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Classification of Injuries: (section 44 IPC)

Medical Classification:

- Mechanical
- Thermal
- Chemical
- Physical agents
- Explosions

MECHANICAL INJURIES:

Blunt Force
i) Abrasion
ii) Bruise/Contusion
iii) Dislocation & Fractures
iv) Laceration

Sharp Force
i) Incised wound
ii) Chop wounds
iii) Stab wounds

Firearms

THERMAL INJURIES:

Due to cold

With tissue freezing
i) frostbite
ii) frostnip

Without tissue freezing
i) Trench foot
ii) Chilblains

Due to heat
i) Burns
ii) Scalds

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CHEMICAL INJURIES:

i) Due to corrosive acids
ii) Due to corrosive alkali
iii) Due to corrosive salts

PHYSICAL AGENTS:

i) Electricity – High tension
– Low tension
ii) Lightning
iii) X-rays
iv) Radioactive substances

Legal Classification:

- **Simple Hurt** — s. 319, IPC.
- **Grievous Hurt** — s. 320, IPC.

Medicolegal Classification:

- **Suicidal** (Hesitation cuts)
- **Homicidal**
  - **Lawful**
    - i) Justifiable
    - ii) Excusable
  - **Unlawful**
    - i) Culpable homicide not amounting to murder. [s. 299 IPC]
    - ii) Culpable homicide amounting to murder. [s. 300 IPC]
- **Accidental**
- **Self-inflicted** (Fabricated)
- **Defense**
- **Iatrogenic**
  - Ex: Surgical incisions, thoracotomy wounds.

Injury: Any harm, whatever illegally, caused to any person in body, mind, reputation or property (S. 44 IPC) B, M, R, P

Wound: any injury that causes a break in the continuity of any tissues of the living body.

Culpable homicide: Causing death by doing an act —

i) with the intention of causing death
ii) with the intention of causing such bodily injury as is likely to cause death
iii) with the knowledge that such an act is likely to cause death.
(S. 299 IPC)

Justifiable homicide: person committing the homicide is at no fault in a legal sense & is commanded or authorized to do so by law

Ex: legal officer who commits the homicide in order to execute the death sentence of an accused.

S. 299	Definition of culpable homicide
S. 300	Definition of murder
S. 302	Honor killing
S. 303	Punishment for murder
S. 304	Punishment for culpable homicide not amounting to murder
S. 304 A	Causing death by negligence
S. 304 B	Dowry death
S. 305	Abetment of suicide of child or insane person
S. 306	Abetment of suicide.
S. 307	Attempt to murder
S. 309	Attempt to commit suicide.

- Culpable homicide amounting to murder → 1st degree murder
- Culpable homicide not amounting to murder → 2nd degree murder
- Causing death by negligence → 3rd degree murder
- Participating in a related act which led to murder → 4th degree murder

Hurt: bodily pain, disease or infirmity caused to any person (s. 319 IPC)

Grievous Hurt: (s. 320 IPC) ⇒ s. 116 BNS

i) Emasculation
ii) Permanent privation of sight of either eye
iii) Permanent privation of hearing of either ear
iv) Privation of any member or joint
v) Destruction or permanent impairing of powers of any member or joint
vi) Permanent disfiguration of head or face
vii) Fracture or dislocation of a bone or tooth
viii) Any hurt which –
- endangers life
- causes the sufferer to be in severe bodily pain for 15 days
- causes the sufferer to be unable to follow his ordinary pursuits.

Dowry death: (s. 304 B IPC)

→ Death of a woman caused by burns or any bodily injury or occurs otherwise than under normal circumstances

i) occurs within 7 years of marriage

ii) it is shown that she was subjected to cruelty or harassment by her husband or his relative for dowry

→ Punishment: - minimum = 7 years imprisonment
- maximum = Life imprisonment
- No fine.

[s. 498 A IPC - treating a married woman with cruelty]

Causes of Death from Wounds:

① Shock:

i) Cardiogenic shock

ii) Hypovolemic shock (haemorrhagic shock, burn shock)

iii) Septic shock

iv) Anaphylactic shock

v) Neurogenic shock

vi) Surgical shock

② Reflex vagal inhibition

③ Air embolism

i) Venous (more common)

ii) Arterial

For fatality: (min. volume of air in embolism)
- venous = 100 mL
- arterial = 2-3 mL.

④ Mechanical injury to a vital organ

⑤ Natural diseases

⑥ Remote causes

i) death from trauma, long time after it was inflicted

ii) Crush syndrome (traumatic rhabdomyolysis / Bywaters' Syndrome)

iii) DIC

iv) Embolism

v) Gangrene or necrosis

vi) Infection

vii) Negligence

viii) Surgical operation

ix) Supervention of disease from a traumatic lesion.

Feature	Antemortem Wounds	Postmortem Wounds
Haemorrhage • amount • source	abundant, copious Arterial	None / slight Venous
Spurting	Present	Absent
Extravasation of blood	Into surrounding tissues	Absent
Staining of wound edges	Yes, resist washing	No staining; even if stained ⇒ can be easily washed
Coagulation	Blood is firmly coagulated	No coagulation / soft clot
Wound edges	Everted, gaping, retracted, swollen	Less gaping (∵ muscles are not in tension), skin elastin fibres retain tension even after death
Signs of vital reaction (repair, inflammation, etc)	Yes	No
Histology	Infiltration by immune cells, formation of new capillaries	No sign of cellular proliferation & infiltration
Enzyme histo-chemistry	Decreased activity of vasoactive amines & enzymes	No activity

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Torture: deliberate, systematic or wanton infliction of physical or mental sufferings

→ punishable under s. 330 IPC & s. 331 IPC

Methods of Torture:

I] Physical torture:

i) Beating
ii) Chepuwa (Bhutanese torture technique)
iii) Electric torture
iv) Falanga (beating the soles with canes or rods)
v) Force feeding
vi) Forced standing
vii) Knee capping
viii) Submarino (suffocation)

II] Mental torture:

i) Blindfolding
ii) Deprivation techniques
iii) Mock execution
iv) Providing false information to victim
v) Confinement
vi) Threat
vii) Witness torture

Duties of a Medical Practitioner in Case of Torture:

Istanbul Protocol for Examination:

i) Obtain complete history from patient about methods of torture
ii) Record symptoms & disabilities following torture (acute & chronic)
iii) Injuries must be recorded & marked on body diagrams.

iv) Photographs of injuries with a scale placed near them
v) Examine all systems of the body completely
vi) X-rays & CTs to detect fractures & soft tissue injuries

Treatment:

i) Developing a good rapport with the patient
ii) Empathizing with the victim & his family
iii) Avoiding situations or objects that remind the victim of the torture event
iv) Psychotherapy
v) Rehabilitation, Counselling & Re-assurance.

Abrasions: destruction of epidermal layers of the skin & dermal papillae.

→ caused by tangential force or perpendicular force
- tangential force ⟹ scratch & graze abrasions
- perpendicular force ⟹ pressure & impact abrasions

→ Abrasions always HEAL WITHOUT SCARRING.

→ If injury extends to subepidermal areas (below dermal papillae) ⇒ called Superficial laceration (heals with superficial scarring)

→ Abrasions are difficult to see on wet skin

→ On drying, abrasions become dark brown or black.

Types of Abrasions:

i) Scratch
ii) Graze
iii) Pressure
iv) Impact
v) Miscellaneous – tattooing & pseudotattooing
– drug injuries

① Scratch Abrasion: (linear abrasion)

→ Appreciable length, no significant width
→ typically produced by sharp, pointed objects
→ tip of knife / razor produces ⇒ Point scratches
→ nails produce ⇒ semilunar abrasions
→ surface layers of skin are heaped up in the direction of movement
→ clean area at the start of abrasion, epithelial tags at the end of abrasion.

② Graze Abrasion: (grinding, scraping, sliding abrasion)

→ Most common abrasion

→ uneven, longitudinal parallel lines (grooves/furrows) with epithelium headed up at the end of these lines (indicates direction of force)

→ may extend into dermis due to corrugations of dermal papillae (bleeding occurs)

③ Pressure Abrasion: (crushing, friction abrasion)

→ crushing of epithelium

→ relatively small force is applied to the skin for large time periods.

→ tissue fluid is extruded out ⇒ skin becomes dry & parchment-like.

Impact abrasion: force applied is tremendous, time period is negligible

- no substantial extrusion of tissue fluid (skin is not dry & parchment-like)

→ Examples: – corneal abrasion (due to contact lens)
– nappy abrasions in babies
– ligature marks
– shoe bites
– teeth bite marks.

④ Impact abrasion: (contact, imprint abrasions)

→ crushing of epithelium

→ relatively large force is applied perpendicularly to the skin for minuscule (negligible) time periods.

→ slightly depressed below the surface

→ dermis is damaged, underlying bruise present

→ Examples: – recoil/muzzle impression
– tire marks of a car

Patterned abrasion: [special subset of pressure & impact abrasions]

→ pattern of object is reproduced on the skin, enabling its identification.

→ Examples: – bicycle chains
– serrated knife
– shoe

Medicolegal Importance [MLI] of Abrasions:

i) Direction of force can be estimated
ii) Force of impact can be judged
iii) Important sign of internal injuries
iv) generally accidental or homicidal (may be self-inflicted)
v) usually simple (∵ they heal without scarring)
vi) Time of assault can be calculated
vii) Site of abrasion indicates type of offence
- around anus ⇒ homosexuality
- around breast, inner side of thigh ⇒ sexual assault
- over face ⇒ struggle
- over mouth & nose ⇒ smothering
- over neck ⇒ throttling

viii) Weapon: can be identified from patterned abrasions

Bruise/Contusions: effusion of blood into tissues under the skin due to rupture of blood vessels

→ situated in the dermis & subcutaneous tissue
→ lighter in the center (darker periphery due to extravasated blood pushed outwards)
→ caused by blunt force
→ Associated findings: — pain, tenderness
→ Abrasion & contusion may occur together —
- Abraded contusion ⇒ contusion is more prominent
- Contused abrasion ⇒ abrasion is more prominent

→ Size:
- Petechiae ⇒ 0.1 - 2 mm
- Ecchymosis ⇒ 2 - 5 mm
- Bruise ⇒ > 5 mm
- Haematoma ⇒ > 5 mm, forms a fluctuant mass (can be aspirated the way a pus collection is aspirated)

→ Shape: does not correspond to the offending weapon
→ blurred margins

Classification:

① Intradermal bruise: bleeding in dermis
→ amount of extravasated blood is small

② Subcutaneous bruise: bleeding in subcutaneous tissue
→ Most common type of bruising, appears immediately

③ Deep bruise: bleeding in deep subcutaneous tissue or in between muscle bundles
→ appears 1-2 days after injury (delayed bruising)

Patterned bruising: reflects the pattern of the striking force

Example: — Railway track / Railway line / Tram line bruise ⇒ two parallel lines of bruising with undamaged zone in the centre.

Age of Bruise:

Time	Colour	Pigment
Initially	Red	Oxy Hb
hours – 3 days	Blue	Hb
4th day	Bluish-black to brown	Hemosiderin
5 – 6 days	Greenish	Hematoidin
7 – 12 days	Yellow	Bilirubin
2 weeks	Normal	Oxy Hb

→ Subconjunctival bruises ⇒ do not show colour changes (directly from red to yellow)

→ Bruises in CO poisoning ⇒ Cherry red colour.

MLI of Bruises:

→ Age of bruise can be determined (by colour changes)

→ Alcoholics are more prone to bruising
(Due to – unstable gait
– cirrhotic disease causing bleeding diathesis)

→ Decomposition can cause merging of contusions & blurring of patterns

→ Distribution of bruises can indicate the manner of injury.

→ Bruises all over a child's body indicate regular child abuse
→ Position of fingertip & thumb bruises over the neck indicate method of strangulation (asphyxia)
→ Bruising of shoulder blades indicates pinning on the ground
→ Restraint signs: 3-4 coin-sized bruises on one side of arm & one larger bruise on the opposite side ⇒ indicate that arms were held together by the assailant
→ Bruising on inner aspect of thigh indicates sexual assault
→ self-inflicted bruises are rare (∵ it is painful)
→ accidental bruises are generally seen on bony prominences, homicidal bruises can be seen on any part of the body.
→ bruises may appear away from the site of injury (ectopic bruises)
→ not very well visible in dark skinned people.
→ Micro-contusions: seen in firearm entry wounds
→ Six-penny bruises: discoid bruises of 1-2 cm diameter, present in group of 3-5
- caused from fingertip pressure
- seen in child abuse, criminal abortion, rape, attempted rape, throttling

→ size can indicate the degree of violence.

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Lacerations:

(aka ruptures) tears or splits of skin, mucus membrane, muscle or internal organs, produced by application of blunt force which stretches tissues beyond their limits of elasticity.

→ irregular, ragged, uneven margins

→ Edges:

- Angular impact – skin on opposite side of direction of motion is torn free & undermined
  – skin on the side from which the blow was delivered is abraded & bevelled.
- Perpendicular impact – equal undermining on all sides

→ depth depends on degree of force applied

→ shape & size may not correspond with the weapon

- linear ⇒ crowbars, pipes
- irregular, ragged or Y-shaped ⇒ produced by objects with flat surfaces
- stellate ⇒ blunt round object
- crescentic ⇒ hammer-head
- semicircular ⇒ hard surface (eg: wall)

→ Gaping: present due to pull of elastic & muscular tissue

→ Tissue bridges: (Bridging fibres) seen at the base of the wound [formed because deeper tissue are unevenly divided]

- tissue bridges become apparent when the edges of the wound are gently separated manually.

→ hair bulbs are crushed

→ hair & epidermal tags are deeply driven in the wound

→ haemorrhage is less in lacerations (except: scalp lacerations)

Types:

① **Tear**: Most commonly encountered
- → occurs when blunt force is applied to the skin having sufficient amount of underlying fat & muscle (ex: thigh)
- → has ragged & bruised margins

② **Split Laceration**: when blunt force is applied to skin directly overlying a bone (minimal amount of underlying fat & muscle)
- → mimics an incised wound ⟹ incised-looking lacerated wound.

③ **Stretch Laceration**: caused by force which causes the skin to be overstretched, resulting in a large flap.

④ **Cut Laceration**: produced by heavy cutting weapons (axe, chopper, industrial machinery)
- → ugly, wide gape
- → aka **Chop wounds**.

⑤ **Avulsion**: produced by grinding compressive force
- → separation of large areas of skin from its underlying attachment
- → aka **Flaying**.
- → underlying muscles are heavily bruised

MLI:

- → In case of disputed pregnancy, age of perinatal laceration indicates possible date of delivery
- → Punching, Kicking & Stomping can produce Abrasion + Contusion + Laceration
- → suicidal lacerations are very rare
- → lacerations on the vertex indicate homicide
- → shape of laceration very rarely indicates the nature of the offending weapon

Incised Wounds: clean cut wound through tissues caused by a sharp-edged instrument

↓

Length is its maximum dimension

→ force is delivered over a very narrow area, corresponding with the cutting edge of the instrument.

→ Causes:

i) blade, knife, razor, scalpel, sword, glass, sickle.

→ length of the incised wound has no relation with the cutting edge of the weapon

→ clean-cut, well-defined margins

(serrated knife may produce a saw-toothed cut)

→ everted edges

→ abrasion & contusion are not seen on margins if weapon is perfectly sharp

→ usually spindle-shaped (crescentic if blade is curved)

→ gaping is greater if underlying muscle fibres are cut transversely or obliquely

→ incised wound is deeper at the beginning ⇒ Head of the wound

→ wound becomes increasingly shallow away from the head

→ Tail of the wound ⇒ only epithelium is cut.

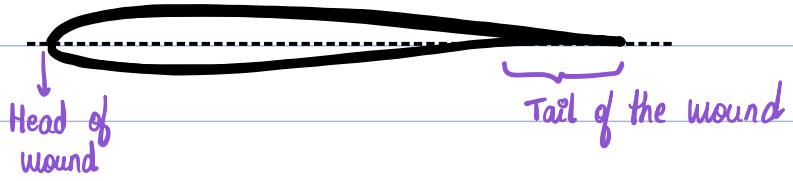
Beveled cut: cut which is not perpendicular to skin surface, but at an angle

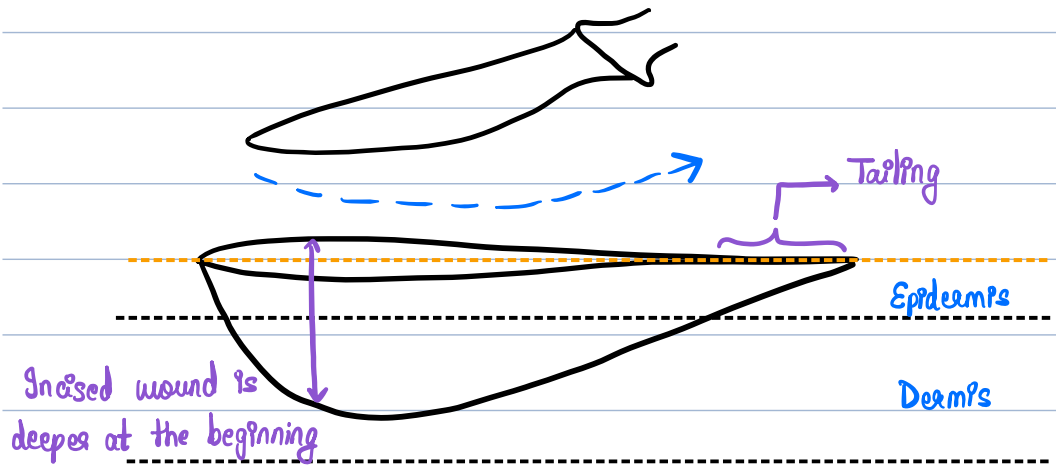
- beveled edge makes an angle of $> 90°$ with skin surface
- other edge (undermined edge) makes $< 90°$ with skin surface
- Beveling usually indicates homicide.

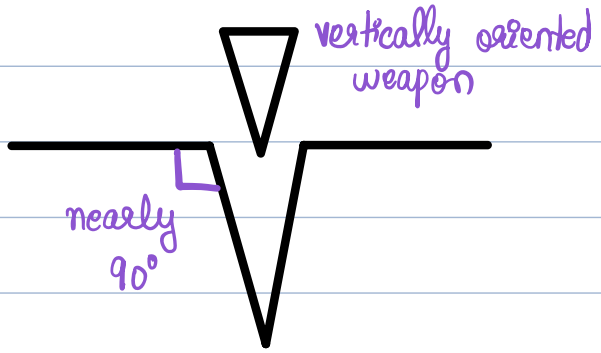
→ Haemorrhage is more as the vessels are cut cleanly

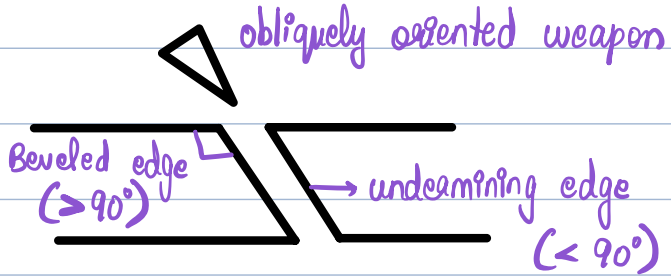
(spurting occurs if an artery is cut)

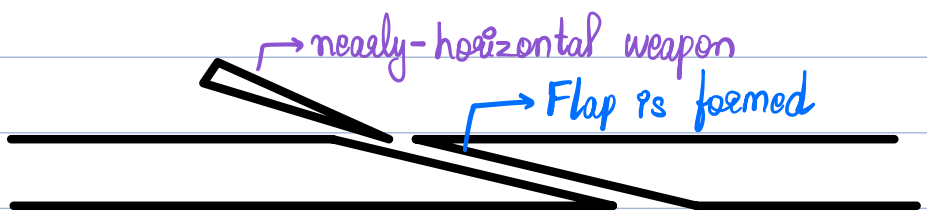
Spindle-shaped wound











MLI:

→ Reconstruction of crime: can be done when there is an incised wound
- enables determining of – nature of weapon (sharp)
  – age of injury
  – direction of force

→ In a decomposed body ⇒ difficult to differentiate between incised & lacerated wound

→ If a body with incised wounds is immersed in water soon after death → blood in wounds is lysed by water → difficult to differentiate between AM & PM wounds

→ Incised wounds – can be accidental/homicidal/suicidal.

Chop Wounds: (aka Slash Wounds)

→ same as cut lacerations

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Stab Wounds: wound in which depth is the maximum dimension

→ produced when force is delivered along the long axis of a narrow/pointed object into the depths of the body

→ Punctured wound: caused by an 'ice-pick' shaped object

- typically terminates in flesh
- homicidal puncture wounds are generally, intentionally caused at hidden locations ⇒ Concealed puncture wounds.
- Needle punctures are a common method of infanticide (through anterior or posterior fontanelle).

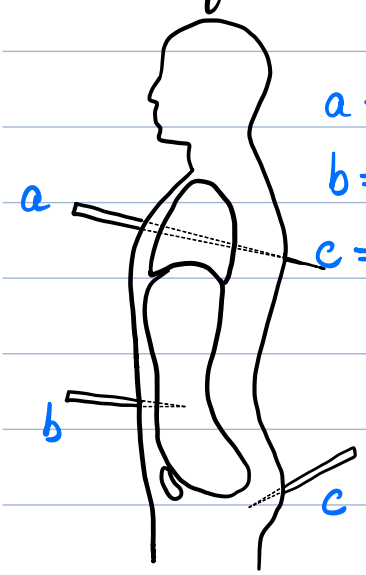
→ Penetrating Wounds: enters into a body cavity without coming out

- there is an entry wound, but no exit wound
- Examples: – tracheostomy wound
  – gunshot wound to head
  – drainage tubes in chest/abdomen

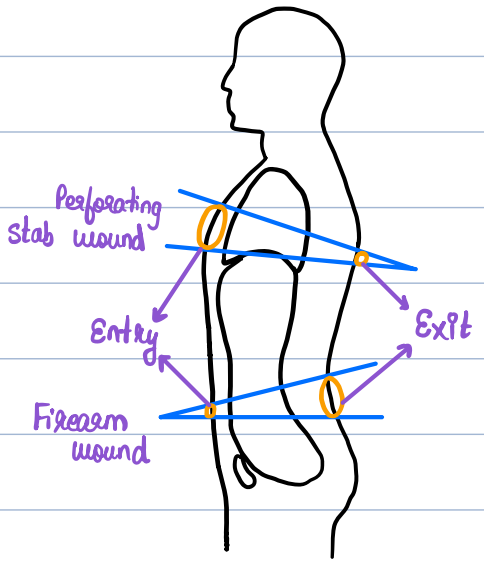
→ Perforating Wounds: has both an entry & an exit wound

- wound of entry is larger, has inverted edges
- wound of exit is smaller, has everted edges

(In firearm wounds, entry wound is smaller than exit wound)



a = Perforating wound
b = Penetrating wound
c = Puncture wound.



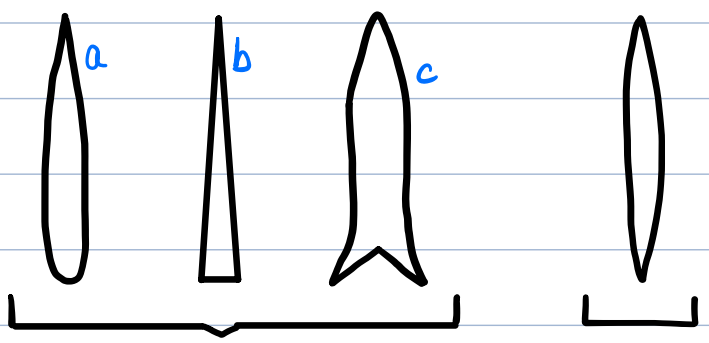
→ Length (l) of stab wound is normally lesser than width (w) of weapon
→ Width of the stab may not indicate the true thickness of the blade (due to retraction following withdrawal of weapon)

→ Margins:
- If weapon has sharp edges ⟹ clean cut margins [Incised Stab Wound]
- If weapon has rounded edges ⟹ margins are contused & lacerated [Lacerated Stab Wound]

→ the depth of a stab wound must never be probed in the living (as it may disturb a loose clot)
- In the dead, radiopaque dye must be injected & visualised by X-ray

→ Cleavage Lines of Langer: lines within the skin along which the dermal collagen & elastin fibres are arranged
- arranged in parallel rows (longitudinally in extremities)
- If wound is present:
  i) parallel to line ⇒ no gaping
  ii) across the line ⇒ gaping is produced
  iii) oblique to the line ⇒ oval/crescentic/semicircular wound.

→ Stab wounds are normally slit shaped with two acute angles
- single-edged weapon ⇒ tear drop or wedge-shaped wound (fishtail wound)
- double-edged weapon ⇒ elliptical or spindle-shaped wound



{ a = tear drop
b = triangular/wedge-shaped
c = fishtail wound

→ Penetration at angle produces — bevelled margin on one side
— undermined margin on other side.

Complications of Stab Wound:

i) air embolism
ii) choking (due to inhalation of blood)
iii) haemorrhage
iv) infection
v) pneumothorax

MLI:

→ Concealed puncture wounds ⇒ used homicidally
→ Depth of wound indicates ⇒ force used
→ Direction of wound indicates ⇒ relative position of assailant & victim
→ manner of injury — suicidal / homicidal / accidental — may be determined
→ multiplicity of wounds ⇒ indicates overkill (seen in sexual, revenge murders)
→ shape of wound indicates whether weapon was single or double edged
→ age of stab wound is used to determine time of attack.

FEATURES	Suicidal Stab	Homicidal Stab	Accidental Stab
Cause	Self-inflicted	Inflicted by others	• falling against sharp objects • horns of animals
Position of wound	Accessible parts	Generally, on vital parts (can be anywhere)	On front or back
Grouping	Well arranged in parallel lines (hesitation cuts)	No definite grouping	May be a single large wound
Number of wounds	Generally, one large fatal wound with multiple superficial hesitation cuts	Single / Multiple	Generally one
Direction	From left to right (in right-handed persons)	Any direction	Generally, straight inside
Severity	Hesitation cuts are superficial (not fatal) Final cut is deep & fatal	Severe, extensive	Severe
Defense wounds	Absent	Present (if victim was conscious & resisted)	Usually absent

FEATURES	Incised Wound	Lacerated Wound	Stab Wound
Manner of production	By sharp objects or weapons	By blunt objects or weapons	By blunt/sharp object
Site	Anywhere	Over bony prominences	Chest, abdomen usually
Margins	Clean cut, everted, smooth	Irregular, undermined	Clean cut, parallel edges
Abrasion on edges	Absent	Usually present	Absent
Bruising of adjacent tissue	Absent	Present	Present (if weapon was blunt pointed)
Shape	Linear / spindle-shaped	Irregular	Linear or irregular
Dimensions	length is the greatest dimension	Usually longer than deep	Depth is the greatest dimension
Anatomical structures at base of wound	Cleanly cut	Bridging strands are seen	Cleanly cut
Hair bulbs	Cleanly cut	Crushed or torn	Clean cut if weapon was sharp
Haemorrhage	Usually profuse & external	Slight (except: scalp), occurs externally	Profuse, external or internal.
Underlying bones	May show cuts	May show fractures	May show cuts
Foreign bodies	Absent	Usually present	Usually Absent

Defense Wounds: caused by immediate & instinctive reaction of victim in order to protect himself.

→ depends on the nature of the attacking weapon

→ Location:

- Palm ⇒ when the victim tries to seize the weapon
- Back or ulnar aspect of forearm ⇒ when the victim raises his arms for protection

→ defense wounds are absent in suicide or accident & in some cases of homicide (unconscious victim, sudden attack, etc.)

Self-Inflicted Wounds: (Fabricated / Fictitious Wounds)

→ wounds inflicted by a person on his own body or by another with his consent.

→ may be new injuries or existing injuries may be enhanced

→ Causes:

- by an assailant ⇒ to change the appearance of the wound so he may not be linked to the crime
- by the victim ⇒ to charge an enemy with assault or attempt to murder
  ⇒ to make a simple injury appear more serious
- by policemen ⇒ to show they were defending property
- by prisoners ⇒ to falsely accuse policemen
- by women ⇒ to falsely charge someone of rape
- by mentally ill

→ Most commonly: i) Incised wounds
ii) burns, contusions, stabs

→ multiple, parallel, superficial
→ generally present on accessible areas
→ if incised wound ⇒ equal depth at origin & termination

Iatrogenic Wounds: (Therapeutic Wounds)

→ wounds produced by doctors during treatment
→ Examples: – surgical wounds
– wounds of drainage tubes in chest/abdomen
– tracheostomy
– thoracotomy
– cut-open wounds for IV catheters
→ may be mistaken for traumatic wounds
→ sometimes, an originally traumatic wound may be enlarged & used for therapeutic purposes.

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MLI of Wounds: to determine if the wound is suicidal/homicidal/accidental.

	FEATURE	SUICIDE	HOMICIDE	ACCIDENT
2	Type of wound	usually incised/stab	laceration/stab	abrasion/contusion/laceration
2	No. of wounds	Multiple	Usually single (may be multiple ⇒ overkill)	Multiple
3	Severity	mostly superficial wounds & one deep fatal wound	Severe & extensive	Depends on severity of accident
4	Target area	Accessible parts only (vital & sensitive areas are avoided)	Vital parts (chest, abdomen, head)	Exposed body parts & bony prominences
5	Grouping of wounds	Well arranged in parallel lines	Irregular	Exposed parts & bony prominences.
6	Hesitation marks	Usually present	Absent	Absent
7	Defense wounds	Absent	Present if victim was awake & resisted	Usually absent
8	Direction	from left to right (in right-handed persons); from above downwards.	No particular direction	in the direction of movement of vehicle (in RTA).
9	Associated findings	No signs of struggle No signs of sexual assault	Hands may be tied, signs of struggle &/or sexual assault may be seen, person may be gagged.	Hands are not tied, no gag, no signs of sexual assault

FEATURE	SUICIDE	HOMICIDE	ACCIDENT
10 Weapon	Lying by the side of body Maybe grasped firmly due to cadaveric spasm	Absent (Killers take it away)	May be present or absent
11 Clothes	Not damaged usually	Damaged & torn due to struggle (stabs are present through clothes)	Torn & damaged, soiled extensively.
12 Scene of crime	Usually, room is locked from inside & surroundings are not disturbed. Suicide note present/absent	Room never locked from inside. Surroundings are disturbed. No suicide note.	Closed room / roads
13 Motive	Chronic disease, failure in love, debt, torture, failure	Revenge, robbery, sexual assault, domestic quarrels, financial or land disputes.	Absent (unforeseen, unintentional)

FEATURE	PM Hypostasis	Bruise
Cause	Distension of vessels with blood in dermis	Rupture of vessels which may be superficial or deep
Cuticle	Not abraded	May be abraded
Site	Occurs over extensive area of most dependent parts	Occurs at site of & surrounding injury
Appearance	No elevation of involved area	Often swollen (because of extravasated blood & edema)
Margins	Clearly defined	Merge with surrounding area
Colour	Uniform bluish-purple colour	Different colours depending on the age of the bruise
On incision	Blood is seen in blood vessels, can be easily washed away, subcutaneous tissues are pale.	Extravasation of blood into surrounding tissues, cannot be washed by water, subcutaneous tissues are deep reddish-black
Effect of pressure	Absent in areas of body which are under even slight pressure	Lighter over the area of pressure or support
Superimposed abrasion	Not present	May be present
Microscopically	Blood cells within blood vessels & no evidence of inflammation.	Blood cells found outside blood vessels, evidence of inflammation present.

FEATURE	SUICIDAL CUT-THROAT	HOMICIDAL CUT-THROAT
Situation	Left side of neck, passing across front of the throat	Usually on the sides
Level	High, above thyroid cartilage	Low, on or below thyroid cartilage
Direction	Obliquely, above downwards, from left to right in right-handed person	Transverse or below upwards
No. of wounds	Multiple superficial parallel wounds with one deep fatal wound	Multiple, cross each other at a deep level
Edges	Usually ragged (due to overlapping of multiple superficial incisions)	Sharp & clean cut, bevelling may be seen
Hesitation cuts	Present	Absent
Tailing	Present	Absent
Severity	Multiple superficial non-fatal wounds with one deep fatal wound	More severe (vertebrae may also be cut)
Wounds in other parts of the body	May be present across wrist, groin & thigh.	No wounds on wrist. Head injuries may be present.
Defense wounds	Absent	Present, unless taken unaware
Hands	Weapon may be firmly grasped due to cadaveric spasm	Fragment of clothing/hair of assailant may be grasped, weapon usually absent
Weapon at site		
Vessels	As head is thrown back, carotid artery escapes injury	Jugular vein & carotid artery are likely to be cut
Clothes	Not cut or damaged	May be cut (corresponding to body injury)
Blood stains	Splashing on surrounding objects or body parts	Found in palms in an effort to cover the wound, behind neck & shoulders
Circumstantial evidence	Quiet place, room generally locked from inside, suicide note may be present	Disturbance at scene, footprints may be found outside.

Firearm Injuries:

Ballistics: science of projectile units (bullets, missiles, bombs)

Forensic ballistics: science which deals with investigation & identification of firearms, its wounds & their findings.

Firearm: any instrument/device that discharges a projectile unit by the expansile force of gases produced by the burning of an explosive substance.

→ **Parts:**

i) **Barrel**: hollow metal cylinder in which the propellant charge is placed
ii) **Bore**: lumen of barrel
iii) **Muzzle**: front end of barrel from which bullet/shots come out.
iv) Hammer (striker)
v) Trigger
vi) Extractor
vii) Butt/grip
viii) Magazine

Classification of Firearms:

Rifled weapons

i) Rifles
ii) Revolvers
iii) Single-shot & auto-loading pistols
iv) Submachine & machine guns

Smooth-bore weapons (shotguns)

i) Single-shot & double barrel
ii) Bolt, pump & lever-action
iii) Auto-loading.

Rifled Firearms: bore is scored internally with number of shallow spiral grooves which run parallel to each other, but twisted spirally from breech to muzzle end

- Groove = Rifling
- Projecting ridge = Land

→ direction of rifling may be clockwise or anti-clockwise

→ when the bullet passes through the bore, its surface comes in contact with the projecting spirals ⟹ bullet is set into rotational motion along its longitudinal axis.

→ Rifling gives the bullet a signature marking that is unique to the weapon fired.

→ Advantages of rifling:
- imparts gyroscopic stability
- increases accuracy & range
- prevents wobbling or tumbling end-over-end
- gives greater power of penetration

Smooth-Bore Firearms / Shotguns:

→ Bore of inner surface of barrel is uniformly smooth

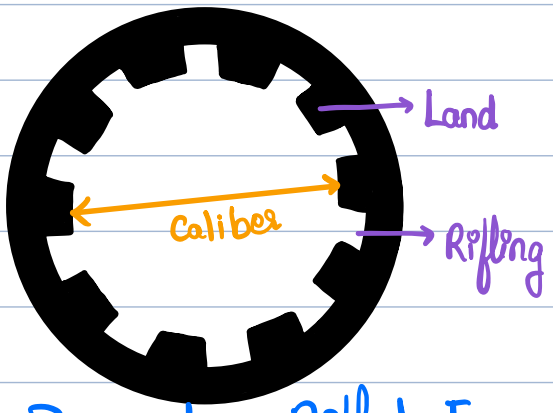
→ designated to fire multiple pellets from the barrel

Choking: interior constriction of shotgun bore at muzzle end for the purpose of controlling the pattern of the fired shot.

→ usually, distal 7-10 cm of the barrel is narrow

→ Advantages of choking:
- lessens the rate of spread of shot (prevents pellets from spreading too quickly)
- increases the explosive force & velocity

→ Paradox guns: some shotguns have a small portion of their bore near the muzzle end rifled.



Bore of a Rifled Firearm

Caliber of Rifle: diameter of the interior of barrel measured between diagonally opposite Lands (diameter of barrel before rifling grooves are cut)

Caliber of Shotgun: number of spherical lead balls of size fitting the barrel of a shotgun which can be made from one pound of lead (454 g) ⇒ ex: 12, 16, 20 bore.

Bullet: projectile of a rifled firearm that leaves the muzzle when it is discharged.

i) Dum-dum bullet / Expanding bullet: jacketed bullet which does not cover the entire bullet (an area near the nose is left uncovered to expose the core)

ii) Hollow-point bullet: modern version of dum-dum bullet, there is a pit present in front of the nose

iii) Tandem bullet / Piggyback bullet: bullets ejected one after another, when the first bullet having struck in the barrel, fails to leave the barrel & is ejected by a subsequently fired bullet.

→ Cause: faulty ammunition or loaded firearm unused for years.

Gunpowder: explosive substances used as propelling charges in guns

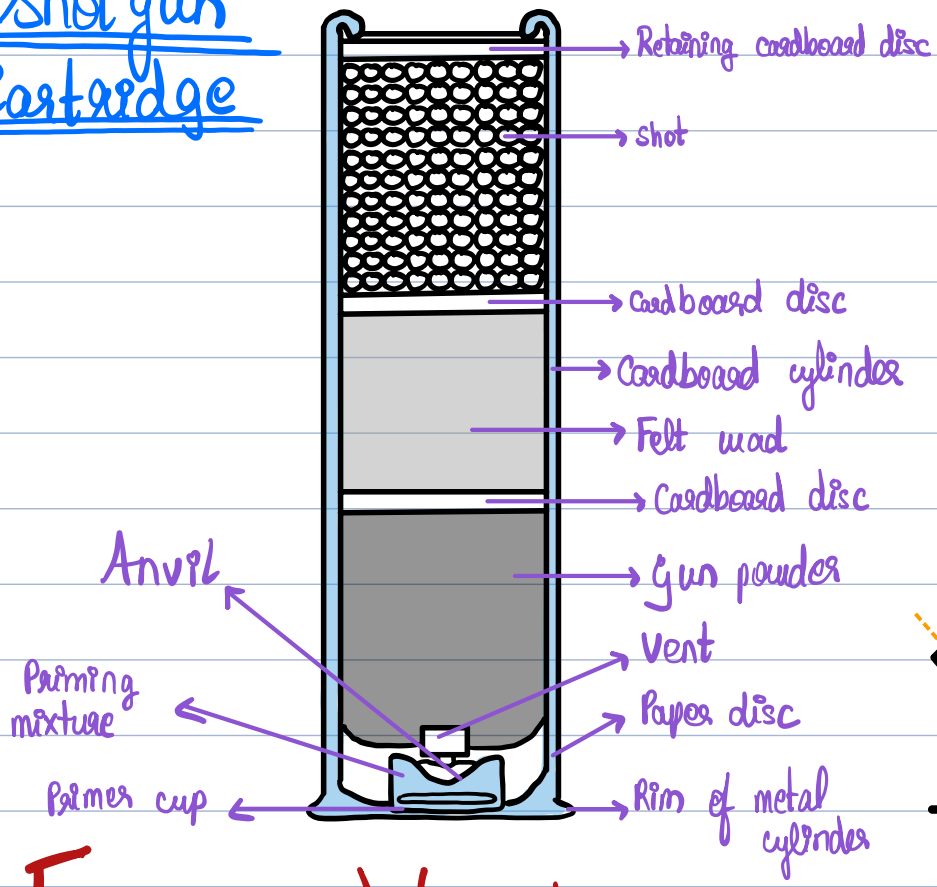
i) Black powder: produces flame, smoke & heat

ii) Smokeless powder: more effective than black powder as it burns more efficiently & produces much lesser smoke ∴ lesser blackening & tattooing

- Potassium nitrate – 75%
- Sulfur – 10%
- Charcoal – 15%.

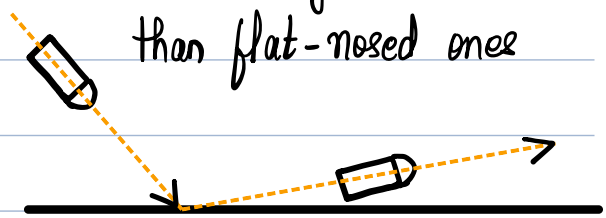
ISHITA KANODIA

Shotgun Cartridge



Ricochet Bullet: rebound, deviation or deflection of a bullet from its course by striking an intermediate surface

→ round-nosed bullets are more likely to ricochet than flat-nosed ones



Firearm Wounds:

- **Penetrating wounds:** bullet enters the body & does not exit
- **Perforating wounds:** bullet passes completely through the body.

① **Tattooing:** caused by unburnt / partially burnt powder particles embedded in & under the skin surface

→ It is an antemortem phenomenon ⇒ indicates that individual was alive

→ cannot be wiped away with a wet cotton

→ greater the range, larger & less dense is the tattooing

② **Stippling:** visible mark that powder grains leave when they do not get embedded in the skin

③ **Blackening / soot / smoke soiling / smudging:**

→ caused by smoke leading to deposition of soot (carbon) produced by combustion of gunpowder

→ can be wiped away with a wet cotton

→ greater the range, larger & less dense is the blackening.

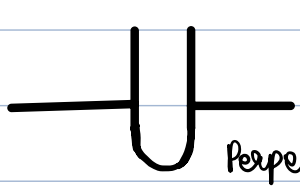
④ **Fouling:** tiny lesions around the entry wound caused by fragments of metal expelled by the discharge

⑤ **Abrasion collar/ring:** as the gyrating (spinning) bullet strikes the skin, it indents the skin surface & then, stretches the surface → perforation takes place through a tense area → production of rim of flattened reddish-brown zone of abraded epidermis surrounding the entrance wound.

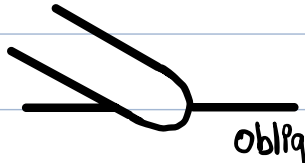
→ Bullet striking perpendicularly produces ⇒ concentric ring

Bullet striking obliquely produces ⇒ eccentric ring (wider zone on the side from which the bullet came)

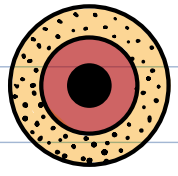
→ entry wound on palms & soles lack an abrasion collar (∵ skin is thick & keratinized here)



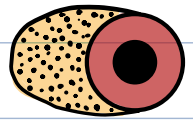
Perpendicular bullet



Oblique bullet



Concentric Abrasion Ring



Eccentric Abrasion Ring

⑥ **Grease/dirt collar:** black/grey coloured ring lining the defect, sharply outlined.

→ caused from removal of substances from the bullet as it passes through skin

→ consists of lubrication, paraffin, lead from surface of the bullet

→ soot is dark in the center & fades at the periphery

→ Abrasion collar surrounds dirt collar.

⑦ Muzzle Imprint: patterned abrasion/intradermal contusion

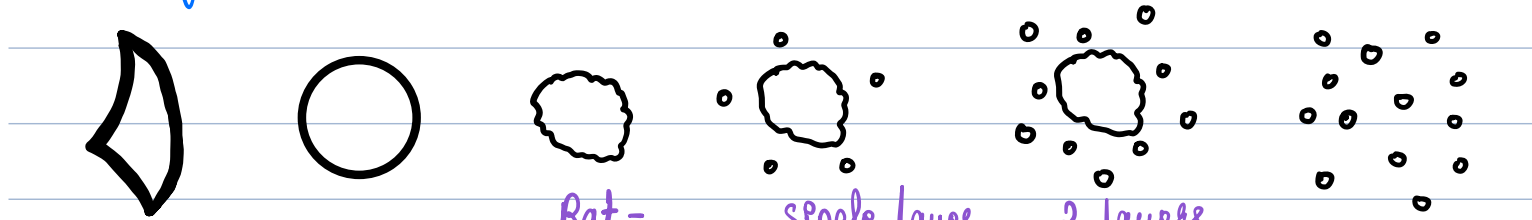
→ caused by expansive power of gases lifting the skin forcibly against the muzzle

→ sign of a contact shot

→ characteristic imprint mark can provide clues to the type of firearm used.

- Smoke ⇒ 30 cm ⇒ Blackening
- Flame ⇒ 15 cm ⇒ Singeing
- Unburnt/partially burnt powder ⇒ 60-90 cm ⇒ Tatooing.
- Wad ⇒ 2-5 m

Shotgun Wounds:



Split Wound — Contact over bone

Round — Other contact wounds

Rat-hole wound — upto 1m

Single layer of satellite pellets — 2-3m

2 layers of pellets — 3-4m

Pellets only — >4m

Features of Different Ranges of Shotgun Injuries:

FEATURES	Contact Shot	Close range (contact – 3 ft.)	Mid-range (upto 7ft.)	Long-range (> 7ft.)
Wound	circular, size equal to bore of weapon (mutilation & evisceration of in head) 	Circular/elliptical with no separate pellet holes (mutilating in head) 	Round, edges crenated (rat-hole appearance) with satellite pattern pellet holes 	Uniform distribution of pellets with no central aperture 
Muzzle Impression	+	–	–	–
Burning	–	+	–	–
Blackening/soot	–	+	–	–
Singeing	–	+	–	–
Tattooing	–	+	+/–	–

Features of Different Ranges of Rifle Injuries:

FEATURES	Contact Shot	Close range (2-3 inches)	Mid-range (<2 ft)	Long-range (> 2 ft.)
Wound	Large, irregular (stellate in head)	Small, circular	Circular, same size as bullet	Circular, smaller than bullet
Margins	Everted	Inverted	Inverted	Inverted
Muzzle impression	+	–	–	–
grease/abrasion collar	–	+	+	+
Burning	–/+	+	–	–
Blackening/soot	–	+	+/–	–
Singeing	–	+	–	–
Tattooing	–	+	+	–

FEATURE	Entry Wound	Exit Wound
Definition	Wound that results from a projectile entering the body	Wound that results from a projectile exiting the body
Size	Smaller than diameter of bullet	Bigger than bullet
Edges	Inverted	Everted, puckered
Skull	Clean cut on outer table & beveled in internal table	Beveled in the outer table & clean cut on the inner table
Bruising, abrasion, grease collar	Present	Absent
Burning, blackening, tattooing	May be seen	Absent
Bleeding	Less	More
Condition of hair	Singeing or breakage of hair	Hair may overlies the wound
Fat	No protrusion	May protrude
Wound track	May be cherry red due to carboxyHb &/or carboxymyoglobin	No colour change
Fibers of clothes	Turned in	Turned out
Histopathology	Coagulative necrosis of keratinocytes with subepidermal crack & tattooing	Presence of adipose, muscular & bone tissue
Radiological/micro-chemical examination	Lead ring may be seen	Absent
Spectrograph	More metal is found	Less metal found