

FORENSIC BALLISTICS

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Learning objective

- ▶ Describe different types of firearms including structure and components.
- ▶ Along with description of ammunition propellant charge and
- ▶ Mechanism of fire-arms
- ▶ Different types of cartridges and bullets and various terminology in relation of firearm– caliber , range, choking

- ▶ Describe and discuss wound ballistics- different types of firearm injuries and their interpretation
- ▶ Preservation and dispatch of trace evidences in cases of firearm injuries
- ▶ Various tests related to confirmation of use of firearms

Forensic Ballistics is the Science which deals with firearms, ammunitions and the problems arising from their uses.

FIREARM



AMMUNITION

RIFLED CARTRIDGES



SHOTGUN CARTRIDGES



FIREARM INJURIES



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Sub branches of forensic ballistics

- **Internal Ballistics**- deals with study of motion of projectile within the firearm.
- **External Ballistics**-deals with study of motion of projectile after it leaves the firearm.
- **Terminal Ballistics**-deals with study of effect of projectile on a target.
- **Wound Ballistics**-implies the study of injuries produced in the body by the firearm.

Firearm

A Firearm is an instrument or device which forcefully ejects out a projectile through its muzzle because of expansive force of gases generated by combustion of explosive gunpowder particles.



Barrel

Chamber

- It is situated at the breach end to accommodate the cartridge.

Taper/lead/lead

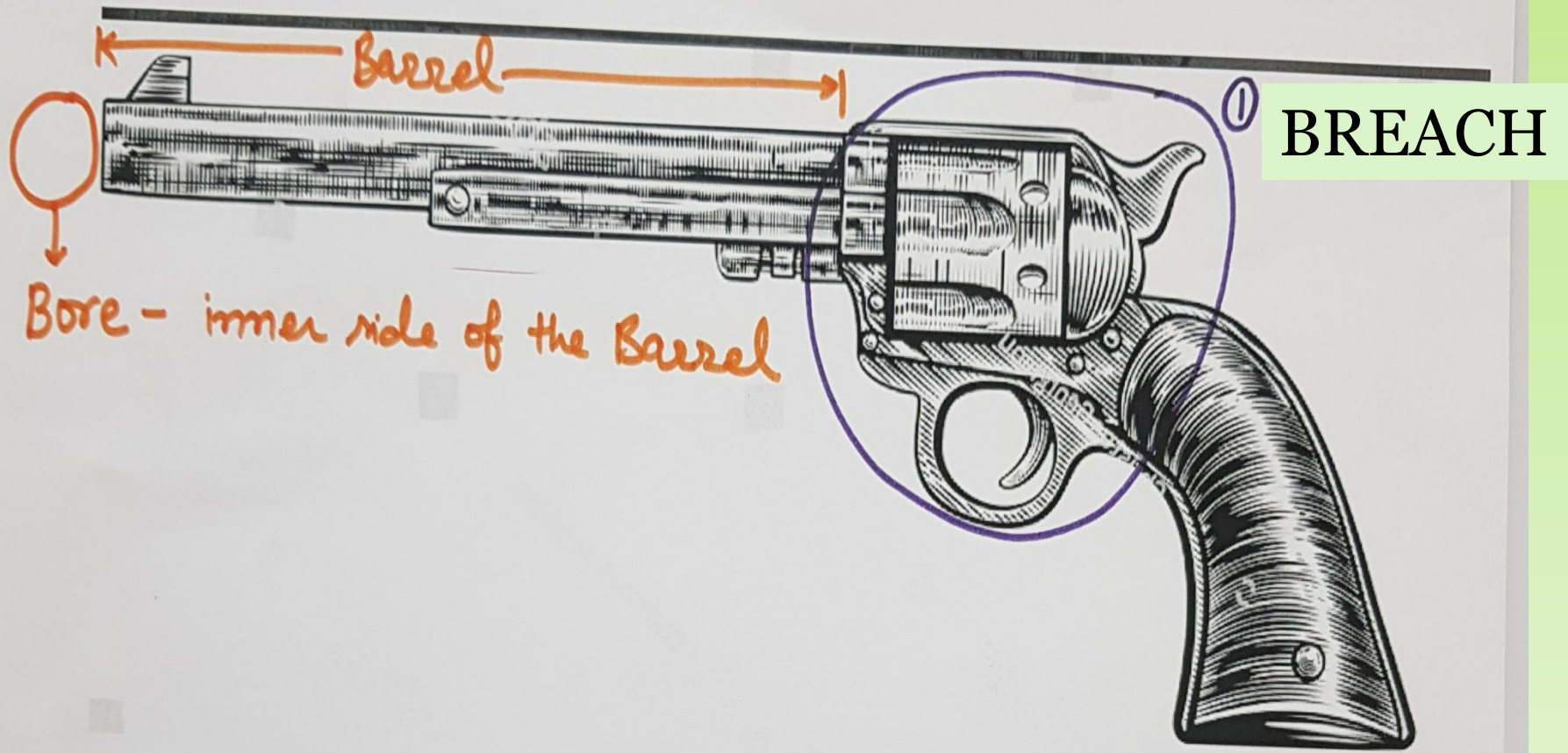
- Chamber is connected with bore through a short cone k/a taper.

Bore

- It is from lead upto muzzle end of the barrel.

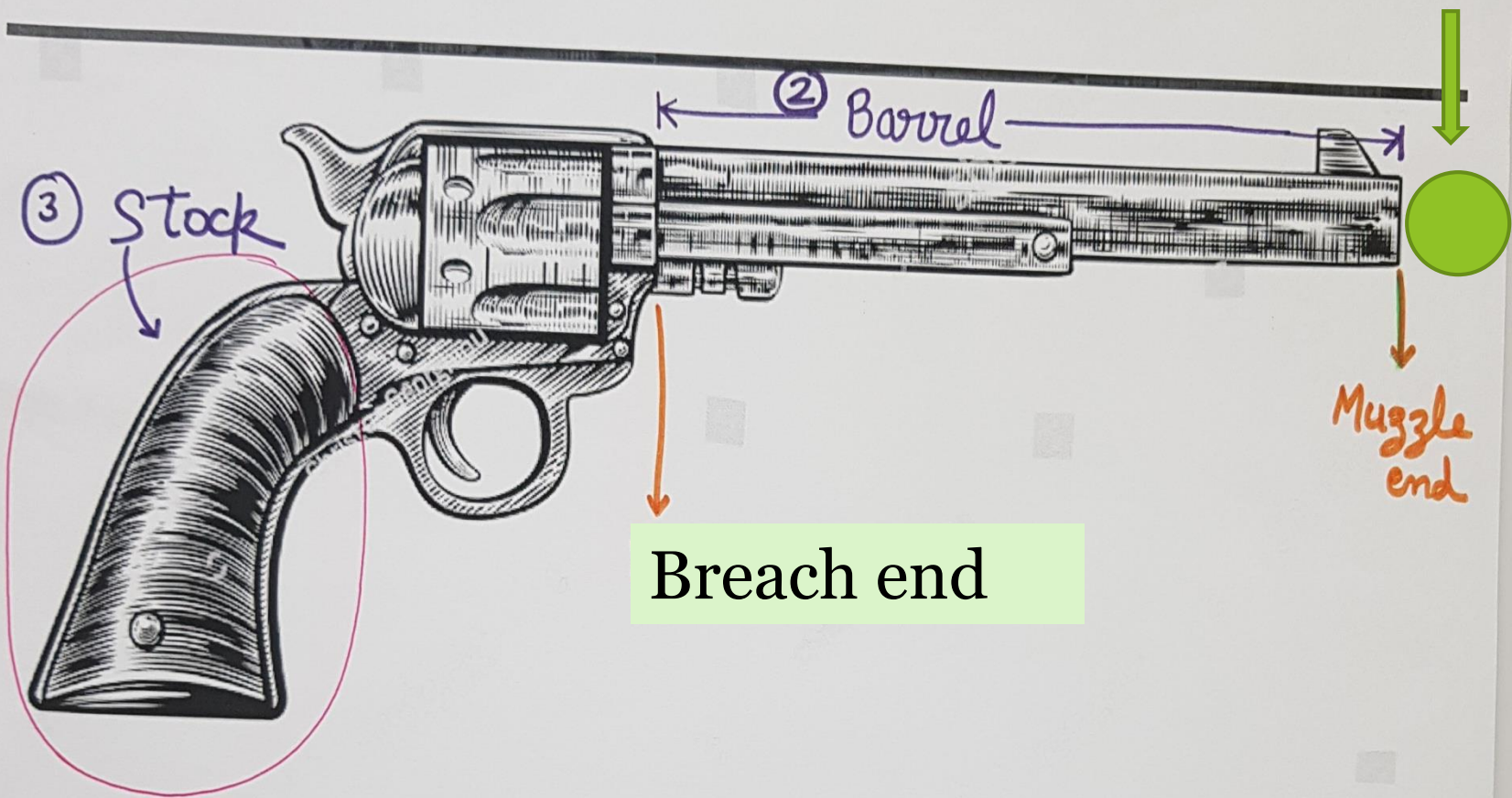
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BREACH

BORE



Firearm

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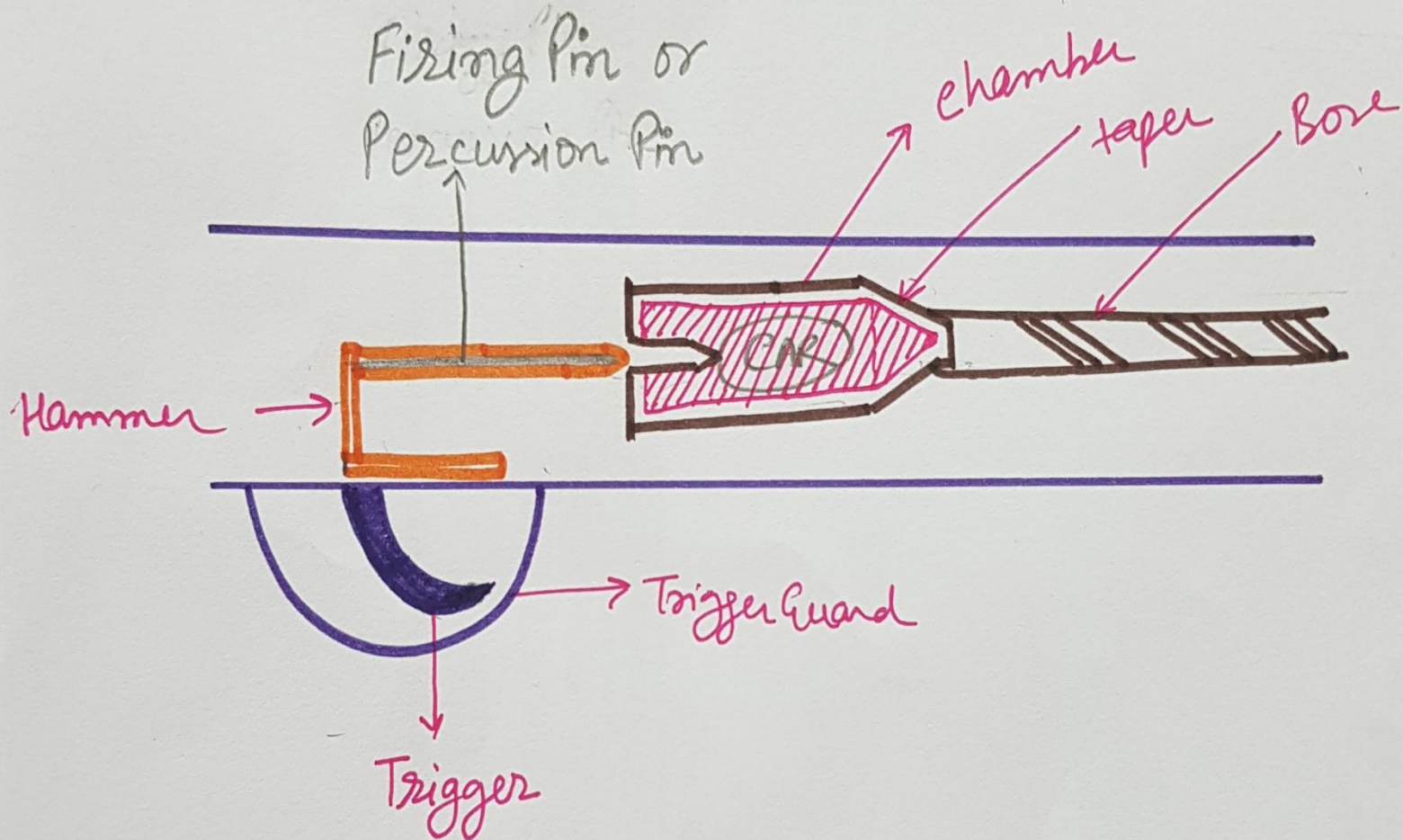
Bore

- It is from lead upto muzzle end of the barrel.

Barrel



Cut section of BREACH



Classification

- ▶ The classification of guns depends on the inner side of the barrel (bore).
- ▶ The inner surface of some barrel is smooth or in other variety has rifling or grooves.

Classification

1. Smooth bored weapon



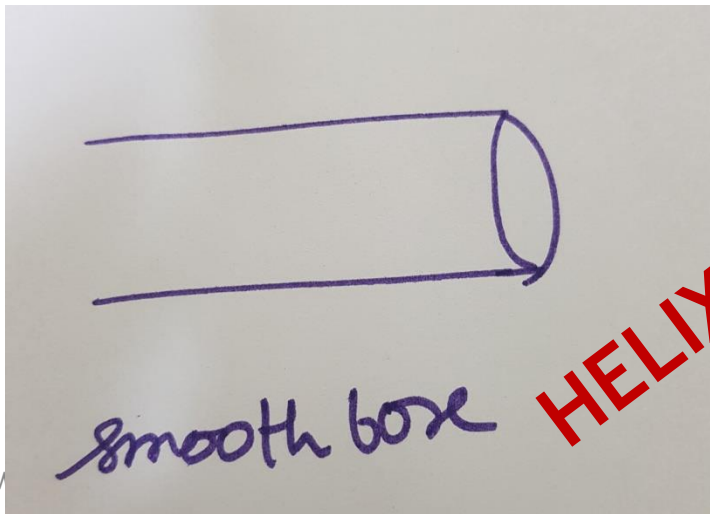
2. Rifled Weapons



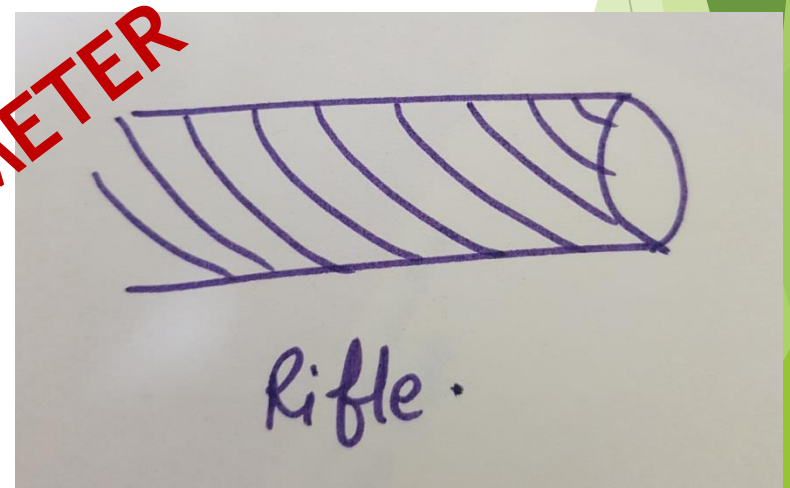
Classification

FIREARM

1. Smooth bored weapon



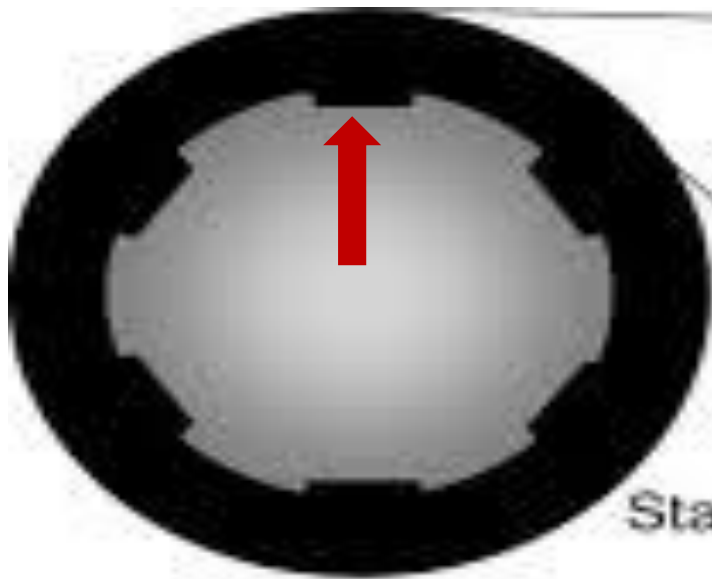
2. Rifled Weapons



HELIXOMETER

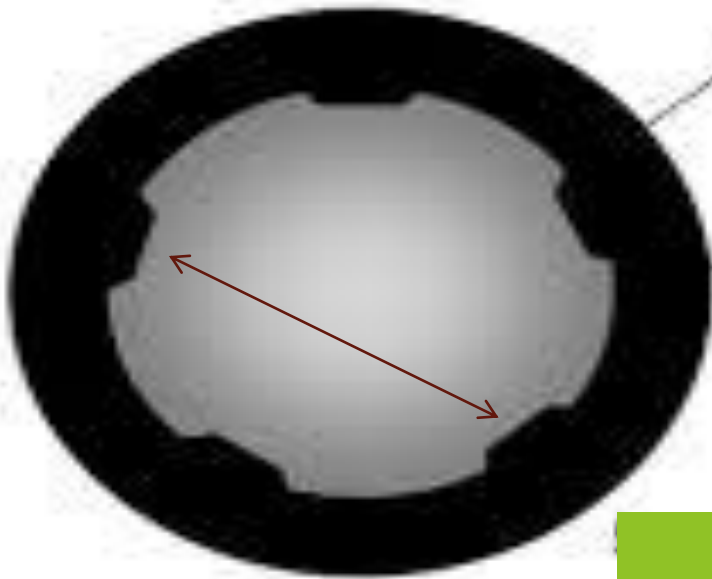


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LANDS

Standard Rifling Profile

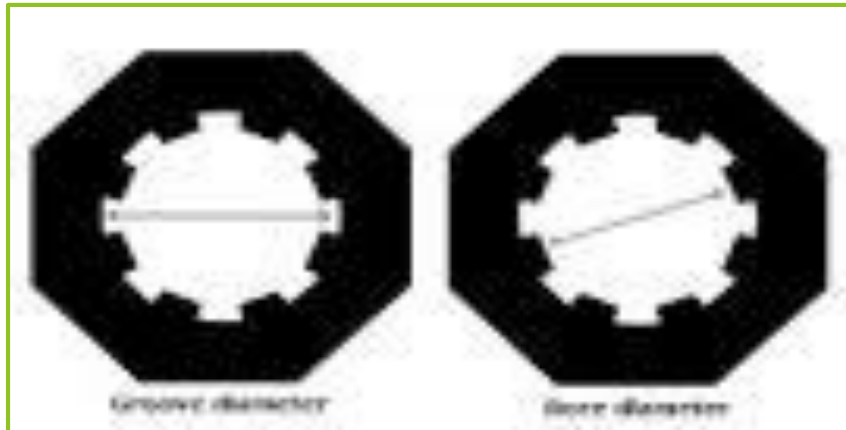


Notice the slanted sides of the land.

CALIBRE

- ▶ In rifled weapon, the bore from breach end to muzzle end is cut longitudinally in to a series of spiral grooves called rifling.
- ▶ No. of spiral grooves vary in no. from 2 to 20 or more.
- ▶ They all are parallel to one another but are cut with a twist.
- ▶ The raised portion in b/w the grooves inside the bore k/a lands.

Rifled weapon



In rifled weapon, the bore from breach end to muzzle end is cut longitudinally in to a series of spiral grooves called rifling.

No. of spiral grooves vary in no. from 2 to 20 or more.

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The raised portion in b/w the grooves inside the bore k/a lands.

Purpose of rifling

- ▶ Imparts spin to the missile
- ▶ Produces greater power of penetration
- ▶ Prevent wobbling and to give gyroscopic steadiness to the bullet during its flight straight onto its trajectory

Thus rifling improves accuracy and efficiency of firing.

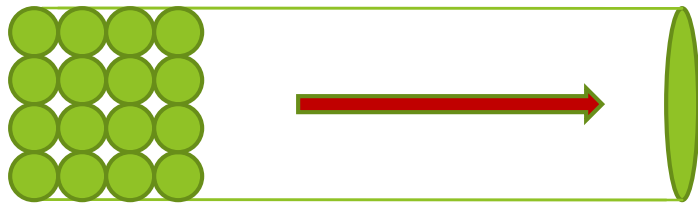
Rifled weapon

- ▶ Fire a single missile through rifled barrel
- ▶ Long barreled rifles with high muzzle velocity
 - ▶ rifles
 - ▶ sporting rifles
 - ▶ military rifles
 - ▶ 0.22 rifles
- ▶ Short barreled rifles with low muzzle velocity-eg.Revolver, automatic pistols.

Smooth bored weapon

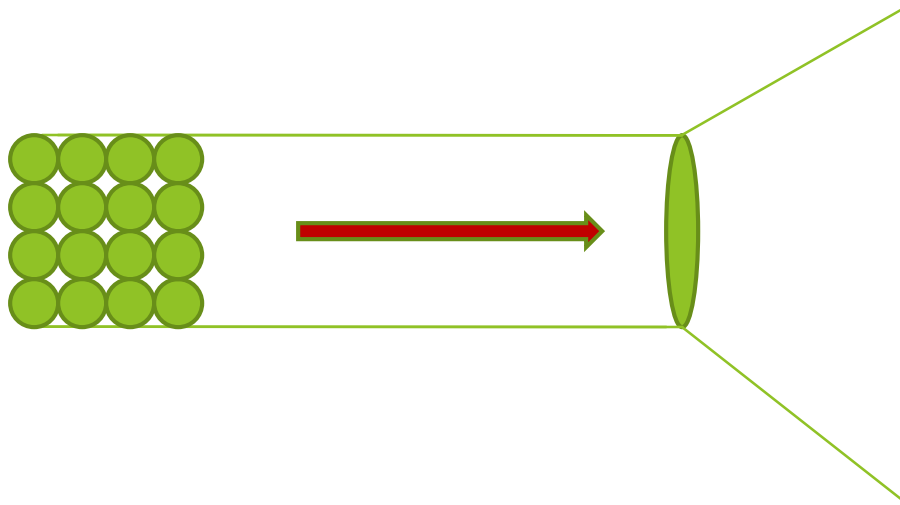
- ▶ Fire several lead pellets of standard size or a charge of shots , slugs through smooth bored barrel.
- ▶ Shot guns
 - ▶ single barrel
 - ▶ double barrel
 - ▶ self loading
 - ▶ semiautomatic
 - ▶ bolt action
 - ▶ automatic

Smooth bored weapon



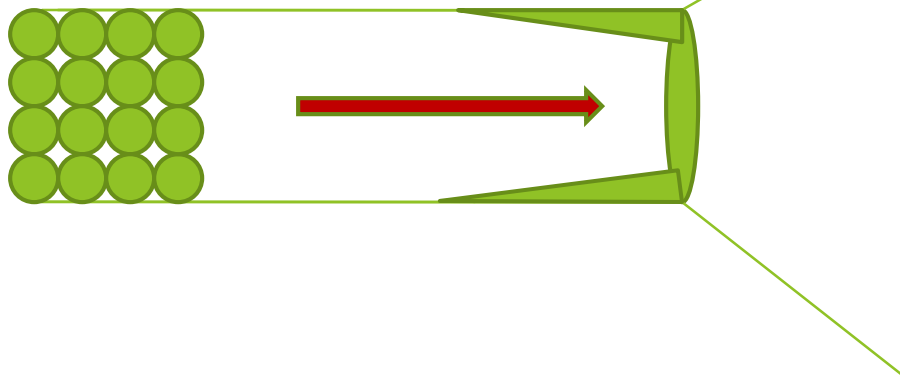
Smooth bored weapon

DISPERSION



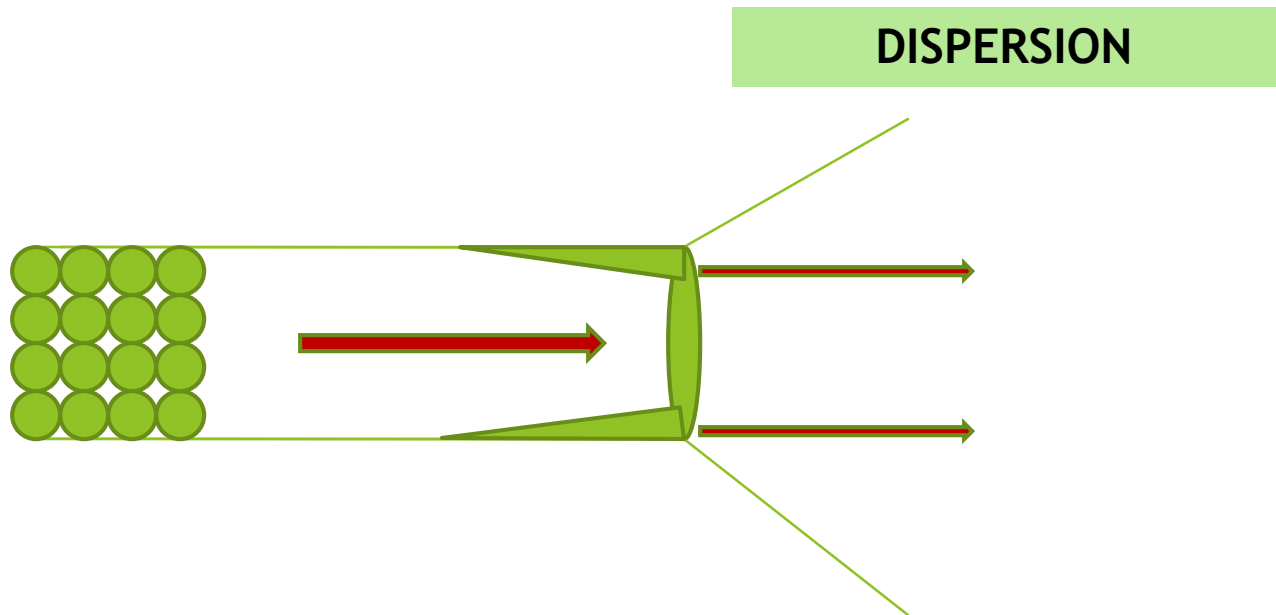
Smooth bored weapon

DISPERSION



$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

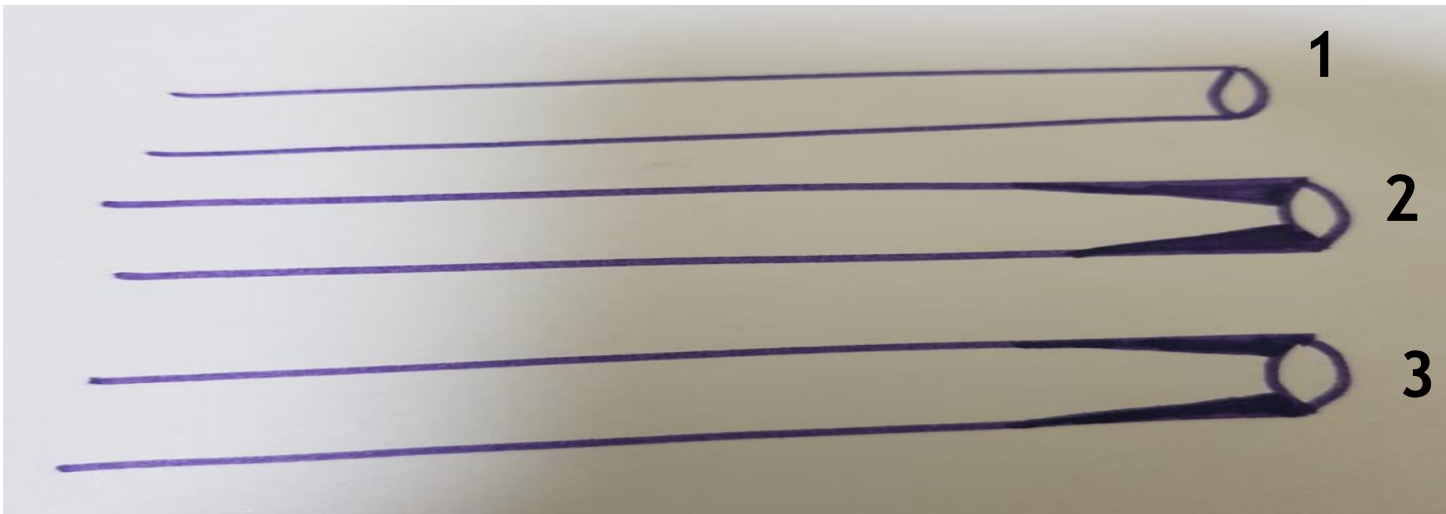
Smooth bored weapon



$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

Choking

- ▶ Tapering of bore at 1½” to 2½” (9 to 10 cm) from the muzzle end.
- ▶ Degree of constriction varies from 40/1000th of an inch to 3/1000th of an inch.



- ▶ Unchoked gun
- ▶ Improved cylinder
- ▶ Modified cylinder
- ▶ Fully choked

Purpose of choking

- ▶ Keep the charge of shots in a compact group for longer distances and decreases the rate of spread of shots.
- ▶ Enhance explosive force
- ▶ Increases the velocity

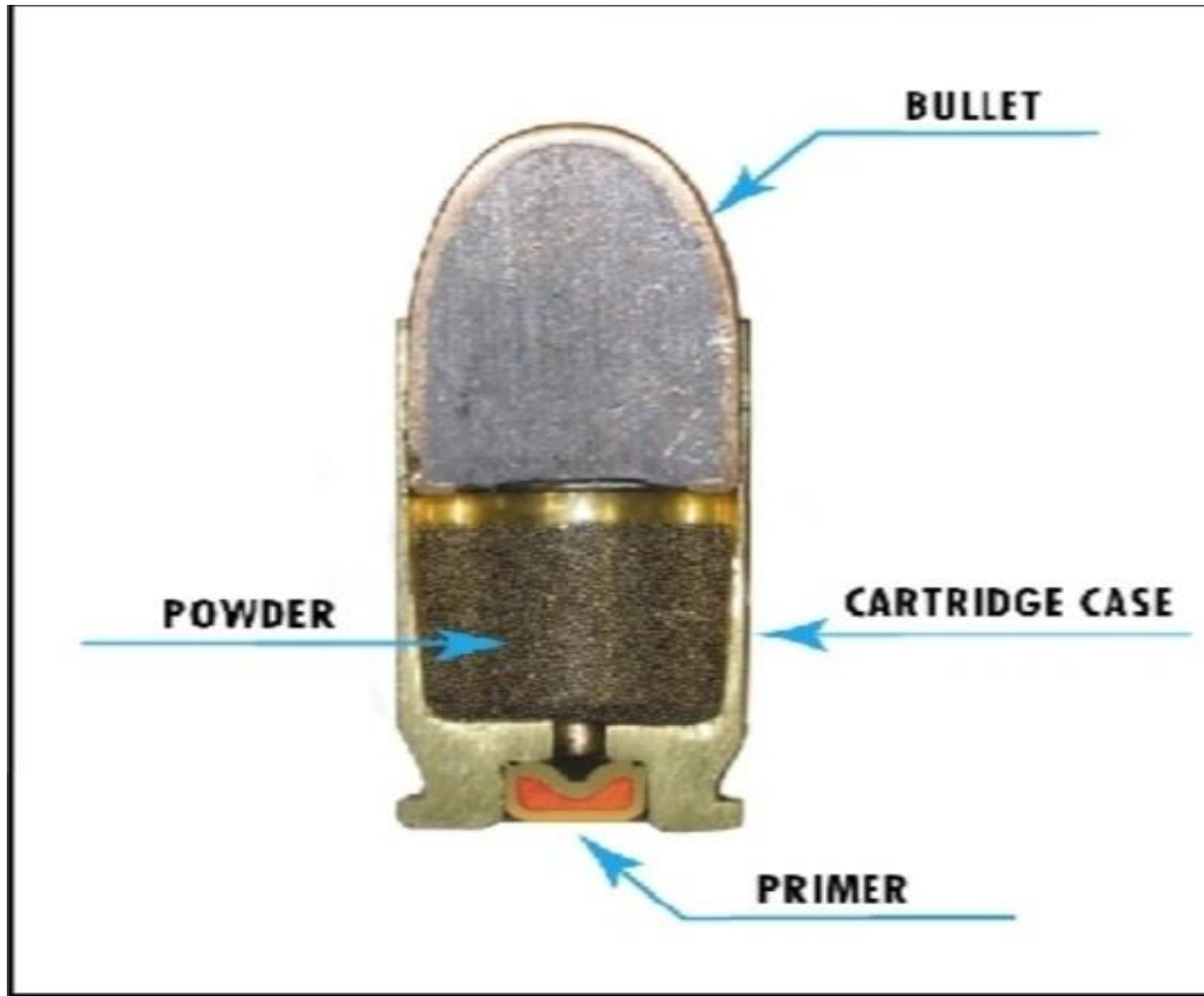
overall it increases the lethal range of weapon.

Ammunitions

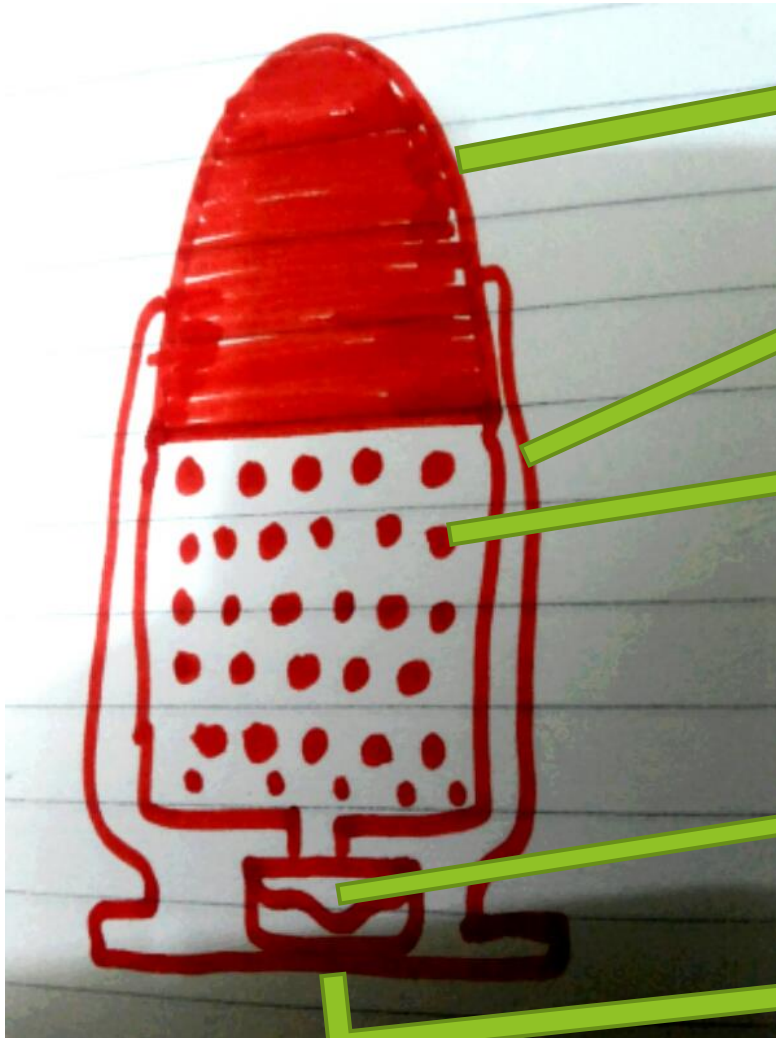
Cartridge denotes an assembled complete round of ammunition.

- ❑ Cartridge case
- ❑ Percussion cap
- ❑ Powder or propellant
- ❑ Projectile

Cartridge of a rifled firearm



Cartridge of Rifled Weapons



Bullet

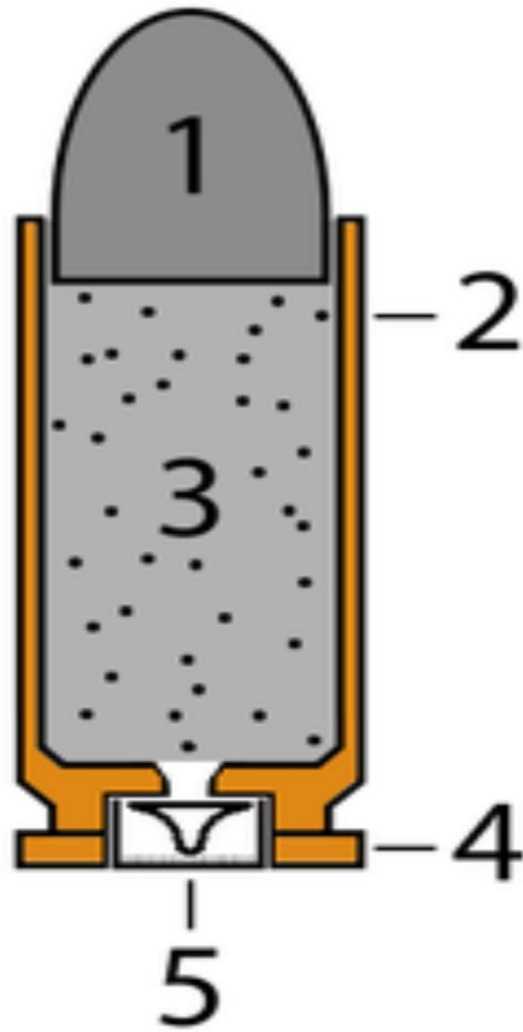
Cartridge case

Powder charge

Primer

Percussion cap

Lead peroxide
Lead styphnate
Tetrazene
Barium nitrate
Antimony sulphide
Pentaerythritol tetranitrate



Projectile -Bullet

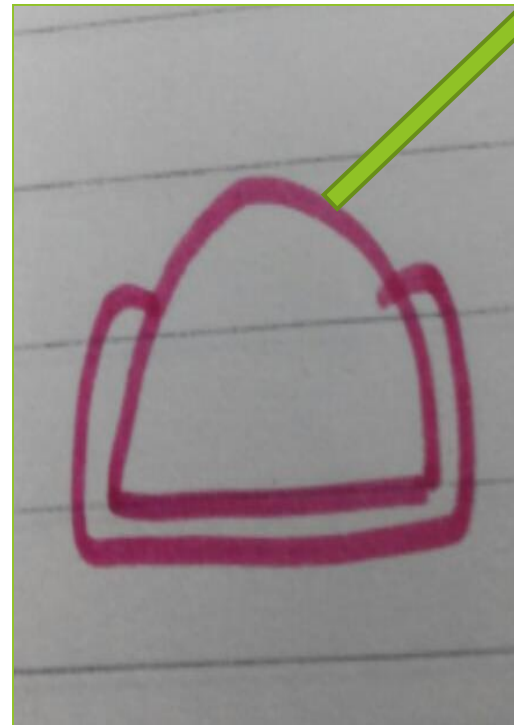
- ▶ Lead
- ▶ Momentum
- ▶ Softness

Bullet



Full jacketed

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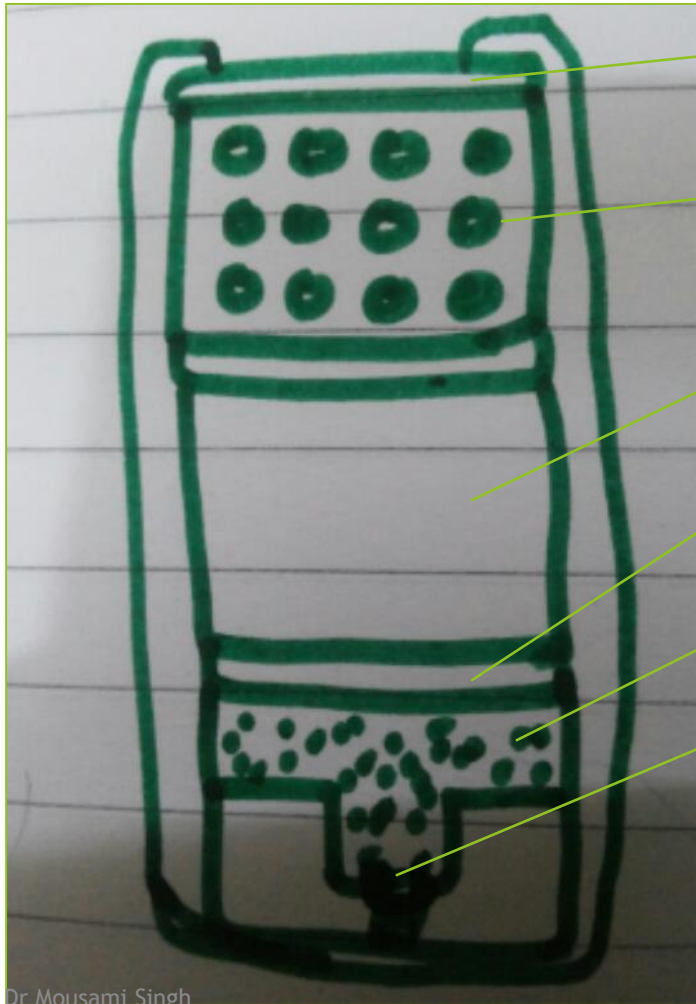


Semi jacketed

Types of bullet

- ▶ Wad cutter
- ▶ Hollow point variety
- ▶ Dum dum bullet
- ▶ Frangible bullet
- ▶ Incendiary bullet
- ▶ Tandem or piggy back bullet
- ▶ Tumbling bullet
- ▶ Souvenir bullet

Cartridge of shotgun



Retaining card board disc

Charge of shots

Felt wad

Card board disc

Gun powder

Primer

Percussion cap

► **Wad**- diameter is greater than that of the bore of gun.

It prevent heat from the gunpowder from fusing or distorting the pellets.

It acts like a piston and seals the bore completely,thus preventing the expanding gases from escaping and disturbing the shot charge.

Felt wad contains grease ,which lubricates the bore after firing of each round.

- ▶ Buck shot (2 to 20)
- ▶ Bird shot(200 to 400)
- ▶ Dust shot (2000 to 4000)

Buck shot is largest and has a diameter of 6 to 8mm

Propellant

- ▶ Black powder- Charcoal 15%, Sulphur 10%, KNO_3 75%

It is designated as FG, FFG, FFFG.

More the no. of Fs , more finer the quality.

- ▶ Smokeless powder- Nitrocellulose ,nitroglycerine and nitroguanidine
- ▶ Semi-smokeless powder- 80% black + 20% smokeless

Calibre or gauze of a gun

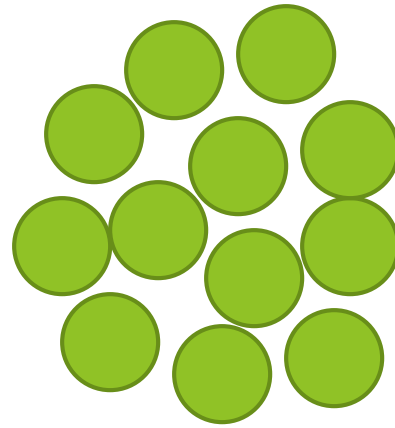
- ▶ Inner diameter of the barrel
- ▶ In rifled weapon, it is the diameter between the lands
- ▶ It is expressed in terms of cm or inch or indirect way of expression.

Indirect expression

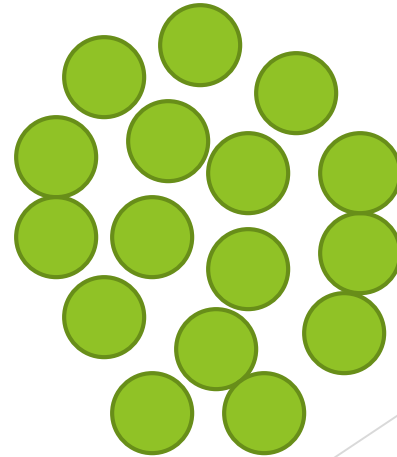
- ▶ A number is used
- ▶ Which is the number of spherical lead balls
- ▶ Which can be made of one pound of lead
- ▶ The size of each of which will exactly fit the inner diameter of the barrel



12



16



Example-12 bore

It means that if 12 spherical balls are made out of one pound of lead then the diameter of one such ball will be equal to the inner diameter of the barrel

Mechanism of discharge of projectile

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- ▶ When the trigger is pulled
- ▶ It will release the firing pin to strike at the percussion cap
- ▶ As it strike primer get detonated
- ▶ Resultant hot flame will inturn ignite the propellant charge in the cartridge
- ▶ Large amount of gas generated
- ▶ Will exert tremendous pressure with in confined space of cylinder
- ▶ As a result cartridge case swell outwards for which its hold on bullet is released.
- ▶ Bullet propels forwards
- ▶ Followed by blast of highly compressed hot gases , flame, smoke , partially burnt and un burnt powder particles, grease ,wad , cardboard discs etc.

PROJECTILE IS FOLLOWED BY

- ▶ Blast of highly compressed hot gases
- ▶ Partially burnt and unburnt gun powder
- ▶ Flames
- ▶ Smoke
- ▶ Carbon, metal particles, grease, wad, card board disc depending on whether shot gun or bullet cartridge has been fired.

How to recognize that this injury is due to firearm

- ▶ Characteristic wound of entry
- ▶ Characteristic wound of exit
- ▶ Presence of bullet or projectile
- ▶ Nature of track of bullet or projectile
- ▶ Presence of residual products in and around the wound of entrance and recovery of bullet or pellet from the body.

Entry wound

- ▶ Shape
- ▶ Size
- ▶ Abraded collar
- ▶ Grease or dirt collar
- ▶ Lead or metal ring
- ▶ Gas ring



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Exit wound

- ▶ Larger
- ▶ Irregular and everted margins
- ▶ Single/multiple
- ▶ No burning, singeing, blackening , tattooing, abraded collar, grease collar, metal ring or gas ring.

Range of products of combustion

Product of combustion	Rifle	Pistol/revolver	Shotgun
Flame	6"to8"	2"to3"	4"to5"
Smoke	12"	8"to10"	10"
Partially burnt powder	24"	18"	30"
Unburnt powder	30"	24"	30"
Wad	×	×	5 feet

Firarm Injuries

- ▶ Pellets or bullets
- ▶ Punctured wounds
- ▶ Glancing wound

PROJECTILE IS FOLLOWED BY

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- ▶ Partially burnt and unburnt gun powder
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Injury in case of a rifled weapon

- ▶ Single punctured wound of entrance
- ▶ Track
- ▶ Sometimes an exit wound too

Injury in case of a rifled weapon

- ▶ Circular/oval
- ▶ Small in close range firing/large in distant firing
- ▶ Abraded and contused collar
- ▶ Dirt /grease collar
- ▶ Corona
- ▶ Inverted and no protrusion of fat through the wound

- ▶ Singeing of hair
- ▶ Scorching and burning of skin
- ▶ Blackening
- ▶ tattooing

Contact shot

Close range- with in the range of flame, smoke and gunpowder(2"-3")(6"-8")

Near range- outside the range of flame but with in the range of smoke and gunpowder more than 6"and less than 12"
more than 12"and less than 24"

Distant range more than 24"(more than 2 feet) outside the range of powder deposition

Contact shot

- ▶ Little or no evidence of burning, singeing, blackening and tattooing around the wound of entrance
- ▶ Muzzle imprint abrasion
- ▶ Bright pink discoloration of the muscles in the track
- ▶ Skull
- ▶ MLI

Close shot

- ▶ with in the range of flame, smoke and gunpowder(2"-3")(6"-8")
- ▶ Circular/oval
- ▶ Small
- ▶ Inverted contused lacerated margins
- ▶ Grease collar and abraded contused collar
- ▶ BSBT

Near shot

- ▶ outside the range of flame but with in the range of smoke and gunpowder
- ▶ Beyond 3 inches but within 12 inches
- ▶ No evidence of burning and singeing
- ▶ Blackening will be present
- ▶ Tattooing will be present

Distant shot

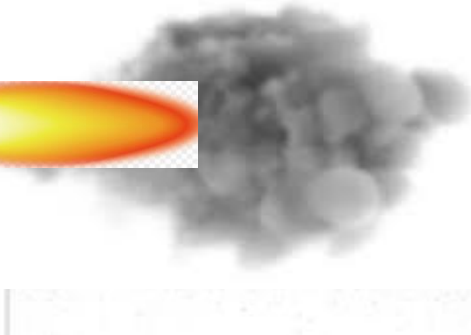
- ▶ more than 24”(more than 2 feet) outside the range of powder deposition
- ▶ No evidence of BSBT



CONTACT



**CLOSE
RANGE**



**NEAR
RANGE**



**DISTANT
RANGE**

SMOKE



CONTACT

CLOSE
RANGE

NEAR
RANGE

DISTANT
RANGE



CONTACT



**CLOSE
RANGE**

**NEAR
RANGE**

**DISTANT
RANGE**

Injury in case of a rifled weapon

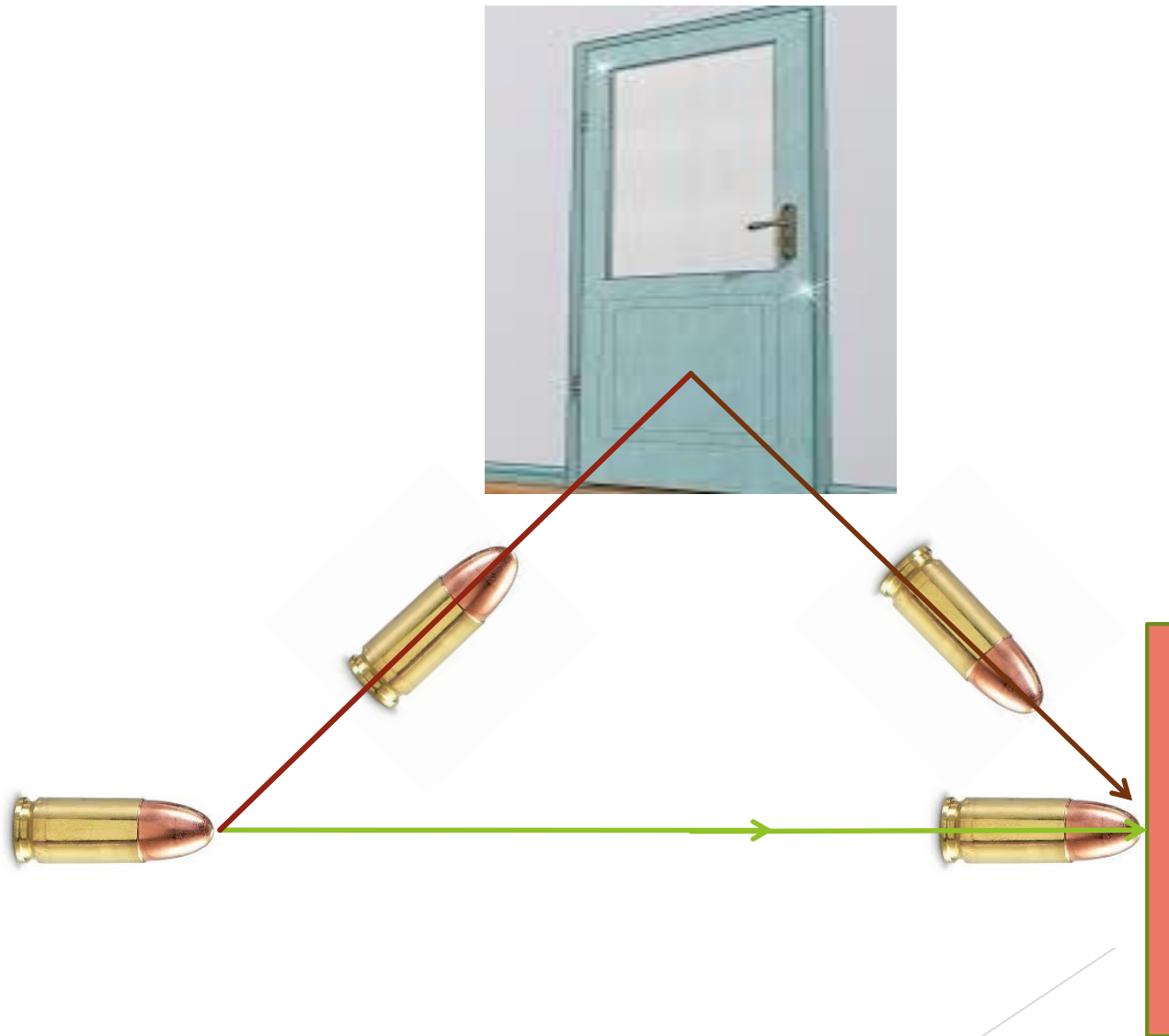
DEPTH AND THE TRACK

Injury in case of a rifled weapon

EXIT WOUND

- ▶ Larger
- ▶ Everted with protrusion of fatty tissue
- ▶ Shored exit wound
- ▶ Punched in and punched out hole in skull

RICOCHET BULLET WOUND



Entrance Wounds of Shotguns

Entrance Wounds of Shotguns:

1. Characteristics of wound when **close contact / Very near range**
 - ▶ With in few inches or cms. from the body
 - ▶ Large lacerated wound of entrance as charge of shots will go as a single mass followed by gases.

Entrance Wounds Shotguns

1. Characteristics of wound when **close contact / Very near range**
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- ▶ Size –equal or larger than the bore of the weapon

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- ▶ Large lacerated wound of entrance as charge of shots will go as a single mass followed by gases.
- ▶ Contused inverted margins
- ▶ Size –equal or larger than the bore of the weapon
- ▶ Wad and unburnt powder particles

- ▶ **Singeing** of hair
- ▶ **Burning and scorching of skin** surface and tissue
- ▶ **Blackening and tattooing** may be noticed around the wound margins and mostly in depth of the wound

► **If cloth in b/w**

no burning, singeing, blackening and
tattooing

Exit wound

- ▶ Larger than the wound of entrance
- ▶ Everted margins.
- ▶ No burning, blackening and tattooing

2. Characteristics of entrance wound When firing range is within 3 feet / 1 yard (approx. 1m)-

Close range

Within a distance of 6 inches

Beyond 6 inches but within a distance of 12 inches

Beyond 12 inches and less than 24 inches

Beyond 24 inches to 1 meter

2. Characteristics of entrance wound When firing range is within 2-3 yards or metres-

SHORT RANGE

- ▶ Irregular lacerated central aperture
- ▶ Surrounded by few separate small openings by the scattered pellets

2. Characteristics of entrance wound When firing range is upto 4 yards or metres-

INTERMEDIATE RANGE

- ▶ One central opening with irregular and lacerated contused margins
- ▶ Surrounded by several separate small openings by the scattered pellets

Long or distant Range (above 4 metres)

With increase in distance of firing the area of dispersion of pellets increases.

For 1st yard the diameter is equal to the distance of firing in yards.

After this distance diameter of dispersion in inches is equal to the distance of firing in yards multiplied by 1.5

BILLIARD BOARD RICOCHET EFFECT

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Preservation and dispatch of trace evidences in cases of firearm injuries

- ▶ Bullets, fragments of bullets or pellets
- ▶ Swab from the skin from around the entrance wound for detection of unburnt gunpowder and type of grease
- ▶ Torned margins of the clothes should be dried and preserved

Medico-legal information from a firearm injury

► Nature of death due to firearm injury

Suicidal

Homicidal

Accidental

- ▶ Direction of firing
- ▶ Distance of firing
- ▶ Identification of the firearm weapon used

Primary markings

Secondary markings

Various tests related to confirmation of use of firearms

- ▶ Dermal nitrate or paraffin test
- ▶ Harrison and Gilroy test
- ▶ Spectrophotometry
- ▶ Atomic absorption spectroscopy
- ▶ Neutron activation analysis
- ▶ Scanning electron microscope energy dispersive X-ray analysis
(SEM-EDXA)

Dermal nitrate test or Paraffin test

- ▶ Nitrates and nitrites
- ▶ Diphenylamine and diphenyl benzidine
- ▶ Blue colour

Harrison and Gilroy test

- ▶ Antimony
- ▶ Barium
- ▶ Lead

Neutron activation analysis

- ▶ **ANTIMONY**
- ▶ **COPPER**

AAS/FAAS

- ▶ Atomic absorption spectroscopy
- ▶ Flameless atomic absorption spectroscopy
- ▶ ANTIMONY
- ▶ BARIUM
- ▶ LEAD
- ▶ COPPER

SEM-EDXA

SCANNING ELECTRON MICROSCOPE ENERGY DISPERSIVE X RAY ANALYSIS

► GSR

Thank You

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