WOUNDS

Dr Hasan Abd-alrahman

Definition and features

- What is injury??
- Injury is any harm caused illegally to a person in body, mind, reputation and property…

- So this harm does not only include bodily harm but also includes mental suffering and harm caused to reputation or property…
- Using the term “illegal” here in the definition means that some injuries are legal, for example if the surgeon applied a surgical incision over patient with consent it should be considered as a legal injury as it is caused for benefit of the patient….

❑ what is wound???

Wound is an injury produced by impact the tissue against object or by impact the object against the tissue leading to disruption of the continuity of the tissues(skin, bone, vessels, organs)….

Classification of wounds :

According to the causative force

A) Mechanical injuries

1. Blunt force injuries
– Abrasion
– Contusion
– Laceration
– Fracture and dislocations of teeth/bone
2. Sharp-edged weapon injuries
– Incised wounds
– Chop wounds
3. Piercing weapons – stab wounds
4. Firearm weapons – firearm wounds.

B) Thermal Injuries

1. Due to cold

– Frost bite

– Trench foot

– Immersion foot

2. Due to heat

– Burns

– Scalds

C) Chemical injuries

1. Corrosion – corrosive acid/alkali/metal salts

2. Irritation – weak acids or alkali

D) Miscellaneous injuries

1. Electricity

2. Lightning

3. X-rays

4. Radioactive substances.

- **Medicolegal classification**

1) Suicidal injury
2) Homicidal injury
3) Accidental injury
4) Defense wounds
5) Fabricated wounds

- **Legal classification**

1) Simple wounds: heal in less than 20 days leaving no permanent infirmity
2) Dangerous wounds: heal in more than 20 days or leave permanent infirmity
3) Fatal wounds: leads to death

❑ *what is permanent infirmity???*

Loss of functioning organ or loss of the function of this organ….

And so if one lost his unfunctioning eye, should we call that "permanent infirmity"???????

Forensic anatomy of skin

- The weight of skin is 4 kg and surface area in adult is 2 square meters.
- Skin is composed of :

1)Epidermis

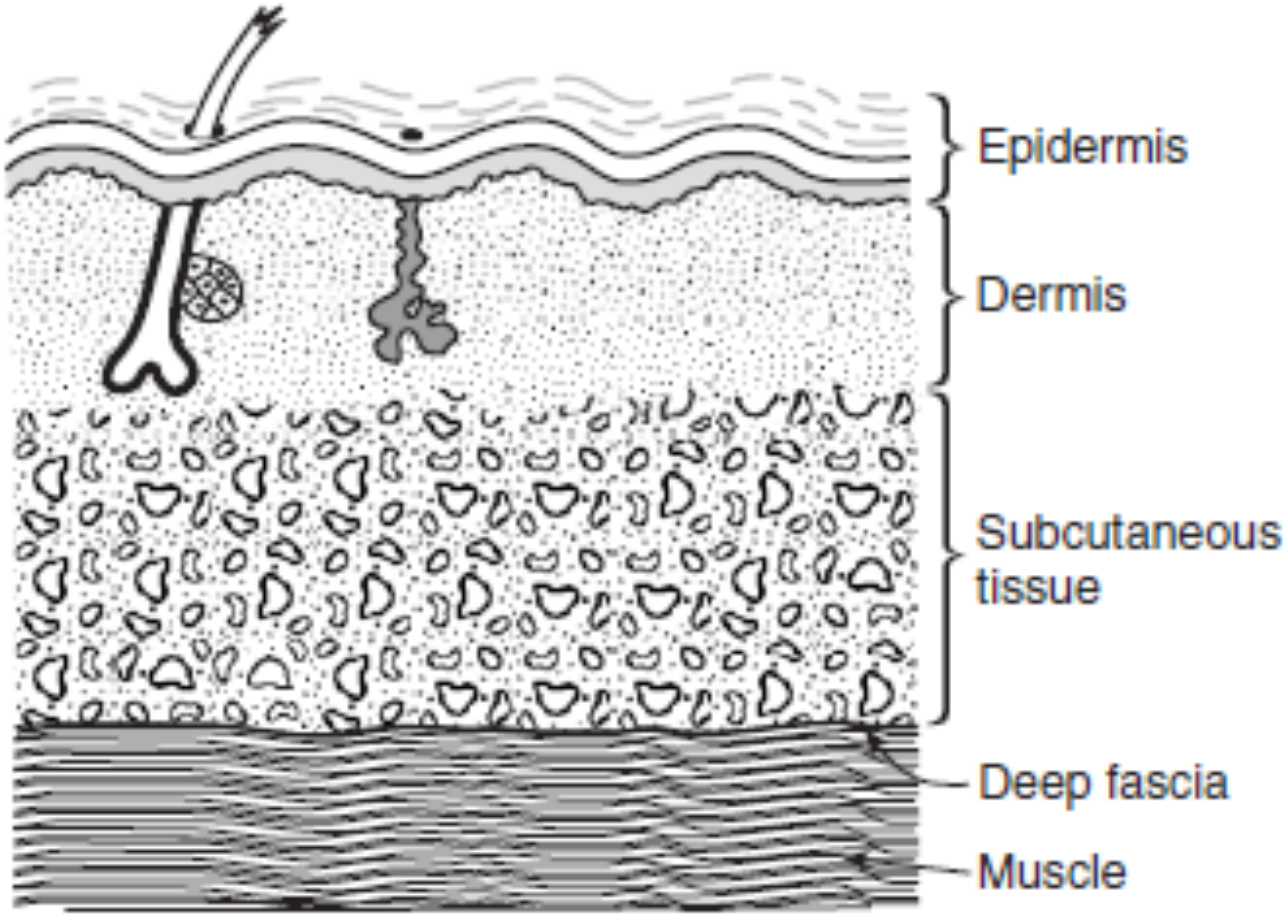
2)Dermis

3)Hypodermis

- Epidermis is composed of :

1) Basal cell layer
2) Prickle cell layer
3) Granular cell layer
4) Stratum lucidum
5) Horny layer or stratum corneum

Components of the skin



General structure of skin.

- Most superficial layer is the keratinized dead layer of cells, stratum corneum that varies greatly in thickness from one part of body to another. on sole and palm, it is thick enough while in scroyum and eyelids it measures only a fraction of millimeters...
- The thickness has forensic relevance in the amount of injury that is needed to penetrate the skin and allow bleeding from underlying tissues..
- The living layer of skin combines with the horny layer to form the epidermis and has no blood vessels in its thickness…

Biophysics of wounds

- The human body is constantly subjected to mechanical forces during the normal course of life, but usually the body absorbs these forces by the elasticity of its soft tissues or rigid strength of its skeletal framework..
- Wound is produced only when the intensity of the applied force exceeds the capability of the tissues to adapt or resist.
- A wound is produced mechanically by physical contact between the object and the body because of either:

1- a moving object strikes the body.

2-the moving body strikes against a stationary object.

But usually a combination of both forces are involved…

- Due to impact between the force and the counter force, energy gets transferred to the body that in turn produce changes in their state of rest or motion..
- Human body is composed of different complex tissues with different physical properties such as solidity , fluidity , elasticity… and so an impaction of a force to the body will not affect all tissues uniformly..

Forces acting over body

1) Tensile force -traction strain-

It is the force that leads to pull a body apart if sufficient, may cause separation of body into parts..

2) Compressive force –compression strain-

It is the force that tends to push body together and if sufficient, the body may break into pieces..

3) Shearing force -shear strain-

It is a force that tends to slide one part of body over an immediate adjacent parts(tangential force)...

- There is a great variation in resistance of the different body tissues to the tensile force, rupture of tissues occurs when extensibility is exceeded. For example, bone is a rigid tissue and resist deformation but when its limit of elasticity is exceeded then fracture results..
- The soft tissues are soft, plastic and pliable. They will rupture when they are stretched beyond the limits of their tensile strength..

Force and Area

- The force acting over the body varies directly with the mass of the object and directly with the square of the velocity of impact.

Force =1/2 * mass * velocity^2

This mean for example, a 1 kg object pressed against the scalp will cause no injury. however if the same object thrown against the head at velocity of 10 feet per sec may break the skull..

- Another factors of importance are the *Area* over which the force acts and the surface area of the object itself.

What does that mean???

In simple words, the force derived from same mass and velocity if applied over smaller area it will cause greater harm than applying over broader surface.. in the other hand if an object with a small surface area applied and another which has larger surface area, the smaller will cause more damage…

Factors influencing for causation of wounds

- 1. nature of object-weapon2
- 2. amount of energy discharged during impact
- 3. conditions under which the energy is discharged
- 4. nature of tissue affected (skin, subcutaneous tissue, muscle, bone, body fluids and gases)

Nature of object

- If weapon used is sharp, the force is concentrated over the small area of strike resulting in deep penetration injury.
- The force acting from blow by broad/blunt surface of weapon will be dissipated over larger area of body with less damage
- A rigid weapon will produce more damage than a plastic or flexible one.
- If the weapon breaks on striking the body, much of kinetic energy is lost, less damage

Amount of energy discharged during impact

- The kinetic energy is= ½ MV^2
- A mass of definite weight moving at a definite speed will gather definite amount of energy
- the amount of kinetic energy will be doubled when weight of weapon is doubled but it will quadrupled(4 times) when velocity of the moving mass is doubled . Hence velocity of object/weapon is more important than its weight.

Condition under which the energy is discharge

- If the body is struck by an impact and the person falls, then the kinetic energy liberated will be small with less local damage. If the person do not fall, more kinetic energy is liberated causing greater damage.
- Similarly, if time period of discharge from impact is increased, the destructive effect on the target gets decreased.

Affected skin

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

Affected 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. However, 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.

Affected muscle

- Muscles are elastic and plastic which can resist impact up to certain extent however, if its elasticity exceeds, the muscles will get avulsed, torn, rupture, stretch or crushed.

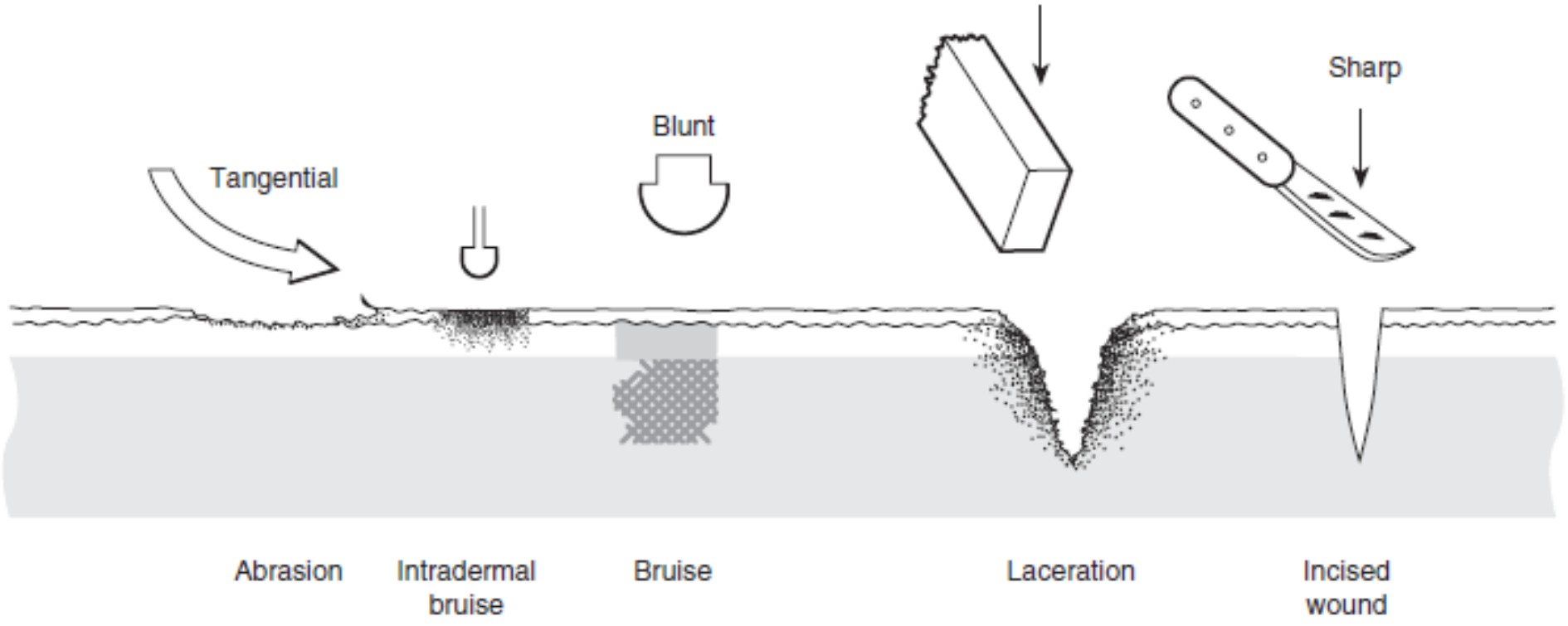
Affected bone

- The bones are rigid and elastic. They bend against force without breaking and recoil back to its original shape after releasing the force.
- However, when the bone is bent beyond its limit of elasticity, it breaks at the point of max convexity of bending result green stick fracture.
- When applied force is acting over greater surface area, it causes multiple fracture fragments
- A twisting strain produces spiral fracture.

Body fluid and gases

- Fluid can be easily displaced but cannot be compressed or reduced in size whereas gases can be compressed easily.
- Example- 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 pnaumostatic force causing damage (blast injury).

Mechanical Injury



Abrasions

- Definition :

It 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)…

- Features :

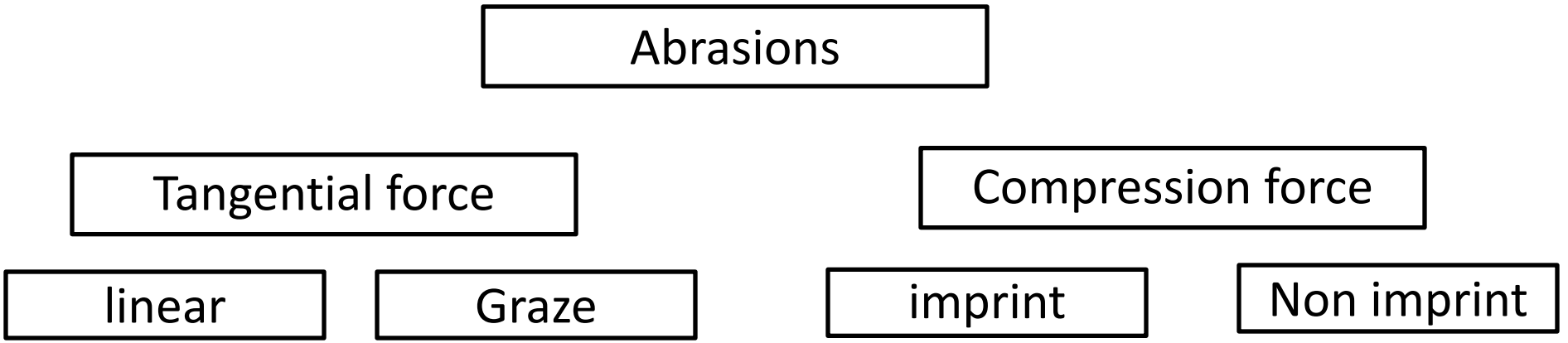
- pure abrasions involve epidermis only.
- abrasions do not bleed,,,WHY??? And we notice bleeding with abrasions,,,WHY???
- Abrasions do not leave a scar on healing.

- Mechanism of production :

The mechanical force producing abrasion acts on the skin in one of the following :

1- sliding force (friction)

2- compression force



- Sliding force :
- If causative force is narrow and sharp, linear abrasion is produced.
- If causative force is wider or broad , the abrasion caused will be wider and called as graze abrasion
- Compression force :
- Imprint abrasions..produced by applying a perpendicular force on skin with imprint of acting abject over superficial layer of skin. Any example??? ☺
- Pressure abrasion..produced by applying a relatively perpendicular force on skin with movment of the object that causes crushing of the superficial layer of epidermis. Any example???☺

- Types :

1- linear abrasions.

2- graze abrasions

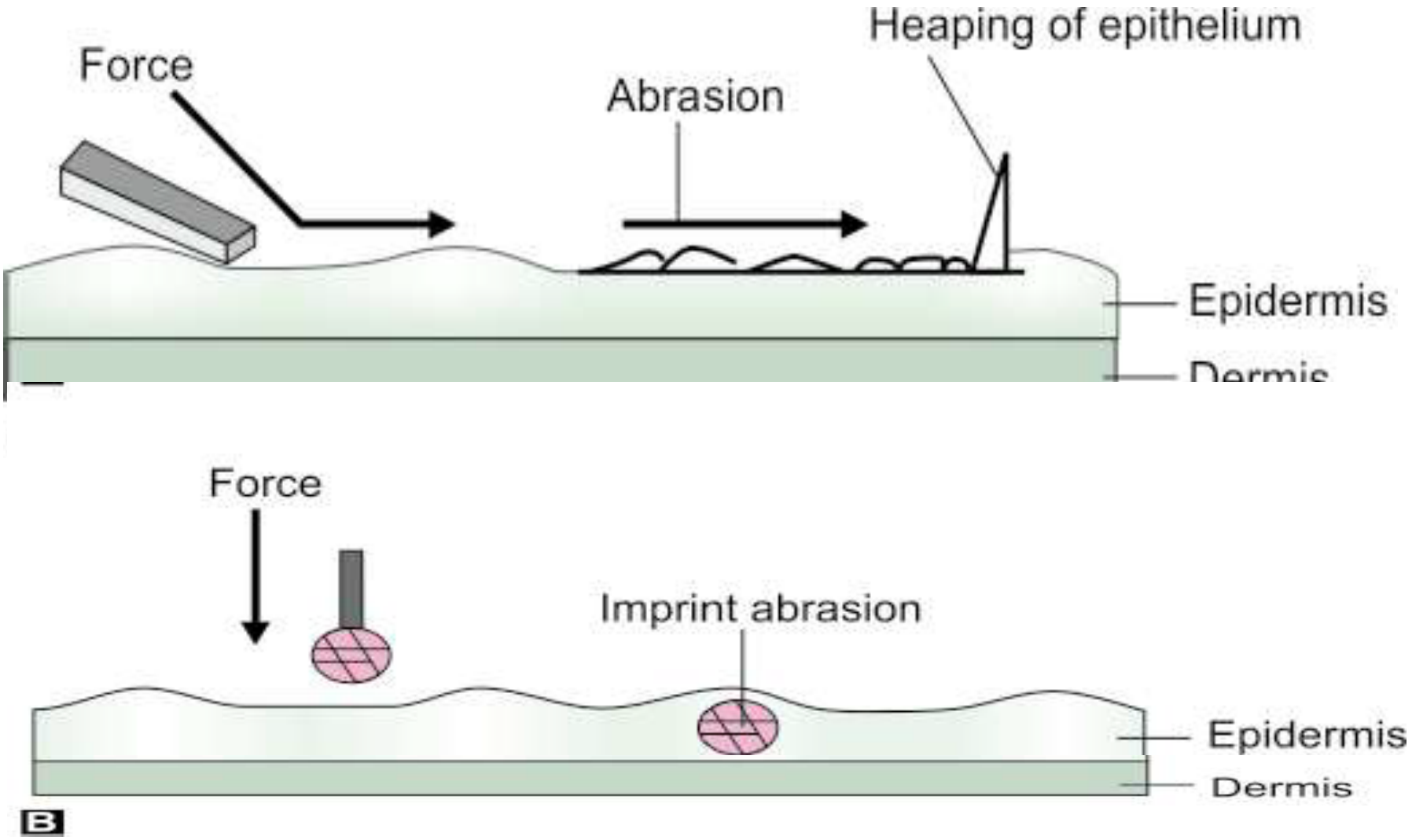
3- pressure abrasions

4- imprint abrasions

Mechanism of production of abrasion.

A: Force acting tangentially producing linear or graze abrasion

B: Force acting perpendicularly causing imprint abrasion



Linear abrasion

- Also called scratch abrasion..
- These abrasions are caused by sliding movment of sharp, narrow object such as pin,pointed end of a weapon..
- The feature of such abrasins is that are wider at the starting point and show *heaping* of epithelium(accumulation) at the end,,what does this heaping indicate???☺

Graze abrasion

- Also called sliding abrasion, gliding abrasion, brush abrasion, scrape abrasion.
- These abrasions are produced by sliding movment of broad or wider surface against skin..
- Graze abrasions are wider at the starting point and become narrower at the end with heaping of epithelium..
- They show parallel lines(furrows, grooves) .
- When the friction force is great, grazed area appears like burn injury and it is called in such cases the brush burn..

Imprint abrasion

- Also called as pattered abrasion or impact abrasion or contact abrasion..
- They are produced when force is applied perpendiculary to the skin which leads to direct impact of the force to the skin causing stamping of skin with the force..
- skin gets depreesed or compressed as the pattern of the object(resemble it).

Pressure abrasion

- Also called crushing abrasion.
- Some authorities consider it as a type of imprint abrasion.
- These abrasions are caused by direct impact or pressure of an object over the skin accompanied by slight movement resulting in crushing of superficial layer of skin. The pressure abrasion, due to crushing, on getting dried up resembles parchment like and appears brown to black.
- Example of pressure abrasion includes ligature mark found in hanging or ligature strangulation.

Other Types of Abrasions

1. Contused abrasion and abraded contusion : When the crushing force of the causative object is more, then the weapon or object fails to imprint the pattern or design. The crushing will cause damage of capillaries in the dermis with extravasation of blood (contusion) surrounding the abrasion. If the contused area is more marked than abrasion, it is called as **abraded contusion**. Alternatively, if abraded area is more prominent than contusion, it is called as **contused abrasion**

2. Postmortem abrasion:
These are the abrasions produced after death. These abrasions are pale white in color and dry.

	Antemortem abrasion	**Postmortem abrasion**
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

3. Ant bite marks in postmortem state may resemble abrasion. Ant bite marks are usually pale and are irregular in shape (map like). They are mostly located in moist regions of body such as axilla, groins, scrotum, nose, and mouth or around eyes.

4. Fabricated abrasion: These are the abrasions inflicted by a person by oneself or with the help of others, with a motive to implicate another person for false allegation of injuries.

5. Nappy abrasions: These abrasions are seen in infants due to excoriation of skin at the nappy area

Differential Diagnosis

Abrasions may be confused with :

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

Healing of Abrasion

- Abrasion heals by undergoing contraction of wound and replacement of lost tissues. Initially the abrasion will be 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 hour and about 12 hour three layers are identified consisting of surface zone of fibrin and red cells, a middle zone of polymorphnuclear 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.

Age of Abrasion

- Age of abrasion can be estimated.

Age	**Feature**
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

1. Site 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.

CONTUSION (Bruise)

- *Definition :*

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.

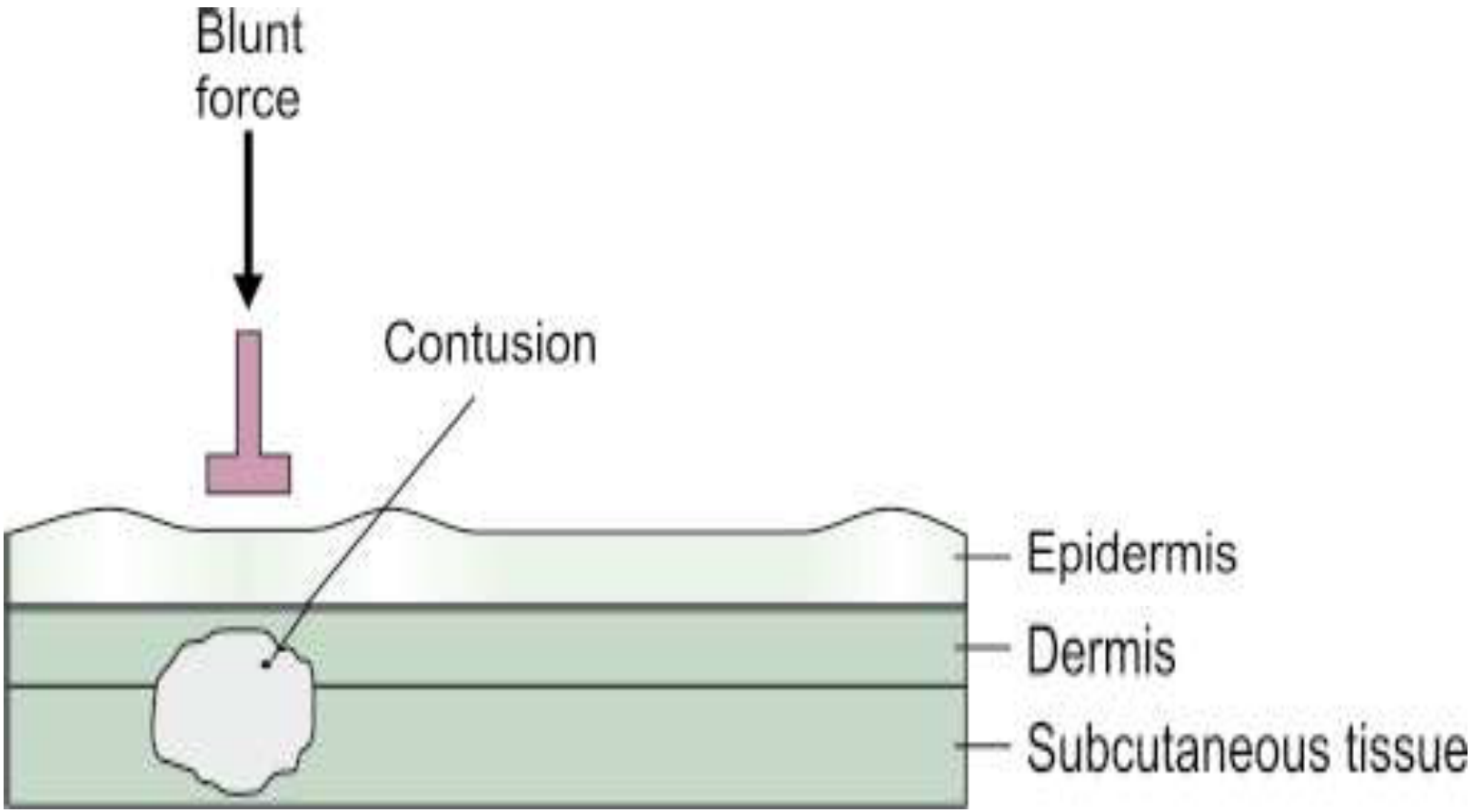
***What is ecchymosis and petechiae??

- In fact an extravasation of blood that is larger than few mm in diameter is usually termed bruise or contusion, this size overlaps the older and now little used the term ecchymosis which is really a small bruise.
- Even smaller is the petechial hemorrhage which is the 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.

Mechanism

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.

- Mechanism of contusion formation



Terms used in this subject

- Intradermal bruise
- Subcutaneous bruise
- Patterned contusion
- Deep bruise
- Tram-line contusion
- Six-penny bruises
- Horse-shoe-shaped contusion
- Contusion over organs
- Gravitating or shifting contusion
- Spectacle hematoma.

Intradermal Bruise

In this type, the bruise is situated in the sub-epidermal

layer of skin. Patterned bruises are often associated with intradermal bruise. Due to superficial position of these bruises and translucency of the skin that overlies these bruises, the patterned contusion becomes more prominent. The bruises are usually occurred at the point of application of force. The margins in intradermal bruises are well-defined.

- Examples – motor tyre marks, impacts from whip, impact from rubber soles of shoes.

Subcutaneous Bruise

- These bruises are the commonest types and are located in the subcutaneous tissue often in the fat layer above the deep fascia and therefore are fairly visible through the skin. Such bruise is called as **superficial bruise**

- If such bruises are located below the deep fascia, such bruises are called as **deep contusions** and these bruise take time to appear over surface. The features of these bruises are that the margins appear blurred(ill-defined) especially at the edges.

Patterned Contusion

These contusions are called as patterned contusions

because in such contusions, the imprint or design of the Offending weapon or object is imprinted over the skin.

- If such patterned contusions are present, they provide vital information regarding the nature of the offending object or weapon.
- Examples – impression of motor tyre, impression of rubber sole of shoe, etc.

Shifting Bruise

- Bruises that appear at different site from the actual site of application of mechanical force. This sort of feature is frequently associated with deep-seated contusions.
- When the bruise is located in deep tissue then it takes time to appear at skin surface. The movement of bruise from deep-seated tissue to surface is affected by number of factors such as fascial planes, anatomical structure of that particular location and gravitational force acting.
- An example of contusion in forehead. If the victim survives for some period after sustaining bruise then the contusion in forehead can slide downwards over the eyebrow and appear as ***black eye***.

Similarly bruises situated at arm or thigh may gravitate downward to appear at lower surface at elbow or knee.

Such shifting of bruises from the point of impact to newer area are also called as **migratory contusions** and if they appear at newer areas then such contusions are called as **ectopic contusions** or **percolated contusions**. Similarly the occurrence of bruises to come out from deep site to surface is also called as **come-out-bruise**. This phenomenon is due to hemolysis of blood. The freed hemoglobin stains the tissue more and more densely with time.

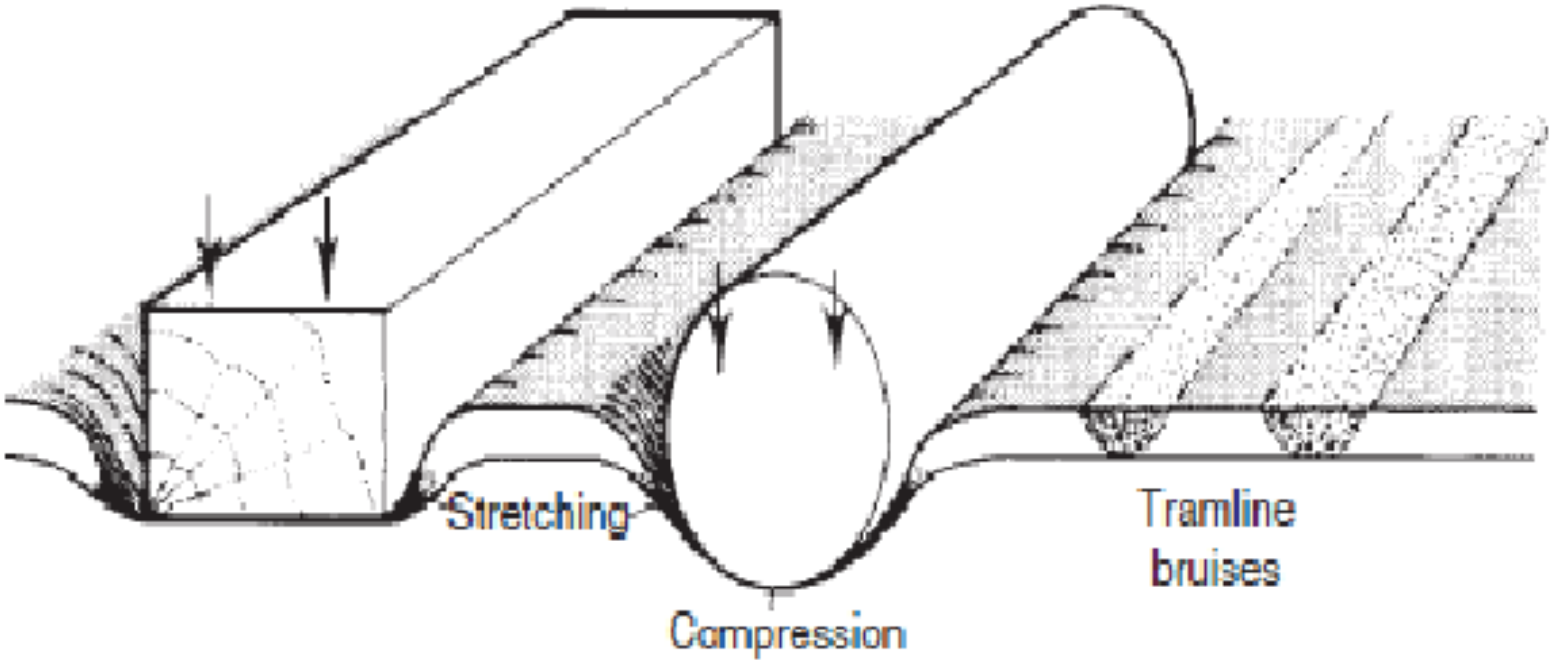
Tram-Line Contusion

Also called as rail-way contusion or tram-track contusion

- These contusions are caused by blow with rod, stick, whip or belt etc.
- The contusion is characterized by two-parallel tram-track like lines of hemorrhages with intermediary area of skin remains intact.
- Mechanism – blow with object like stick or rod over skin

causes the skin under the part of contact of weapon 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.

- Tram-line contusion



Six-Penny Bruises

- These are the discoid shaped bruises of about a centimeter in diameter and resulted from fingertip pressure. These bruises are called as six-penny bruises because of the apparent resemblance with six penny.
- These bruises are usually found in neck region in case of manual strangulation. They may also be noted over the arms, forearms or wrist of children in ***child abuse*** cases caused by holding a child.

Tissue and Organ Contusion

- 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 heart 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

- 1. **Condition of tissue** – contusion results from extravasation of blood in the surrounding tissue. To accommodate this extravasated blood, space should be present in the tissue. In lax tissue, comparatively more space is available and therefore bruising occurs with ease in lax tissue such as eye socket or scrotum, whereas it is rare in dense tissue such as sole of foot or palm of hand. Similarly, in fat people, there is greater volume of fat and therefore they are more susceptible for easy bruising than the thin people.
- 2. **Body part** – apperance of contusion depends on the body part affected by the impact. yielding areas such as abdominal wall or buttock will bruise lesser than rigid surface such as head, chest or shin.
- 3. **Situation of bruise** – contusions located in dermis or in subcutaneous tissue above deep fascia are fairly visible whereas bruises situated in deeper tissues are non visible and we should dissect to view them.

4. **Condition of blood vessels** – the amount of blood extravasated in the surrounding area depends upon the state of blood vessels and coagulability of blood. In older individuals, the vessels being more fragile bruises easily and heavily even with minimal trauma.

5. **Presence of disease** – concomitant presence of any disease such as bleeding diathesis, scurvy, liver disorder, arteriosclerosis, purpura, leukemia, hemophilia, vitamin C and K deficiency, chronic alcoholic or certain medications such as aspirin will lead to bruising easily in comparison with normal people.

- 6. **Sex** – women will bruise easily in comparison with male because of presence of abundant subcutaneous fat and delicate tissues.
- 7. **Age** – older individuals' bruises easily – *vide supra*. Children tend to bruise more easily than adult because of softer tissue composition and less volume of protecting tissue.
- 8. **Color of skin** – bruising is more apparent and easily visible in fair skin person than dark complexion persons.

9. **Optical character of skin** – bruises localized near the surface have more reddish appearance while bruises in deeper layer (subcutaneous) give a more bluish color impression. This is because of optical characteristics of skin. Blood localized in the subcutaneous tissue appears blue on the surface due to scattering processes in the dermis (**Rayleigh scattering**) as the blue wavelengths of light are scattered (and thus reflected) to a greater extent than the red wavelengths.

Repair and Healing

With advancement 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 colours 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 exravasation 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	Billirubin 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 of Bruise!!!

Bruises have less value than abrasion because:

- The size may not correspond with the size of offending weapon
- The bruise may 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 do not indicate the direction of the force applied.

Complications

1. If inflicted on vital parts (e.g. neck, heart), the contusions may cause death
2. Multiple contusions may cause death by shock and hemorrhage
3. The contusions are painful lesions
4. Multiple contusions of intestine may cause ischemia or gangrene
5. The collected blood in contusion may act as a suitable media for proliferation and multiplication of bacteria
6. Pulmonary fat embolism – due to fat expressed from fat cells and then liquid fat entering the injured and torn blood vessel may lead to pulmonary fat embolism.

Differential Diagnosis

The bruise may be confused with

1. Postmortem lividity
2. Congestion
3. Artificial bruise
4. Purpura – bruising need to be differentiated from purpura. Purpura develops spontaneously in those persons with a hemorrhagic tendency.

Artificial Bruises

Artificial bruises are produced due to application of some irritant substance or juice to the skin. Such irritant substance produces inflammation and vesication simulating bruises.

These contusions are produced with intention to make false allegations against somebody or to implicate someone else.

Causes of artificial bruises:

- Marking nut
- Calatropis
- Plumbago rosea
- Plumbago zeylanica

	Contusion	**Postmortem lividity**
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

Differences between contusion and congestion

	Contusion	**Congestion**
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

Medicolegal Importance

1. Offending weapon can be known.
2. Character and manner of injury can be known.
3. Application of degree of violence can be estimated.
4. A bruise is usually simple injury but if present on vital parts or organs may cause death.
5. The age of injury can be determined ?!!!

Be attention!!!

- It is not practicable to construct an accurate time according to colour changes, as was done before, as there are too many variables for this to be reliable. These include:

■ the size of the extravasation – changes begin at the margin and a larger bruise will take a longer time to be absorbed. A large old bruise may contain all the colours possible – from purple in the center to yellow at the edges.

■ the age and constitution of the victim. Aged persons may not heal their bruises at all and carry them for the remainder of their lives.

■ a personal idiosyncrasy in the rapidity with which such changes occur in any one person, including coagulation defects.

LACERATED WOUNDS

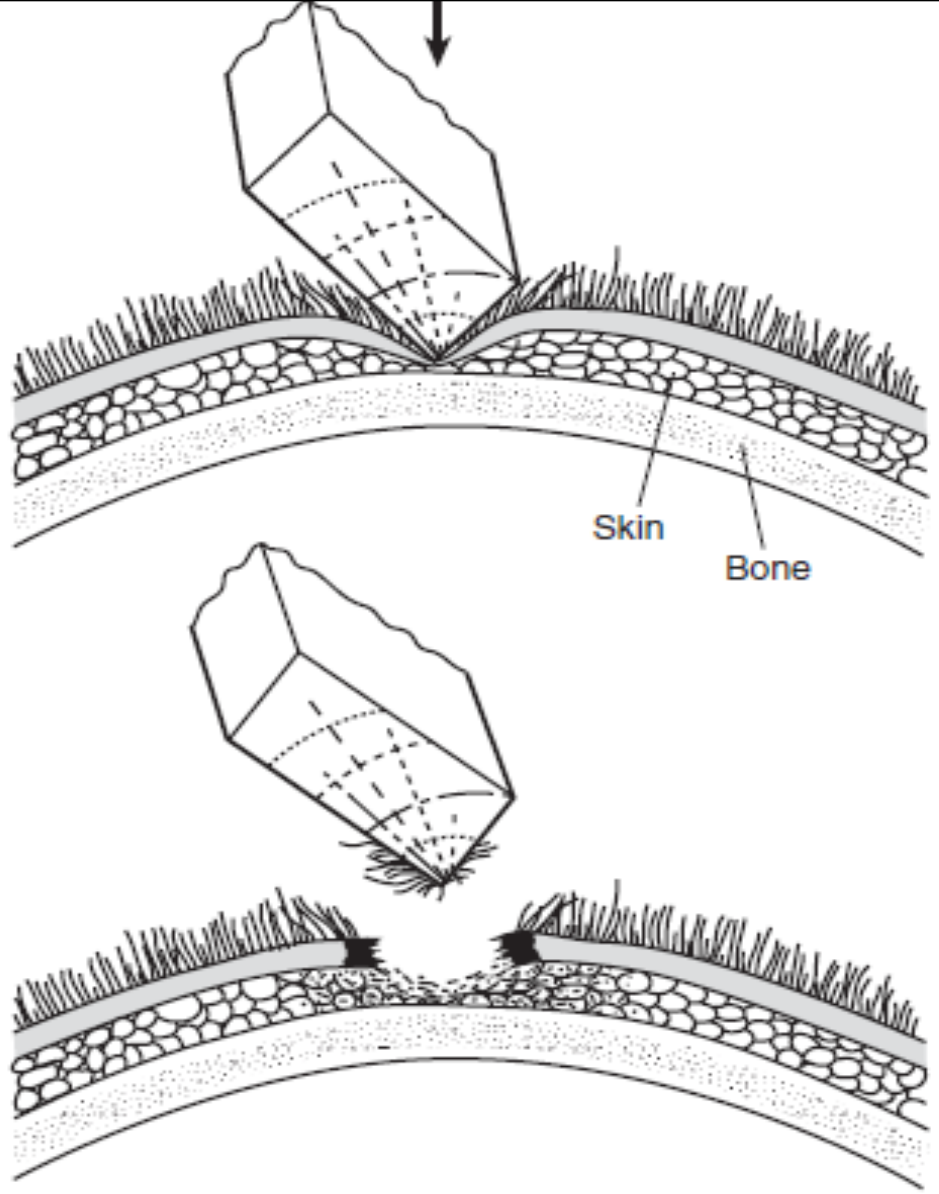
Laceration wound *is form of mechanical injury caused by hard and blunt force impact which is characterized by splitting or tearing of tissues*.

It's characterized by the affection of the whole thickness of the skin.

Mechanism

When the skin or other structures are subjected to blunt forces, the tissue gets crushed or stretched beyond the limits of their elasticity leading to tearing of the skin or other tissue thus producing laceration. Laceration differs from the incised wounds because in laceration*, the continuity of the tissues is disrupted by tearing rather than clean slicing.*

- Lacerated wound



Crushing impact of a blunt object on skin supported by bone, such as scalp on skull. The skin is sandwiched between weapon and bone and this causes a lacerated split that has bruised margins and bridges of hair and tissue in the wound.

Types

Following are the types of lacerated wounds

1. Split laceration
2. Stretch laceration
3. Tear laceration
4. Avulsion laceration
5. Crush laceration
6. Cut laceration

Split Laceration

- Also called as incised looking laceration
- Split lacerations are caused by blunt force(heavy edged object) splitting the thickness of the skin most frequently when the skin and soft tissues are crushed between impacting force and underlying bone(sandwich like).
- These types of lacerations are usually found in body parts with underlying bones without much tissue in between.
- Common sites includes – scalp, face, shin etc.
- Due to splitting of skin these lacerations appear like incised wounds.

Stretch Laceration

- Stretch laceration results due to over-stretching of the fixed skin till it ruptures. In such type of lacerated wound, there is localized pressure with pull that causes tearing of the skin. Thus a pulling force causes stretch laceration
- Example – if pressure is applied over the thigh stretching the skin towards knee, then such force can cause laceration along the inguinal line.
- *Striae -like lacerations or stretch mark-like lacerations* are also considered as a variety of stretch laceration. These lacerations are superficial and multiple and mostly located at groin. They are usually present in traffic accidents when the body is run over. The crushing weight of car wheel causes stretching of the skin .

Tear Laceration:

- It is common form of laceration
- In this type, tearing of the skin and subcutaneous tissue occurs from localized impact by hard and blunt force
- The acting force from object or weapon rips the skin or tissues producing the laceration.

Crush Laceration:

- Here compression force causes crushing of tissues below. This form of injury may cause total or partial amputation of the affected body part, for example limb.
- It may also be associated with avulsion(if there is a rotary action) and/or stretch laceration.

Avulsion Laceration

- Also called as flaying injury or grind laceration
- Avulsion laceration occurs due to grinding compression of the tissues to such an extent that the skin gets detached from the deeper tissues thus resulting in the degloving of the skin.
- Here, large area of the skin and subcutaneous tissue is rolled off from body part, almost always by the rotary action of the causative object such as rotating motor wheel or tyre.

Patterned Laceration

- Up to some extent, some weapons may produce patterned laceration but the patterns are not prominent like patterned abrasion or bruises. From some injury pattern, some weapons shape may be recognizable.

The examples are given below:

- Blow with hammer head with circular face may produce

a circular or an arc of circle (crescentic) shaped laceration

- Long and thin objects may produce linear laceration
- Heavy focal blow may cause a stellate shaped

Laceration(in which the center is the site of impaction).

Features

- In laceration wounds, continuity of the tissues or skin is disrupted by tearing or splitting rather than by clean slicing as observed in incised wound.
- Margins – the margins are irregular and may be slightly inverted.
- In Lacerated wounds there is gapping of the edges.
- There may be bruising and crushing of the edges often placed in a narrow zone and requires lens for viewing
- The underlying blood vessels, nerves and delicate tissue bridges may be observed in the depth of wound.
- Hair follicles are crushed.
- There is absence of sharply linear injury in the underlying bone.

• The ends of the lacerations at angles may show shallow tears, diverging from main laceration itself. Such small tears are known as shallow tails.

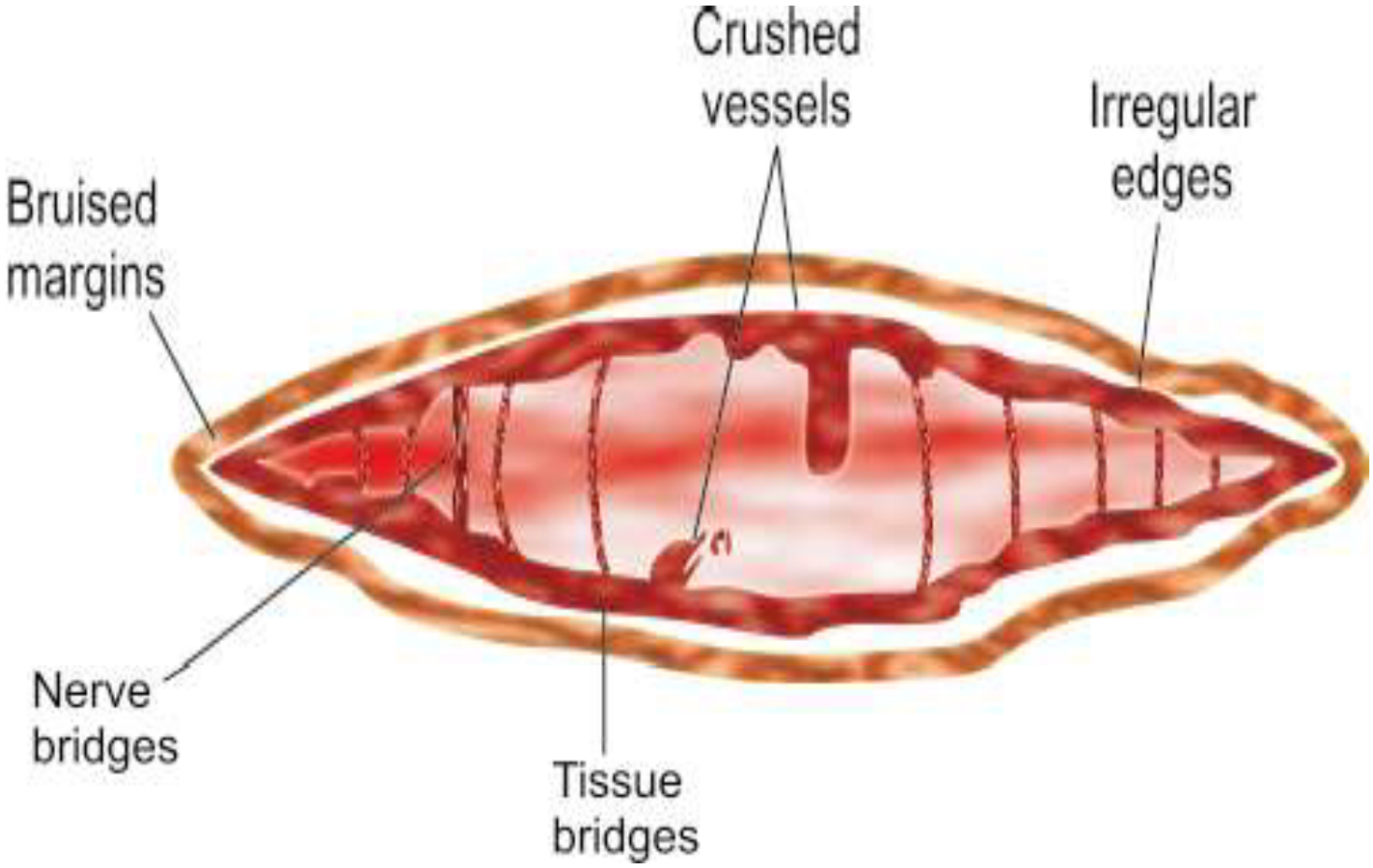
• Bleeding from lacerated wound is less in comparison to incised wound because the vessels are torn and crushed. The crushed vessels are capable of retracting and undergo thrombosis thus causing less hemorrhage.

• Foreign body or matter may be driven in the lacerated wound or may be soiled by grit, paints, fragments or glass etc.

• The shape and size of lacerated wound may not correspond to the causative weapon or object. However, sometimes some weapons may leave patterned lacerated wound such as hammer.

- Examination of lacerated wound will reveal the direction of the application of the force or how the blow was applied to effect the laceration. The more undermined edge of the laceration is the side toward which the force of striking object was directed; the slopped side of the laceration is that side from which the blow was directed. Similarly the side of laceration with adjacent contusion is often the side from which the force was directed.

- Features of lacerated wound



Laceration of Organs

Laceration of the internal organs are caused due to application of blunt mechanical trauma. It may possible that externally no injury may be evident but internal organs may suffer damage. For example, if kick is applied over yielding surface such as abdomen, externally there may be no evidence of injury but internally may cause injury to pancreas, liver and spleen.

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 postmortem laceration.

Difference between Antemortem and postmortem lacerated wound

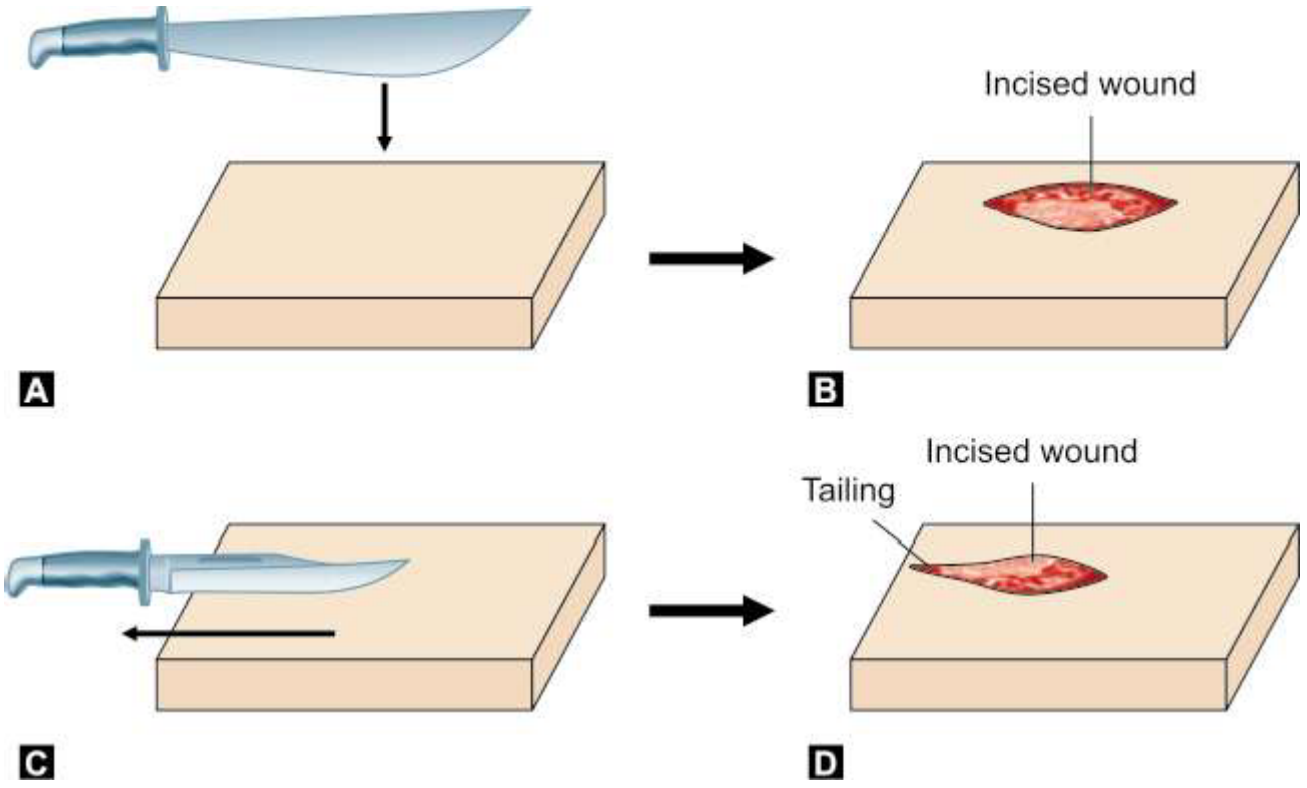
	Antemortem	Postmortem
Extravasation of blood	Present	Absent
Coagulation of blood	Present	Absent
Increase enzyme activity	Present	Absent
Signs of healing	Present	Absent
Pus/infection	Present	Absent

INCISED WOUND(Slash, cut)

An incised wound *is the wound caused by drawing or striking the edge of sharp object on the skin and underlying tissues.*

	Lacerated wound	**Incised wound**
Edges	Lacerated, irregular, ragged	Clean cut
Bruising of margins	Present	No bruising
Injury to blood vessels, nerves	crushed	Clean cut
Hair bulbs	Crushed	Clean cut
Bleeding	Less	More
Underlying bone	No sharp injury	Sharp linear injury

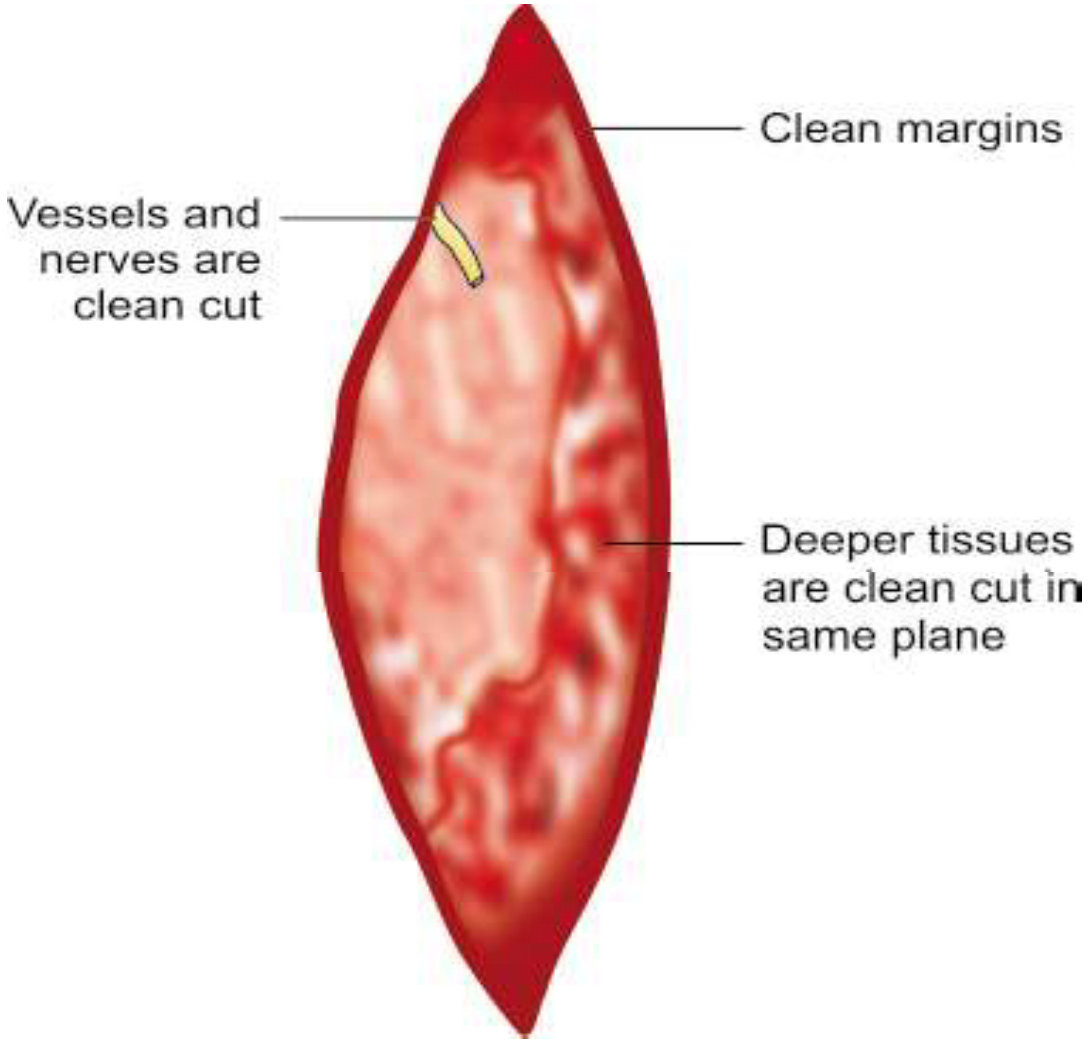
Mechanism of incised wound production. **A and B :** Incised wound produced by striking force **C and D:** Incised wound produced by drawing the weapon



Features of incised wound

- Incised wounds are always broader than the edge of the weapon causing it because of retraction of the divided tissues
- Often, it is somewhat spindle-shaped and gaping but may be zigzag if the skin is lax(corrugated) like skin of scrotum or axilla.
- The length of incised wound is greater than the breadth or depth of wound(DD of stab wounds).
- Margins – margins of incised wounds are clean-cut, well defined. Mostly the margins are everted but may be inverted in some, especially if thin layers of muscle fibers are closely attached to the skin as in scrotum.
- Deeper tissues are all cut cleanly in the same plane.
- The length of incised wound has no relation to the length of the cutting edge of the weapon.

- Features of incised wound



• If incised wounds are inflicted on body areas with loose skin, as in axilla, the wound appears irregular due to puckering of skin occurring at the time of cutting the tissue.

•Usually, the starting end of incised wound is deeper than end part because the wound gradually becomes shallower and may ends in a "**tailing**" or scratch tailing. The tailing off of an incised wound indicates the direction in which the weapon was drawn off.

• Hemorrhage in case of incised wound is more in comparison

with lacerated wound because the blood vessels are cleanly cut. The clean-cut ends are not effectively retracted and bleed considerably.

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.

Self-Inflicted Wounds

Also called fabricated wounds or sympathy wounds

- These injuries are on the accessible part of the body.
- They are usually superficial or minor.
- They are regular.
- Similar in style or shape.
- Multiple.
- Parallel or grouped together.
- Handedness – in right-handed person, injuries are predominantly on the left side and for left handed person; the injuries are inflicted on right part of body.
- Old scars of previous attempt of self-infliction may be noted.
- There may be any underlying psychiatric disorder.

Defense Wounds

- Defense wounds are the injuries inflicted to a person when he tries to defend himself against an attack.
- The person may ward-off the weapon or trying to catch or grabbing the weapon – cuts the palm and ulnar aspect of hand.
- To protect the exposed surface of body, the upper limbs– extensor surface of forearms (ulnar side), the lateral/posterior aspect of arm and dorsum of hand may receive injuries.
- Similarly the anterior and posterior aspects of lower limbs and back may be injured when an individual(curls into a ball) with flexion of spine, knees and hips to protect the anterior part of body.

CHOP WOUND

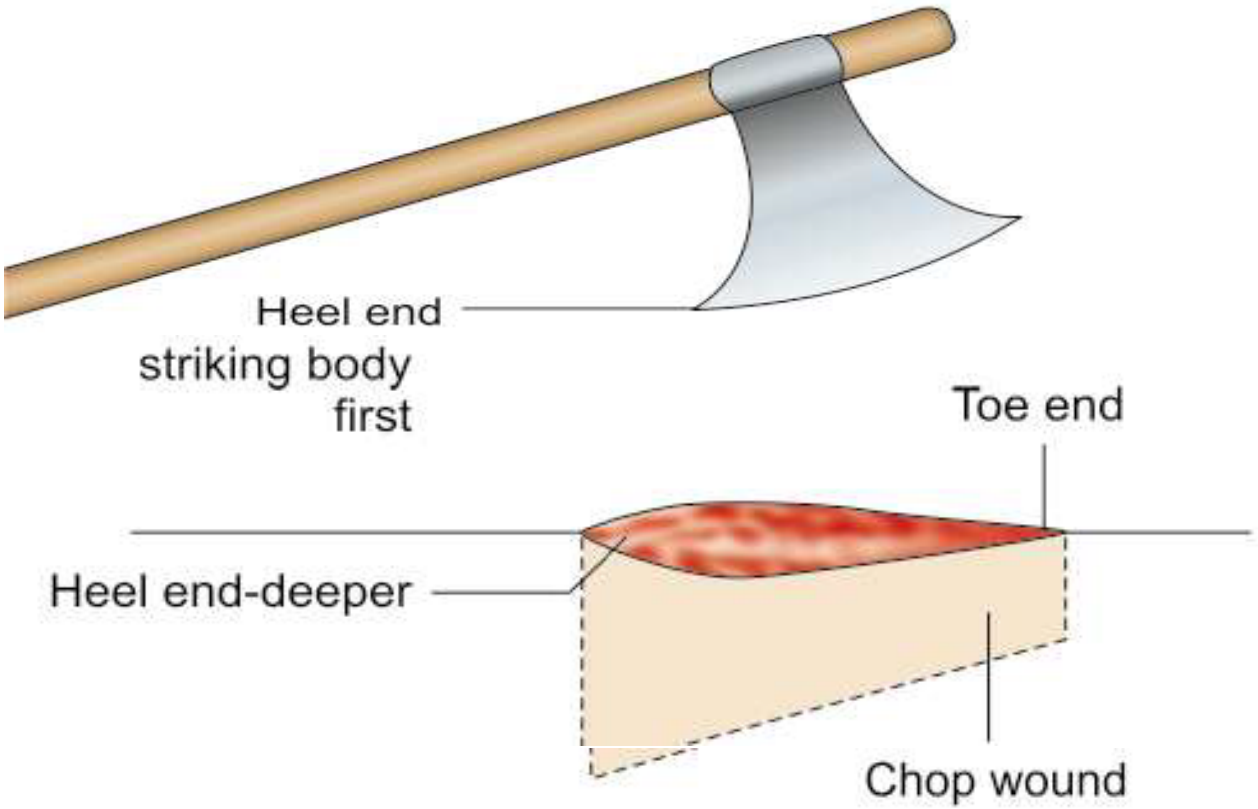
- **Definition**

Chop wounds are type of incised wounds made by hacking or chopping motion with a fairly sharp and relatively heavy weapon such as axe.

Features

- Chop wounds are produced by relatively heavy sharp cutting weapons such as axe, chopper, sword.
- The edges of chop wounds are not so sharp compared to incised wound and often the margin shows bruising or abrasion.
- The weight of weapon act as strong force to penetrate the weapon into tissues considerably
- The wound is comparatively wider and deeper than incised wound
- If the wound is inflicted obliquely, margin may show beveling
- Two parts in the chop wounds may be identified. The part of wound nearer to the assailant, known as ***heel end of the chop***, is deeper than distal part from the assailant– known as ***toe end of the chop***. Thus identification of toe and heel end of the wound may offer help to know the relative position of the assailant and the victim.

- Features of chop wound



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)

Stab wound is a piercing wound produced by application of mechanical force along the long axis of a narrow or pointed object.

Classification:

A. Based on Depth of wound;

1. Penetrating wounds

2. Perforating wounds

B. Based on the Causative Weapon;

1. Incised stab wounds – caused by sharp edged, pointed weapons:

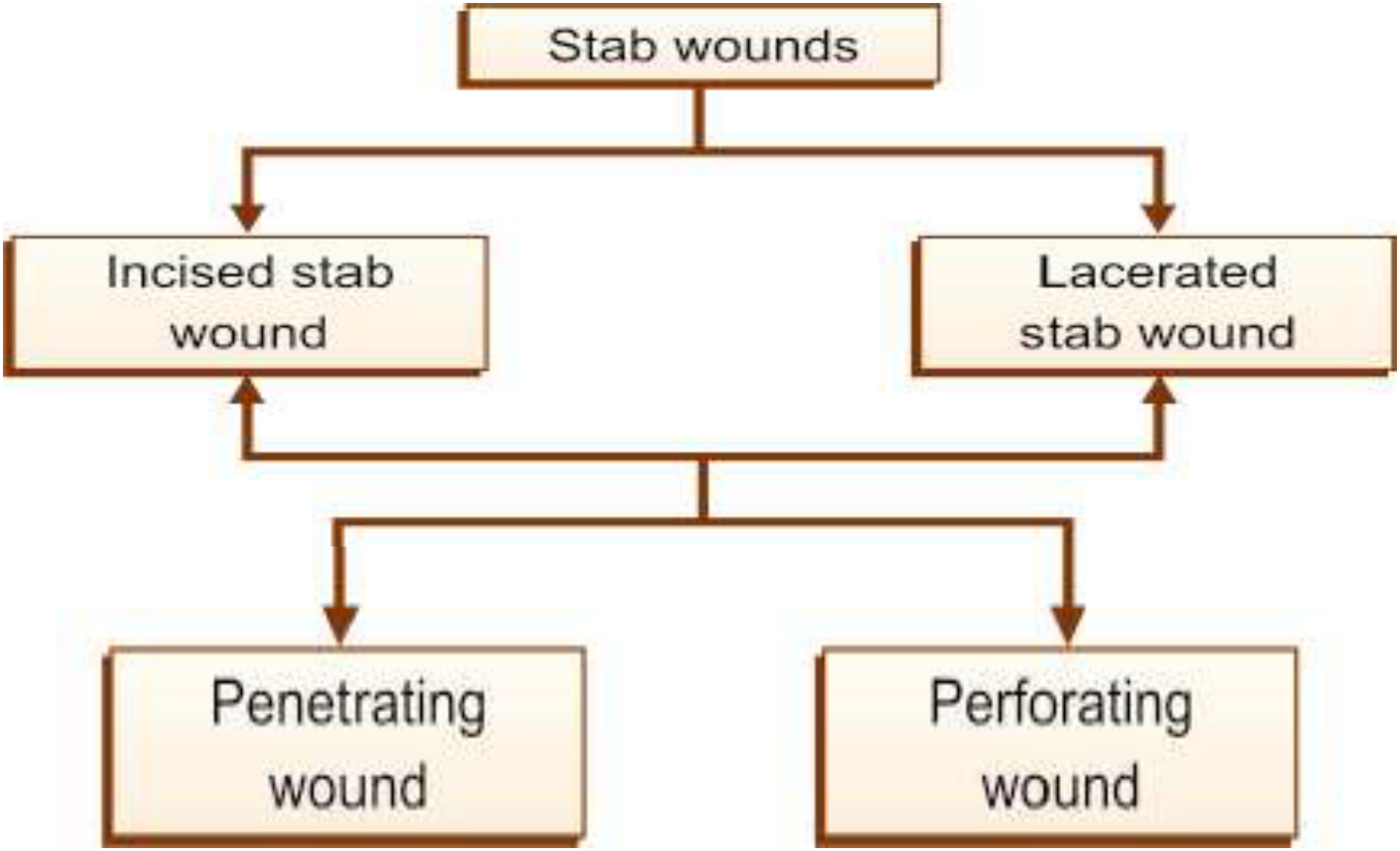
- Penetrating wounds
- Perforating wounds

2. Lacerated stab wounds – caused by not so-sharp weapons or relatively blunt penetrating weapons, such as garden fork:

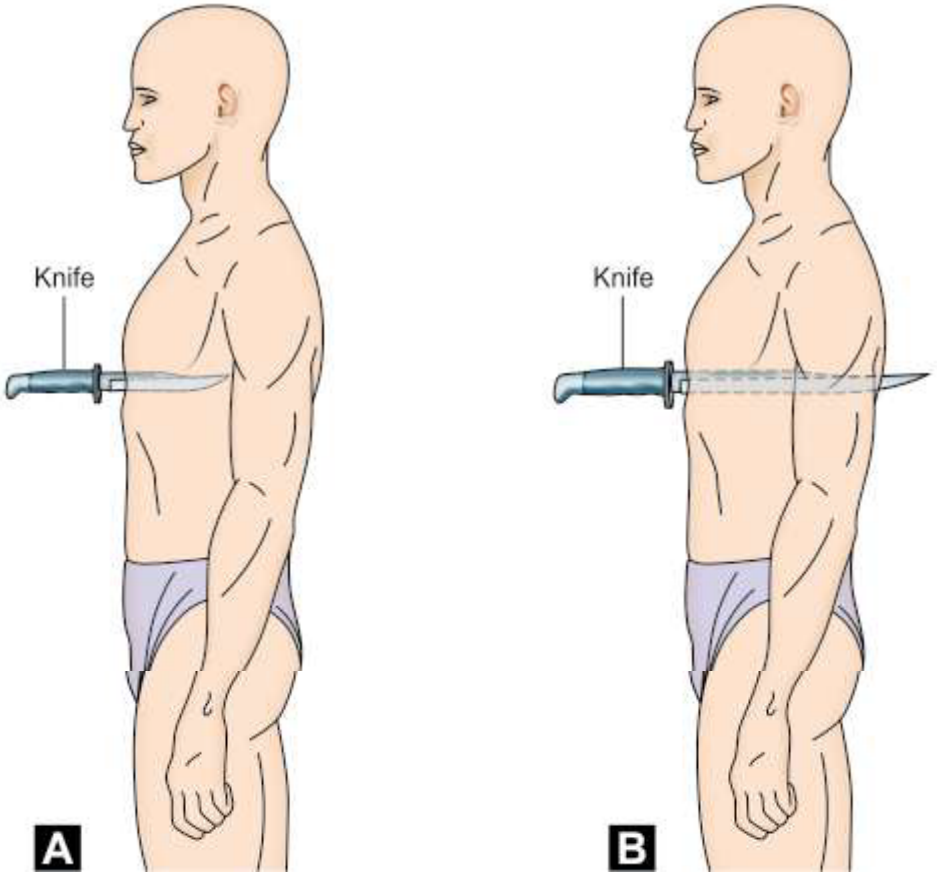
– Penetrating wounds

– Perforating wounds

- Classification of stab injuries



- **Stab wound. A: Penetrating wound. B: Perforating wound**



Penetrating Wounds:

- These are the stab wounds that terminate in the tissue/organ/cavity.
- In these wounds, only one surface wound is present on body due to entry of blade and no exit wound as the stab terminates in the tissues/organ/cavity.

Perforating Wounds:

- These are the stab wounds that are passing the body through-and-through.
- In these wounds, two separate surface wounds will be observed over body; one caused by the entry of weapon (entry wound) and another caused by the exit of the weapon (exit wound).
- Entry wound is usually larger than the exit wound because the weapon tapers towards the tip.
- The edges of entry wound are usually inverted while in case of exit wounds, the edges are everted.
- Foreign bodies such as cloth fabric/hairs etc. may be found in tract or near entry wound. The clothes may be pushed in the entry wound.
- Joining the entry and exit wound gives direction of infliction of injury.

1. Type of weapon used and the shape of wound :

– The type of weapon usually means the type of blade and it includes whether it is sharp cutting or blunt edge? Whether it is single edged weapon or double edged weapon? If single edged, what is the back edge? Whether it is serrated or squared-off? Whether the blade tapers from hilt to tip?

– Commonly knife is used to inflict stab wounds, Most of the knives have a single sharp edge and other edge being blunt or modified. Such weapon may produce wedge shaped stab wound with one end of the stab appear sharply cut like “V” point and other blunt. The sharp angle represents injury caused by sharp edge of blade and blunt angle by blunt edge of weapon. If such pattern of injury is visible, a medical examiner can say that a single edge weapon was used.

In some weapons, one edge is sharp throughout and other edge is made sharp only at distal part near the tip of the blade. When such weapon is used, the initial part of blade being sharp on both edges pierces the skin and as weapon advances in the body, the skin often splits behind the blunt edge to produce a symmetrical appearance.

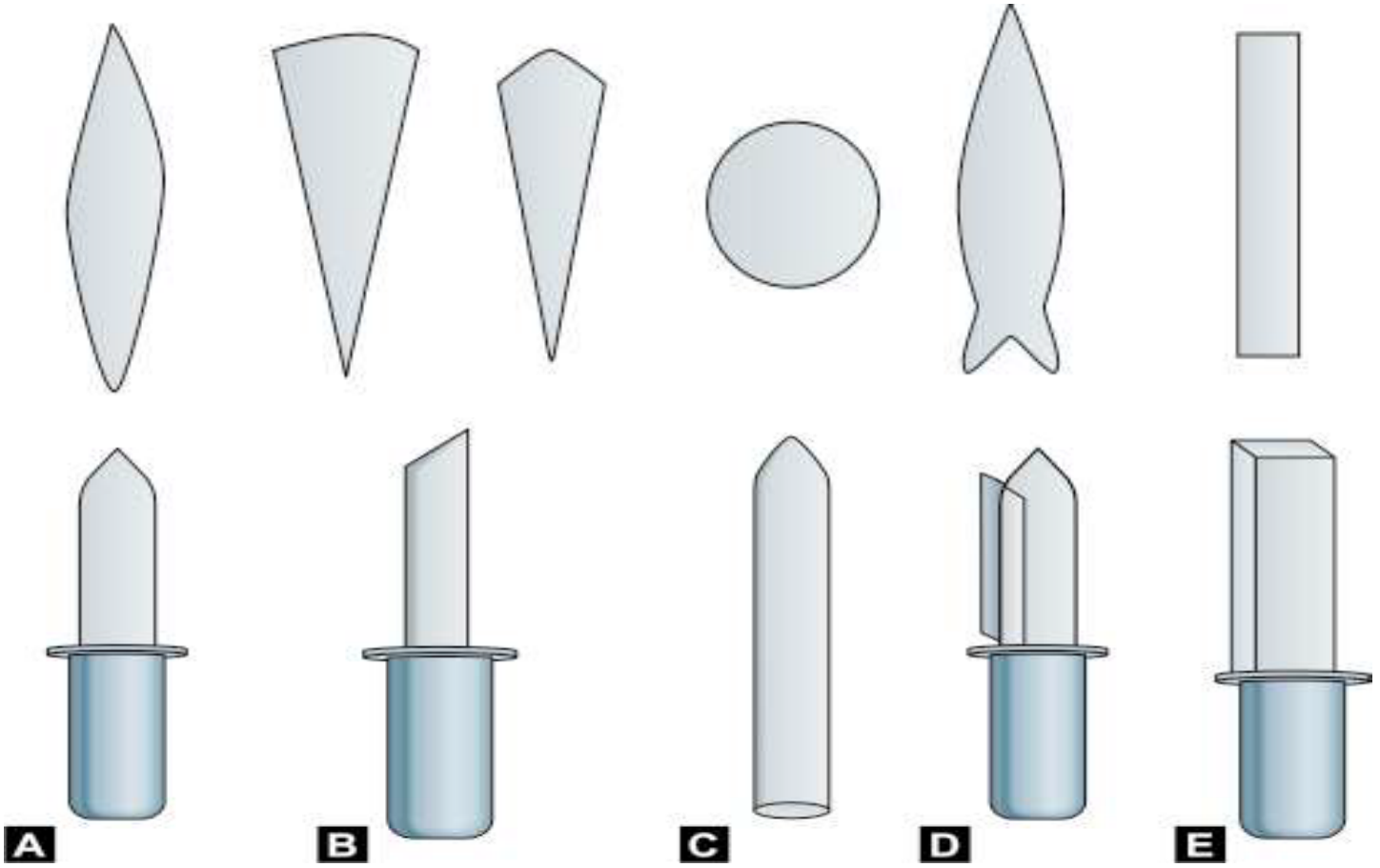
– When one edge of weapon is sharp and other edge is made squared or flat, such weapon may split back slightly from each corner of the angle, produced by non-sharp edge of weapon, forming the so called "**fish-tail appearance**".

– If one edge of a weapon is sharp and other edge is serrated, the angle produced by serrated edge may be torn in appearance and, when weapon is thrust obliquely, may leave serrated abrasions on the skin adjacent to the end of wound.

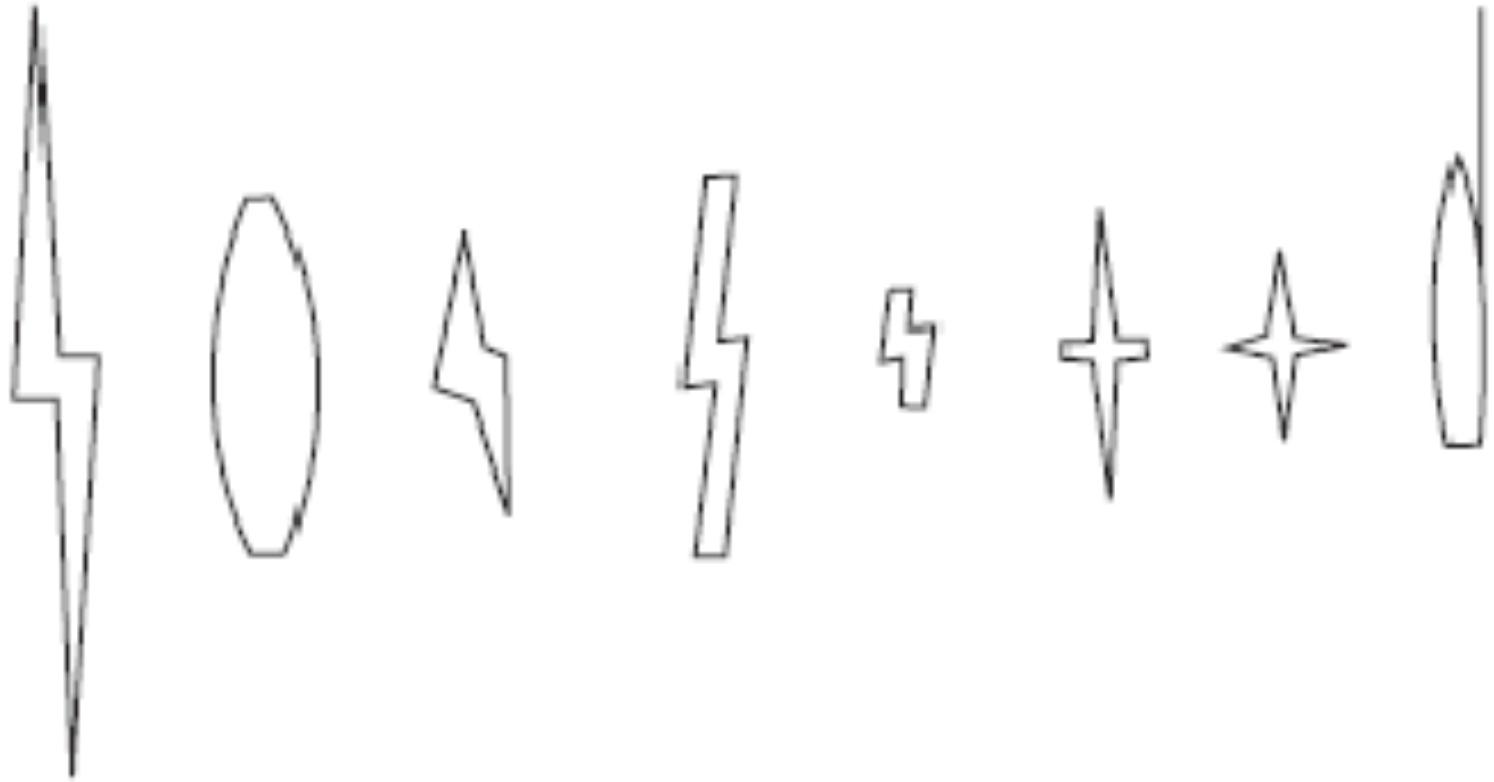
– If the weapon has a hilt and is propelled into full extent of the blade in the body, then there may be a hilt contusion or abrasion on the skin surrounding the wound. Presence of such hilt abrasion or contusion indicates that blade of weapon was pushed completely in the body and indicates force used for stabbing.

– External appearance of the wound may vary and resemble the cross-section of the weapon or blade of the weapon. Therefore, a stab wound may have spindle shape or elliptical appearance or fish-tail appearance or ovoid or rounded or may be notched if accompanied by rocking.

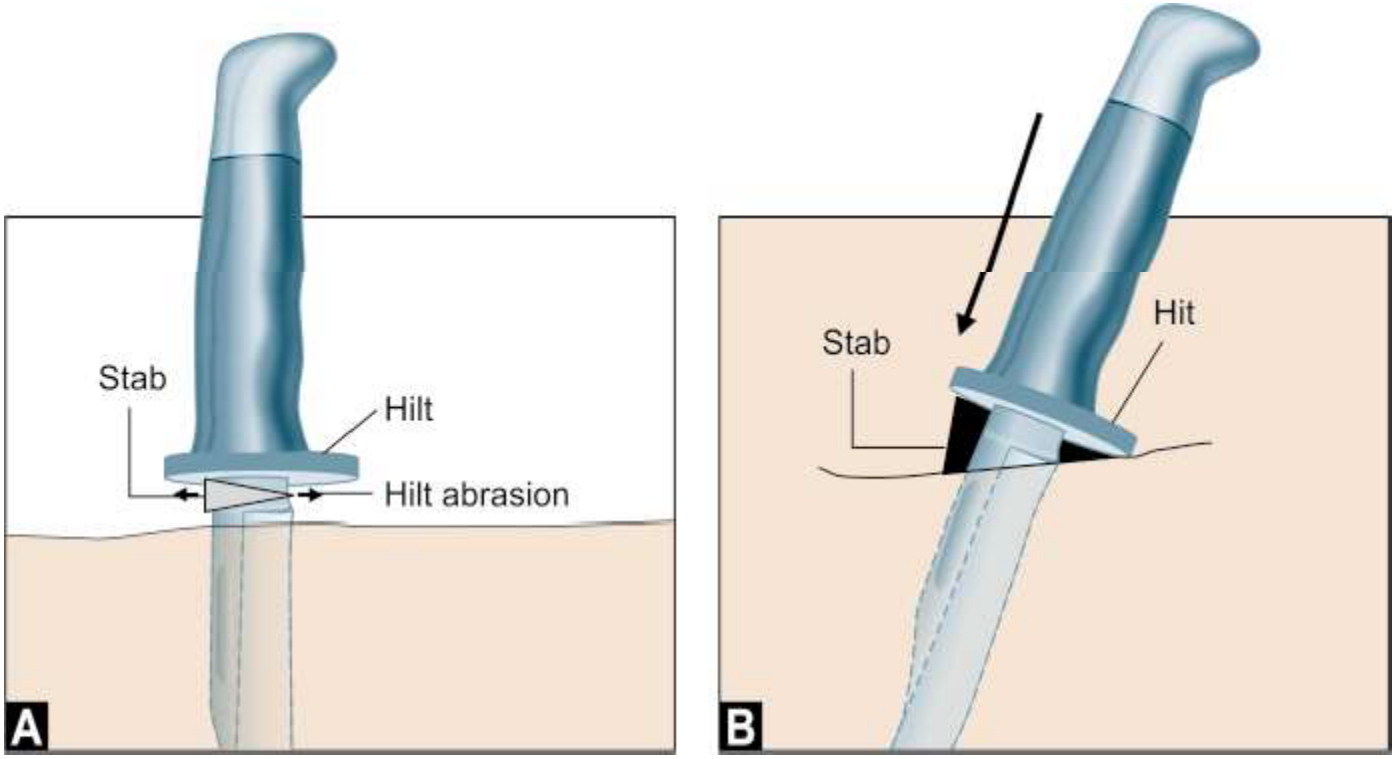
Stab wound. **A:** Stab wound caused by blade with both edges sharp resulting in spindle shaped. **B:** Wedge shaped wound or tear drop wound if one edge of blade is sharp and other is blunt. **C:** Round shape wound resulting from round object.**D:** fishtail appearance of wound resulting from weapon with one edge sharp and other edge square-off. **E:** Rectangular shape or slit like wound that is caused due to rectangular object.



What about scissor injury??



Stab wound with hilt abrasion. **A:** Weapon is penetrating skin perpendicularly and completely thus producing hilt abrasion around wound. **B:** Weapon is being thrust obliquely thus producing hilt impression on one side where hilt comes in contact



2. Depth and thrust

If, for example knife is used for stabbing and the knife is withdrawn along the same track then it will form a track inside the body and the measurements of wound will indicate the dimensions of weapon.

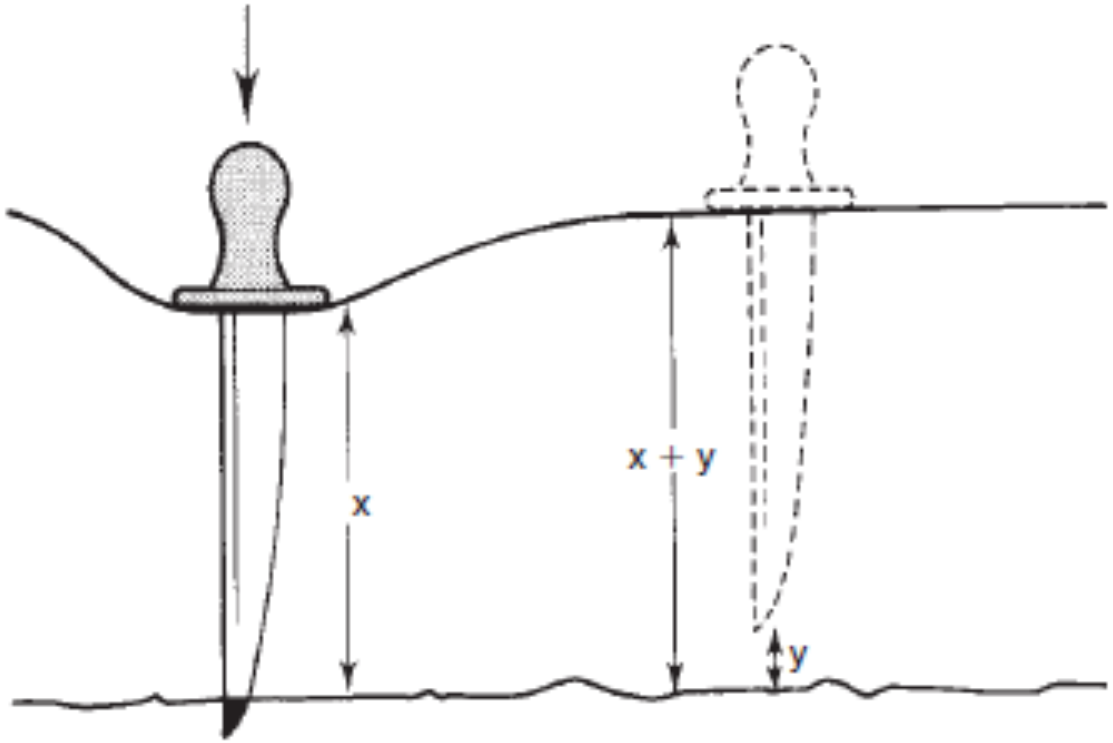
length of blade=depth of wound

Thus the depth of stab wound is important parameter to assess the length of weapon used.

When depth of wound > length of weapon ??

The depth measured at autopsy may be actually more than the length of blade of a weapon and this phenomenon is commonly encountered over body parts that are yielding or compressible such as abdomen, chest. Due to compression of body part, the tip of blade will penetrate more in depth. Now if same weapon is used to inflict on non-yielding part, for example head then blade would not penetrate deeper than its length.

Forcible stabbing can indent the body surface so that deep structures can be injured that appear to be beyond the reach of the knife.



3. Movement of weapon in the wound

- If, for example, knife is used for stabbing a person and the knife is withdrawn along the same track after inflicting the stab then the knife will form injury inside the body called as tract of stab wound.

Measurement of such track would indicate the dimension of the knife used to cause stab.

- if a person causes stab to another person with knife and he do not withdraw the knife along the same track but rotate the knife (rocking of weapon), then there will be greater wound defect.

The term “rocking” is used when the weapon is moved inside the wound with leverage or angulation in the plane of wound. Due to rocking, the cutting edge of weapon extends the wound. The rocking can be done by the assailant with active movement of weapon inside the wound or may be done by the victim due to body movement in relation to knife (weapon). In some cases, both mechanisms may act.

4. Direction of stab wound

– Direction depends upon the entry wound, the track and the exit wound if present. Careful dissection of the body in layers would reveal the track of the wound.

With advancement in imaging techniques, attempts had been made to view the direction of wound by filling the wound defect with radio-opaque dye and X-ray films taken. However, these radio-opaque substances often exhibit leaks making more difficult to access the track. In similar manner, magnetic resonance imaging (MRI Scan) has been attempted.

5. Pattern of stab injuries

– If the weapon used for stabbing, enters the skin obliquely, the edge of the wound that first cut the skin becomes *beveled* while the other edge *overhangs* the wound.

6. Dimension of wound

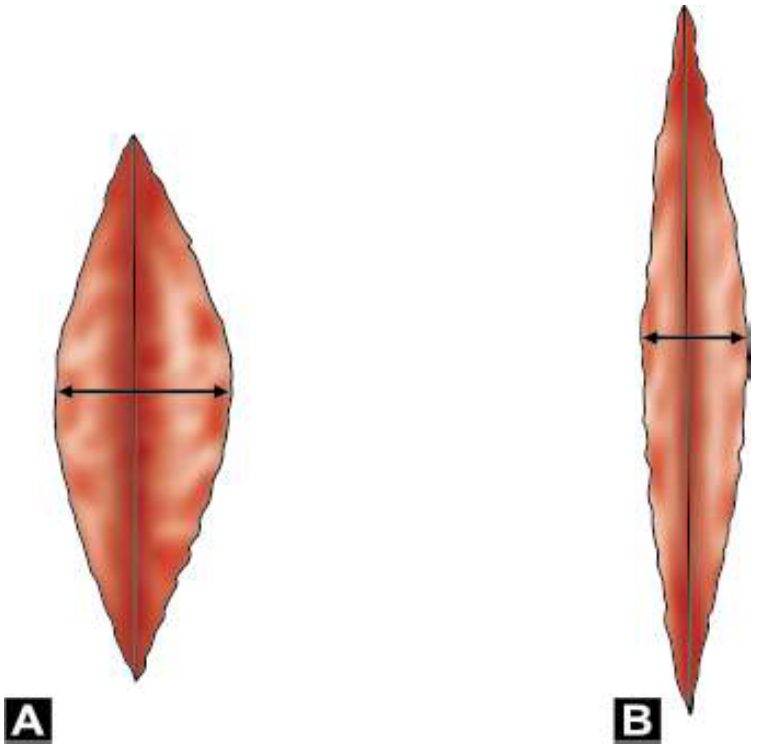
– Length of stab wound is usually corresponds with that of breadth of blade, but when the length of Wound is shorter in measurement than actual breadth of blade ,this shortening of wound is due to elasticity of skin, gaping of wound and contraction or postmortem shortening of underlying muscles, especially when the muscle fibers are cut across.

– Depth of stab wound is more than length and width.

- Important point for length and width depends on wheather the axis passing through a muscle/elastic tissue or not :

A: Stab wound appears short and wide because the long axis of wound is at across to muscle fibers or elastic tissue of skin.

B: The wound is parallel to muscle or skin plane and thus it appears narrow and long



A stab wound and the inflicting knife. The wound is slightly shorter than the width of the blade at the depth of penetration because of sideways gaping and the contractile elasticity of the skin…

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

Breach in the continuity of bone due to application of mechanical force or other traumatic agent is called as fracture. The force applied to bone may be direct or may be indirect.

A. Based on etiology

1. Traumatic fracture – fracture resulting from application of mechanical force

2. Pathological fracture – due to some pathology or disease, the bone is weak.

B. Based on displacements

1. Un-displaced

2. Displaced

C. With relation to skin and external environment

1. Simple fracture – the overlying skin and tissues are intact

2. Compound fracture or open fracture – here the overlying skin and tissues are torn and communicating with the exterior

D. Based on pattern of fracture

1. Transverse fracture
2. Spiral fracture
3. Oblique fracture
4. Segmental fracture
5. Comminuted fracture

E. Direct fracture

1. Focal fracture
2. Crush fracture
3. Penetrating fracture

F. Indirect fracture

1. Traction fracture
2. Angulation fracture
3. Rotational fracture
4. Vertical compression fracture
5. Angulation-compression fracture

Complication of Fracture

Early complications

1. • Shock
2. • Injury to vessels, muscles, tendons
3. • Injury to joints
4. • ARDS
5. • Fat embolism
6. • Deep vein thrombosis
7. • Pulmonary embolism
8. • Compartment syndrome
9. • Crush syndrome
10. • Aseptic traumatic fever

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