FIRE ARMS

Ballistics:- it is the science deals with projectiles, bullets, bombs & explosives, encompassing their physical phenomenon & characteristic feature of their abuse

Forensic ballistics

(1) Deals with investigation of fire arms and their ammunation & effects caused by their use

Fire arm → Any instrument or device that discharges a missile/ projectile by the expansive force of gases produced by burning of explosive substance.

Types → Internal Ballistics → Fire arms & ammunation Mech.
External Ballistics → Movement & path & projectile of bull
Terminal Ballistics } effects of the bullets on the targ
Wound Ballistics } con tissues respectively.

Types → Rifled fire arms
Smooth bored fire arms } Mainly depend upon the Characteristic of barrel.

Loco velocity fire arms
High velocity fire arms
Sub sonic fire arms
Super sonic fire arms } Depends on velocity.

Depends on Mfg → factory made
country made

Depends on user → Civilian fire arm → pistol, shot, revol
military fire arm → Machine gun, rifles, AK-4

Depends on Environment → Compressed atmosphere
Under water condition

Fire arms

parts → Action part
Frame part
Barrell part

All the movable parts of fire arms → Action part

Stability & integrate all the parts → Frame part

Metal tube in which bullet travel → Barrel part

{ Back part of Barrel is Breach part (or) End
Front part of Barrel is Muzzle part (or) end }

Muzzle velocity → the velocity the bullet leaves the muzzle End.

→ In riffle fire arms, shallow, parallel, spiral grooves will be there in the inner aspect of barrel. & these grooves are called rifling.

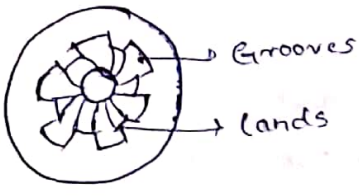
2-20 grooves → Depends of mfg.
[avg - 6 grooves]

→ rifling can be C.W (or) A.C.W [clock wise - C.W]

→ Some guns will have micro spirals

Due to the spiralling - it has lands & grooves in cut section.

in smooth bore firearms
↓
Bored



in rifled firearm
↓
land to land
Diameter
↓
Calibre

→ Spiraling of bullet helps in pathway of travelling in a single projectory straight pathway & velocity also will be increased & reaches the target with the more accuracy.

→ This rifling causes I° marking of the surface of bullet.

→ Helixometer is the instrument used to measure the lands & grooves in rifled fire arms.

Smooth Bore fire arms

→ no rifling in barell

Ex: shot gun [single / double barel]

rifled fire arms → revolver, Machine guns, pistol.

Paradox gun

Smooth bore fire arms, where terminal 7-10 cm of the fire arm will have rifling [lands & grooves]

1° markings → caused by lands & grooves.

2° markings → caused by abnormality & special characteristic of an individual gun.

Revolver

Calibre → 0.22 - 0.45 inch

Muzzle velocity → 180 m/sec - 410 m/sec

Range of wound → 150 meter

Terminal range → 200 meter.

pistol

Calibre → 0.25 - 0.45

muzzle velocity → 400 m/sec

range → 200 m

Terminal range → 400 m

Rifle

Muzzle velocity - 450 - 1500 m/s

range → 1000 - 3000 m

Shot gun

Muzzle velocity - 300 m

range - 30 - 40 m

Terminal - 50 m

Choking of the shot gun barrel

cylinder barrel

choked barrel

Choking → Terminal part of barrel of smooth bored guns

i.e., Terminal - 10 - 25 cm of barrel.

→ this choking of the barell helps the pellets to move as a single mass, in a straight pathway, without any early dispersion. the velocity also ↑ed & penetrating capacity also ↑ed.

Types.

Chokes { full → more constriction.
Half
Quarter.

Ammunition

A catridge is the Ammunition, is used in fire arms.

parts → case
projectile
propellant
primer

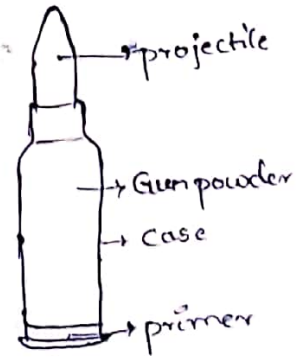
Rifle catridge

case → Brass [70% Cu & 30% Zn]

projectile → Bullet

propellant → Gun powder

primer →



Base of catridge → rimo

↓

metal cup

↓

filled with primer mixture

Primer mixture

↓

pressure sensitive chemical composition

[BL²AST]

BLAST

Barium nitrate ← B
Lead styphenate ← L²
Lead peroxide
Antimony sulphide ← A S
Tetracene ← T

Gun powder → Combustive material
↓ Release huge amount of gases

Black powder
Smokeless powder

potassium nitrate, charcoal, sulphur → Black powder

↳ 280 cc of gas per gram.

Each catridge → 2-20 gms of gun powder

Disadvantages → produces excessive flame
Excessive smoke
30-40% of powder is not combusted.

→ it is rarely used in most country made weapons.

Smokeless powder

Most commonly used propellent

3 types,
Single base - Nitrocellulose
Double base - Nitrocellulose + Nitroglycerine
Triple base - Nitrocellulose +
Nitroglycerine +
Nitroguanidine.

↳ 950 cc of gas per gram.

→ produces less flame & less smoke.

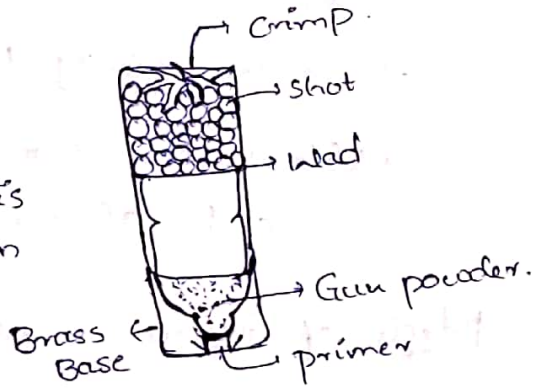
Rifle - projectile → lead
Bullets

→ there are so many types of bullets

Hollow nose
Jacketed
non-jacketed
Semi-jacketed
Glacier (Tip of bullet will have pellets)

*→ incendiary
Frangible

Shotgun catridge



Crimp - plastic discs.

→ The quantity of the gun powder is more in shot gun catridge than the rifle catridge.

4 types of shots;

i) soft shots
ii) hard shots
iii) steel shots
iv) plated shots → layered with bismuth [made with of steel]

→ shots are usually made up of lead.

→ The bullet with divided into multiple pieces & cause multiple injuries - Frangible bullet.

Injuries due to fire arms.

Mech. of injury

In revolvers & pistols;

The flame - 8 cms
Smoke - 15 cms
powder - 40-50 cm in handguns
60-100 cm in rifle guns.

Bullet

→ The bullet wounds are caused by bullets due to velocity by the spinning effect & their penetrating capacity can cause entry & exit wounds & most of times they are round in shape.

→ if a bullet enters the tissue in a tangential direction the shape of the wound will be oval.

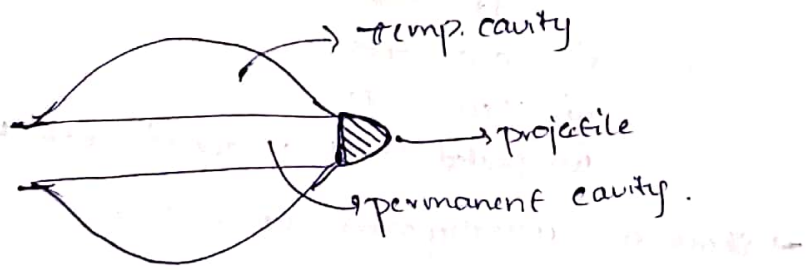
→ if the velocity is more, more diverse effects will be present in the target.

→ the Min. Velocity to pentrate the bullet is 200-300 ft/sec.

→ Velocity less than this bullet can cause very minor & trivial injuries.

Mech of injury → When the bullet passes through the tissues, it produces a temporary cand permanent cavity.

⇒



Due to this form^{n} of temporary cavity, there is shearing, compression forces, which can cause severe damage to the surrounding tissue, along with the permanent cavity produced by bullet, this is due to dissipation of huge amount of kinetic energy in the target tissue.

→ if the tissues are hard, more damage will occur bcoz resistance ex: bone.

product of fire arm	Responsible for	Detected by.
flame	Burning Scorching Singeing	Looking at singed hair around the wound.
Smoke	Blackening	wiping the wound wet sponge - blackening vanish.
unburnt gun powder	Tattooing.	wiping the wound with wet sponge does not vanish.

Range of fire arms

	Burning, Singeing, Scorching	Blackening	Tattooing.
pistols/revolvers	3" (7.5cms)	6" (15 cms)	12-18" (30-45cms)
Rifles	6" (15 cms)	12" (30 cms)	24-36" (60-90cms
Shot guns.	12" (30 cms)	24" (60 cms)	48-72" (120-180cms)

Range	Effects
Contact	Gases, Smoke, Unburnt powder enter inside the wound.
Near contact/ Close range	Burning, singeing & scorching (flame effects) present
immediate/ near range	Tatooing present, blackening may or may not be present depending on distance.
Distant	Burning, Singeing, blackening, tattooing absent.

Singeing

Bcoz of the excessive heat, the keratin will be melted at the tip of the hair & after cooling it appears like bulbous structure at the tip of hair & the hair will become hard, curly & friable.

Range of firearm wounds

Contact wound.

- there will be a Direct contact b/w muzzle end of the barrel and the tissue
- Muzzle impression of the barrel will be imprinted around the entry wound.
- No blow back phenomenon in rifled firearms.
- Flame, smoke, gun powder of bullet enters into the tissue.
- No blackening, No burning, No singeing, No tattooing will be seen on ext. surface of wound.

Contact shot on head region

Cruciate, stellate con star shape due to underlying hard skull bone.

- cavitation will be seen in the head (i.e., brain)
- punched out lesion at the outer table, bevelling of the inner table at the entry point of the bullet.

Contact wound on the trunk

- in the chest region & abd. region, the wound will be round in shape.
- cavitation will be seen in viscera & intestines.

Close range

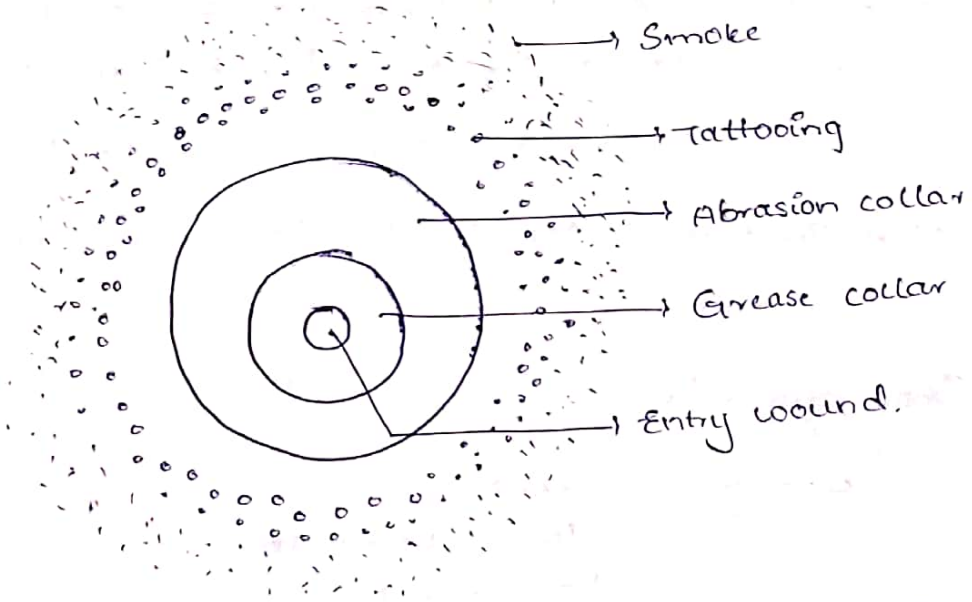
- Within in the range of flame [5-8 cms]
- Burning, singeing, Tattooing [faint tatooing]

Tattooing - produced powder particles embedding into skin.

Stippling - Brown colour mark on the skin.
[powder can reach the target but not embedded]

Near range
⇒
The powder can reach the target but not flame
[30-60 cms]
No burning, Tattooing ✓, Blackening [✓~~✗~~✗]

Distant
⇒
More than 60 cms
No blackening, No tattooing.
No singeing, only Entry wound



Grease collar → is due to the lubricant present inside the barrel, which will be swiped off, at the moment where the bullet pentrate the tissue.

Abrasion collar → Due to spinning of bullet, while penetrating it produces abrasion around the Entry wound.

Exit wound
⇒
- May (or) May not be present in Every case.
- they are like split injuries / lacerations without any burning.

blackening, tattooing, no abrasion & grease collar.

Shored exit wound

- will occur, if the body is in contact with any hard object, at the region of exit of bullet.
- Due to this hard object, an abrasion will be formed at exit wounds.

"Back Spatter"

Blow back phenomenon, due to '-ve pressure' in the terminal part of the barrel

- skin tissues, sub cutaneous tissue, blood will be sucked in to the inner aspect of the terminal part of barrel.

Very commonly seen in smooth bored & Shot guns.

→ As the bore of the gun↑, the incidence of "barespatter" is more

Shot gun injuries

4 ranges → Contact
Close - with in 1m
Near - 1-4 m
distant - >4 m

Contact wound

injuries on head

A stellate (or) Cruciate a large star shaped injury, will be seen in Contact region for head region.

injuries on trunk

~~They may be wrong~~

They may be Round

Burning ✗
Blackening ✗
Tattooing ✗
Muzzle impression ✓

Feature	Entry wound	Exit wound
Size	Smaller than the diameter of bullet [except contact shot]	Bigger
Edges	inverted	Everted, torn
Burning, Blackening, tattooing	May be seen around the wound	Absent
Grease abrasion, contusion collar	present	Absent
Bleeding	less	More
wound track	May be cherry red	No such colour
Fibers of clothing	Turned in & may be carried into the wound	Turned out, No blackening
Radiological signs	Materials present in grease collar may be detected. in case of unjacketed bullets lead on outside the wound	No such material detected.
Spectrography	Same as above	Same as above
Skull	punched out clean cut hole on the outer table, bevelled bevelling in inner table	punched out clean cut hole on the inner table & bevelling on outer tabl
protrusion of fat.	No protrusion.	May be protruded.

→ Muzzle impression present around the entry no burning, neuropathy

No blackening, no tattooing will be seen in ~~ext parts~~ of injury

→ All these feature will be ~~present~~ present inside the wound

② Close range [Within 1m] Burning (30cm) ✓ Tattooing ✓ Blackening ✓

→ if the close range is within 30cm burning present,

Beyond the region 30cm on burning.

→ Tattooing, blackening present.

→ Muzzle impression is absent.

③ Near range

- upto 4m
- The dispersion of pellets with occur beyond < 2m.
- In near range, if it is < 2m, there will be single large entry, irregular, inverted, Invented, scalpel edge. it was called ~~as~~. Rat-hole injury.

→ Wads can travel

→ Beyond < 2m in near range dispersion of pellets will starts. This will cause satellite pellet holes

→ Beyond 3m no burning, no tattooing, no blackening

→ Beyond 6m no central hole, groups & single pellet holes seen.

contact

Split wound from contact over bone

Burning

Soot

Tattooing

CO, bruise wads

○ Few cms

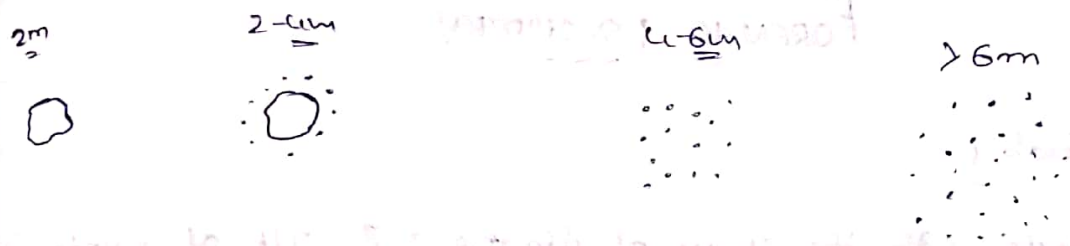
Round Contact wound

○ 30 cms

1-inch irregular hole

Burning, soot, tattooing

CO wads with in the wound.



- Wad can cause contusions & abrasions.
- → in distant shot no burning, no scorching, no tattooing, no blackening.
- NOTE:- No abrasions collars, no contusion collar, no grease collar in shot gun injuries.

KRONLEIN SHOT

- → Most commonly seen in head region
- → Entry wound- Very small
- → Excessive pressure will cause big burst with multiple fragmentory fracture of skull bone with complete damage of brain

Souvenir bullet

FIRE ARMS

11/4/25

Atypical entrance wounds of fire arms

→ Mainly due to faulty fire arms & faulty ammunition.

→ Old unused guns & old ammunition without any obturation, Due to this the bullets cannot travel long distance this produce less severe entry wounds even sometimes lacerations & contusions.

→ Sometimes due to this the trajectory of the bullet may not be in straight path & it travels in different fashions like, yawning bullet, tumbling bullet, pitching bullet, Mutation bullet, precision bullet

Ricochet bullet

The bullet intervenes with the an object / surface & will be reflected out & rebounding from surface causes an abnormal entry wound in the tissues.

2 types,
i) External ricochet
ii) Internal ricochet

External ricochet

After, leaving the muzzle end of barrel it strikes any object like wall, car etc. & it rebounds into surface & enter into tissues. The injury looks like laceration with irregular margins & there is no singeing, blackening etc..

→ One of the main causes for atypical entry wound.

→ The Trajectory is not straight.

Internal ricochet

Seen in skull, chest & pelvis.

Single ricochet

Double ricochet

Inner tangential at entrance side

Inner tangential at contralateral side

Inner tangential at contralateral & ricochet.

→ The derangement of bullet occurs in ricochet, sometime the bullet splits into multiple fragments & cause multiple entry wounds.

→ 1. The single firing, multiple (2) bullets in the body is due to "TANDEM BULLET" [one behind the another].

⇒ Single entry wound ; multiple exit wound, due to tandem bullet (or) Frangible bullet (or) it may be due to multiple fragmentary shortening of bone, where each bone piece acts as missile & causes multiple exits.

2. In a single five multiple entries & exits with a single bullet if a bullet five at forearm, it may cause entry wound & exit wound on the forearm (or) upper arm & entry wound of chest & exit wound on back.

TANDEM CATRIDGE - 2 bullets in one single catridge.

In Manfacturing [Mfg].

Bullet Graze

it is an abrasion (or) laceration, where the bullet passes on superficial layers of body, without entering into the tissues Sometimes margins will be irregular, sometimes there will be contusions.

Gunshot residue

it is used to detect the assailant / shoota, This includes power, metal, blood stains.

Puppies rule

it is used to detect how many bullets are fired in skull region.

Tests for Gunshot residue

① Dermal nitrate test [paraffin test]

1. Molten paraffin wax will be applied to hands
2. After hardening it is peeled off
3. The inner surface of wax is coated with diphenyl amine (or) diphenyl benzidine reagent.
4. Blue colour will be formed if powder residue present.

Not a test of preference now a days.

② Harrison & Gilroy test

③ Griess test & modified griess test - using frequently now a days

④ Neutron activation analysis

⑤ Atomic absorption spectroscopy

⑥ Scanning electron microscopic energy dispersive x-ray analysis [Sem - edxa]

⑦ Anodic stripping voltammetry.

Features	Suicide	Homicide
Sex	male	Any sex
Site of Entrance wound	Head, centre of forehead under the chin inside the mouth.	Generally, head but may be any part of the body.
Distance	contact or very close range	Any range
Direction	upwards & backwards	Any direction
No. of wounds	usually one	Any number
Hands of the victim	show GSR	NO GSR
Cadaveric spasm	May be present	Absent
weapon	May be grasped tightly in hands, if not in hands it will be around at scene	Absent
Scene	usually own house or locked inside, Suicide note may be seen, no Evidence of struggle	Any place, no lock from inside, Evidence of struggle
Motive	present (depression)	Revenge, robbery, Gangwars.