

### “Penetrating (non-exiting) and Perforating (exiting) GSW Trauma”



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### Role of the Medical Examiner's Office

- Determines Range of Fire & Direction of Fire in gunshot wound cases
- Identifies, recovers & preserves evidence (powder, projectiles, knife blades, etc)
- Proper determination of classification of wound (entrance vs. exit)
- Tracks the wound
- Interpretation of the circumstances of the event
- Document findings (autopsy report)
- Testifies in Court

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### GSW Trauma

- Broad Categories GSW Penetrating Trauma
  - Entrance Wound
    - Contact
    - Near Contact
    - Intermediate
    - Distant
- Types of GSW Perforating Trauma
  - Exit Wound
    - Shored
    - Non-Shored (most common)

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### General Information Regarding Guns

- Handguns are weapon of choice in majority of homicides & suicides
- More than a bullet comes out of the end of a barrel

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### Types Of Small Arms

- A. Five Types of Small Arms
  - 1. Handguns
  - 2. Rifles
  - 3. Shotguns
  - 4. Submachine guns (machine pistols)
  - 5. Machine Guns
- All these weapons, except shotguns, have rifling if the interior of the barrel.

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### Rifling

- B. Rifling is a series of parallel spiral grooves cut the length of the bore of the barrel.
  1. The metal left between the grooves is the **lands**.
  2. The number of grooves can vary from 2 – 20 with the direction of the rifling either clockwise (right) or counterclockwise (left).
    - a. Virtually all handguns have 5-6 grooves with a right-hand twist. Colt has a left-hand twist.
    - b. In centerfire rifles, virtually all weapons have a right-hand twist with the number of grooves varying from 4-6.
    - c. .22 rimfire weapons generally have a right-hand twist with 4, 5 or 6 grooves

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**Rifling**

- 3. Rifling causes a rotational spin on the bullet as it travels down the barrel.
- The spin imparted to the bullet stabilizes its flight through the air, preventing it from tumbling.

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**Types Of Firearms**

- A. Handguns
  - Revolvers (cartridges are carried in a cylinder which is rotated by pulling the trigger)
  - Autoloading Pistols (automatic and semi-automatic) – cartridges are kept in a magazine; the first round has to be manually loaded into the chamber.

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### Types Of Firearms

- B. Rifles & Shotguns
  - Both are meant to be fired from your shoulder.
  - 1. Shotguns have no rifling...rifles do have rifling.
  - 2. Shotgun is designed to fire multiple pellets down a barrel, while a rifle is intended to fire a single missile down the barrel.
  - 3. An assault rifle:
    - Is self loading rifle
    - Is capable of full automatic fire
    - Has a large magazine capacity
    - Is chambered for intermediate powered rifle cartridge

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### Types Of Firearms

- C. Submachine gun pistol
  - is a weapon capable of full automatic fire which is chambered for pistol cartridge.
- D. A machine gun fires a rifle cartridge and is capable of full automatic fire.

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### Components Of Gunfire



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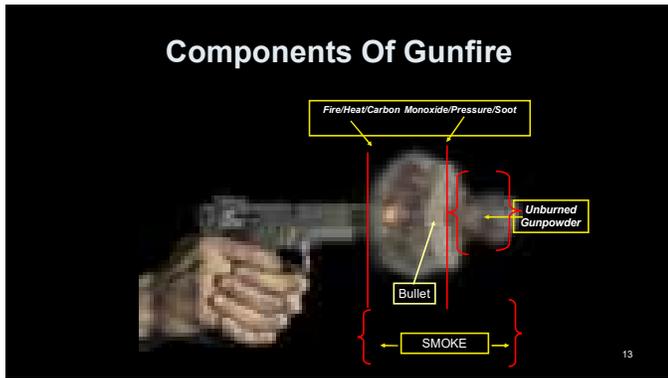
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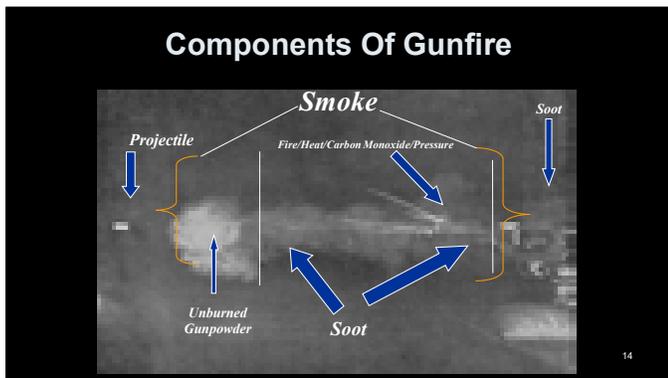
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### Components Of Gunfire

- Components of Gunfire
  - Flame, 1-2 inches long, temp ~ 1400F.
  - Vaporized metal from the bullet, cartridge case and primer
  - Gas Cloud (carbon dioxide)
  - Pressure
  - Burnt & Unburnt gunpowder grains
  - Smoke is (soot and gunpowder)
  - Carbon or soot from burnt gunpowder
  - Heat and carbon monoxide are also expelled.

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### Components Of Gunfire

Depending on distance between the muzzle end and target...

- Close range
  - Soot and gunpowder around bullet holes is sometimes referred to as "smudging & tattooing or stippling".
  - The pattern and density of these deposits permit assessment of the range of fire.
  - Careful examination of clothing is imperative in order to determine the presence of gunpowder and soot around the bullet hole.
  - When light colored clothing is involved, soot and gunpowder is easily recognizable. When dark clothes are involved residue not quite as visible with the naked eye.

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### External Wounds Caused by Gunshot

- Depending on the distance between the muzzle end of the gun and the body, components of gunfire may influence the appearance and extent of the GSW.

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### *Classification/Range of Fire Types of Entrance Gunshot Wounds*

- Contact Wounds (Loose & Hard)
- Near Contact
- Distant Wounds
- Intermediate Wounds

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### Factors Affecting the Appearance of Entry Wound

- \* Location on the body where wound is located.
- \* Intermediary Target may deform the bullet thereby making the entry wound irregular shaped
- \* Type of ammunition used may affect the appearance of the entry wound

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### A. Contact GSW's

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### A1. Hard GSW Contact Wounds

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### Entrance Hard Contact Gunshot Wounds

- A. **Contact wounds** (muzzle of the gun is against the skin at time of discharge)
  1. Hard Contact GSW – it indents the skin guaranteeing a complete seal between the muzzle end and the skin.
    - A. All material exiting the muzzle goes underneath the skin
    - B. Wound edges are seared/burned and blackened due to the burning from the flame exiting the muzzle and soot in the area of burning.
  2. Hard Contact of chest and abdomen, whether it's a rifle, handgun or shotgun causes:
    - = circular perforation surrounded by seared blackened margins
    - = Muzzle imprint on skin due to gas from gun filling the chest or abdomen causing the cavities to bulge outward impacting the muzzle end

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### Entrance Hard Contact GSW



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### Entrance Hard Contact Gunshot Wounds

- A. **Contact wounds** (muzzle of the gun is against the skin at time of discharge)
  3. Hard Contact GSW over head (i.e. Skull...thin layer of scalp stretched over bone)
    - a. Hard Contact GSW over bone with handgun...
      - a1. Round entrance with blackened seared wound margins.
      - a2. Entrance wound with muzzle imprint around it or.....
      - a3. Stellate entrance
      - a4. The edges of stellate entrance reveal circular defect with blackened seared margins from which tears radiate.

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**Entrance Hard Contact Gunshot Wounds**

- A. **Hard Contact wounds** (muzzle of the gun is against the skin at time of discharge)

Continued...

3. **Hard Contact GSW** over bone with handgun...

- a5. Extent of injury and appearance depends to a degree on the caliber of weapon.
- a6. .22 rimfire bullets – entrance wound tends to be round with blackened and seared margins.
- a7. with a .357 magnum, typically a stellate wound with extrusion of brain tissue.

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**Entrance Hard Contact Gunshot Wounds**

A. **Contact wounds** (muzzle of the gun is against the skin at time of discharge) continued...

3. **Hard Contact GSW** over head (i.e. Skull...thin layer of scalp stretched over bone)

a8. With contact wounds of head with centerfire rifles or shotguns, large gaping tears of the scalp and extrusion of brain tissue is noted. This is due to the effects of a temporary cavity plus the effects of gas under pressure expanding the cranial cavity.

a9. Back splatter may be present on the weapon and/or the firer.

- \* Not all cases will there be blood and/or tissue will be present on the weapon or the firer.
- \* More commonly seen with a weapon such as shotgun or .357 Magnum than a .22 handgun.

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**Entrance Hard Contact Gunshot Wounds**

- A. **Contact wounds** (muzzle of the gun is against the skin at time of discharge)

4. **Hard Contact GSW**

4. C. Some contact wound have powder both at the entrance and exit wound

- Occurs with ball and powder and is assoc with hard contact wounds.
- The powder accompanies the bullet as it travels through the body and is deposited at the exit.
- Carbon Monoxide may be present at both the entrance and exit sites.
  - presents as a light pink discoloration of muscle around site or along the wound track
  - Not a reliable indicator for an entry site

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**A2. Loose Contact Gunshot Wounds**

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**Entrance Loose Gunshot Wounds**

- A. Contact wounds
- 1. Loose Contact GSW-
  - A. muzzle of the gun is against the skin but for a short time following discharge of the weapon, a gap opens up between the muzzle and skin, so a ring of soot is deposited around the entrance hole.
  - B. Soot can be washed away.



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**B. Near Contact Gunshot Wounds**

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**B. Near Contact Gunshot Wounds**

- B.1 Muzzle end is held a short distance from the skin
- B.2 Bullet hole is surrounded by a band of blackened seared skin.
- B.3 The band is significantly wider than one in a contact wound.
- B.4 Handgun near contact GSW – occurs @ ranges less than ½ inch

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**C. Intermediate Range Gunshot Wounds**

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**Intermediate Gunshot Wounds**

C. Intermediate GSW

1. Characterized by presence of powder tattooing around the entrance wound.



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**Intermediate Range Gunshot Wounds**

**C. Intermediate GSW**

- Occurs when the muzzle end of a gun is held away from the body at the time the gun is fired.
- It is close enough so that the powder grains coming out of the muzzle end with the bullet strikes the skin.
- It then produces punctate abrasions on the skin.
- Commonly called "powder tattoo marks".
- Powder tattooing are reddish brown to orange red punctate lesions of the skin around the entrance wound.

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**C. Intermediate Range Gunshot Wounds**

1. "Powder Tattoo marks"

- A. \* Powder tattoo marks are punctate abrasions.
- B. They cannot be wiped away
- C. They are not burns.
  - 1C1. Unfortunately referred to as powder burns
    - The term burn is incorrect in describing the etiology of the marks.
    - The term "powder burns" should never be used when describing the "powder tattooing or the searing blackening of the skin by the flame and or soot".
- D. With handguns, "powder tattooing" begins when the muzzle end of the gun-to-target is greater than  $\frac{1}{2}$  inch.
- E. The maximum range where powder tattooing extends depends on the type of gunpowder and the weapon.

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**C. Intermediate Range Gunshot Wounds**

1. "Powder Tattoo marks" and Gunpowder considerations

- F. Centerfire handguns
  - Usually loaded with ball or flake (disc) powder (usually appearance of shape of powder grains).
  - Traditional Flake powder ammo used in handguns is circular discs of powder.
  - Powder Tattoo marks extends to a max 2 feet with cartridge loaded with flake powder.
  - Powder Tattoo marks extends to a max 3-4 feet with cartridge loaded with ball powder in centerfire handguns.
- G. Shotguns
  - Use either flake or ball powder
    - Winchester produces the only shotgun ammo loaded with ball powder.
    - All others use flake powder.
    - Shotgun tattoo marks extends to a max 2 feet with flake and 3 feet with ball powder.

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**C. Intermediate Range Gunshot Wounds**

- 1. "Powder Tattoo marks" and Gunpowder considerations
  - H. Centerfire Rifles
    - Two types of powder used.....ball powder and cylindrical powder (gunpowder is shaped like small cylinders).
    - Powder tattooing extends out to approx 2 feet with cylindrical powder.
    - Powder tattooing extends out to approx 3 feet with ball powder.
  - I. Rimfire Ammunition (22 short; 22 long rifle ammo)
    - Ammo is loaded with either ball or disc powder.
      - Winchester produces the only ball powder ammo.
      - Ball powder for rimfire ammo is extremely fine and does not travel a great distance.
      - Max distance for Ball powder for rimfire ammo is 1 ½ feet.
      - Disc powder will produce tattooing out to 2 feet.

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**C. Intermediate Range Gunshot Wounds**

- 1. "Powder Tattoo marks" and Gunpowder considerations
  - J. Palms of the hand and soles of the feet
    - Are very resistant to powder tattooing.
    - What is seen instead of tattoo marks is embedded into the skin unburned and partially burnt grains of gunpowder.

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**Intermediate/Close-range**



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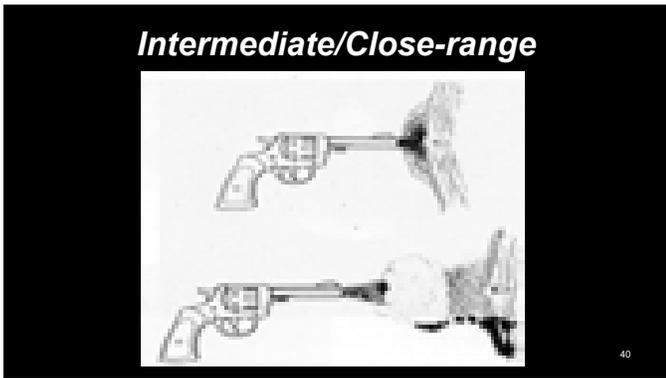
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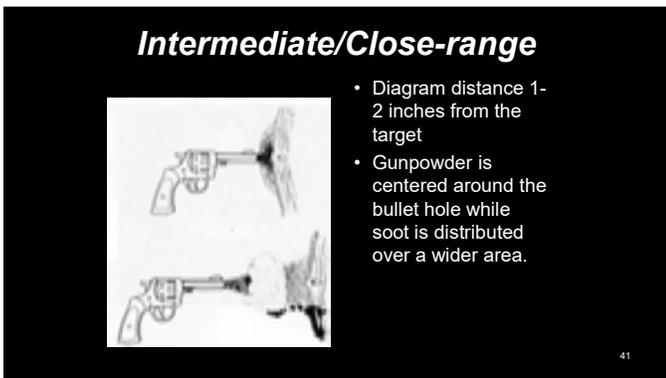
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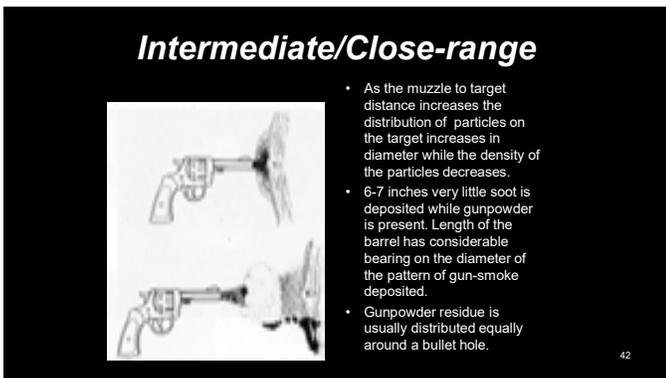
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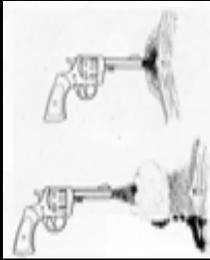
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### Intermediate/Close-range



Generally speaking as the distance between the muzzle and the target increases the pattern of particles on the target increases in diameter and the density of particles dispersion decreases.

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### Soot Deposits

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### Soot Deposits

- B. If the weapon is held close to the body:
  - Soot will be deposited either on the skin or clothing.
  - Handguns = soot deposition max is 12 inch/1 foot
  - Many times, it disappears before 12 inches.

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**D. Distant Gunshot Wound**

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**D. "Distant GSW's"**

Once the range of powder tattooing is exceeded, a distant gunshot wound is the correct classification.

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**"Classification of Gunshot Wounds"**

- **Distant range wounds**  
Lack powder tattooing and usually present with a round to oval hole with punched out sharp margins.

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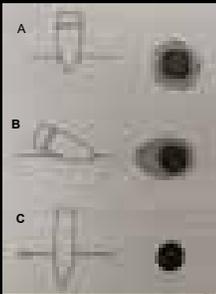
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### Abrasion Ring from Distant GSW

**Distant range wounds:**

1. Tend to be round to oval with sharp punched out margins. Typically, the edges are surrounded by an abrasion ring.
2. Lack powder stippling & usually exhibit a hole roughly the caliber of the projectile fired.



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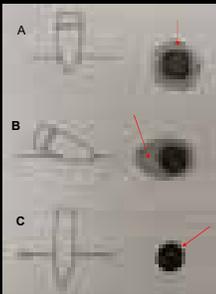
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### Abrasion Ring from Distant GSW

**Distant range wounds:**

- A. Bullet enters at right angle producing a regular, round abrasion collar.
- B. Bullet enters at oblique angle causing a crescent-shaped abrasion collar.
- C. A center fire rifle bullet with micro tears around the edge of entry defect.



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### Abrasion Ring

**Cause:**

3. The ring is caused by the scraping and compressing the edges of the skin as it indents and perforates it. Not due to heat of the bullet or its rotary movement.
4. Irregular Shaped Abrasion Rings can be due to:
  - a. Bullet impacting the skin at an angle.
  - b. Irregularities of the skin at the point of entrance
  - c. A deformed bullet
  - d. Destabilization of the bullet in flight

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### No Abrasion Ring Entrance

Cause:

- 5. No Abrasion Ring:
  - a. Centerfire rifle wounds.
  - b. Handgun wounds from semi- jacketed & full metal jacketed bullets (i.e .357 & less common in 9 mm)
- 6. Centerfire rifle possible small micro tear around entrance defect.
  - a. Tears are 1-2 mm long, radiating outward from the entrance wound.
  - b. May or may not have abrasion ring.
  - c. sometimes seen with high velocity pistol ammo (i.e. .357 magnum)

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### No Abrasion Ring Entrance

Cause:

- 7. Palms of hand, soles of feet ..... Different type of skin  
Because they have different type of skin, the distant entrance wound appearance is different shaped.....
  - a. Irregular shaped rather than round or oval.
  - b. Stellate appearance
  - c. Lacks abrasion ring
  - d. Has appearance of exit wound.

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### Graze Wound

Characteristic:

- 1. Bullet travels across skin
- 2. Shallow angle
- 3. Produces elongated abrasion
- 4. NO perforation of skin
- 5. Difficult to tell which direction bullet was traveling



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### Factors Affecting the Appearance of Entry Wound

- Appearance and characteristics of the wounds may differ:
  - Clothing worn by the victim
  - Caliber of the weapon/s used
  - Angle the bullet entered the body
  - And the information gathered from the scene investigation.

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### Exit GSW

- Appearance and characteristics:
    - Larger more irregular shaped than entrance wounds.
    - Due to destabilization, not traveling point forward and possibly deformed bullet from striking bone as it travels through the body.
1. Varying shapes....slit like to stellate.....small to large.
  2. Typically, NO abrasion ring present

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### Exit (Shored) GSW

- Appearance and characteristics:
  1. Shored exit wound - An exit wound with an irregular shaped abrasion ring.
  2. Shored = At time bullet exits the body, skin at point of exit is pushed outward against a firm surface such as the ground, wall, surfaced roadway/sidewalk etc.
  3. Surface of skin is rubbed raw the margins of skin around the exit wound.
  4. May also be caused by clothing (bras, belts, multiple layers of tight clothes).
  5. Bullet may not have completely exited the body. May be seen just below inside the exit wound.

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### Exit (Shored) GSW

- Appearance and characteristics:
  1. Shored exit wound - An exit wound with an irregular shaped abrasion ring.



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### Appearance & Characteristics of Gunshot Wounds

#### Distant Entry Gunshot Wounds

- Abrasion ring is the hallmark of a gunshot wound of entrance.
- Abrasion ring present & lack of other findings is typical of the distant gunshot entry wound.



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### Appearance & Characteristics of Gunshot Wounds

#### • Distant Entry Gunshot Wound

- *Ring of abrasion present* around a typical round or oval *entry hole*
- *Bullet Wipe on clothing sometimes present*

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### Appearance of GSW

- Location of GSW on the body can affect the appearance of GSW
- Two places where GSW's may not appear with abrasion rings....Soles of feet..palms of hand

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### Appearance & Characteristics of Gunshot Wounds

#### • Contact Entry Wounds

- Depending on caliber of weapon and location on the the body, the skin may be torn/lacerated.
- Muzzle imprint on the skin may be present

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### Contact Entry Wounds Characteristics

- Muzzle Imprint
- Helps to determine range of fire (commonly seen in contact GSW)
- Sometimes helps determine features on muzzle of the gun



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**Contact Entry Wounds  
Muzzle Imprint**



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**Contact Shotgun Wound with  
Muzzle Imprint**



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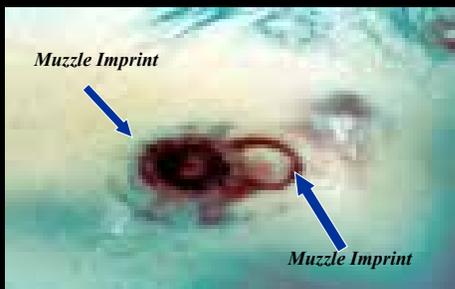
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**Shotgun Blast – Double Barrel**



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**Contact Entry Gunshot Wound**



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**Contact Entrance GSW**



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**Skin Tears from Intra-Oral**



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***Entrance vs Exit  
GSW Through bone***

Entrance Wound  
Bullet hole has a "Punched Out Appearance" through bone

Exit Wound  
Outer table of the bone is beveled out as the bullet exits

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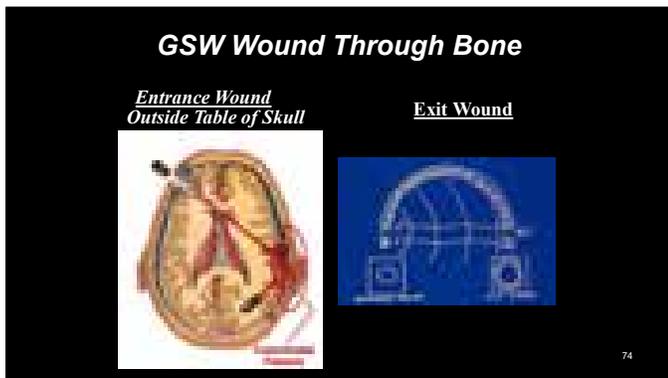
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Distant Entrance GSW (Slightly Angled)



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Distant Entry Gunshot Wound



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Distant Entry Gunshot Wound



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Entrance GSW



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Entrance GSW



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Entrance GSW



87

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### Entrance GSW



88

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### Entrance Intermediary Target GSW



89

89

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### Entrance Distant GSW



90

90

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Entrance GSW



91

91

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Entrance GSW



92

92

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Entrance GSW



93

93

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Entrance Rifle GSW



94

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Entrance Rifle GSW



95

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Entrance GSW



96

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102

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**Distant Entry Gunshot Wounds**



103

103

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**Distant Entry Gunshot Wounds**



104

104

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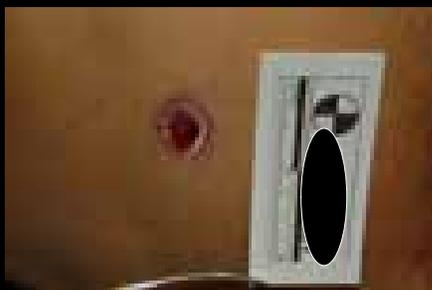
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**Distant Entry Gunshot Wound**



105

105

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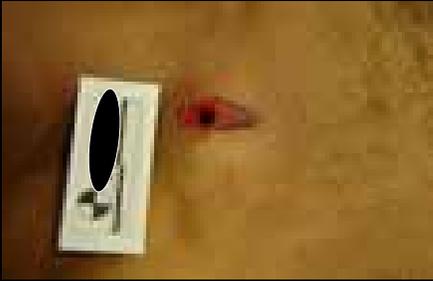
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*Distant Entry Gunshot Wound*



106

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*Distant Entry Gunshot Wound*



107

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*Distant Entrance Gunshot Wound*



108

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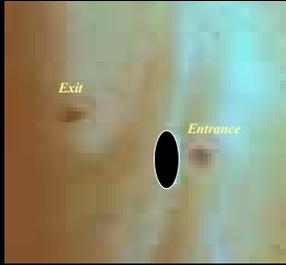
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### Exit & Entrance Distant GSW



109

109

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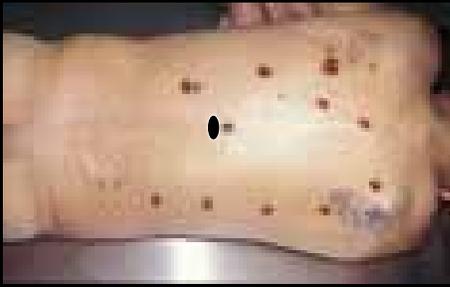
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### Stab Wounds & GSW



110

110

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