

# **WOUNDS**

**Forensic medicine**

**Anas Mustafa, Abdullah Al-baw and Amr Abdullah**

# Definitions

- Injury: An illegal harm to a person's body, mind, reputation or property
- Wound: Is an injury caused to the tissue by impaction of an object to the tissue or vice versa leading to discontinuity of such tissue.

# Classifications

1. According to the causative agent
2. Medico-legally
3. Legally

# 1. By the causative agent

## Thermal injury

- Due to cold: frost bite
- Due to heat: burns

## Chemical Injury:

- Corrosion (strong)
- Irritation (weak)

# 1. By the causative agent

## Mechanical injury:

- Blunt: Contusion, Abrasion, Laceration, Fractures and dislocations
- Sharp edged: Incised and chop wounds
- Piercing: stab wound
- Firearms

## Miscellaneous:

- Electricity
- Lightning
- Radiation



# 2. Medicolegally

- Suicidal
- Homicidal
- Accidental
- Defense
- Fabricated

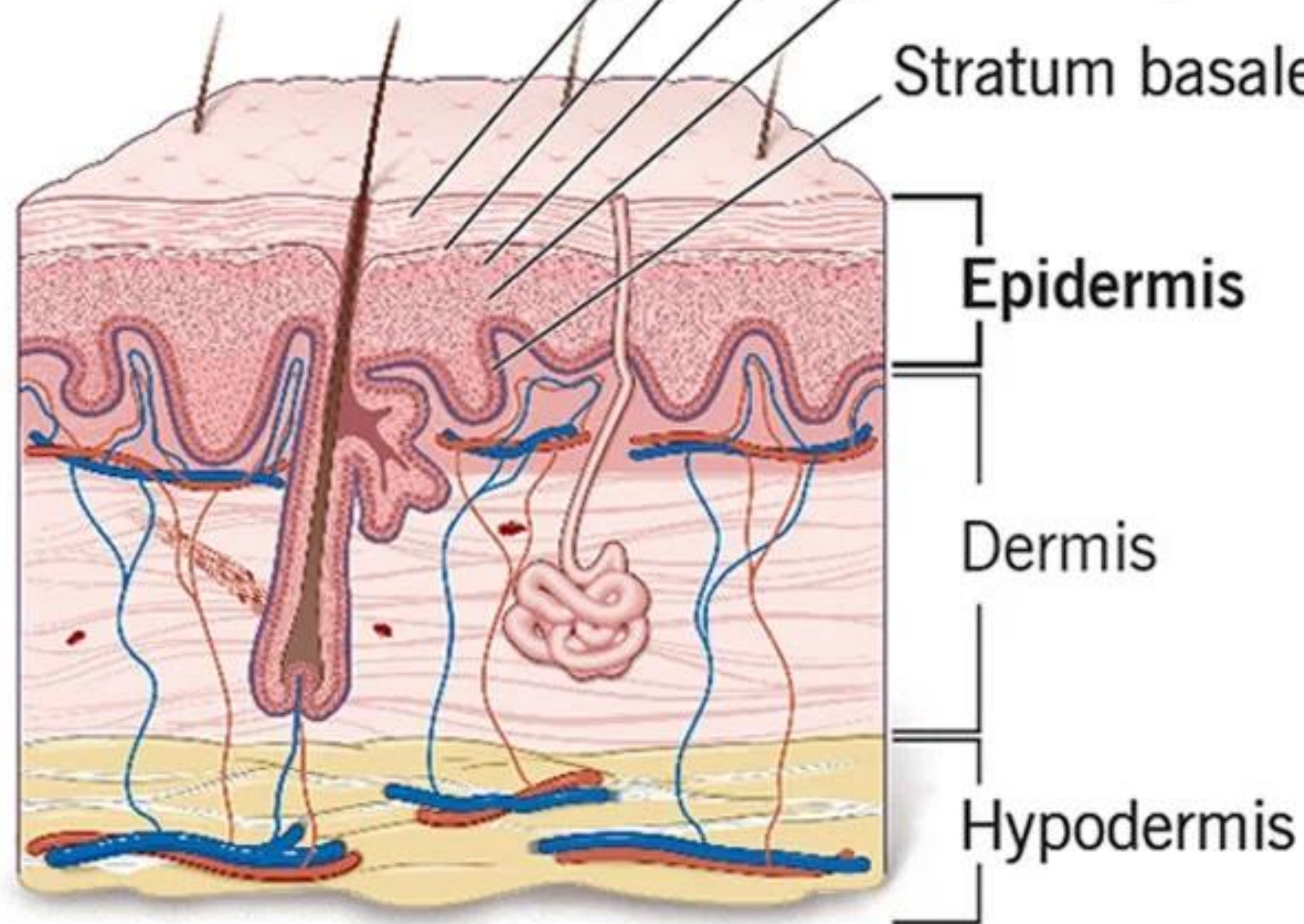
# 3. Legal classification

- Simple wounds: <20 days
- Dangerous wounds: >20 days, permanent infirmity (of function)
- Fatal wounds

# Layers of the Skin

Layers of the epidermis:

- Stratum corneum
- Stratum lucideum
- Stratum granulosum
- Stratum spinosum
- Stratum basale





- The thickness of skin -which varies depending on location- has forensic relevance to determine the amount of force needed to cause wound

# Biophysics

- Wounds are due to forces that could not be adapted or resisted by body tissues, and they are due to:
  - A. Moving object that strikes body
  - B. Moving body that strikes stationary object
  - C. Combination of both (usually)

- This impaction will result in some energy that will lead to tissue changes
- And body tissues are different in their characteristics (solidity, elasticity..etc) so it's not expected impact tissues uniformly

Types of forces affecting body

- **Tensile force:** It is the force that leads to pull a body apart if sufficient, may cause separation of body into parts
- **Compressive force:** It is the force that tends to push body together and if sufficient, the body may break into pieces..
- **Shearing force:** It is a force that tends to adjacent parts

**Tensile Force**



**Compressive Force**



**Shear Force**



- As said earlier, resistance to a force depends on the type of tissue
- For example, Bones may resist deformation more than soft tissue (that will rupture) but it may end up fractured beyond the limit of its elasticity

# Factors influencing wound causation



1. The nature of the object
2. Amount of energy produced
3. Area affected of the tissue
4. Conditions under which the energy is produced
5. Area affected of the tissue The nature of the tissue affected

# 1. Nature of object

- If object used is sharp, the force is concentrated over the small area of strike resulting in deep penetration injury.
- A rigid object will produce more damage than a flexible one.
- If the object breaks on striking the body, much of kinetic energy is lost, less damage

## 2. Amount of energy produced

- We have two factors that affect the force caused by an object against body:

A. The mass of the object

B. The velocity

These are according to the law of kinetic energy  $K=1/2*m*v^2$

## 3. Area affected

- The smaller the area affected, more damage

- 
- If the person moves or falls, less energy produced
  - If the time of energy producing increased, less impact

# 5. Examples of tissue affected

# Skin

- When skin is struck with blunt object the cells affected will get flattened or elongated but not damaged.
- The skin will readily split when struck and crushed against the hard bones.

# Subcutaneous tissue

- subcutaneous tissues are plastic and pliable due to deposition of fat, so it acts as cushion for body. Therefore it will provide cushioning effect for ordinary blows
- with severe blunt blows, the SC vessels will get crushed and displaces fat droplets and tear the connective tissue framework resulting in contusion and laceration

# Muscles

- Muscles are elastic and can resist impact to a certain level
- With severe stretching, it can get avulsed, torn, ruptured or crushed



# Bones

- The bones are rigid and elastic. They bend against force without breaking and recoil back to its original shape after releasing the force
- when the bone is bent beyond its limit of elasticity, it breaks at the point of max convexity of bending.

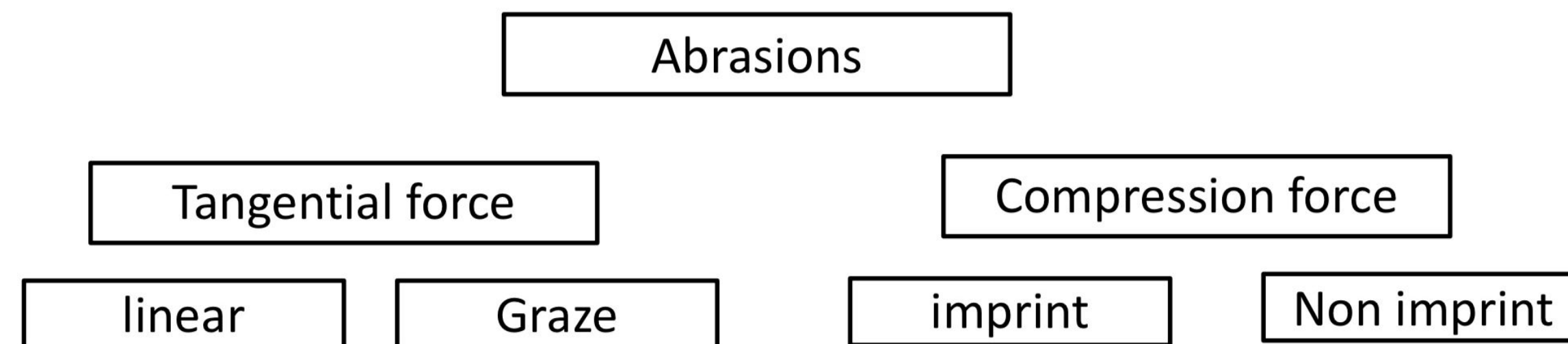
# Body fluids

- liquids can be easily displaced but cannot be compressed or reduced in size whereas gases can be compressed easily
- e.g sudden compression of chest may cause rupture of capillaries and small venules in the face, neck and shoulder from the retrograde displacement of blood in these veins
- Though gases are compressible, but violent compression may set up powerful pneumostatic force causing damage ( blast injury)

# Abrasions

is a type of mechanical injury characterized by loss of superficial layer of skin (epidermis) or mucous membrane due to application of mechanical force (rough blunt object)

pure abrasions involve epidermis only, hence they do not bleed or leave scars



of production of abrasion.

A: Force acting tangentially (sliding) producing linear ( sharp narrow object )or graze(broad wide object) abrasion

B: Force acting perpendicularly causing imprint (takes the pattern of the object) or pressure (imprint +slight movement of the object, resembles parchment ) abrasion

Abrasions may be confused with :

1. Postmortem abrasions
2. Excoriation of skin by excreta
  - Pressure sore/bed sore
1. Ant bites

	<b>Antemortem abrasion</b>	<b>Postmortem abrasion</b>
site	Anywhere in body	Over bony prominences
color	Bright red	Pale dry parchment like
covering	scab composed of coagulation of blood & lymph	No such scab
inflammation	Redness , vital reaction( healing & sepsis)	No signs of inflammation
microscopy	Congestion & vital reaction present	No

# Healing of Abrasion

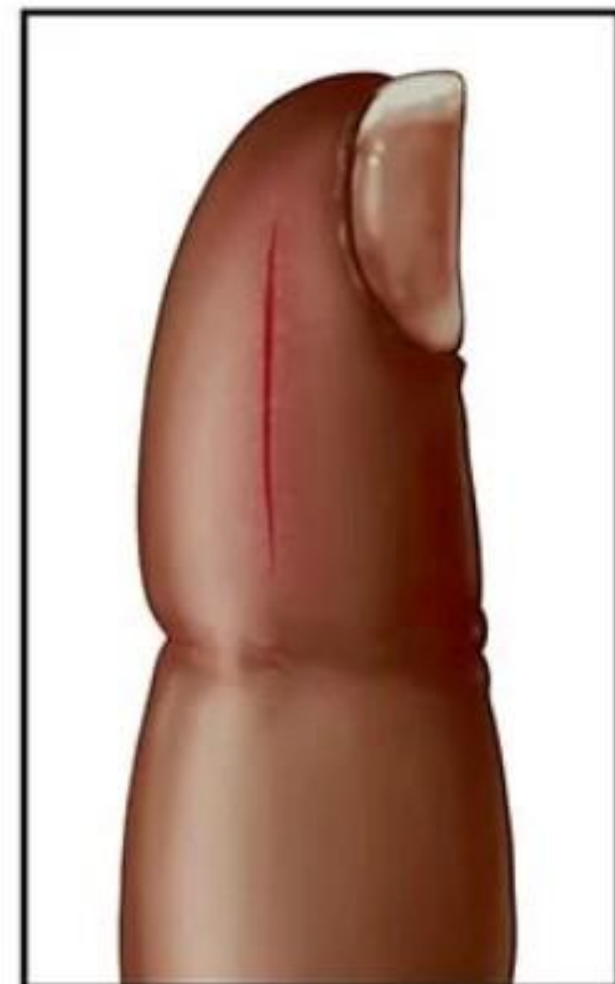
- Abrasion heals by undergoing contraction of wound and replacement of lost tissues. Initially the abrasion is bright red in color and it is covered by scab composed of blood and lymph.
- Microscopically, there is cellular infiltration seen at about 4 to 6 hours and about 12 hours three layers are identified consisting of surface zone of fibrin and red cells, a middle zone of polymorphonuclear cells and deeper layer of damaged and abnormally staining collagen. At about 48 hours, epithelial regeneration is evident at periphery with formation of granulation tissue at sub-epithelial area.
- Abrasions heal from periphery by new growth of epithelial cells. Usually, scab falls off by 7 to 10 days and leaves pale hypopigmented area

<b>Age</b>	<b>Feature</b>
Fresh	Reddish, no scab
12-24 hours	Dark red scab
1-2 days	Reddish brown scab
3-5 days	Dark brown scab
5-7 days	Blackish scab shrinks and falling begins from margin
7-10 days	Scab falls off, leaving hypopigmented area

# Medicolegal Importance of abrasion

- of impact and direction of force used to inflict abrasion can be known
2. Type of weapon/object used can be identified
  3. Time of crime can be determined from the age of abrasion
  4. Abrasions are usually simple injuries. However, abrasion over cornea may produce corneal opacity and restrict vision of a person.
  5. Can give idea about some type of offenses committed. For example abrasion near private parts of female may be suggestive of sexual offense attempted or committed. Similarly abrasion at neck may be indicative of throttling. Abrasion around mouth and nose may be suggestive of smothering.
  7. Presence of foreign material along with abrasions, such as sand particles, mud, dirt, grease etc. may connect the injuries with scene of crime

## Abrasion



Linear  
abrasion



Grazed or  
brushed abrasion



Pattern  
abrasion

# CONTUSION (Bruise)

A contusion is an extravasation or collection of blood due to rupture of blood vessels caused by application of mechanical force of blunt nature without loss of continuity of tissue. The word 'bruise' usually implies that the lesion is visible through the skin or present in the SC tissue, while 'contusion' can be anywhere in the body such as spleen and muscles.

## **Ecchymosis and Petechiae**

Ecchymosis which is really a small bruise, Even smaller is the petechial hemorrhage which is size of pen-head or less, both ecchymosis and petechiae are not caused by mechanical trauma, they are caused by pathological disorder such as bleeding tendency.



Contusion is caused by blunt force impact causing crushing or tearing of subcutaneous tissue or dermis without breaking the overlying skin or mucous membrane. Due to rupture of blood vessels, there is extravasation of blood out of vessels and collected underneath the tissue. Collection of blood is accompanied by swelling and pain.

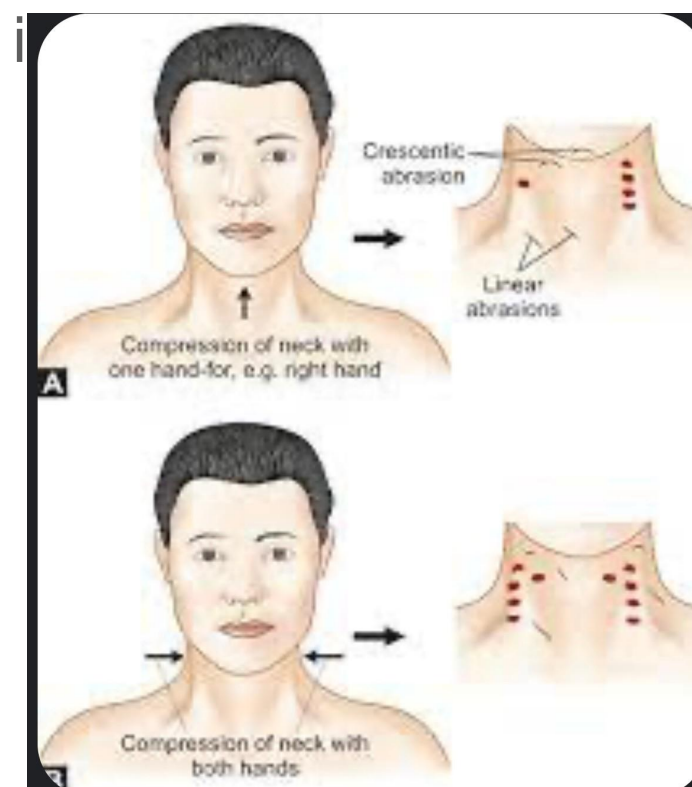
# Types of contusions and terms used

1. Intradermal bruise : the bruise is situated in the sub-epidermal layer of skin, with well defined margins , bruise may take the shape of the offending object then it's called a patterned bruise.
2. Subcutaneous bruise : commonest type ,divided into deep (below the deep fascia)/superficial (above the deep fascia), so bruises appear with well defined margins.
3. Shifting bruise : from the name it's a Bruise that appear at different site from the actual site of application of mechanical force, the cause of this phenomena that multiple factors affect the appearance of the bruise from the deep tissue layers to the skin from the forces of gravity to the anatomy of the region , eg; a black eye after forehead trauma  
The primary bruise that translocated is called a migratory bruise , and if other ones appear in a different area they are called ectopic bruises.

1. tram-line bruise: blow with object like a stick or a rod over skin causes the skin under the part of contact to get compressed. Due to compression of skin by the offending object or weapon, the blood in that part is displaced sideways causing tram-track like hemorrhages on the side of the skin where the impact of the object happens.



2. Six-penny bruise : discoid lesions taking the shape of fingertips that appear in the neck region due to strangulation.





## Tissue and Organ Contusion

- Contusion isn't a term specific for the skin only All organs can be contused.
- A contusion of the brain with bleeding into the substance of the brain, may initiate swelling with generalized accumulation of acid byproducts of metabolism that causes further swelling and impairment of brain functions. Contusion over brainstem often fatal.
- Heart is also vulnerable to contusion. A small contusion on the **may cause serious disruption of the normal rhythm or cessation of cardiac actions by interfering with initiation and conduction of impulse responsible for heart beating.** Similarly, large contusion, due to swelling and interference with muscle action, often prevent adequate cardiac emptying and lead to cardiac failure.
- Contusion of other organs may cause rupture of that organ's cellular covering with resulting bleeding, either slow or brisk into the body cavity containing that organ.

## Factors affecting contusions

- Condition of the tissue , the more space a tissue has the more blood would be able to spread
- Body part : the composition of the area that underwent trauma
- Situation of the contusion: the more superficial the more the bruise would be visible.
- Condition of the blood vessels and it's susceptibility to break and leak blood
- The presence of the other comorbidities , especially blood

in the age of bruise, the blood collected in contusion will begin to disintegrate causing hemolysis. The process of hemolysis liberates hemoglobin. The freed hemoglobin breakdown into hemosiderin → hematoidin → bilirubin by tissue enzymes and histiocytes.

With breakdown of hemoglobin and formation of these pigments, certain colour changes can be visualized by naked eye examination. These colour changes are utilized to estimate the age of bruises.

- The time taken for a bruise to disappear will depend on its size. In larger extravasation – the changes usually begin at the margin and takes longer time to be absorbed than smaller contusions.

### Age of Contusion

- There is temporal series of changes occurring in contusion in living person.

Age	Changes	Caused by
Fresh	Red	Fresh extravasation of blood
1-3 days	Bluish	Deoxyhemoglobin
4 days	Bluish black to brown	Hemosiderin pigment
5-6 days	Greenish	Hematoidin pigments
7-12 days	Yellow	Bilirubin pigments
2 week	Complete disappearance of contusion	

### Postmortem contusion

it is stated that with greater degree of application of mechanical force in immediate postmortem period results in contusion. In such cases, the hemorrhage is little and scarce and these contusions are easily differentiated from antemortem bruises.

	Antemortem contusion	Postmortem contusion
swelling	Present	Absent
Extravasation of blood	Present	Absent
Signs of inflammation	Present	Absent
hemorrhage	considerable	Insignificant

# value and disadvantages

have less value than abrasion because:

- the offending object may be known but the size of the bruise may not correspond with the size of it
  - usually is a simple injury with no complications, but identifying the time of the bruise may be difficult since some may be visible immediately or may be delayed in appearance
  - The bruise may shift from the actual site of assault to other site as ectopic contusion
  - The contusions may help in determining the severity and the degree of violence in the act but do not indicate the direction of the force applied.
  - The age of the injury can be determined
- \*\*\*\*\*the appearance, any change depending on multiple factors such as age, size of the bruise, etc...., which may appear as a challenge in establishing the time and how the bruise happened.

## Differential Diagnosis

The bruise may be confused with 1. Postmortem lividity

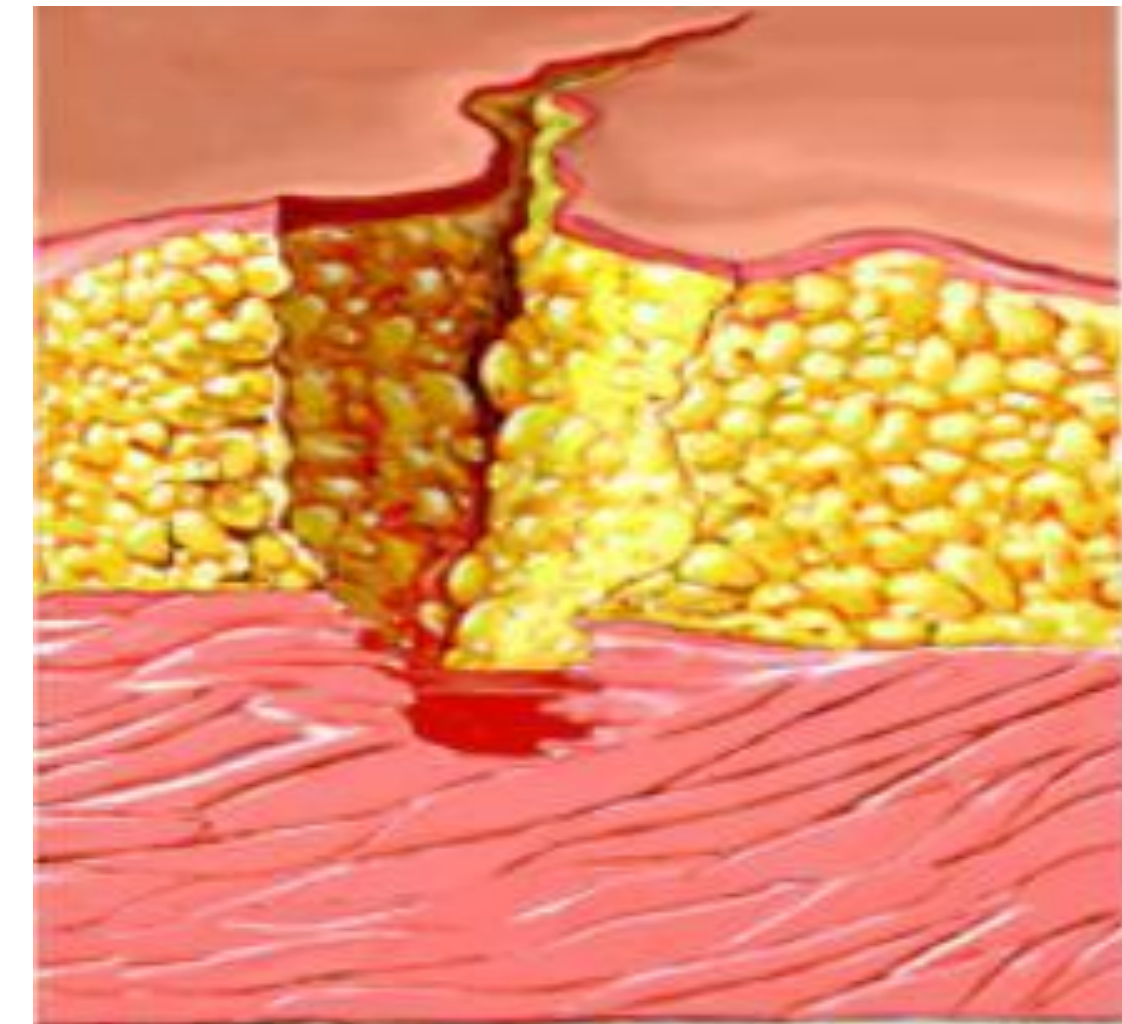
- Congestion
- Artificial bruise
- Purpura – bruising need to be differentiated from purpura. Purpura develops spontaneously in those persons with a

Differences between contusion and congestion		
	<b>Contusion</b>	<b>Congestion</b>
Caused by	Blunt mechanical force	Pathological condition
Color	Variable, depends on the age of contusion	No change of color
Margins	Diffuse and ill defined	Well defined
On dissection	Extravasation of blood	Engorged vessels with blood

	<b>Contusion</b>	<b>Postmortem lividity</b>
Caused by	Rupture of vessels with extravasation of blood due to application of mechanical force	Due to stasis of blood in vessels
Site	Any site	Only on dependent part
Surface	Elevated due to swelling	Not elevated
Swelling	Present	Absent
Color	Variable, depends on the age of contusion	Usually purplish blue
Edges	Ill defined	Well defined
Incision	Show extravasation of blood in the surrounding tissue \$ can't be washed off	Shows blood in vessels \$ can be washed off
Microscopy	Signs of inflammation	No signs of inflammation

# Lacerated wounds

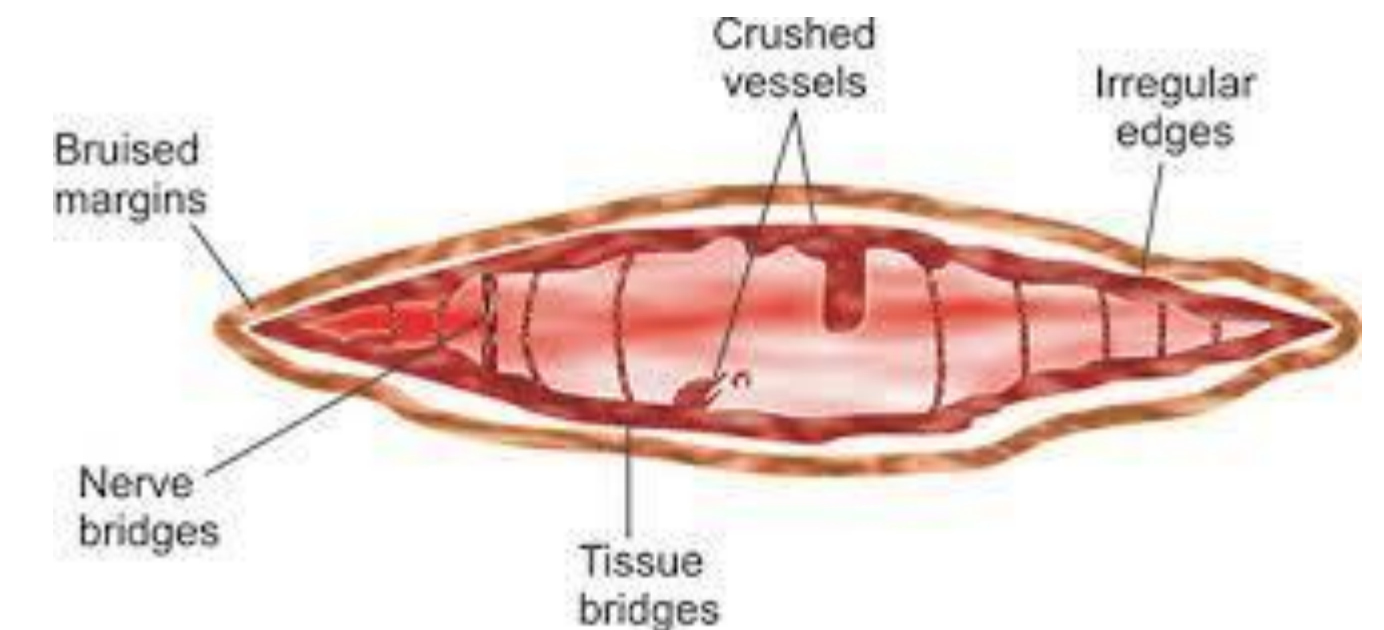
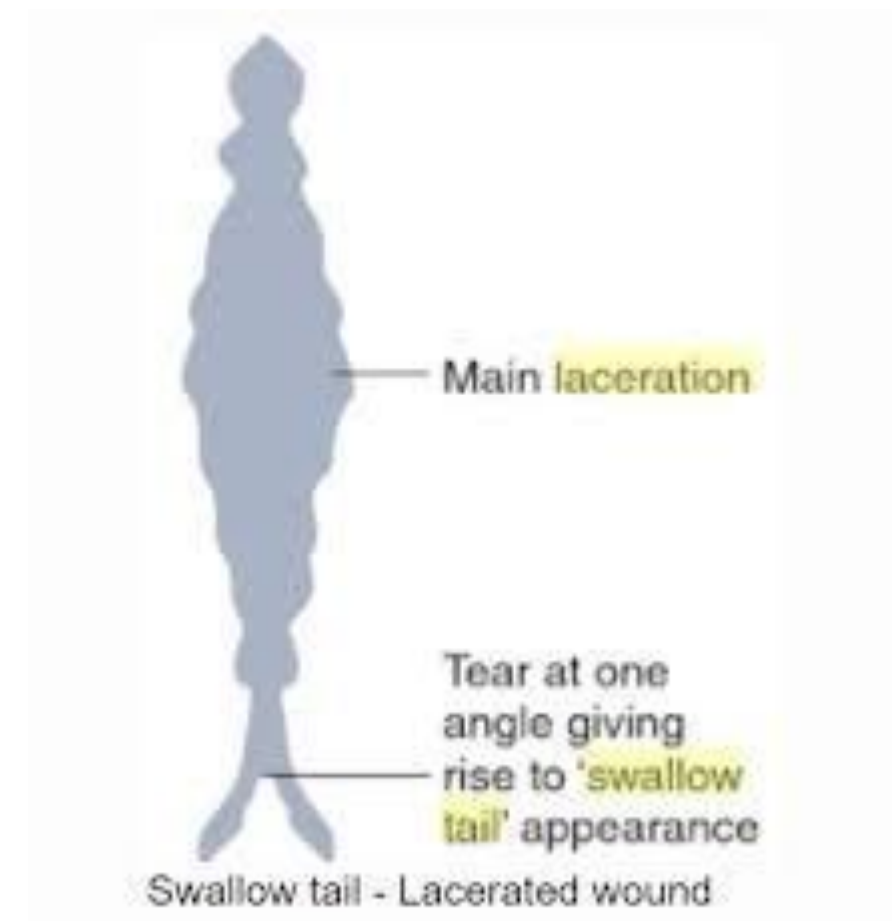
- Caused by hard and blunt force, characterized by splitting or tearing of tissues.
- Differs from incised wounds because there is tearing rather than clean slicing.
- types:
  1. Split laceration
  2. Stretch laceration
  3. Tear laceration
  4. Avulsion laceration
  5. Crush laceration
  6. Cut laceration



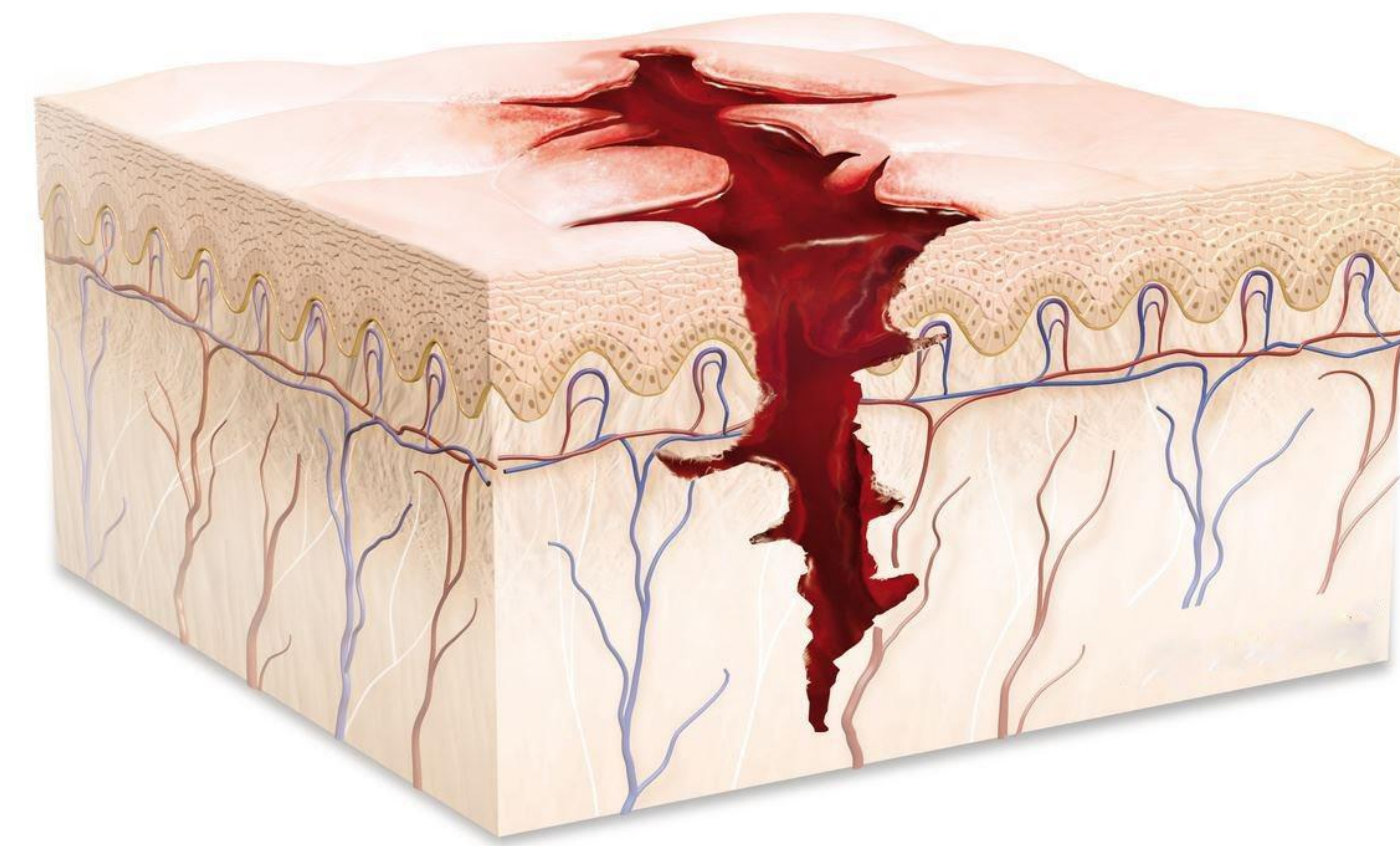
- Split Laceration: incised looking laceration, sandwich like, common in scalp, face, shin etc.
- Stretch laceration: caused by over-stretching(pulling force) like striae.
- Tear laceration: **common** form, tearing skin and the subcutaneous tissue by blunt force such as weapon which rips the skin producing laceration.
- Crush laceration: compression force may cause amputation of the affected limb.
- Avulsion Laceration: grinding compression resulting in the degloving of the skin, caused by rotary action such as rotating motor wheel.

# Features

- Tearing rather than slicing.
- Irregular margins, slightly inverted.
- Gapping of edges.
- Crushed hair follicles.
- Shallow tails.
- Foreign body can be found.
- Absence of linear bone injury.
- Bleeding is less in comparison to incised wound. Why?
- The shape and size may not correspond to the causative object.
- Blood vessels, nerves and delicate tissue observed in the depth.



- The examination will reveal the direction of force.
- Undermined edge, slopped side and adjacent contusion is often the side which force was directed.
- lacerations of internal organs may be occurs without an evidence externally.



# Medicolegal Importance

- 1. Cause of injury can be known.
- 2. Nature of injury can be determined– whether simple or dangerous.
- 3. Foreign bodies present in wound may help in identification of the offending weapon/place of incident etc.
- 4. Age of injury can be estimated.
- 5. It can be known whether the injury is accidental or suicidal or homicidal.
- 6. Direction of application of force can be known.
- 7. It may be confused with incised wound.
- 8. Differences between antemortem and post-mortem laceration.



# Difference between Antemortem and post-mortem lacerated wound

	Antemortem	POSTMORTEM
Extravasation of blood	present	absent
Coagulation of blood	Present	absent
Signs of healing	Present	absent
Increase enzyme activity	Present	absent
Pus/infection	Present	absent

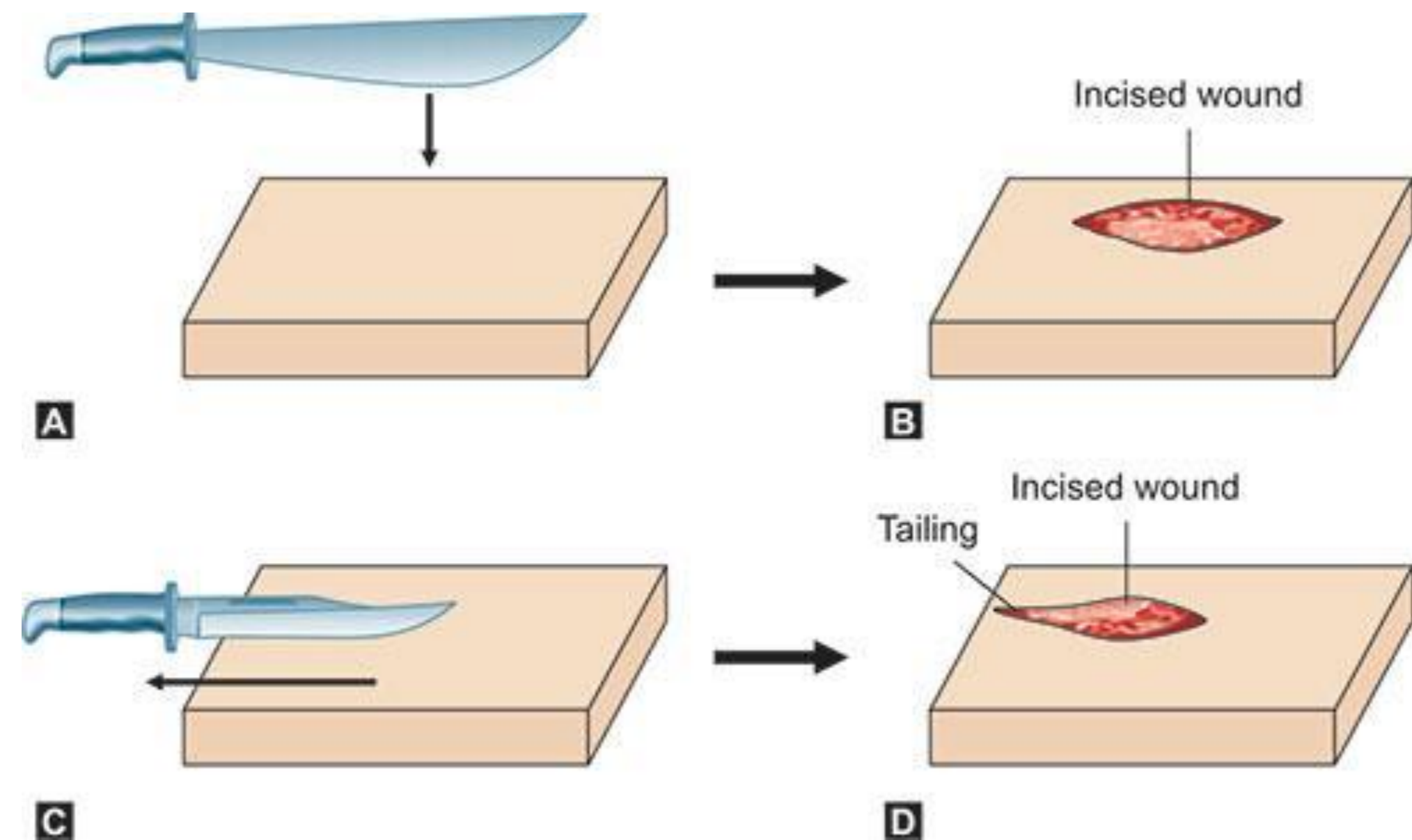
# Incised wound

- Is the wound caused by drawing or striking the of sharp object on the skin and underlying tissues.

- mechanism:

1-Striking force.

2-Drawing force.

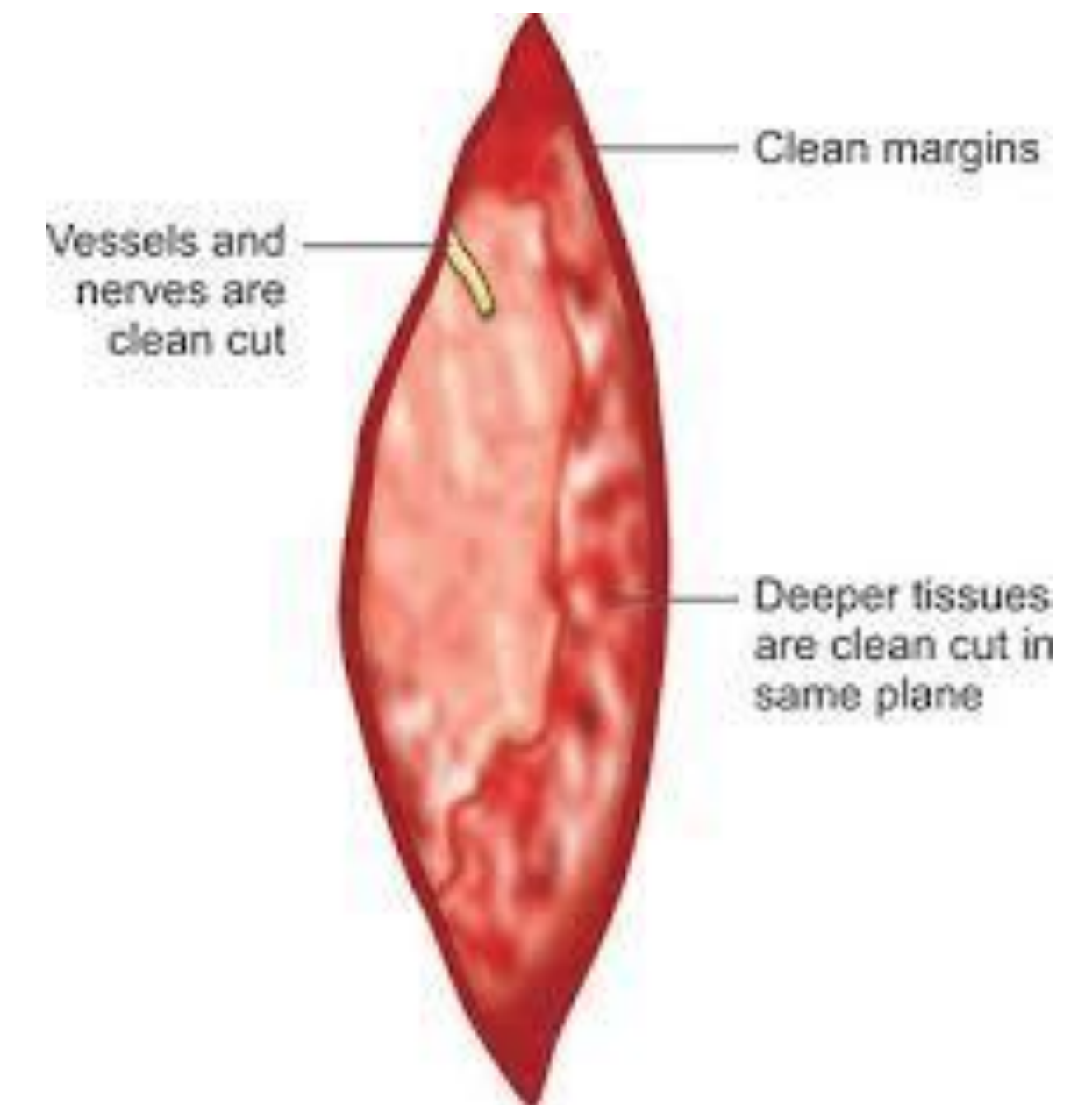


# Features of incised wound

- Broader than the edge of the weapon (retraction).
- Spindle-shaped, zigzag and appears irregular in lax loose skin like axilla.
- The length is greater than the breadth(DD).
- Clean, well defined margins mostly everted and maybe inverted in scrotum.
- The length of incised wound has no relation to the length of the cutting edge of the weapon.
- The starting end is the deeper than end part( tailing).
- Haemorrhage is more common

# Medicolegal Importance

1. Cause of injury can be known.
2. Nature of injury— whether simple or dangerous.
3. Age of injury can be estimated.
4. It can be known whether the injury is accidental/suicidal/ homicidal.
5. Direction of application of force can be known.
6. It may be confused with lacerated wound.
7. Self-inflicted injuries.
8. Defense injury.



# Difference between A.M , P.M Incised wounds

- Ante mortem  
Bleed freely and profusely  
Arterial spouting present  
Blood is clotted  
Edges gape  
inflammation present  
Serum serotonin and histamine Increased
- Post-mortem  
Very slight or no haemorrhage  
Not present  
Not clotted  
Edges closely  
Not present  
Not raised

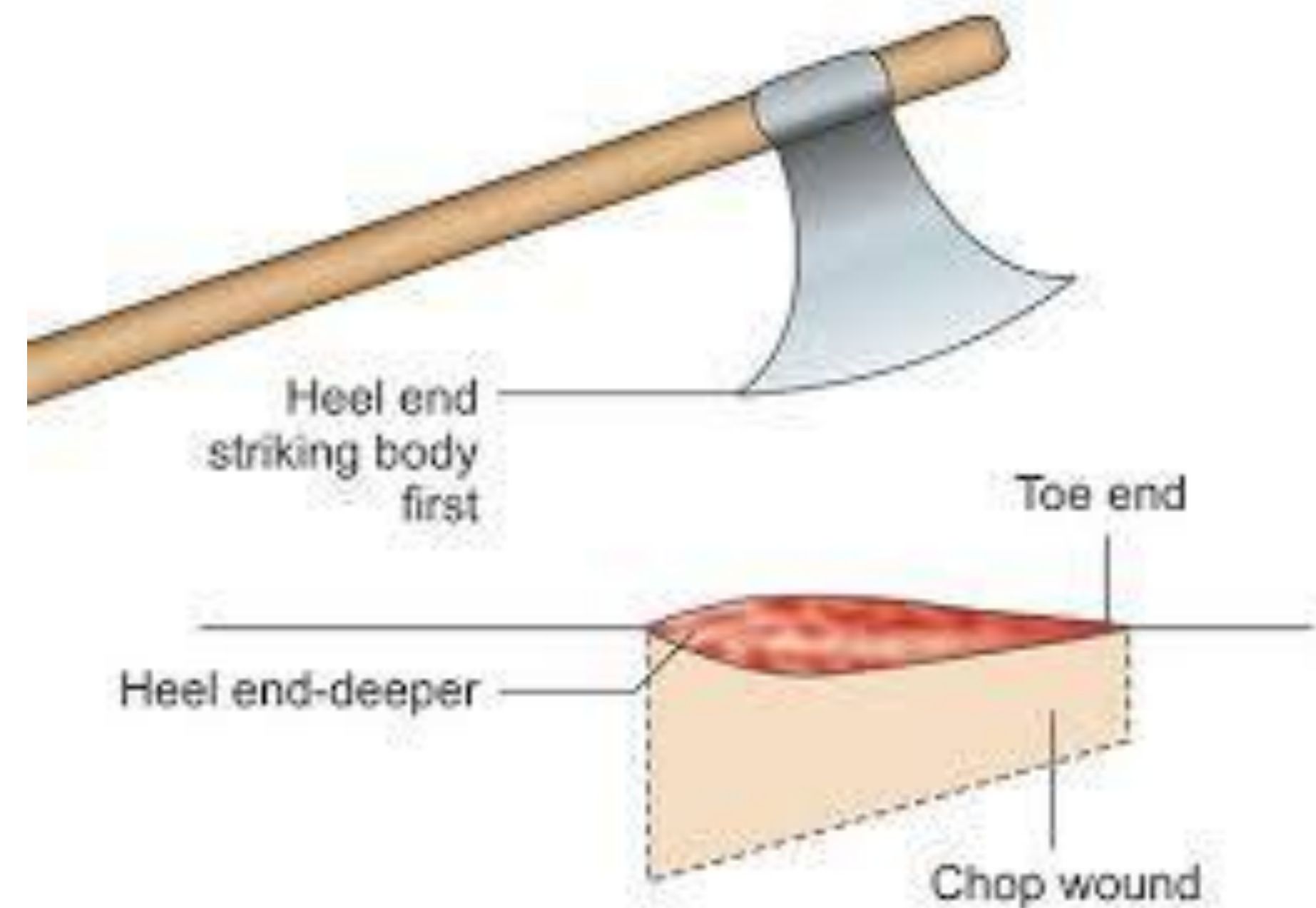
- **Self-inflicted wounds:** Injuries on the accessible part of the body, usually superficial or minor, regular, similar in shape, multiple, parallel or grouped together, handedness, old scars may be noted and may be related to psychiatric disorder.
- **Defence wounds:** injuries inflicted to a person when he tries to defend himself against an attack.
- ward-off or grappling -> cuts the palm and ulnar aspect of hand.
- Upper limbs-> the lateral/posterior aspect of arm and dorsum of hand may receive injuries.
- Lower limbs and back->curls into a ball to protect the anterior body.

# Chop wounds

- type of incised wounds made by hacking or chopping motion with fairly sharp and relatively heavy weapon such as axe.
- **features:**
- The edges are not so sharp like incised wound, margin shows bruising or abrasion.
- The weight act as strong force to penetrate the tissues.
- Wider and deeper than incised
- The wound is inflicted obliquely margin may show bevelling.
- Two ends: heel end of the chop (deeper, proximal), toe end of the chop (distal).

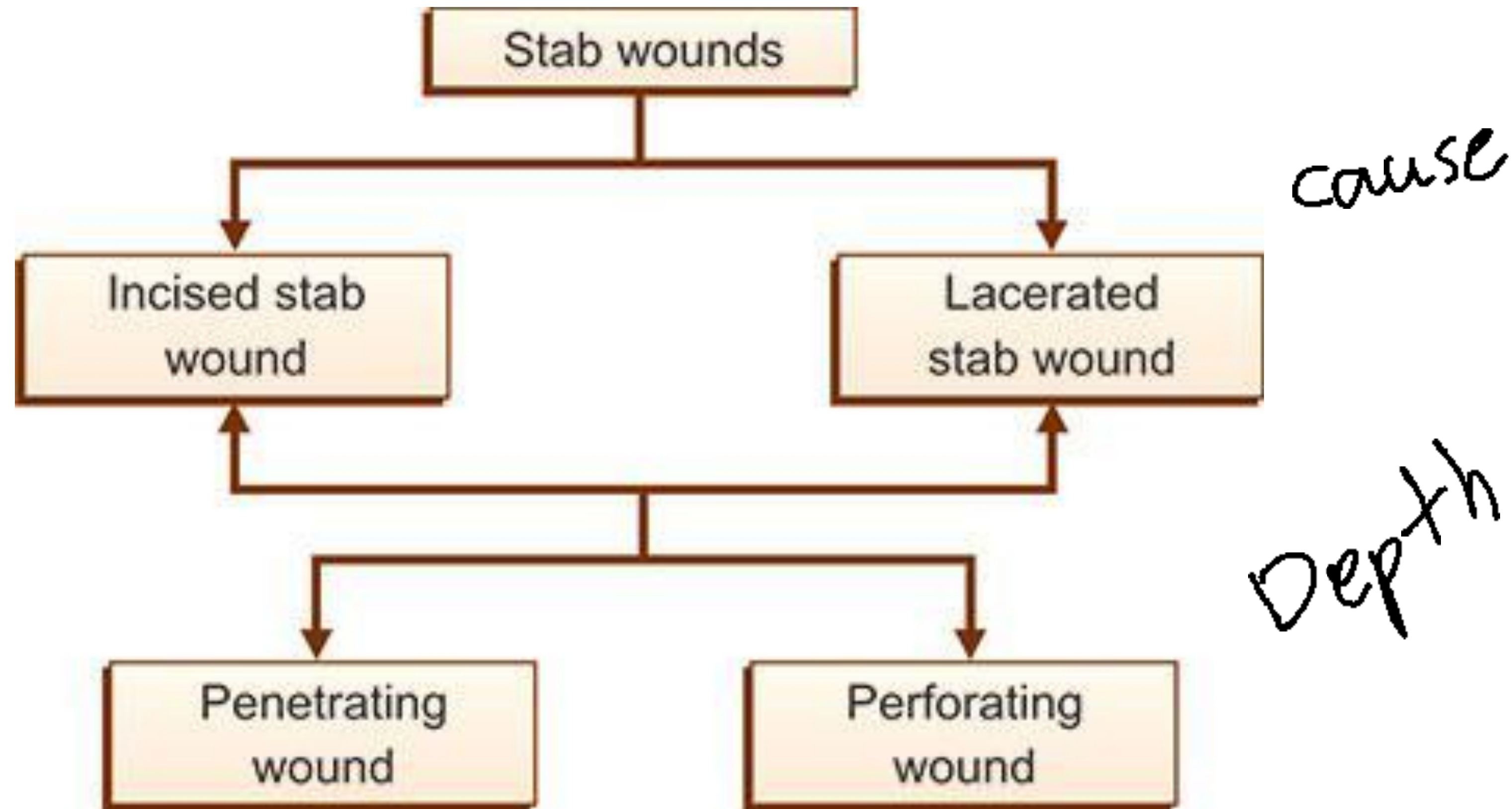
# Medicolegal Importance

- 1. Chop wounds are usually homicidal in nature however, accidental injuries may be sustained by a person working in factories etc.
- 2. From the heel or toe end, the relative position of the assailant and the victim can be known.
- 3. The type of weapon used can be known.
- 4. Age of injury can be known.

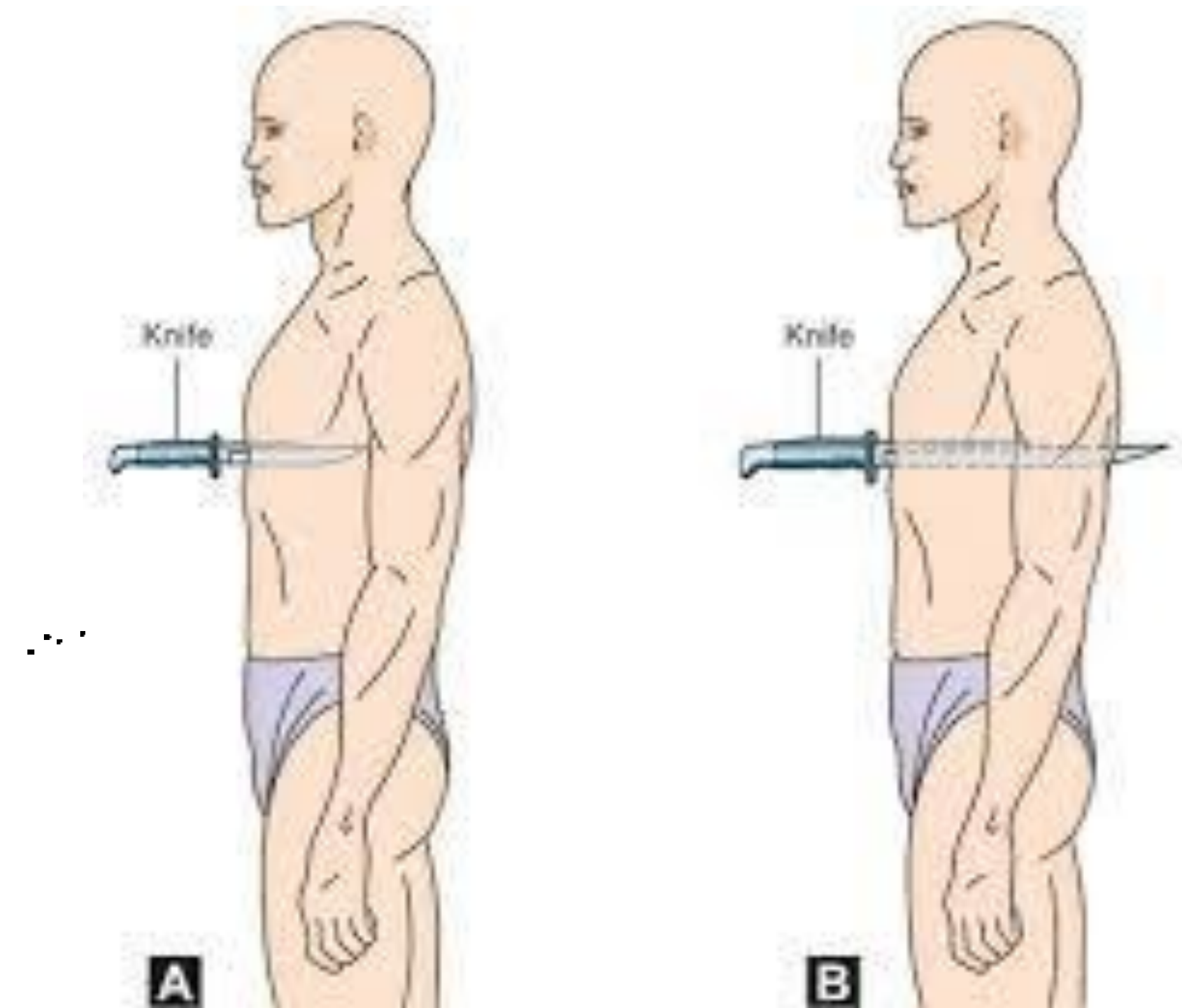




# STAB WOUNDS (PUNCTURE WOUNDS)



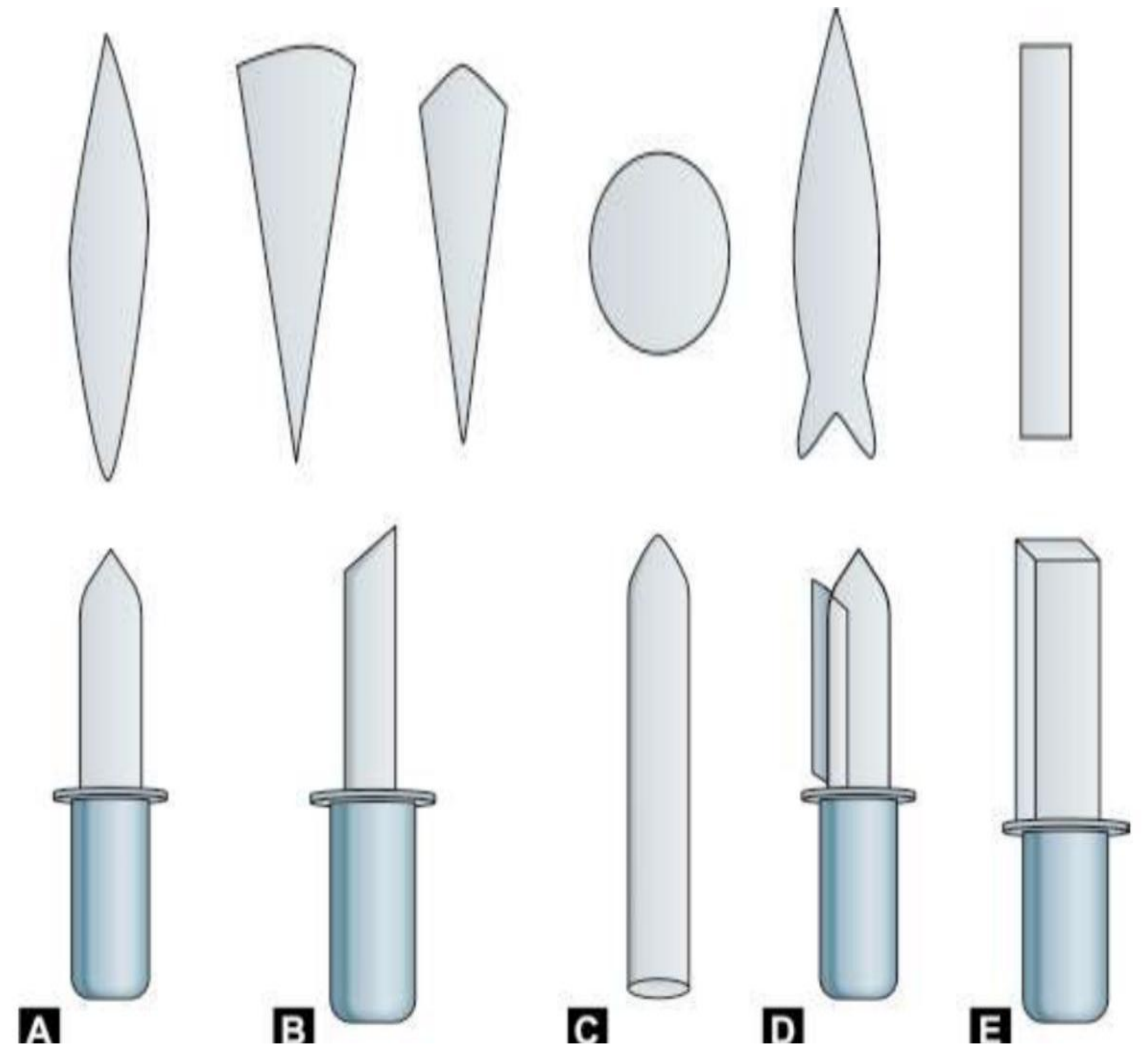
- Penetrating wounds: entry with no exit.
- Perforating wounds: entry and exit.
- Entry: larger, inverted
- Exit: smaller, everted.



# Type of weapon used and shape of wound

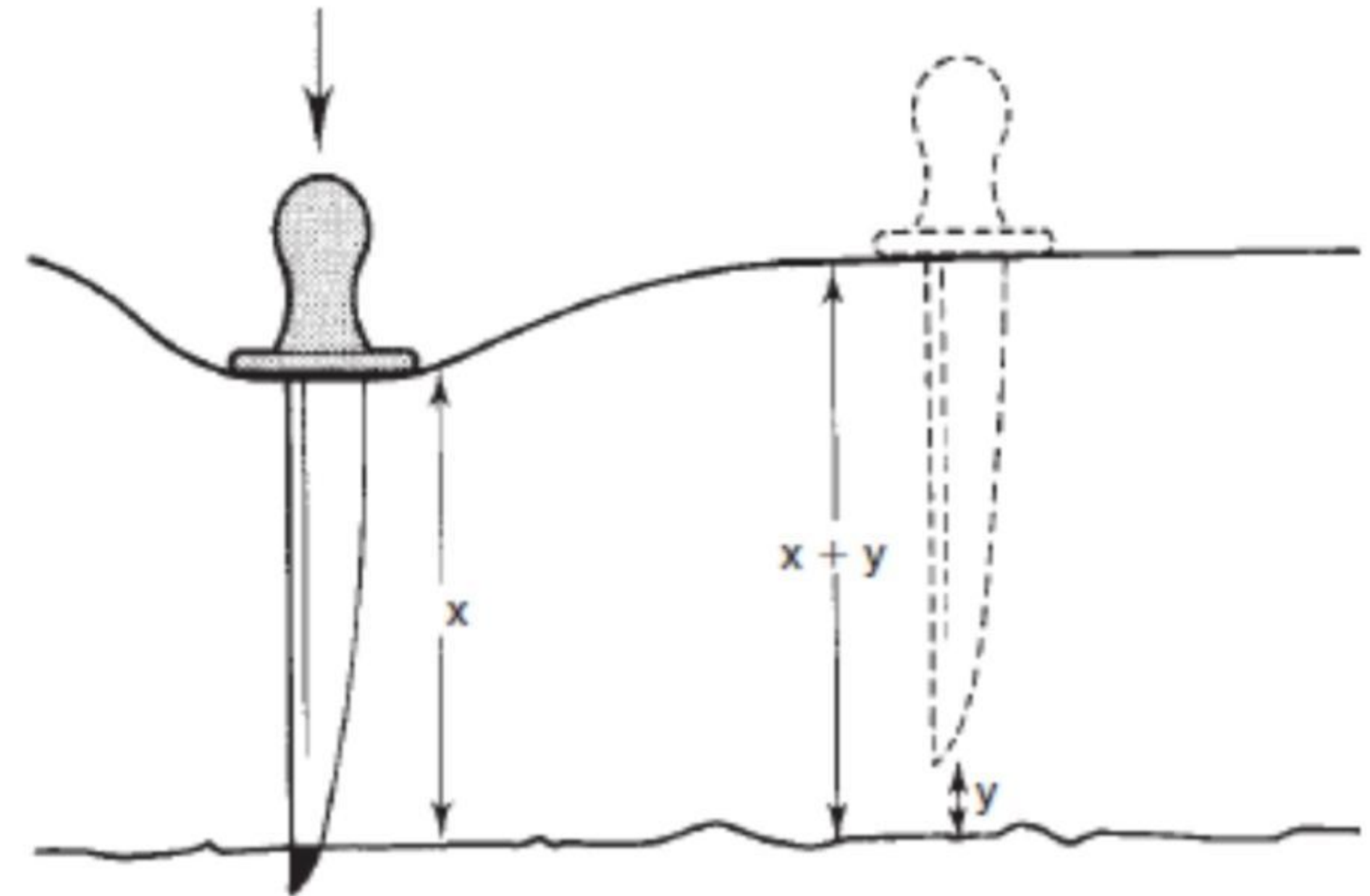
- The type of blade?
- Sharp cutting or blunt edge?
- Single or double edge?
- Serrated or squared off?
- If the blade tapers from hilt to tip?

- A: both edges are sharp resulting in spindle shaped wound.
- B: one edge is sharp and other is blunt resulting in wedge shaped.
- C: round object resulting in round wound
- D: one edge is sharp and other is edge square-off resulting in fishtail appearance.
- E: rectangular object results in rectangular shaped wound.

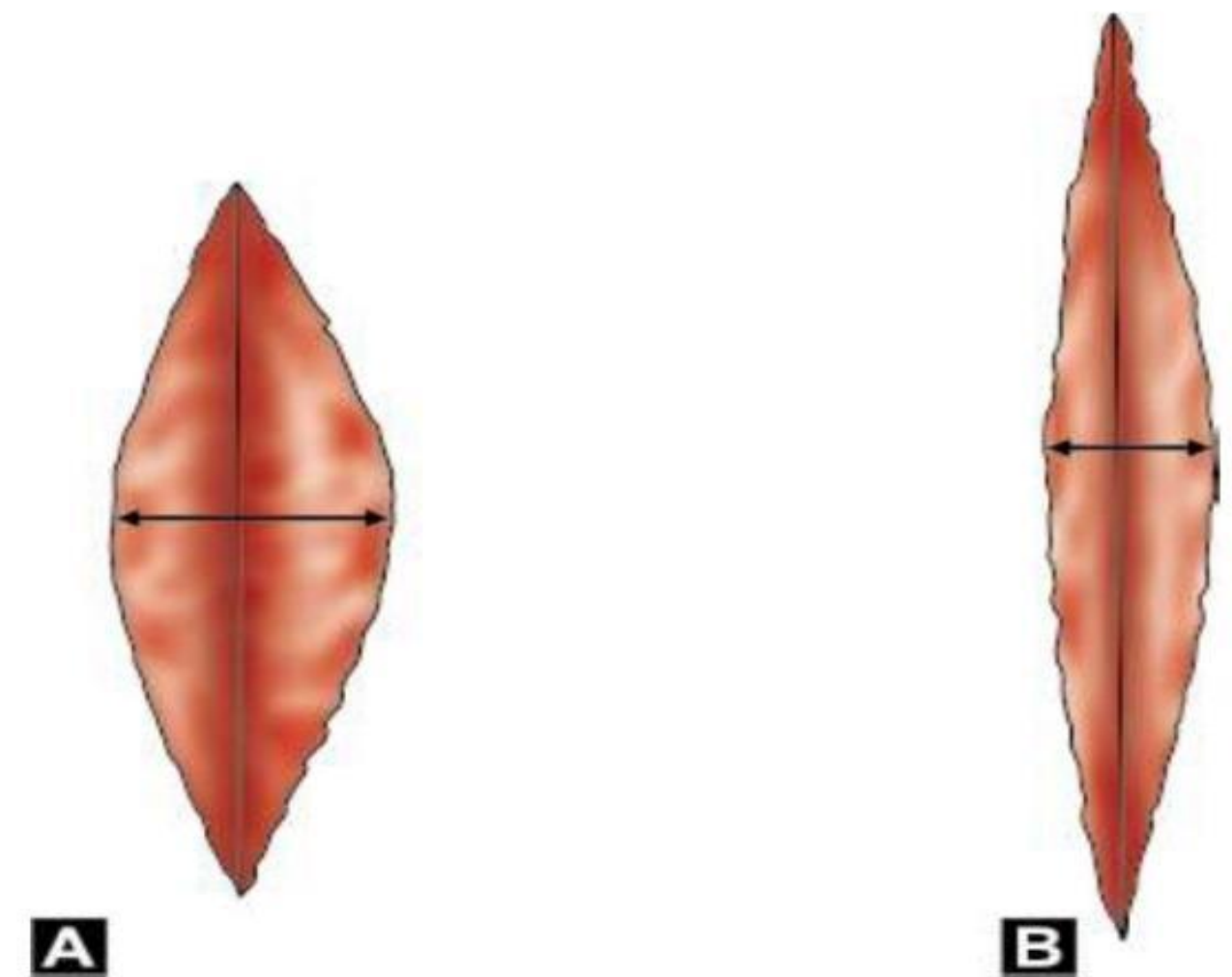


# Depth and thrust

- length of blade=depth of wound
- When depth of wound  $>$  length of weapon ?? Yielding or compressible body parts such as abdomen.



- **Movement of weapon in the wound**
- Tract of stab wound: knife is withdrawn along the same track of stabbing.
- Rocking of weapon: withdrawing the knife with different track and rotation which results in greater wound defect.
- **direction of stab wound:** xray, MRI.
- **Pattern of stab injuries.**
- **Dimension of wound:** depth of stab wound is more than length and width.
- **A:**Short and wide(perpendicular).
- **B:**Long and narrow(parallel).



# Medicolegal Importance

- 1.Type of weapon used can be known.
- 2. Dimensions of weapon can be known.
- 3.Movement of knife in the wound can be known.
- 4.Depth of thrust can be known.
- 5.Direction of thrust can be known.
- 6.Amount of force used can be known.
- 7.Age of wounds can be known.
- 8. Manner of infliction – suicidal/homicidal/accidental can be known.

# FRACTURES

- A. Based on aetiology: traumatic or pathological.
- B. Based on displacements: displaced or un-displaced.
- C. With relation to the skin and external environment:
  - 1- Simple: intact skin
  - 2- Compound or open
- D. Based on pattern of fracture: transverse, spiral, oblique, segmental, comminuted.
- E. Indirect fracture: Traction, Angulation, Rotational, Vertical compression and Angulation-compression.
- F. Direct fracture: Focal, crush and penetrating.



# *Complication of Fracture*

## **Early complications**

1. • Shock
2. • Injury to vessels, muscles, tendons
3. • Injury to joints
4. • ARDS
5. • Fat embolism
- • Deep vein thrombosis

# Delayed complications

1. • Septicemia
2. • Delayed union
3. • Non-union
4. • Mal-union
5. • Avascular necrosis
6. • Joint stiffness
7. • Sudeck's dystrophy
8. • Osteomyelitis
9. • Ischemic contracture
10. • Myositis ossificans

# Medicolegal importance

1. Fracture of bone constitute great hurt.
2. Fracture accompanied with vessel injury may endanger life.
3. Fracture associated with injury to nerve may cause deformity or loss of function.
4. Multiple fracture with hemorrhage may cause death of a person.
5. Age of injury can be known