shot is fired from a very close range or in contact with the skin, some carbon monoxide (produced in the combustion of propellants) gets absorbed in the skin and flesh. It gives a pink coloration to the skin around the wound which indicates firearm injury and injury from a close range.

4. Charring/ Scorching/ Burning/ Singeing

These are the effects of flame or hot gases produced in the combustion of propellants. The charring is caused when the shot is fired from a very close range. The size, shape and extent are characteristic of the firearm and range. The Charring is often confused with the Blackening, Tattooing, and Dirt Ring or even with Contusion Ring. The Charring is different from Blackening. The later can be removed with a cotton swab moistened with spirit while the former cannot be removed in this way.

5. Blackening

The blackening is caused by the smoke deposits. The smoke particles are light. They do not travel afar. Therefore, smoke deposit i.e. blackening is limited to a short range. The colour of smoke is grey to black in black powder and light grey to dark grey in smokeless powder. As the range from the muzzle to the target increases, the size of the zone of powder soot blackening will increase, whereas the density will decrease.

6. Tattooing

The tattooing is also known as peppering or stippling. It is the deposit of unburnt or semi- burnt powder particles under the skin. Tattooing, normally, cannot be removed with a wash. Tattooing is an ante- mortem phenomenon and shows that the individual was alive at the time he was shot. If the individual was lifeless before being shot, even though the powder may produce marks on the skin, these marks have a moist gray or yellow appearance rather than the reddish brown to orange-red coloration of an ante- mortem injury. There should be no difficulty with differentiating the two.

7. Dirt Ring or Projectile Wipe Ring

The dirt ring is deposited by some projectile around the wound. The projectile may carry grease on them. The dirt gets collected on the grease which, in turn, gets deposited around the wound. Deposit of soot/GSR present on bullet. The projectile picks up the soot/GSR from the powder ejecta which rush past the projectiles inside or outside the barrel. Dirt may be due to intermediate target (clothes, mud walls etc.) or from the surface from which the projectile has ricocheted. In shot gun ammunition, the pellets and buck shots are rubbed with graphite. A small amount of

graphite is carried by the projectiles which they deposit around the entry hole. The lead bullets may also blacken the edges of the entry wound.

8. Foreign Material

The projectile or their fragments and sometimes the wads are found inside the body, these may also indicate the nature of firearm used.

9. Contusion

The edges of wound are contused by the impact of the projectile. The colour of contusion varies from reddish dark to bluish black. The contusions are in the form of a band around the wound and are often of uniform width. The tissues are ruptured and swollen.

10. Muzzle Impression

The annular skin impression against muzzle produced by the discharged gases or momentary cavity formation in contact and near contact gunshot wounds is known as Muzzle Impression. Muzzle impression is not seen in usual exit wounds, but may be seen in "shored" exit wounds. Muzzle imprints are much more common than in wounds from the Short cartridge because of the greater gas volume produced.

11. Blast Injury

This type of injury is generally observed in Shotguns and sometimes High Velocity Ammunitions. In this injury there is a devastating effect caused by the Shotgun pellets or the high velocity projectile. Generally the portion of the target affected is blown off giving an impression of explosion injury.

12. Grazing shots

A grazing shot is one in which the bullet passes along the surface of the body without penetrating. Injury to the surface of the body is generally limited to the skin itself and to the subcutaneous connective tissue. However, the subcutaneous fatty tissue may be affected, as may the upper layers of muscle, depending on the area of the body concerned and the thickness of the fatty tissue. The resulting defect often takes the form of a channel, with abraded tissue. The shorter the area of contact between projectile and skin, the smaller and more insignificant-looking such a graze is likely to be. In the graze wounds it is difficult to ascertain the direction of the projectile was travelling.

13. Abrasion Ring:

Abrasion ring is characterized by reddish brown colored area of flattened and abraded skin (epidermis), surrounding the entrance hole. Generally, fresh entrance wounds have an abrasion ring with a moist, fleshy appearance. The abrasion ring is produced when a projectile scours the hole as it depresses and perforates the skin. The abrasion ring can vary in width depending upon the caliber of the firearm, the angle at which the projectile entered the body (skin).