# CHAPTER I

## INTRODUCTION

Firearms means arms of any description designed or adapted to discharge a projectile or projectiles of any kind by the action of any explosive or other forms of energy, And also we can say that a firearm is a gun (a barreled ranged weapon) designed to be readily carried and used by a single individual. It inflicts damage on targets by launching one or more projectiles driven by rapidly expanding high-pressure gas produced by exothermic combustion (deflagration) of chemical propellant.

A firearm-related injury is defined as a gunshot wound or penetrating injury from a weapon that uses a powder charge to fire a projectile. A gunshot injury is physical trauma caused by a bullet from a firearm. Damage may include bleeding, broken bones, organ damage, infection of the wound, or loss of the ability to move part of the body. Damage depends on the part of the body hit, the path the bullet follows through the body, and the type and speed of the bullet. Long term complications can include lead poisoning and post traumatic stress disorder

There are many unique features of firearms that may be of critical importance in a forensic investigation. Although the forensic pathologist need not be an expert on all types of firearms, he or she must be familiar with the basic operation of different weapons in order to interpret the injuries resulting from them. For example, knowledge about the safety features of a weapon that would have allowed or prohibited its operation in a given set of circumstances may be of great importance in determining the plausibility of a given death scene scenario. Similarly, knowledge of muzzle shapes, size and configuration of a weapon, approximate weight of trigger pull, amount of recoil, and a host of other factors may serve to refute or substantiate a putative explanation for how the injury was sustained.

In this study I am going to identify the different types of injuries caused by different types of firearm in human body. This will be helpful for the investigating officer and forensic pathologist to identify the type of firearm used in the commission of crime.

# CHAPTER II

## LITERATURE REVIEW

1. Uzar Al conducted a study to investigate the factors that influence the severity of soft tissue and bone injuries occurring in gunshot traumas and to compare the effects of handgun and rifle bullets on these injuries.

   Sixteen tissue simulants which were made of transparent gel candle blocks and calibrated to muscle tissue were targetted by pistol (9 mm parabellum) or military rifle (G-3) bullets. Half of the blocks contained fresh calf humerus bone. The effects of the bullets in tissue simulants were monitored by using high velocity cameras capable of taking 1,000 views per second.

   On a millisecond time scale, handgun bullets produced a small-sized temporary cavity while rifle bullets produced a wide temporary cavity in isolated soft tissue simulants. It was shown that the differences in the size of temporary cavities resulting from the blast effect correlated highly with the severity of injury occurring in soft tissues. In samples at which calf humerus bone was targeted, we observed that fragmentation and cavity effects correlated highly with the velocity of the bullet and determined the severity of injury. Experimental demonstration of differences in the size and severity of injuries caused by handgun or rifle bullets may have significant implications in the planning of treatment.

2. Panagiotis K. Stefanopoulos, Georgios F. Hadjigeorgiou, Konstantinos Filippakis, and Dimitrios Gyftokostas conducted a study to examine the gunshot injuries. Civilian gunshot injuries from handgun and rifle ammunition vary in severity depending on the anatomic location involved and the different effects from the ballistic properties of the penetrating projectiles. Ballistic factors such as the impact velocity and energy should not be considered in isolation, as their specific effects are determined by the interaction between the projectile and tissues. Increased tissue damage can result from tumbling of non-deforming rifle bullets and deformation of expanding bullets. Both of these mechanisms increase substantially the energy transfer to the wound and its diameter, also producing a pulsating temporary cavity associated with pressure changes within tissue.

   They were examined the Ballistic behavior of the bullet, Energy transfer characteristics of gunshot wounds like velocity, speed etc, Mechanisms of gunshot injuries, Cavitation, Direct tissue damage, bone injuries, head injuries etc and they concluded that The damage produced by penetrating bullets depends on the amount of their impact energy that is delivered to the tissues, the rate at which this occurs, and the local response of the tissue zone subjected to cavitational effects from high-energy injuries. Although the complex interactions of the projectile with the various tissues result in a wide range of ballistic injury patterns, awareness of the specific mechanisms that cause increased tissue destruction, namely bullet tumbling and deformation, will assist recognition of the less common injuries involving high energy transfer, which are also associated with a higher risk of infectious complications.

3. Molina DK, DiMaio V, Cave R has conducted a study on the gunshot injuries.This study was designed to address that deficiency. Existing data sets of nonaccidental deaths by

handguns, shotguns, and rifles were reviewed. The victim data were analyzed by age and sex of the victims, wound location, range of fire, manner of death, and type of firearm. Handguns were the most common firearm used in both suicides and homicides, followed by rifles and then shotguns. For both homicides and suicides, there were significant differences between the firearm types for age of victims, range of fire, and wound locations. Possible reasons for those differences are discussed. It is concluded that information about the type of firearm is crucial to have when examining the nature of a firearm injury and determining the manner of death.

4. Peonim V, Srisont S, Udnoon J, Wongwichai S, Thapon A, Worasuwannarak W has conducted a study on entrance and exit gun shot wound with respect to velocity of bullets. This study presents 27 forensic autopsy cases with 32 shots fired by 5.56×45mm. HVB (M-16 rifle bullets) during the dispersing the mass rally in Bangkok Thailand, May 2010. It was found that twenty-three (71.88%) typical entrance HVB wounds had round sizes less than the bullet diameters. Most entrance wounds had microtears but no collar abrasion since a HVB has a small streamlined spitzer tip and full metal jacket. For exit wounds, there were various sizes and shapes depending on which section of wound ballistics presented when the bullet exited the body. If a bullet exited in the section of temporally cavity formation, there would be a large size exit wound in accordance with the degree of bullet yaw. This is different from civilian bullets whereby the shape looks like a cylindrical round nose and at low velocity that causes entrance wounds with a similar size to the bullet diameter and is usually round or oval shape with collar abrasion. The temporary cavity is not as large as in a HVB so exit wounds are not quite as large and present a ragged border compared to a HVB. We also reported 9 out of 32 shots (28.13%) of atypical entrance wounds that had various characteristics depending on site of injury and destabilization of bullets. These findings may be helpful to forensic pathologists and to give physicians, who need to diagnose HVB wounds, more confidence.

5. Case report by Dr. Virendar Pal Singh, Demonstrator, Dr. B.R.Sharma, Dr. Dasari Harish, Dr. Krishan Vij, Professor and Head , Department of Forensic Medicine, Government Medical College and Hospital, Chandigarh

   The deceased was a 19 year old boy. At the time of incident he was lying on the bed. His father was standing outside the room and cleaning the revolver, when accidentally a shot got fired and hit him. The boy was immediately rushed to the hospital, where he could not be revived and died after 6 hours of the incident. Medico legal autopsy was conducted 15 hours after the death.

   Autopsy examination revealed a well-built body of a young boy. Five wounds were present on the body. Two each on the right knee (Photograph1)and right hand and one on the abdomen with omentum protruding out of the wound. Initially it appeared that these five wounds were due to three shots that hit at three distant sites on the body. But as per

history given by the eyewitness a single shot was fired. OnOn careful examination of the direction of the wounds and by correlating the wounds (by keeping the body in a posture with knees semi flexed and right hand lying in between the right knee and the trunk) it was found that all the five wounds were in a single line. It was concluded that the single bullet resulted in multiple wounds. The bullet first hit the right knee and came out from its upper part then entered the dorsal aspect of right hand and came out of its palmer aspect and finally hit the abdomen. On exploring the abdominal wound it was found that the bullet entered the abdominal cavity, went upwards and laterally and ruptured the anterior and posterior wall of stomach, then hit the spleen and ruptured the diaphragm and finally entered the left thoracic cavity. It was retrieved from the left $10^{th}$ inter costal space near para vertebral region. About 1500 ml of clotted and liquid blood was found in the abdominal cavity and 500 ml of blood in the left thoracic cavity. The cause of death was hemorrhagic shock.

6. Basant Lal Sirohiwal , Pawan Mittal , Ashish Singla , Ashish Tyagi has conducted a study on a atypical firearm wound case to determine the range of discharge. And the case was of A well built wrestler male of 50 years was brought to the Dep't of Accident and Emergency PGIMS, Rohtak in November 2012 with alleged history of self inflicted gunshot injury, over his head with his licensed revolver. The resident doctor noticed an entry wound over right temporal region with irregular margins and an exit wound over left temporal region with everted margins. Immediate emergency tracheostomy was performed and all the necessary supportive measures were carried out but he expired after sometime. The autopsy finding are following An oval shaped entry wound of firearm of size 1.5x1 cm was present over right temporal region of scalp situated 4 cm medial to right ear, 9 cm away from midline and 170 cm above right heel. The margins were inverted, irregular and surrounded by an abrasion collar of width 0.5 cm over its anterior margin with blackish soot deposit over it. Small tears were present within the abrasion collar at places. The tissues inside were somewhat looking charred and cherry red . On dissection the wound was going medially and almost horizontally. The layers of the scalp showed evidence of soot deposition and ecchymosed . The underlying skull showed corresponding hole measuring 2x1.5 cm which was surrounded by an area of black-grey soot deposition of width 0.5 cm around it except over its anterior aspect where the outer table was missing and inner table was visible. A linear fracture was radiating down from the margin into the squamous temporal bone for 7 cm. Small fissure fractures were present in the margins around the central hole. The inner table around the central hole was beveled. On further dissection, the underlying dura showed hole measuring 2.5x2 cm with black-grey area of soot deposition over its margins. The brain showed organized subarachnoid hematoma in right frontal-temporal-parietal region over an area of 8x3 cm and organized subdural hematoma over an area of 7x4 cm over right frontal-parietal region. The wound was penetrating frontal lobes of the brain from right to left across the sylvian fissure. The track showed somewhat expansion with in the brain. The wound further pierced the duramater over left temporal region, left temporal skull region which was showing beveling of the outer table around the hole measuring 2x1 cm and exit out through left temporal region of scalp at the same level. Accumulation of blood was seen in the foramen magnum in the form of subdural hematoma extending up to the T3 spinal canal level with compression of the underlying cord. Linear fracture of anterior cranial

fossa was present. On the basis of these findings the cause of death in this case was pronounced to be cranio-cerebral damage consequent upon of head injury as a result of contact rifled firearm ammunition discharge; could be suicidal as alleged.

From this case they found that In deciding the range of the firearm discharge, the pattern and distribution of gunpowder residue is of paramount importance. The factors that can affect the amount and distribution of gunshot residue (GSR) on skin and clothing include: (1) firing distance, (2) length and diameter of the firearm barrel, (3) characteristics of the gunpowder, (4) angle between the firearm barrel and target, (5) characteristics of the cartridge, (6) the environment (moisture, wind, heat), (7) type of clothing, (8) intermediate targets, and (9) characteristics of the target (tissue type, putrefaction, blood marks). It is well referenced that all the components of gun powder are discharged in the body when the weapon is pressed right angle with the body surface, so, grossly the effect of smoke can be observed in the track in the form of blackening. When gap remains between the body surface and the puzzle then the gases may leak in the surrounding area and the smoke effect may not be appreciated in the track but observed externally around the entry wound.

These findings states that when the external findings are not characteristic to be of contact wound like the presence of the puzzle impression, the internal findings may reflects a clear picture that it is a victim of contact range, as was observed in the present victim during postmortem examination, well appreciable blackening on the outer table of punched in entry hole of skull, duramater and even on brain substances up to the end of the track. This means that all the constituents of gun powder blast were forced in to the track of firearm wound. This may points to the suicidal theory, although, it may be otherwise also.

7. Yuw-ErYong conducted a study on ricocheted gunshot injuries. Ricocheted bullets may still retain sufficient kinetic energy to cause gunshot injuries. Accordingly, this paper reviews the literature surrounding gunshot injuries caused by ricocheted bullets. In doing so, it discusses the characteristics of ricochet entrance wounds and wound tracks, noting several important considerations for assessment of a possible ricochet incident. The shapes of ricochet entrance wounds vary, ranging from round holes to elliptical, large and irregular shapes. Pseudo-stippling or pseudo-gunpowder tattooing, pseudo-soot blackening and tumbling abrasions seen on the skin surrounding the bullet hole are particularly associated with ricochet incidents. Ricocheted bullets have a reduced capability for tissue penetration. Most of the resulting wound tracks are short, of large diameter and irregular—all artefacts of the instability of a bullet that has ricocheted. A ricocheted hollow-point bullet, in particular, may overpenetrate the tissue when the bullet nose is deformed or fails to enter the body in a nose-forward orientation. Similarly, internal ricochet may occur when a bullet strikes hard tissue. Postmortem computed tomographic imaging is useful for localising a bullet and its fragments in the body and characterising the wound track. Ricochet cannot be ruled out in normal-appearing entrance wounds unless that finding is supported by other evidence, including the geometrical constraints of the shooting scene and the absence of ricochet marks and a ricocheted bullet.

8. Dr Andrew provides an evaluation about the firearm injuries and the tissue damage associated with them. As the bullets enters in the body it crushes and shreds tissue in it's path this create a permanent cavity ( bullet holes) in addition the energy of the impact is dissipated in a shock waves that radially flings surrounding tissue away from the path of projectile creating a cavity larger than the diameter of the bullet this is the temporary stress cavity. The temporary stress cavity exist for around 5-10 milliseconds with a series of gradually smaller pulsation and contraction before the formation of permanent cavity. The ultimate extent of wound is determined by the kinetic energy of the impact, extent of temporary cavity and the amount of bullet fragmentation.

   Hand guns are creating wounds that have small temporary cavity, a direct path of destruction with minimal lateral extension. The entrance wounds features for this handguns are following. It has a round to oval defect in which the edges cannot be re-approximated and marginal abrasion is present. The exit wounds can be identified by the torn or lacerated tissue, not always larger than entrance and shores exit wounds mimic the marginal abrasion of exit wound.

   The high velocity rifle bullets cause tail splash which is rearward propulsion of injured tissue and a larger temporary cavity 11-12.5 times larger than the projectile. The maximum cavity diameter occurs at point of maximum loss of kinetic energy. The striking velocity and bullet mass establish a bullet's potential for damage, and set the limits on the tissue disruption produced.

   In case of shot guns the wound edge scalloping is observed at the close range. Also soot and powder may be seen out to 5feet. For distant shot the effect depends upon the weapon and ammunition used, however the wadding/ contusion seen out to 50 feet. The c wounds for shotgun victims are rare. Bullet fragmentation cause significant additional damage.

9. Leandra Engelbrecht, wrote in health 24 entitled Bullet wounds. When a bullet enters the body, the speed at which it travels, the angle at which it hits the body, and the density of the tissue involved all contribute to the damage the shot can cause. The gunshot wound can be penetration, cavitation, fragmentation etc. Once a bullet enters the body, it crushes and forces tissue apart. This becomes serious if a major organ or blood vessel is hit. Only the tissue that has come into direct contact with the bullet will be damaged.

   Cavitation can be described as the bullet leaves a hole in the body, either temporary or permanent, depending on the elasticity of the tissue or organ struck. Penetration is happening when the flesh is disrupted or destroyed by the bullet.

   Fragmentation – bullets may shatter on impact and send fragments through the body. The same thing may happen if the bullet strikes bone: chips of the bone may be driven through the body's tissue, causing damage in their paths. Once a bullet enters the body, it

crushes and forces tissue apart. This becomes serious if a major organ or blood vessel is hit. Only the tissue that has come into direct contact with the bullet will be damaged.

Additional damage is caused by shock waves compressing the tissue in the bullet's path, causing a temporary cavity. Although temporary cavitation lasts for less than a second, muscles, nerves, blood vessels and bone can be damaged.

10. MAJ Constantin von See, CPT Alexander Stuehmer , Nils-Claudius Gellrich, MD, DDS ,Katrin S. Blum, MD, Kai-Hendrik Bormann, DDS,Martin Rücker, MD, DDS has conducted a study on injuries caused by handguns with different projectiles. The experiments were performed on the heads of freshly sacrifice pigs under standardized conditions. Each of these heads was randomly assigned to one of five projectile groups (n = 6). The heads and a commercially available pistol (Browning FN; caliber: 9 × 19 mm Luger) were placed in a special frame and different projectiles were shot into the animal heads through the submental region in the occipital direction. All projectiles that were used in the tests had the same kinetic energy (v 0 = 235 m/s) and the same weight (124 grains). They examined gunshot injuries caused by round lead, partial metal-jacketed, full metal-jacketed, hollow-point, and Action 4 projectiles.

    A macroscopic examination of the entrance sites revealed no differences between the various specimens. All heads showed a circular defect with a diameter corresponding to the projectile. Computed tomography (CT) and 3D face scans of the animal skulls were obtained before and after fi ring. The image data sets were fused and provided the basis for a quantitative analysis of destruction patterns. As a result of the destruction of the parietal bone at the potential exit site, there were signifi cant volume difference between the Action 4 (6.45 ± 3.42 ml) and the Hydra-Shok projectile (12.71 ± 2.86 ml). The partial metal-jacketed projectile showed a minor increase in volume (4.89 ± 1.47 ml) and a partial loss of soft projectile components. Radiology showed differences between the various projectiles in fragmentation and bone and soft-tissue destruction.

# CHAPTER III: AIMS AND OBJECTIVE

## AIM

Identify the difference types of firearms by different types of wounds

## OBJECTIVES

Examination of wounds caused by firearms at different ranges

Examination of entry and exit wounds

# CHAPTER IV: MATERIALS AND METHODOLOGY

## Materials

Young adult swine (Sus scrofa domestica) were used as target since swine's structure is quite similar to human. Swine are acceptable substitute due to the similarity to human torsos in weight, fat to muscle ratio and hair coverage. 6 swines were used and each swine was labeled as 1, 2, 3, 4, 5 and 6. The average mass of each swine was between 25 ± 30 kg. For each shooting distance, 2 swines were used in order to make comparison. Sodium Rhodizonate was the chemical used to determine the presence of gunshot residue (GSR) . The positive result of this test shows a light pink colour which will appear at area containing GSR. A 9 mm Browning semi-automatic pistol with ammunition of 9 mm full metal jacket (FMJ) copper bullets were used for test firing. A specially designed metal stand was used to hang the swine. This metal stand can prevent the swine from moving around during the shooting process. A DSLR camera was used for documentation purpose.

### Methodology

The shooting was carried out at Kothamangalam . During the whole shooting process, shooting range safety protocols were followed strictly. The shooting distance is defined as the distance between the muzzle of the firearm to the target. Swine 1 and 2 were fired at the distance of 0 m or contact distance, swine 3 and 4 were fired at the distance of 1 m or close contact distance while swine 5 and 6 were fired at the distance of 3 m or intermediate distance. For all shooting test, the shooter is in the standing position and the firearm held using both hands. After each shot was fired, the documentation process was carried out. After the documentation of the previous wound was done, then only the next shot was fired. For each swine, a total of 4 shots will be fired where one shot was fired at the head while three shots were fired to the abdomen of the swine. The wounds which appeared on the head were labeled as H1 while wounds on the abdomen were labeled as A1, A2 and A3 according to the sequence.

# CHAPTER V : RESULT

**Differences between entry and exit wound at contact (0 m) shooting range**

Statistical tests prove that at this shooting distance, there is a significant difference in the size between the entry and exit wound, with $t(7) = 4.462$, $p < 0.05$, $d = 2.30$. The mean size of entry wounds are 0.47 cm smaller than mean size of exit wounds. All gunshot wound produced at this shooting range are quite small in diameter. The size of gunshot wounds are affected by factors such as size of the projectile, speed of the projectile and the elasticity of the target body. When the muzzle of the firearm is totally in contact with the target, the bullet fired will travel at a very high speed and thus producing a small gunshot wound. The shape of entry wound at this distance were mostly made up of polygonal shapes such as round and oval while most of the exit wounds showed an irregular shape with tearing effect. When a projectile is shot into the body of the target, the shape of the projectile tends to be altered due to contact with internal structures such as bones or organs. When this altered projectile leave the body of the target, it tends to tear the inner surface of the exit wound, thus easily producing an irregular exit wound due to the tearing of the skin by the altered projectile. GSR was found at all entry wounds but absent at all exit wounds at contact shooting range. At this very close shooting distance, all the GSR material was transferred from the muzzle of the pistol to the surface of the entry wound. For the exit wound, GSR was hardly found since firearm residue will only be detected at the surface facing the shooter. Thus, the presence or absence of GSR at entry and exit wound is very useful to differentiate both gunshot wounds at contact shooting range.

**Differences between entry and exit wound at close contact (1 m) shooting range**

Statistical tests prove that at this shooting distance, there is no significant difference at the size between entry and exit wound with $t(7) = 2.296$, $p > 0.05$, $d = 1.42$. At this distance, both entry and exit wounds showed similar sizes. At this shooting distance, the exit wounds are still dominated by irregular shapes, while the entry wounds are still made up by polygonal shapes. Usually, the characteristic of irregular shape can be a very good indicator to identify a gunshot wound as an exit wound since entry wound seldom show irregular shape. Entry wound will only develop an irregular shape if the bullet entering the target has altered in shape. The exit wounds show no presence of GSR at this shooting distance. However, some of the entry wounds show slight colour change to light pink but the orange colour of Sodium Rhodizonate still dominate. We define this presence of GSR material as slight presence of GSR. Usually, GSR can be detected at close contact shooting distance, but in our research, we define close contact range into a longer distance, which is 1 meter. Normally, close contact distance is around 20 cm to 40 cm between the muzzle of the weapon towards the surface of the shooting target, with the muzzle not in contact with the surface of target


An uncommon shape at the entry wound


A big exit wound at intermediate shooting range

**Differences between entry and exit wound at intermediate (3 m) shooting range**

Statistical tests prove that at this shooting distance, there is a significant difference in the size between the entry and exit wound, with $t(7) = 5.147$, $p < 0.05$, $d = 2.33$. The mean size of entry wounds are 0.39 cm smaller than mean size of exit wounds. At this shooting range, most of the entry wounds are smaller than the exit wounds. Generally, common consensus is that exit wounds are bigger than entry wounds. Actually, exit wound can be in variety of range, either big or small, depending on the rotation of the bullets when it exits the target. If the rotation of the bullet is the same from the moment it enter until it exit the body, the size of exit wound form will be small in diameter. If the bullet hit body structures such as organ or bone, the bullet will undergo a drastic change in rotation and when it exits the body of target, a tearing effect will occur, causing a big exit wound. Figure 3 shows that although the shooting distance is the same, the exit wounds appear in different size. From the aspect of shape, the exit wound shows a lot of different shapes which include oval, ellipse, stellate and irregular shape. Exit wound has a wide variation in shape compared to entry wound . This happen where the rotation of the bullet can change widely when it traveled inside the body. When the bullet exits the body, many shapes can be produced. However, for entry wound, a very uncommon square shape was observed. It is seldom to have a square shape at either entry or exit wounds. It can be deduced that the square shape are formed due to the experiment's design. The skin of the target or pig might be in a stretched condition after it is hung on the metal stand for a long period. Also worthy of note, direct sunlight at the outdoor shooting range also contributed to further stretching the skin of the pig. Due to the stretching on the skin, uncommon square shape was formed at entry wound. Figure 4 shows the uncommon square shape at the entry wound.

All entry wounds and exit wounds at this shooting range also show no presence of GSR material. This reflects other studies' finding that at this long distance, the GSR will not be found at the gunshot wound.

## CHAPTER VI: CONCLUSION

At the contact shooting range, both entry and exit wounds can be differentiated by studying the size, shape and presence of GSR material at the gunshot wound. At the close contact shooting range, both entry and exit wounds can only be differentiated by looking at the shape and presence of GSR material at the gunshot wound. At the intermediate shooting range, both entry and exit wounds can only be differentiated by studying the size and shape of the gunshot wounds. There is a relationship between the shooting distances with the size of entry wounds and an equation to estimate shooting distance using the size of entry wound can be formed.

Shooting distance = 4.901 x diameter of entry wound + (-1.268)

A model to estimate shooting distance by looking into all morphology of gunshot wounds studied in this research can also be formed. In conclusion, different shooting distances produce different features and characteristics in both entry and exit wounds. By studying and analyzing the morphology of gunshot wounds such as size, shape and presence of GSR material at the gunshot wound, information such as shooting distance or distance between the firearm towards the shooting target can be obtained.

# REFERENCE


- Uzar AI, "**Comparison of soft tissue and bone injuries caused by handgun or rifle bullets: an experimental study"** Acta Orthop Traumatol Turc. 2003;37(3):261-7.
- Panagiotis K. Stefanopoulos, Georgios F. Hadjigeorgiou, Konstantinos Filippakis, and Dimitrios Gyftokostas **"Gunshot wounds: A review of ballistics related to penetrating trauma"** Journal of Acute Disease (2014)178-185
- Molina DK, DiMaio V, Cave R **"Gunshot wounds: a review of firearm type, range, and location as pertaining to manner of death."** Am J Forensic Med Pathol. 2013 Dec;34(4):366-71. doi: 10.1097/PAF.0000000000000065.
- Peonim V, Srisont S, Udnoon J, Wongwichai S, Thapon A, Worasuwannarak W **"Entrance and exit wounds of high velocity bullet: An autopsy analysis in the event of dispersing the mass rally in Bangkok Thailand, May 2010"** Leg Med (Tokyo). 2016 Nov;23:10-16. doi: 10.1016/j.legalmed.2016.08.010. Epub 2016 Aug 26.
- Basant Lal Sirohiwal , Pawan Mittal , Ashish Singla , Ashish Tyagi **"Finding in the track of firearm wound answers its range of discharge – an atypical case of firearm wound"** Medical Science, Volume 7, Number 25, April 16, 2014
- Yuw-ErYong **"A systematic review on ricochet gunshot injuries"** Legal Medicine Volume 26, May 2017, Pages 45-51
- Dr. Andrew **" Wound ballistics-Motion and effect if projectile in the human body"** White mountain forensics, January 22,2018
- MAJ Constantin von See, CPT Alexander Stuehmer , Nils-Claudius Gellrich, MD, DDS ,Katrin S. Blum, MD, Kai-Hendrik Bormann, DDS,Martin Rücker, MD, DDS **"Wound Ballistics of Injuries Caused by Handguns With Different Types of Projectiles"** MILITARY MEDICINE, 174, 7:757, 2009
- Leandra Engelbrecht, **"Bullet wounds"** health24 22/11/2007