The Anatomy of Firearm Injuries

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The Basics: Guns and Ammunition

Types of Firearms
- Handguns
  - Revolver
  - Pistols
- Long guns
  - Shotguns
  - Rifles

Revolver
- Hammer
- Cylinder
- Ejector

Pistol
- Hammer
- Cylinder
- Ejector

Types of Firearms
- Handguns
  - Revolver
  - Pistols
- Long guns
  - Shotguns
  - Rifles
**Rifling**

- Rifling is a series of grooves cut inside the barrel.
- The grooves vary in number.
- The “twist” is either right or left.
- Stabilizes bullet.

**Rifled Weapons Cartridge**

- Bullet
- Case
- Powder
- Flash hole
- Primer

**Types of bullets**

- Lead Round Nose
- Semi-Jacketed Hollow Point
- Jacketed Hollow Point
Wounding Theory

- Two major factors
  - Mechanical interaction
  - Temporary cavity formation

- Mechanical interaction: Direct tissue disruption by bullet
- Temporary cavity: Cavity created as tissue flung away from bullet

Temporary Cavity

- Due to transfer of kinetic energy from bullet.
- KE = ½ x Mass x Velocity²
- In other words, kinetic energy goes up linearly with bullet mass, but goes up exponentially with bullet velocity

Examples

<table>
<thead>
<tr>
<th>Cartridge Type</th>
<th>Velocity*</th>
<th>K.E.**</th>
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</thead>
<tbody>
<tr>
<td>.22 Rimfire</td>
<td>725-2200</td>
<td>34-324</td>
</tr>
<tr>
<td>Centerfire handgun</td>
<td>680-1610</td>
<td>65-1000</td>
</tr>
<tr>
<td>Centerfire rifle</td>
<td>2200-3400</td>
<td>1300-2900</td>
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* feet/sec
** kinetic energy in foot-pounds

Temporary cavity

- Plays very little role for handgun rounds
- Plays very important role for rifle rounds
- Maximum damage is point where the deceleration is greatest.
  - Bullet is maximally expanded or turned sideways.
- More damaging to solid organs (liver, spleen, brain)
- Less damaging to compressible organs (lung, bowel)
Autopsy of GSW Victim

Entrance wound.

Range of fire.

Injuries associated with gunshot wound.

Exit wound (or recovered projectile).

Direction of fire.

Entrance Wounds

- Characterized by marginal abrasion ring.
- Tend to be small (except over bone).
- Tend to be circular or oval.
- Intermediate targets (glass, car door) can alter appearance of an entrance wound.

Abrasion Collar

- Caused by bullet rubbing skin as it punches through.
- Not caused by spinning of bullet boring its way into skin.
- Not caused by temperature of bullet.
Entrance Wounds

Marginal Abrasion

Autopsy of the Gunshot Victim

- Entrance wound.
- Range of fire.
- Injuries associated with gunshot wound.
- Exit wound (or recovered projectile).
- Direction of fire.

Discharge of a Gun

On the discharge of a gun, the following material leaves the barrel:

- Bullet
- Carbon (soot)
- Gunpowder (Burning and Unburnt)
- Gases And Flame

Range of Fire

- Entrance wounds
  - Contact wounds
  - Near contact
  - Intermediate gunshot wounds
  - Indeterminate (Distant) gunshot wounds

Contact Wound

- Muzzle in contact with body.

- Characteristics:
  - Scared wound edges.
  - Soot deposited on wound margins.
  - +/- muzzle imprint (caused by gases).

- Manner of death usually suicide.
Contact Wound

Soot stained and seared margins

Red muzzle imprint

Contact Wounds of Head
GSW of Head

Intra-Oral GSW

Near Contact Wounds

Intermediate Wounds

- Characterized by “stippling” aka powder tattooing.
- Stippling are punctate abrasions of the skin due to impact of unburnt and burning grains of powder (Not powder burns).
- Present when gun is fired from 1 cm out to 2-3 ft.
- Hair and clothing may interfere with stippling.
- Almost always HOMICIDE.

Intermediate Wounds

Stippling
Pseudo-stippling

Indeterminate (Distant) Wounds

• Lack the characteristics of contact and intermediate gunshot wounds.
• No:
  – Muzzle imprint.
  – Soot stained or seared margins.
  – Powder stippling.
• Still have marginal abrasion collar.
• Vast majority are homicides.
• Distance may range from near contact if wound is beneath clothing to thousands of feet.
“Distant” or “Indeterminate”

Range of Fire: Review

- Contact
- Near contact
- Intermediate
- Indeterminate (Distant)

Exit Wounds

- Usually larger and more irregular.
  - Bullet tumbling.
  - Bullet deformation.
- May be slit like.
- Usually NO abrasion ring.

Exit Wounds

Exit Wound
Gunshot Wounds
201
Atypical Entrance Wounds
Shored Exit Wounds

Atypical Entrance Wounds

Atypical Entrance Wounds

Atypical Entrance Wounds
The shored exit wound

- Mimics indeterminate entrance wound because:
  - It appears to have an abrasion collar.
  - Lacks soot or stippling.
- Due to shoring of skin by something tight or firm.

Autopsy of the Gunshot Victim

- Entrance wound.
- Range of fire.
- Injuries associated with gunshot wound.
- Exit wound (or recovered projectile).
- Direction of fire.

Pre-Autopsy X-rays
Caliber of Bullet?

Autopsy of the Gunshot Victim
- Entrance wound.
- Range of fire.
- Injuries associated with gunshot wound.
- Exit wound (or recovered projectile).
- Direction of fire.

Direction of fire
- Direction through victim’s body
- Described in three planes (front-back, right-left, up-down)
  - NOT in “degrees” (too many variables)
  - Use standard anatomic position
- Have to be able to tell entrance from exit wound

Direction of Fire
- Front to back, left to right, and upwards.

Direction of Fire: Tangential gunshot wounds
- Tags point toward gun
- Tears point in direction bullet is going
Entrance Wound of Bone
Exit Wound of Bone

Positioning the victim

Smooth Bore Weapons

Shotgun Cartridges

Shotgun’s Gauge

- Gas and Flame
- Wad
- Shot pellets/slug
- Burning and unburnt gunpowder

- Smooth Bore Weapons

- Shotgun Cartridges

- Shotgun’s Gauge

- Exit Wound of Bone

- Positioning the victim

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Range of Fire for SGW

- Contact - same as rifled weapons
- Intermediate - same as rifled weapons
- By spread pattern
- Ancillary clues
  - Petal marks
  - Wad marks

Contact Wounds
Intermediate Wound with Petal Marks

- 1 to 3 feet

Shot Spread Pattern

Wad Mark

Shot Filler
Pre-Autopsy X-ray
Summary

- Guns and ammo.
- Wounding theory.
  - Permanent cavity.
  - Temporary cavity.
- Entrance wound vs Exit wound.
- Range of fire.
  - Contact, near contact, intermediate, and indeterminate.
- Atypical entrance and shored exit wounds.
- Smooth bore weapon injuries.
- Soot staining of hands.