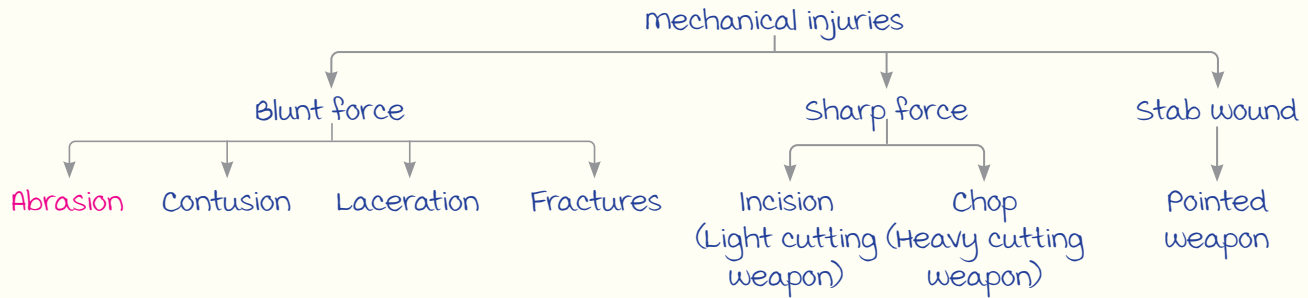


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TRAUMATOLOGY : MECHANICAL AND REGIONAL INJURIES

----- Active space -----



Abrasion

00:01:04

- medicolegally important.
- Injury to partial epidermis → No scarring/bleeding.

Types of Abrasion :

Caused by tangential force

Scratch abrasion : Injury with pin, fingernail, thorn.



Grazed abrasion/Gravel rash/Sliding abrasion :

- D/t friction b/w skin & rough surface.
- m/c abrasion : A/w RTA.



Caused by perpendicular force

Pressure abrasion :

- D/t sustained pressure.
- Eg : Ligature mark.



Imprint/impact abrasion :

- D/t momentary impact.
- Eg : Recoil abrasion, whip mark.

Patterned abrasion :
Either pressure or imprint abrasion displays the pattern of the weapon.

----- Active space -----

Epithelial Tag :

- Epithelium is scraped off & heaped.
- Indicates tail end of the abrasion.
- Determines **direction** of force.

Aging of Abrasion :Based on color of scab : mnemonic **R³B³**.

- **Raw** : <12 hours.
- **Reddish** : >12 hours.
- **Reddish brown** : 2 - 3 days.
- **Brown** : 4 - 5 days.
- **Black** : 6 - 7 days.

Antemortem v/s Postmortem Abrasion :

	Antemortem abrasion	Postmortem abrasion
Site	Anywhere on body	Bony prominence
Colour	Red	Pale
vital reaction	⊕	⊖

Diagnosis Based On Type Of Abrasion :

- Smothering : Nail abrasions + perioral injuries.
- Throttling : Crescentic nail marks.
- RTA : multiple graze abrasions.
- Sexual assault : Abrasions on inner thigh/genitalia.

Contusion/Bruise

00:09:19

Features :

- Seen in blunt force trauma.
- **Ill defined margins** of wound.
- **Extravasation** of blood in dermis.

Note : **Hypostasis** → well defined margins.

Contusion

Types of Contusions :

1. Intra-dermal bruise (Superficial).
2. Deep bruise (AKA come-out bruise) : Delayed appearance.
3. Ectopic bruise (migratory/percolated bruise) : Away from the impact site.
4. Patterned bruise : Shows the pattern of striking surface of weapon.

Examples of ectopic bruise :

1. Raccoon eye/black eye/panda eye sign.
2. **Battle sign** : Ecchymosis in mastoid region d/t fracture of **middle cranial fossa**.



Raccoon eye sign



Battle sign

Examples of patterned bruise :

1. Six penny bruise :
 - Coin shaped bruise d/t pressure of finger tips on the skin.
 - Seen in : Throttling, child abuse.
2. Butterfly bruise : Seen in child abuse d/t pinching.
3. Tramline/Railway line bruise : D/t blow with a rod/lathi/stick.

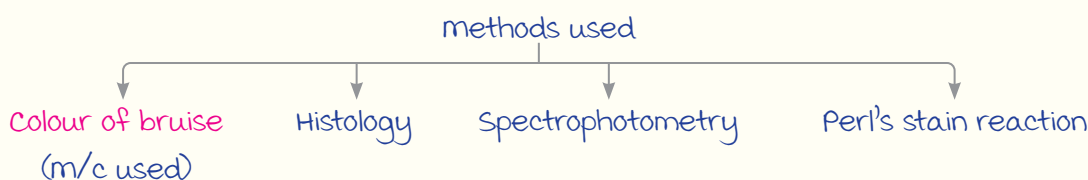
True Bruise v/s Artificial Bruise :

	True bruise	Artificial bruise
Cause	Trauma	Irritant plant extract (Plumbago, Semicarpus, Calotropis)
Site	Anywhere on body	Accessible parts of body
Colour change during healing	Present	Absent
margins	Irregular	Regular
Vesication/blisters	Absent	Present (D/t inflammatory reaction)
Content	Blood	Inflammatory fluid → Acrid serum
Itching	Absent	Present

Factors Affecting Bruising :



Aging of Contusion :


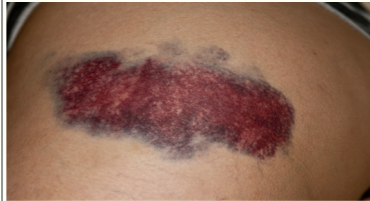


----- Active space ----- Colour of the bruise :

Ageing of bruise by color		
Type of hemoglobin	Color	Age of bruise
Oxyhemoglobin	Red	Fresh
Deoxyhemoglobin	Blue	Few hrs to 3 days
Hemosiderin	Brown	4 days
Biliverdin	Green	5-6 days
Bilirubin	Yellow	7-12 days

- multiple bruises of different colour → Sign of child abuse.
- Bruise with no colour changes :
 - Subconjunctival hemorrhage.
 - Chronic subdural hematoma.



Livor mortis vs. Bruise :

	Livor mortis (Hypostasis)	Contusion
Site	Dependent parts	Can occur anywhere on body
margins	Regular	Irregular
Blanching	Present	Absent
Extravasation of blood	Absent	Present
Colour changes	Absent	Present
Appearance		

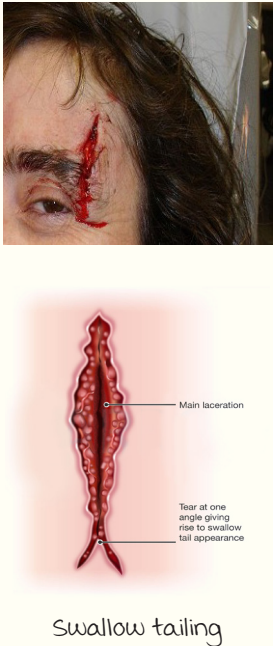
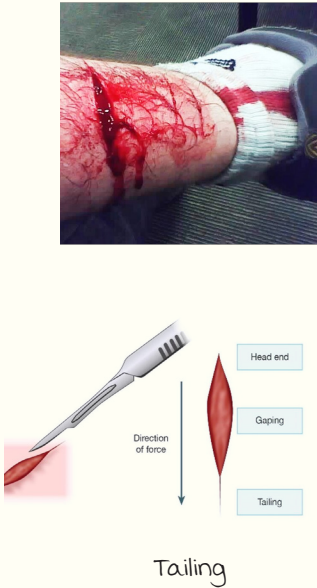
Lacerations & Special Types of Wounds

00:23:56

Laceration vs. Incision :

	Laceration (Tear)	Incision (Cut)
margins	Irregular	Clean cut
Feature	Swallow tails	Tailing (Direction of force can be assessed)
Tissue bridges	⊕	⊖
Floor (Hair bulb, vessels)	Crushed	Cut (↑ bleeding due to cut vessels)
Bleeding	Less	Profuse
Images		

----- Active space -----

	Laceration (Tear)	Incision (Cut)
Images		

Stab Wound :



- Produced by any weapon with a pointed end.
- maximum dimension : Depth.



Note :

maximum dimension of incised wound : Length.

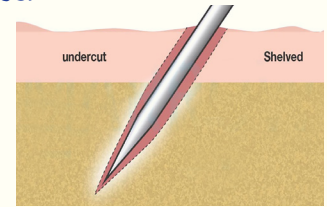
Type of weapon based on shape of stab wound :

Shape of wound	<ul style="list-style-type: none"> • Wedge/Triangle shape • Fish tailing 	Oval spindle shape
Weapon	Single edge knife	Double edge knife
Image		 <p>Hilt mark :</p> <ul style="list-style-type: none"> • Seen in : Complete penetration. • Helps determine : <ul style="list-style-type: none"> - Direction of force. - Type of weapon. - Age of the wound.

----- Active space -----

Bevelling :

- Blade enters obliquely into the skin → undermined edges.
- Indicates **homicide**.



Types of Lacerations :

Split laceration :

- AKA **incised looking laceration**.
- mechanism : Skin crushed b/w two hard objects i.e. **bony prominence**.



Split laceration : Skull

Avulsion laceration :

- Shearing force (Tangential) : Separation of skin from deeper tissues : **Flaying**.
- Eg : Degloving injury, scalping injury.



Degloving injury

Tear lacerations : Caused by semi-sharp objects.

Stretch lacerations : D/t overstretching of skin.

Lacerated looking incision : Seen in areas with skin folds (Scrotum, axilla).

Hesitation cuts :

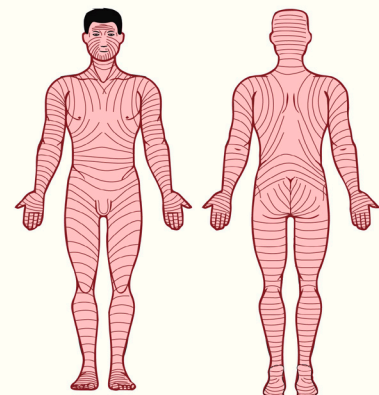
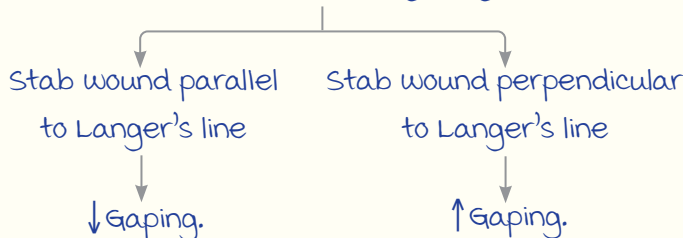
- AKA Tentative cut/intentional cut/feeler's strokes/trial cuts.
- multiple, superficial, linear cuts.
- Site : Accessible parts of the body.
- Indicates suicidal attempt.



Hesitation cuts

Cleavage lines/Langer's line :

- Represent the arrangement of collagen fibers.
- Determine the extent of gaping.



Hara-kiri/Seppuku :

- Suicidal stab wound of the abdomen.
- Cause of death : **Evisceration** → Circulatory collapse.

----- Active space -----



Hara-kiri

Chop Wounds :

- Deep gaping wound caused by heavy sharp weapon.
- margins : Regular with adjacent bruising.
- Floor : Crushing + fracture of bone.
- usually suggestive of homicide > suicide or accidental.



Heavy sharp weapon



Chop wound : Cut fracture

Defence Cuts :

- Indicates homicide.
- Types :

Active :

m/c seen at palm (1st web space).



Passive :

m/c seen at ulnar margin of forearm.



Note : Defence wounds not mandatorily seen in all cases of murder.

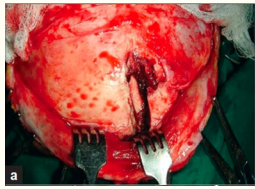
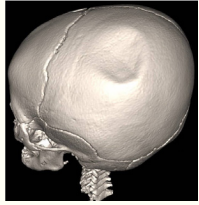
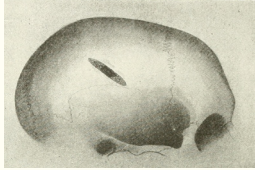
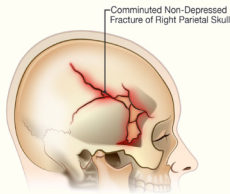
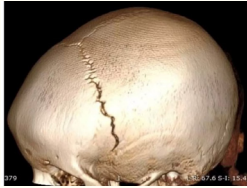
Regional Injuries

00:43:00

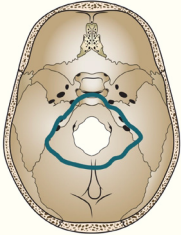
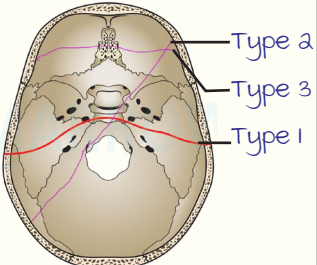
Skull vault Fractures :

Fracture	Image
Fissure fracture (Linear crack) : <ul style="list-style-type: none"> • m/c type of skull fracture. • Caused d/t weapon with broad striking surface. 	

----- Active space -----

Features	Image
<p>Depressed fracture :</p> <ul style="list-style-type: none"> Caused due to weapon with smaller striking surface (Hammer). Also known as signature fracture (Weapon can be identified). 	
<p>Pond fracture :</p> <ul style="list-style-type: none"> Variant of depressed fracture. Also known as indented fracture/ping pong fracture. Seen in infants (Elastic bones) born out of obstetric delivery. 	
<p>Gutter fracture :</p> <ul style="list-style-type: none"> Associated with oblique bullet/glancing bullet. 	
<p>Comminuted fracture :</p> <ul style="list-style-type: none"> multiple fractured segments due to multiple blows to the skull. 	
<p>Diastatic fracture :</p> <ul style="list-style-type: none"> AKA sutural fractures as the fracture line is along the sutures of the skull. Seen in young adults. 	

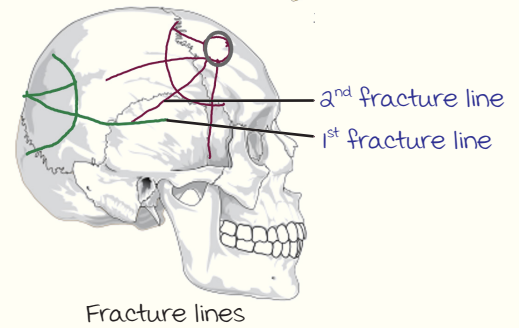
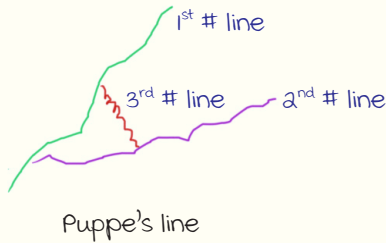
Skull Base Fractures :

Type	weapon/mechanism	Characteristics
<p>Ring fracture</p> 	<ol style="list-style-type: none"> Fall from height : <ul style="list-style-type: none"> Lands on feet. Impact : <ul style="list-style-type: none"> Legs → vertebral column. Legs → Base of skull. Lands on buttock. Impact : Indirect force to base of skull. Heavy weight on the head. 	<ul style="list-style-type: none"> Fracture in base of skull : Around foramen magnum (Size : 3-5 cm). Fracture in posterior cranial fossa.
<p>Hinge fracture</p> 	<p>Type I : Sideway impact in middle cranial fossa.</p>	<ul style="list-style-type: none"> Fracture lines reach opposite side through sella turcica (Through middle cranial fossa). AKA motorcyclist fracture.

Puppe's Rule :

- The new fracture line will never cross previous fracture line.
- Sequencing the fracture lines due to blows.

----- Active space -----

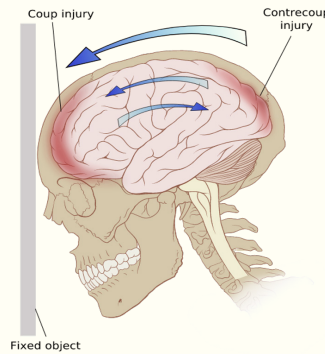


Coup & Contrecoup Injuries :

Coup : Injury at site of impact.

Contrecoup :

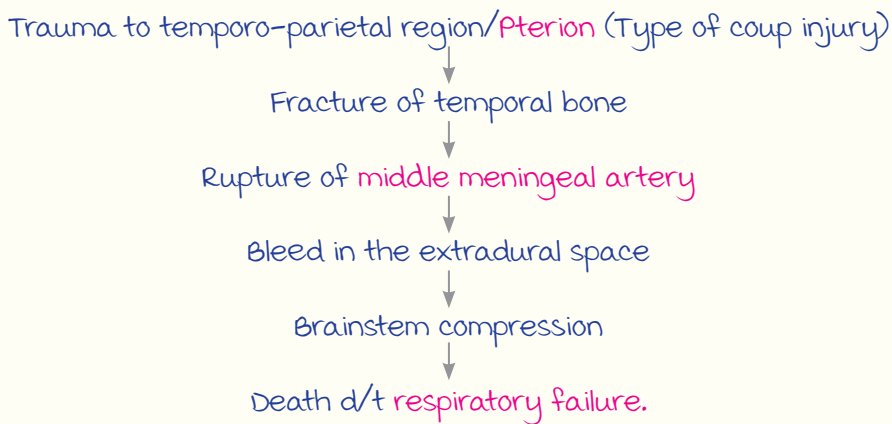
- Injury opposite to site of impact OR C/L surface of I/L lobe.
- m/c site : Occipital impact → Frontal lobe contusion.



Intracranial Hemorrhage

00:51:15

Extradural Hemorrhage (EDH) :



Subdural Hemorrhage (SDH) :

Risk factor : mnemonic ABC.

- Aged person with minor trauma.
- Boxers.
- Child abuse (Shaken baby syndrome).

Subarachnoid Hemorrhage (SAH) :

Causes : mnemonic BATS.

- Berry aneurysm rupture.
- AV malformation rupture.
- Trauma.
- Stroke.

----- Active space -----

Source of bleed :

Type of intracranial hemorrhage	Source of bleed
Extradural hemorrhage	middle meningeal artery
Subdural hemorrhage	Bridging veins/dural venous sinuses
Subarachnoid hemorrhage	Arteries (Circle of Willis)

Imaging :

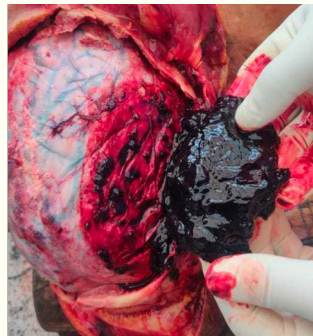
EDH : Biconvex opacity



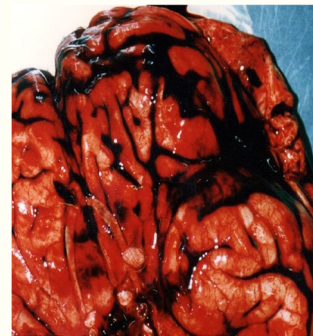
SDH : Crescentic opacity



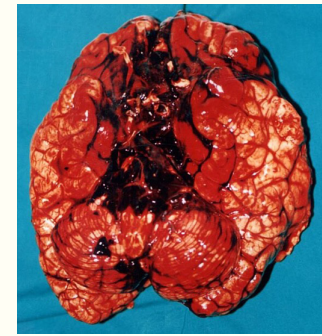
SAH

Autopsy Findings :

EDH



SDH : Clearing of hemorrhage after pouring water



SAH : Hemorrhage remains intact after pouring water

Lucid Interval :

- Period of consciousness b/w 2 periods of unconsciousness.
- Seen in EDH > SDH.

medicolegal importance :

- Patient can provide valid evidence, will & is criminally liable.
- Death d/t failure in diagnosing lucid interval : medical negligence.

↓
Punishable under 106(D) BNS.

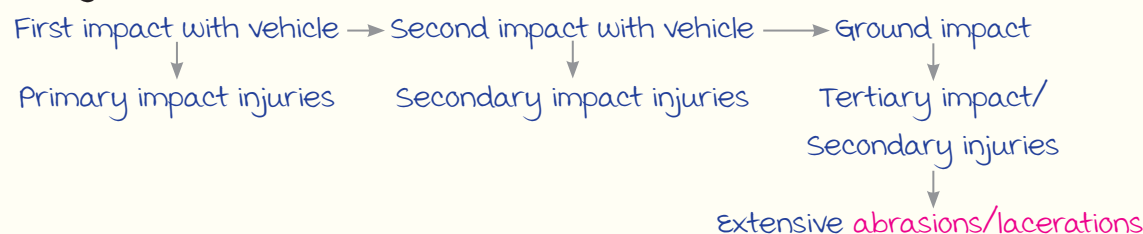
TRAUMATOLOGY : THERMAL INJURIES & MISCELLANEOUS

----- Active space -----

Transportation Injuries

00:00:05

Injury to Pedestrians :



Bumper injuries : Seen in primary impact injury.

- Abrasion.
- Contusion.
- Laceration.
- Bumper fracture :
 - m/c lateral condyle of tibia.
 - Helps determine direction of force.

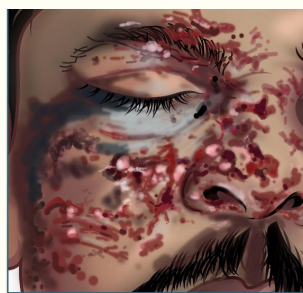
Injury to Vehicle Occupants :

S. No	Impact	Injuries
1.	Windshield	Sparrow foot injuries : multiple cut lacerations to exposed body part d/t broken glass.
2.	Whiplash	Hyperextension f/b flexion (more dangerous) or vice-versa.
3.	Steering wheel	<ul style="list-style-type: none"> • Patterned bruise. • Fractures (Sternum). • Aortic injury (Ladder-rung tears).
4.	Seat belt	<ul style="list-style-type: none"> • Seat belt bruise. • Organ injury : mesentery > Small intestine. • Chance fracture : Transverse vertebral fracture (d/t sudden hyperflexion).
5.	Dashboard	Dashboard fracture : Posterior dislocation of hip.
6.	Car pedals (Clutch & accelerator)	Ankle fracture.

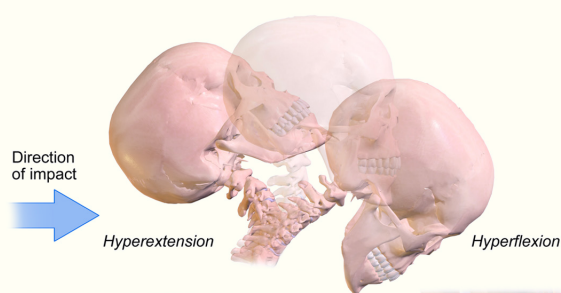
Injuries sustained by :

- Driver only
- Front seat passengers only
- Both

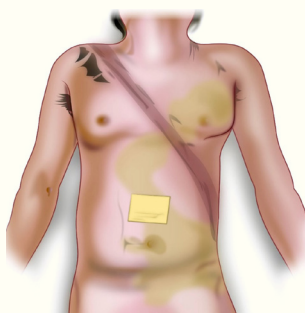
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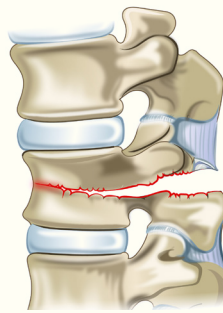
Sparrow foot mark injury



Whiplash injury



Seat belt bruise



mechanism of chance fracture



Thermal Injuries

00:06:10

	Cold injury	Heat injury
General effects	Hypothermia	Heat-related syndromes
Local effects	1. Dry cold : Frost bite 2. moist cold : Trench foot/immersion foot	1. Dry heat : Burns 2. moist heat : Scalds

Hypothermia :

- Body core temperature $<35^{\circ}\text{C}$.
- Commonly affects elderly, newborns, alcoholics, hypothyroid patients.
- $<30^{\circ}\text{C}$ → Hypothalamus stops functioning.

Classification :

- mild : $35-32^{\circ}\text{C}$.
- moderate : →
 - Shivering stops (Hypothalamus not functioning).
 - Reflexes are low.
 - J waves in ECG.
- Severe : → $<28^{\circ}\text{C}$
 - Paradoxical undressing (kills the patient & can mimic sexual offense).
 - Hide & die syndrome/terminal burrowing.



Trench foot

Autopsy findings :

- White deaths.
- Pink hypostasis.
- Wischniewski's bleeding spot in stomach.

Note : Pink hypostasis also seen in refrigerated body.

Frost Bite :

D/t exposure to freezing temperature.

Site : Periphery (Finger, feet, tip of nose/ear lobes).

Progression : Pallor → Erythema/blisters → Gangrene.

Rx : Rewarming at 40°C.



Frost bite

----- Active space -----

Heat Related Syndromes :

	Pathology & C/F	Thermo regulation	Core body temperature
Heat cramps	Sweating causes loss of sodium → muscle cramps.	Intact.	Normal.
Heat syncope	Loss of sodium and water → Cerebral hypoperfusion → Hypotension & syncope.		
Heat stroke	Features : 1. Core body temperature >40.5°C. 2. CNS dysfunction. 3. Clinical findings : - HR ↑. - BP ↓. - Pinpoint pupils ⊕. - Sweating usually absent. 4. Autopsy : Post mortem caloricity.	Impaired.	↑↑↑ (>40.5°C).

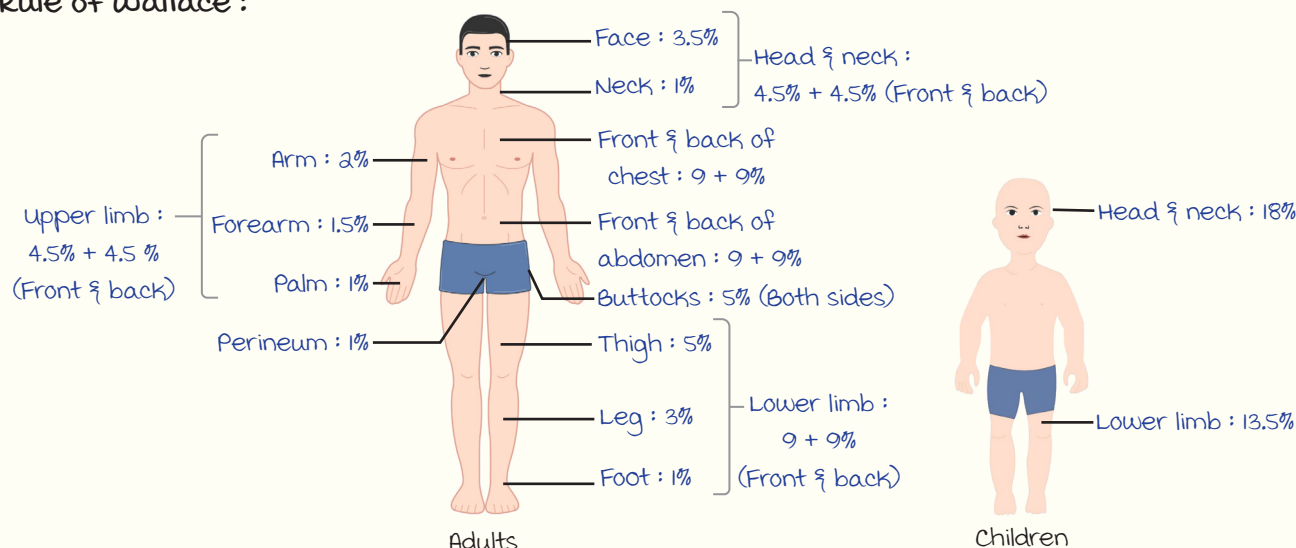
Burns

00:13:25

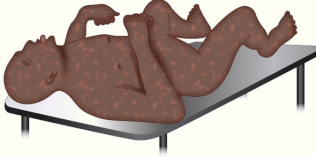


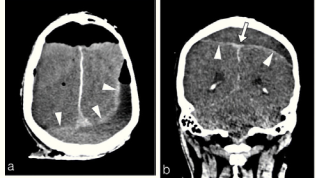
Estimation of burnt surface area :

1. Rule of Wallace/Rule of 9.
2. Lund & Browders chart : Best for children.
3. Rule of palm : Size of burnt area = Size of palm = Approximately 1%.

Rule of Wallace :



----- Active space ----- Autopsy Findings in Antemortem Burns :
Non-specific findings (Heat artefacts) :

	Pathogenesis	Features	Image
Heat stiffening	muscle exposed to heat $>65^{\circ}\text{C}$ ↓ Protein coagulation ↓ Stiffening	AKA Boxer's attitude/Pugilistic attitude/Fencer's attitude	
Heat rupture	Skin exposed to heat ↓ Cracking & splitting of skin	Difference from incised wound : • Large & irregular • Intact vessels & nerves ↓ Pale	
Heat hematoma	Blood clot in the extradural space	• Chocolate brown • Honey comb appearance	 
Heat fracture	Fracture of long bone/skull bones	Long bone fracture ↓ Street & avenue fracture	-

Specific signs :

External signs :

1. Crow feet sign : Features of antemortem burns.
2. Fluid in blisters.
3. Inflammation signs : Indicate healing.
4. Redness/redline/repair.
5. Enzymes ↑↑.

mnemonic :
FIRE.



Redness/Redline Fluid in blisters



Internal signs : 3 Cs

- Carbon deposition (Soot) in airway.
- ↑Cyanide & ↑CarboxyHb in blood (>10 g%).



----- Active space -----

Burns, scalds, chemical burns :

Carbon (Soot) deposition in airway

	Burns	Scalds	Chemical burns
Cause	Fire (Dry heat)	moist heat	Corrosive
Charring & singeing	+	-	-
Soddened & bleached skin	-	+	-
Ulceration	-	-	+
Lines of blisters	-	+	-
Splashing	-	+	-
Clothings	Burnt	Intact	Staining of acid ±

Electrical & Lightning Injuries

00:26:50

Electrocution :

Factors affecting :

- Type of current : AC more harmful than DC.
- Voltage.
- Amperage : Tetanoid/withhold spasms → Death. } Directly proportional to magnitude of injury.
- Resistance :
 - Inversely proportional to magnitude of injury.
 - Dry skin (maximum) > bone > moist skin (No entry wound).

Causes of death :

Entry of current	Exit of current	Cause of death
Right hand	Left hand	Cardiac arrhythmias (m/c)
Right hand	Left foot	
Head	Left foot	Respiratory failure
Right hand	Right foot	

Electrical Injury Burns :

Burns of low voltage current	Burns of high voltage current
<ul style="list-style-type: none"> • Firm contact. • Joule burn/endogenous burn : <ul style="list-style-type: none"> - Central depressed area. - Peripheral raised margins. • Metallization : Deposition of metallic ions in the entry wound. 	<ul style="list-style-type: none"> • Loose contact. • Exogenous burns : <ul style="list-style-type: none"> - Flash burn : Diffuse burn. - Keratin nodule : D/t spark. - Crocodile burn : multiple punctate lesions.



----- Active space -----

Bone : Passage of high voltage current through bone
 ↓
 molten calcium phosphate
 ↓
 Bone pearls/wax drippings.

muscle : Degeneration of muscle
 ↓
 myoglobinuria.

Lightning Injuries :

Filigree burns :

- Burns d/t lightning injury.
- Also known as :
 - Lichtenberg marking.
 - Arborescent burns.
 - Ferning.
 - Keraunographic markings.
 - Feathering.

Filigree burn vs marbling :

	Filigree burn	marbling
Color	Red/pink	Green
Blood vessel	Does not follow	Follows blood vessels

Torture Methods & Explosion Injuries

00:35:30

Declaration of Tokyo (Istanbul protocol) : Deals with reporting & treatment of torture victims.

Various Torture methods :

Black slave : Insertion of hot metal rod into anus.

Cattle's prod :
 Electric shock to genitalia.

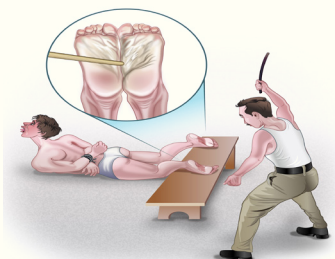


Telefono :

Repeating slapping over the ears.



Falanga/Falaka/Bastinado :
 Beating over the soles.



Wet submarine :

Forced immersion of head under water.



----- Active space -----

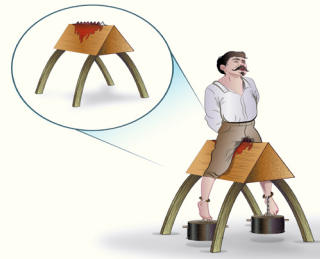
Dunking :

Forced immersion of whole body under water.



Saw Horse :

Forced straddling.



El Planton :

Prolonged standing.



Dry submarine :

Plastic bag asphyxiation.



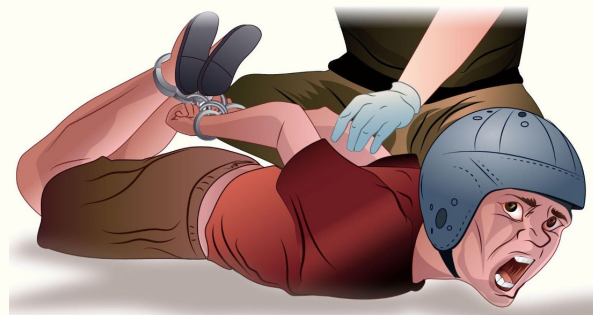
Parrots perch :

Tying upper & lower limb with suspension of body.



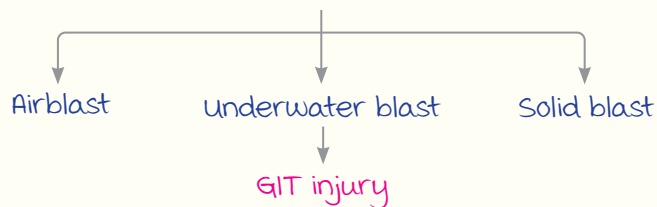
Hog tying :

Tying wrist and ankle together in prone position.



Explosion Injuries :

Types of Blasts



----- Active space ----- Airblast :

Blast Injury	Cause	Organ Injured
Primary	Blast wave	Ear (m/c), Lung (most fatal), GIT
<p>Secondary</p> <ul style="list-style-type: none"> • m/c injury • Directional 	Flying missiles/projectiles	marshal's triad : 1. Abrasion 2. Contusion 3. Laceration
Tertiary	wind/victim displacement	Fractures
Quaternary	miscellaneous	<ul style="list-style-type: none"> • Traumatic asphyxia • Burns

molotov's cocktail : Petrol bomb

- Bottle filled with petrol/kerosene, and a rag to serve as a wick.

FORENSIC BALLISTICS

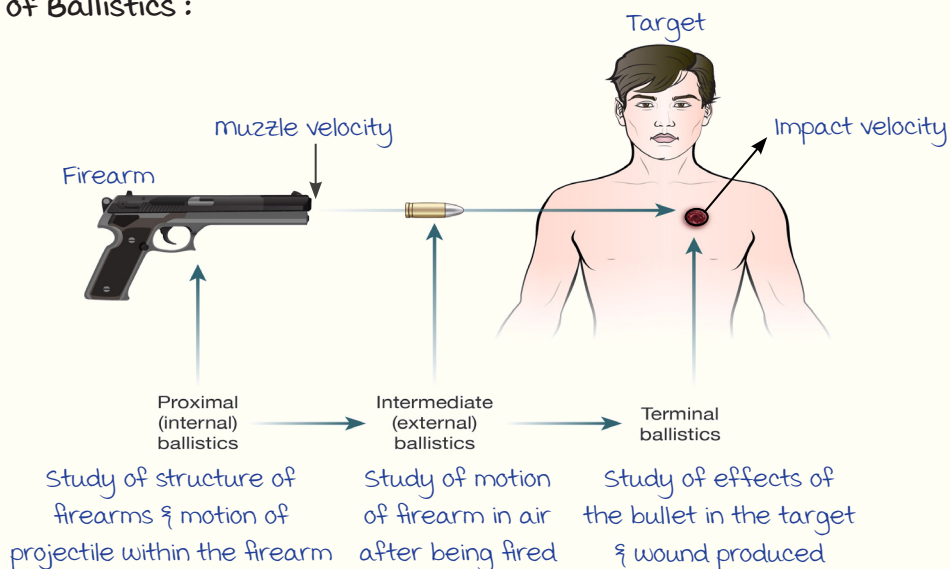
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Basics of Firearms

00:00:10

Ballistics : Study of firearm & its effects.

Types of Ballistics :





Parts of a Firearm :

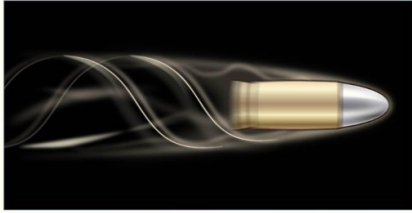



Classification :

Based on the inner surface of the barrel → visualized by helixometer.

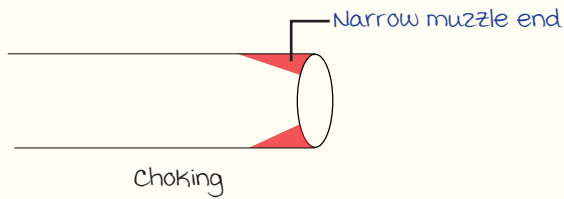
	Rifled gun	Smooth-bored gun/shotgun
Inner surface of barrel	Rifling ⊕ (Spiral grooves made in the inner surface using broach/hook cutter) 	Smooth 

----- Active space -----

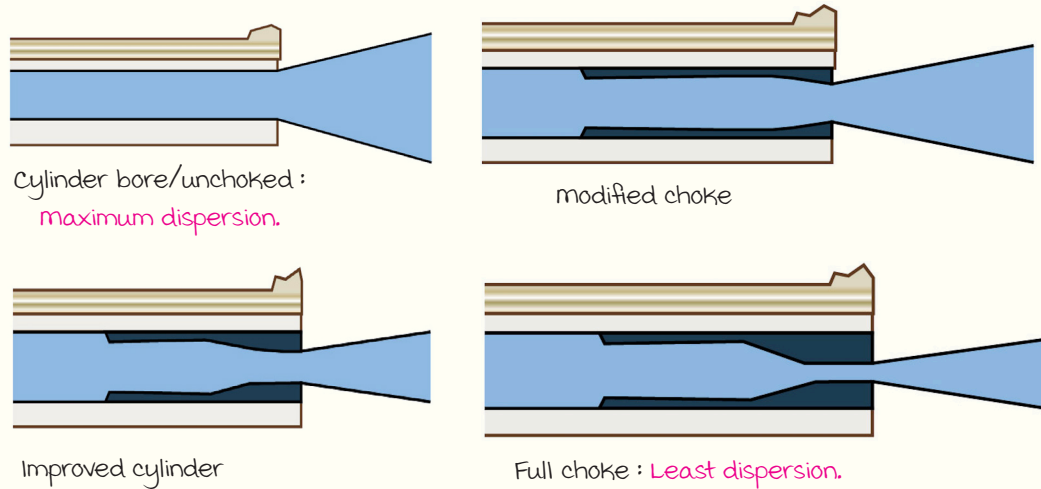
	Rifled gun	Smooth-bored gun/shotgun
mechanisms	<p>Rifling spins the bullet</p> <p>↑ stability</p> 	<p>Dispersion of lead shots</p> <p>↓ poor precision</p> 
Projectile	Bullets	Lead shots/pellets

Choking :

Narrowing the terminal end of the barrel of smooth-bored guns → ↓ dispersion.

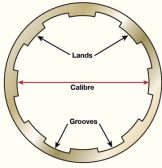


Grades :



Paradox gun : Smooth bored gun with terminal rifling.

Internal diameter of firearms :

	Caliber	Gauge/bore
Type of gun	Rifled guns.	Smooth-bored guns.
measurement	<p>Between a diametrically opposite lands.</p> 	<p>2 methods :</p> <ul style="list-style-type: none"> • Direct : Diameter measured directly. • Indirect : No. of spherical lead balls made from 1 pound of lead that precisely fit the barrel (Diameter of 18G > 24G).

Ammunition

00:07:52

----- Active space -----

Structure :

Shotgun cartridge :

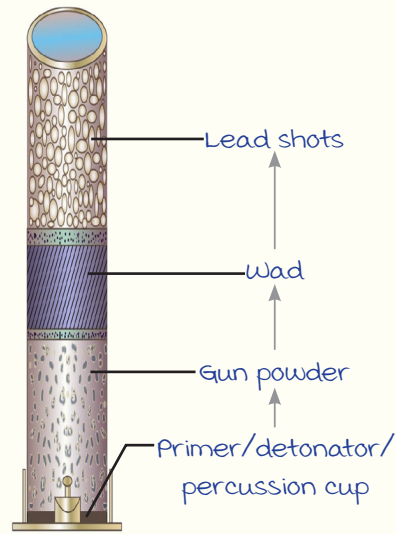
3 compartments :

Top compartment : Contains lead shots.

Middle compartment : Contains wad

- Travels around 2 meters.
- Produces minor bruises.
- Functions :
 - Lubrication of the barrel.
 - Separation : B/w gun powder & lead shots.
 - Obturation.

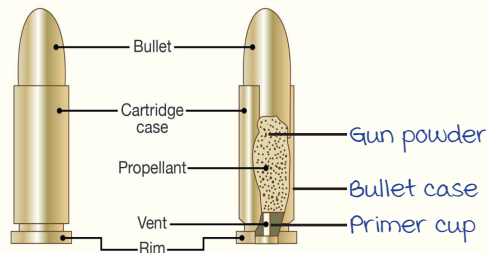
Base compartment : Contains gun powder.




Shotgun cartridge

Rifle bullet :

- Has bullet case.
- Wad : Absent (Single bullet directly placed over gun powder).



Types of Gunpowder :

	Black gunpowder	Semi-smokeless	Smokeless gunpowder
Energy produced	Low (1gm → 3-4 litres gas)	-	High (1gm → 12-13 litres gas)
Smoke	High	-	Low
Components	<ul style="list-style-type: none"> • Potassium nitrate (75%) • Charcoal (15%) • Sulphur (10%) (Preethi Can Sing) 	Black gunpowder (80%) + smokeless gunpowder (20%) 	<ul style="list-style-type: none"> • Nitrocellulose • Nitroglycerine • Nitroguanidine 

----- Active space -----

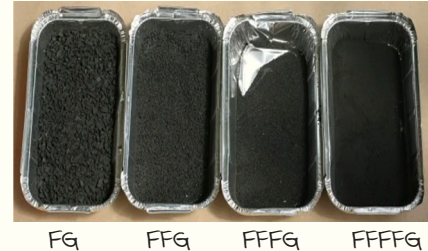
Types of smokeless gunpowder :

- Single base : Nitrocellulose.
- Double base : Nitrocellulose + nitroglycerine.
- Triple base : Nitrocellulose + nitroguanidine + nitroglycerine.

Fineness of gunpowder :

FG < FFG < FFFG < FFFFG

↑ fineness of gunpowder → ↑ in ability to burn



Primer :

Helps to **BLAST** the gunpowder :

- Barium nitrate.
- Lead peroxide.
- Antimony sulphide.
- Styphnate (Lead).
- Tetrazine.

Discharges From a Gun :

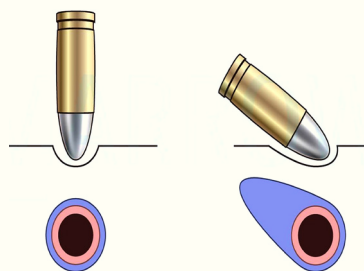
In order of emission from the gun :

S. No	Discharge	Effect
1	Flame	<ul style="list-style-type: none"> • Burns & charring of skin • Singeing of hair
2	Smoke	Blackening/smudging (Can be wiped with a wet cloth)
3	Unburnt gun powder	Tattooing/peppering → Reddish brown abrasions (Can't be wiped with a wet cloth)
4	Bullet	<ul style="list-style-type: none"> • Punctured wound • Grease collar/bullet wipe/dirt collar • Abrasion collar

Grease collar/bullet wipe :

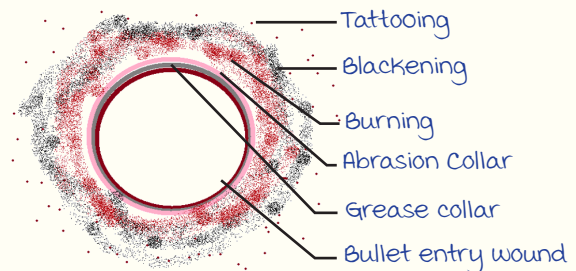
- D/t deposition of grease from the outer surface of bullet onto entry wound margin.
- Sign of entry wound.

Abrasion collar : D/t gyroscopic action of bullet.



Abrasion collar :

Shape gives information on trajectory of bullet



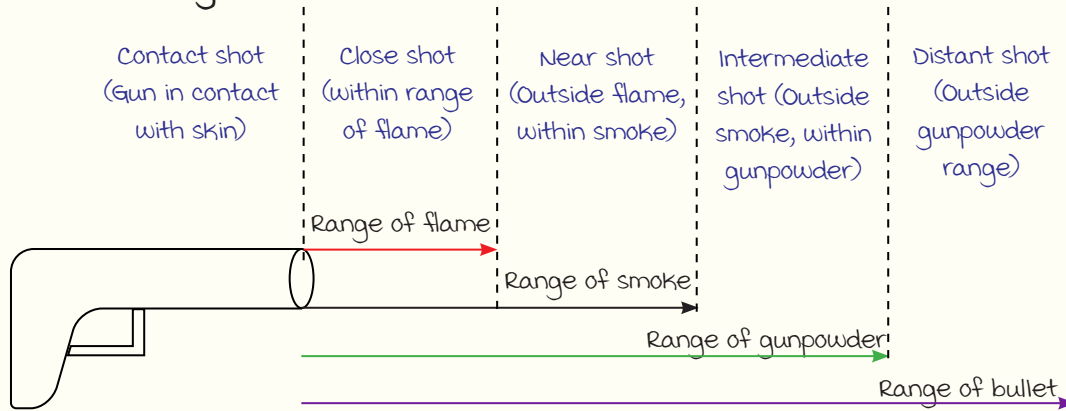
Bullet wound

Gun Ranges

00:20:55

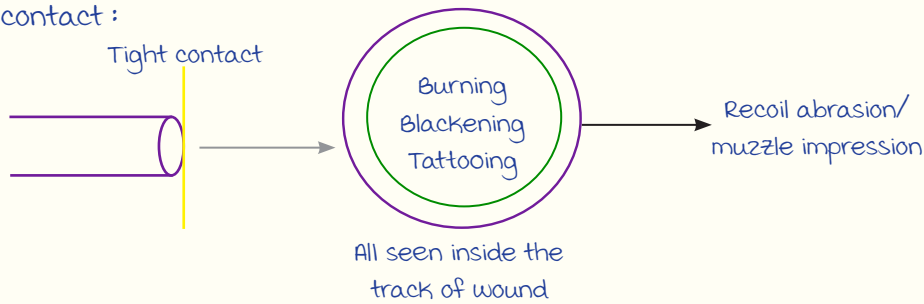
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Rifle Gun Ranges :



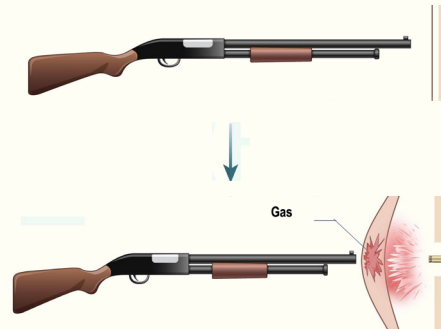
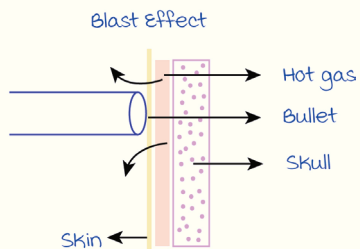
Contact shot :

Tight contact :



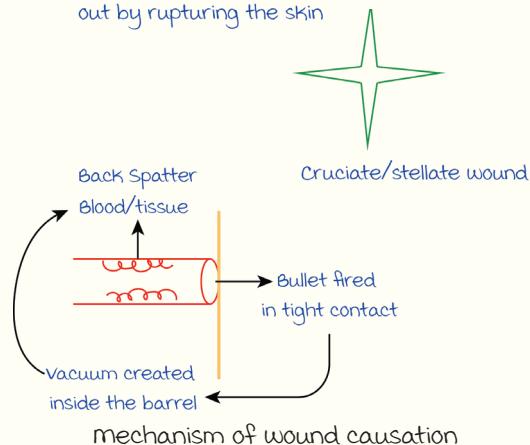
Tight contact on bony prominence (Skull/sternum).

Tight contact on scalp



Hot gas diffuses between skin and skull vault and comes out by rupturing the skin

Tight contact on scalp

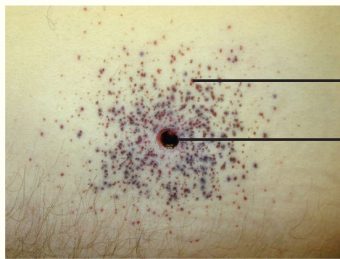


Stellate wound

----- Active space -----

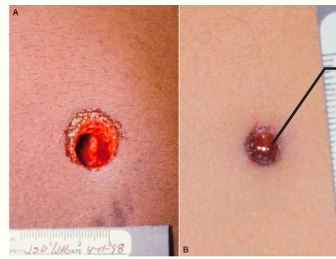
Wound Characteristics in Other Rifle Shots :

Characteristics	Close shot	Near shot	Intermediate shot	Distant shot
Burning	+	-	-	-
Blackening	+	+	-	-
Tattooing	+	+	+	-
Bullet wound, grease collar & abrasion collar	+	+	+	+



Tattooing
Entry wound

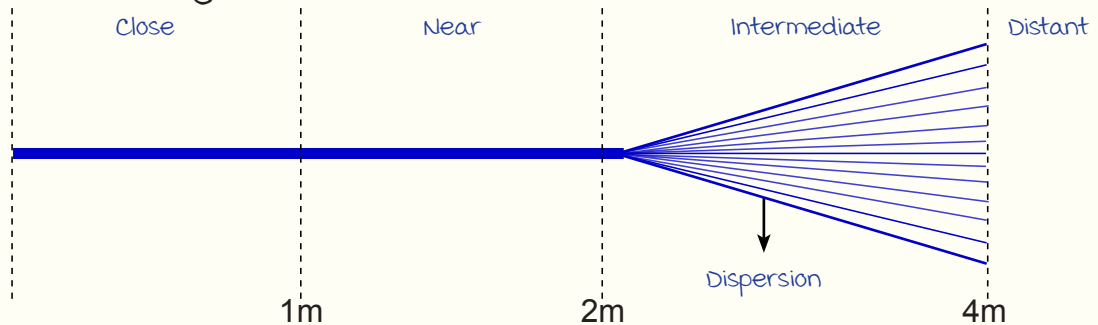
Intermediate shot



Entry wound + grease collar + abrasion collar

Distant shot

Short Gun Ranges :



Range	Wound	Characteristics
Contact		<ul style="list-style-type: none"> Stellate or cruciate margin. Lead shots inside the track of wound as a single mass.
Close		<ul style="list-style-type: none"> All lead shots enter as a single mass. Burning, blackening, tattooing seen around the wound.
Near		<ul style="list-style-type: none"> Central single hole with lead shots as single mass. No other effects around wound.
Intermediate		<ul style="list-style-type: none"> Dispersion has started. Central hole with satellite holes. Satellite holes : Independent pellet holes seen around the wound.
Distant		<ul style="list-style-type: none"> Complete dispersion. Every pellet seen as independent hole.



Intermediate shot





Distant shot

----- Active space -----

Atypical dispersion :

- Balling/welding of shots :
 - Incomplete dispersion of lead shots.
 - D/t excessive grease/lubricant heat.
 - Distant range mimics intermediate shot.
- Billiard ball ricochet effect :
 - D/t erratic dispersion on hitting intermediate object.
 - Near shot resembles distant range.

Determination of Entry & Exit Wound :

	Entry wound	Exit wound
Shape of wound	Inverted	Everted
Burning, blackening, tattooing	Present	Absent
Grease collar & abrasion collar	Present	Absent
Size of wound	Smaller	Larger
Bleeding	Less	more bleeding and spattering (Tissue protrusion)
Image		

Note : Entry wound with everted margin → Contact shot on bony prominence.

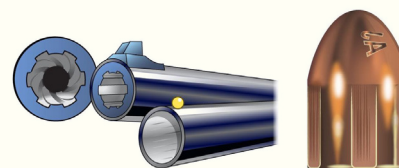
Bullet Fingerprinting & Atypical Bullets

00:34:46

Bullet fingerprinting : Identifying gun from the bullet markings.

markings on a gun :

- I. Primary marking/class characteristics :
 - marks produced on a bullet by rifling in the barrel.
 - Give information about make/model of gun.

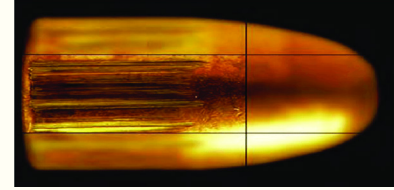


Primary marking

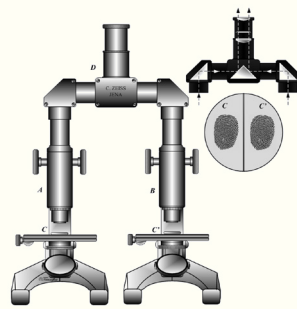
----- Active space -----

2. Secondary marking/fingerprint of a gun :

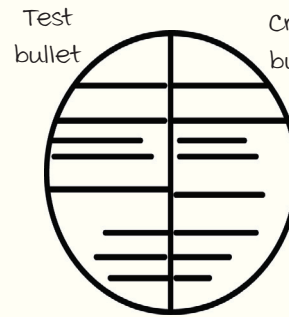
- Produced by irregularities of the barrel (Individual characteristics : vary from gun to gun).
- Irregularities are caused by
 - wear & tear.
 - manufacturing defect.
 - metallic fouling : molten lead particles deposited on barrel → Produce additional markings on bullet.



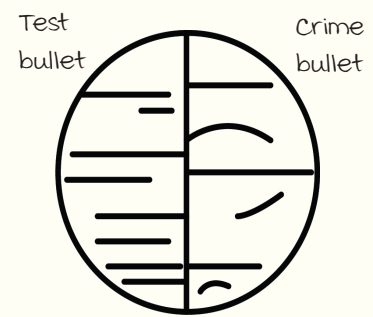
Secondary marking



Comparison microscope



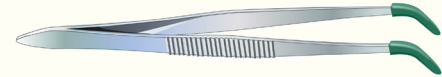
Same gun



Different guns

Note : Handling of bullet :

- Rubber-tipped tweezers (Toothed forceps cause additional markings).
- Gloved hands.



Rubber tipped tweezers

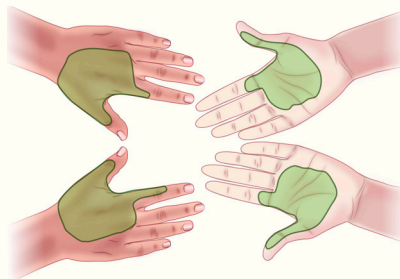
Gunshot Residue (GSR) Test :

To find out if accused has used the gun.

GSR test can be done by :

(mnemonic → Firing HANDS)

- Flameless Atomic Absorption Spectrometry (FAAS).
- Harrison Gilroy test.
- Atomic Absorption spectrometry
- Neutron activation analysis.
- Dermal Nitrate test.
- SEM-EDXA (Specific test).



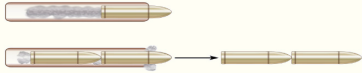

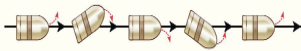
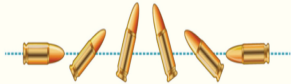
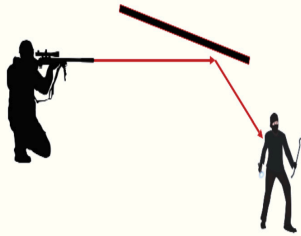
Areas of maximum GSR deposition



Swab collection for GSR test

Atypical Bullets :

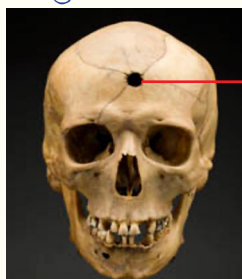
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Type of bullet	Features	Image
Tandem/Piggy-back	2 bullets coming out back to back.	
Semi-jacketed/dum-dum	Tip of lead core is exposed to outside → mushrooms on entering skin & cause greater damage.	
Yawning	Irregular bullet path.	
Tumbling	Bullet rotates end to end.	
Frangible	Fragments on impact.	
Souvenir	<ul style="list-style-type: none"> Retained bullet inside the body. Chronic complication : Plumbism. 	
Ricochet	<ul style="list-style-type: none"> Bullet stops spinning on hitting intermediate surface → No abrasion collar. No effects of flame, smoke, or gunpowder on the entry wound. 	
Tracer	Luminous metal at the base → Glows → Can trace the path of the bullet.	
Kennedy phenomenon	Iatrogenic alteration of gunshot wound ↓ Difficulty in range determination.	

Gunshot Wound on the Skull :

Bevelling : Differentiated entry wound from exit wound.

- ↳ Bevelling in inner table → Entry wound.
- ↳ Bevelling in outer table → Exit wound.



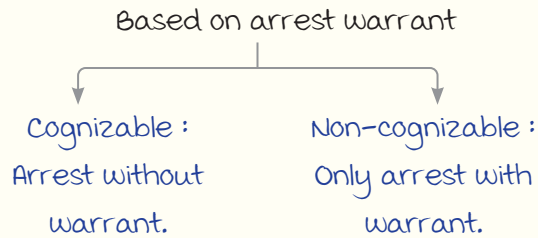
Entry wound



Exit wound

MEDICAL JURISPRUDENCE

Offences :



Inquest

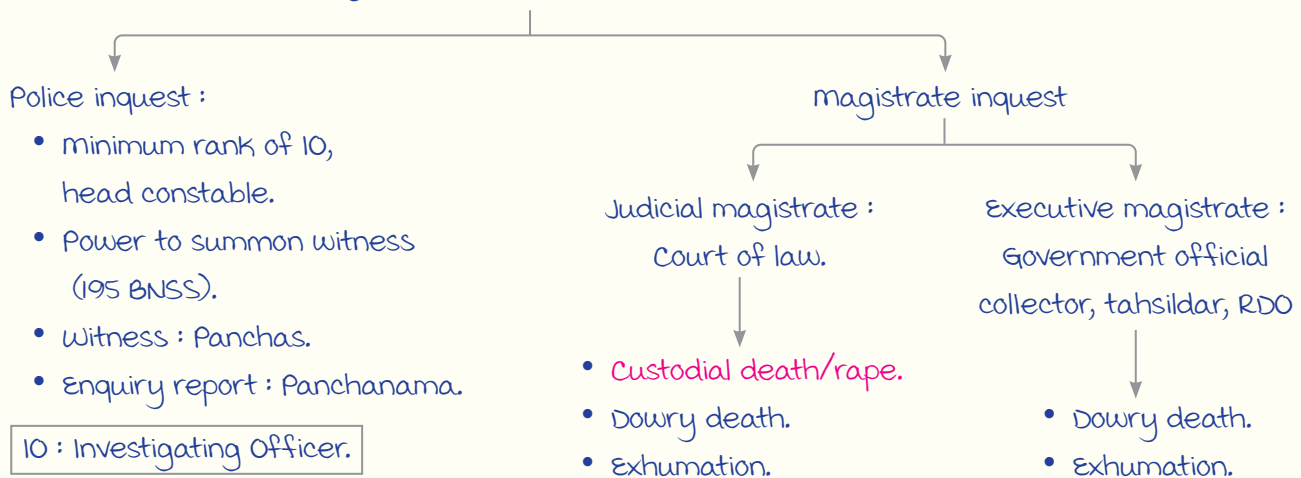
00:01:09

Conducting enquiry.

Types :

- Police inquest : 194 BNSS (m/c)
- magistrate inquest : 196 BNSS (Superior) } India.
- Coroner's inquest.
- medical examiner system (Best).

Police vs magistrate inquest :



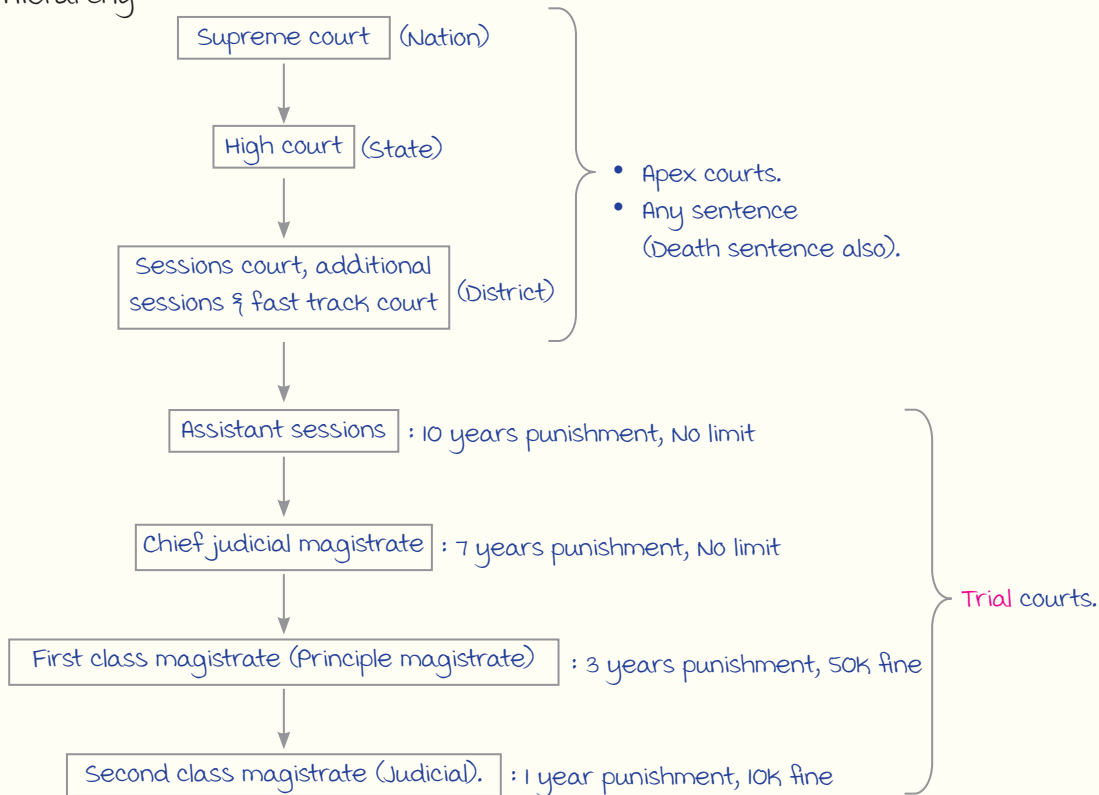
Custodial death : Death in police station, jail, psychiatric hospital, juvenile home.

Indian Legal System Hierarchy

00:06:44

Hierarchy :

----- Active space -----



- Lowest court to give death sentence : District courts.
- Lowest court to confirm/commute/cancel death sentence : High court.
- Death sentence by supreme court can be commuted by : President/Governor.

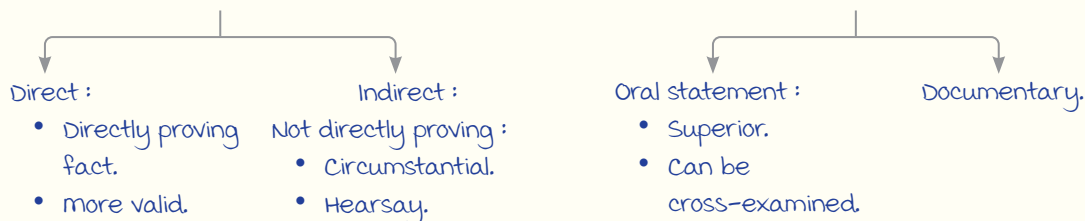
Evidence & Witness

00:11:25

Evidence :

Statement/fact produced in court to prove/disprove something.

Types :



----- Active space -----

Witness :

	Common/Occurrence/Facts witness	Expert witness
Eligibility	<ul style="list-style-type: none"> Any person who has perceived the fact No age limit 	By virtue of : <ul style="list-style-type: none"> Knowledge/skill Experience Training
Evidence	Only facts	Facts
Opinion	None	Can give
First hand knowledge rule	⊕	⊖

Summons

00:16:40

- AKA **Subpoena** (Under penalty for civil/criminal/court).
- Legal document** issued by the presiding officer of the court.
- Compelling the **attendance** of witness.
- If ignored : **Wilful disobedience** (Punishable).

Types :

- Subpoena ad testificandum** : Give oral statement.
- Subpoena duces tecum** : Produce documentation.

Order of attendance in case of**multiple summons :**

- Higher court > Lower court.
- Criminal court > Civil court.
- Equal status of courts : 1st one to summon.

Conduct/diet money :

- Paid to witness** for travelling expenses (While serving summon in **civil cases**).
- Paid by parties** in the civil case.
- Amount fixed by **court**.

Court Proceedings

00:20:10

Types of Cases :

Criminal cases : b/w state and accused.

Civil cases : **Between any 2 parties.**

Recording of Evidence in the Court :

----- Active space -----

Steps :

1. Oath/Solemn affirmation :
 - Compulsory, on refusal → Punishable.
 - Child < 12 years exempted.
2. Chief/direct examination.
3. Cross examination.
4. Re-direct examination.

Note :	
Perjury (False evidence under oath)	: [D] 227 BNS
Fabrication of evidence	: [D] 228 BNS
Both punishable	: [P] 229 BNS

Extra powers of a judge :

- Questions can be asked at any stage of trial.
- Can re-call/re-examine witnesses.

Difference in direct vs. cross vs. redirect examination :

	Chief/Direct examination	Cross examination	Redirect examination
Done by	Same side lawyer	Opposite side lawyer	Same side lawyer
Prosecution witness	PP	DL	PP
Defense witness	DL	PP	DL
Leading questions	Not permitted	Permitted	Not permitted

Dying Declarations vs. Dying Depositions :

	Dying declaration	Dying deposition/Bedside court
Recorded by	<ul style="list-style-type: none"> • Anyone • Ideally : magistrate 	Only magistrate (Superior)
Oath	⊖	⊕
Presence of accused/lawyer	⊖	Only in presence of accused defense lawyer will perform cross-examination
Cross examination Leading questions	⊖	
If patient dies	valid	valid
If patient survives	invalid	valid
India	⊕	⊖

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Medical Ethics

00:28:48

Medical Ethics vs Etiquette :

medical ethics :

- **Compulsory and punishable.**
- Guiding moral principles for
 - Doctor-doctor
 - Doctor-patient
 - Doctor-state
 } Relationships.

medical etiquette :

- **Not compulsory.**
- Dealing with colleagues.

Infamous/Unethical Conduct/Professional misconduct :

Warning notice is given to all doctors informing about :

- Addiction } Practicing
- Alcohol } under influence.
- Adultery.
- False certificate issue.
- Gifts from pharmacy.
- Conducting criminal abortion.
- Association with unqualified person.
- Advertisements
(Repeated/inappropriate).
- **Covering** : Assisting/employing unqualified person.
- **Dichotomy** : Fee splitting.
- **Euthanasia** : Active is crime (Passive is permitted in India).

Disciplinary Action Taken by :

- State medical council (SMC) } • Warning.
- Ethics & medical Registration Board (EMRB) } • Remove name from state medical register
(Penal erasure) :
 - Temporary.
 - Permanent (**Professional death sentence**).

Appeal :

If punished, one can appeal to higher body.

- SMC → EMRB → NMC (National medical Commission).
- EMRB → SMC → NMC.

Declarations :

Declaration	Guidelines about
Tokyo	Torture
Helsinki	Human experimentation
Geneva	medical ethics (modified Hippocratic oath)
Oslo	Therapeutic abortion
Sydney	Death declaration

Declaration	Guidelines about
Venice	Terminal illness
Lisbon	Patient rights
malta	Hunger strike
Washington	Biological weapon

Basic Ethical Principles :

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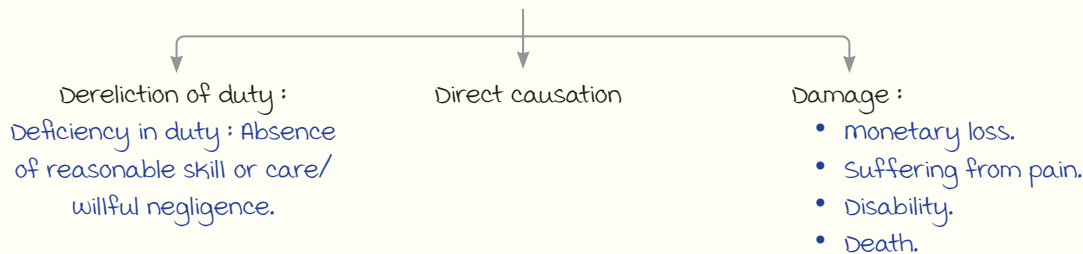
- **Autonomy** : Right of patient to choose treatment.
- **Justice** : Treat all patients same without discrimination.
- **Beneficence** : For the benefit of patient.
- **Non-maleficence** : Do no harm.

Medical Negligence/Malpractices

00:36:00

Omission of right/commission of wrong.

Factors Comprising Negligence :



Types :

	Civil	Criminal	Contributory
.Court	Civil/consumer	Criminal	<ul style="list-style-type: none"> • Only for civil compensation • Doctor negligence + patient contributed negligence
Parties	Patient vs. doctor	State vs. doctor	
Burden of proof (Plaintiff : Person filing case)	Patient	Prosecution	Doctor
Punishment	monetary compensation	Jail/fine 106 (1) BNS	Partial defense : ↓ monetary liability

Doctrines :

Res ipsa loquitur (Facts speaks for itself) :

- Gross negligent act by doctor.
- No expert opinion needed.
- Burden of proof of innocence lies on doctor.

Respondent superior (Let the master answer) :

- Superior is liable for negligent act of the third party.
- Employer is responsible for the negligence of the employee (vicarious liability).
- Only applicable for civil cases.

----- Active space -----

Defences :

- No duty.
- Duty given as per standard protocol : No dereliction of duty.
- Therapeutic **misadventure/mischance** : Accidental damage.
- Contributory negligence (By patient).
- **Novus actus interveniens** :
New unrelated intervening act leading to damage
- **Res indicata** (Time limitation period) :
Civil cases (Within 2 years of knowing), criminal (No time limit).
- **Res judicata** (Things already decided) :
Patient cannot file case again if unsatisfied (Only appeal).

Consent

00:46:31

Treatment without consent : Assault.

Minimum Age & Validity of Consent :

Situation		Consent
MTP	Normally	> 18 years
	< 18 year / mentally ill	Guardians
major procedure		> 18 years
Physical examination		> 12 years
Insanity, influence, intoxication		Invalid
medical examination	Accused	Not mandatory : 52 BNSS
	Rape victim	mandatory : 184 BNSS
Children < 12 years (Residential school)		Loco parentis

AUTOPSY TECHNIQUE AND THANATOLOGY

----- Active space -----

Autopsy : AKA postmortem examination/necropsy.

Types of Autopsy

00:00:25

	medico-legal (m/c)	Clinical/pathological
Type of death	unnatural death	Natural death
Authorization	Investigating officer (IO)	Consent of relatives : mandatory
Body handover		Relatives
Examination	Complete autopsy	Partial autopsy

Virtual autopsy (Virtopsy) :

- Complete imaging of body (CT/MRI).
- Advantage : Non/minimally invasive, **structural lesions** can be identified.
- Disadvantage : Functional lesions can't be identified.

Psychological autopsy :

- Indication : To confirm suicidal death.
- Objective : To assess mental state of deceased.
- Procedure : Interview family, friends & relatives.

SEQUENCE OF DISSECTION

Case	First cavity dissected	Observation
Poisoning	Cranial	Detect smell of poison
Asphyxial death	Cranial	<ul style="list-style-type: none"> • For bloodless dissection : Cranial → Thorax → Abdomen → Neck (Last) • Reason : To avoid Prinsloo gordon artefact (Posterior pharyngeal wall)

Incisions

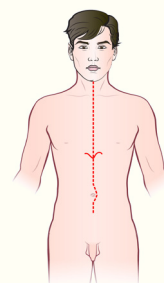
00:07:09

I shaped incision (m/c) :

- Starts at : Chin.
- Ends at : Pubic symphysis.

Y shaped incision :

- Starts at b/l acromion process meets at xiphoid process & ends at pubic symphysis.
- Extends below the breasts.



I shaped incision

----- Active space -----

modified Y incision :

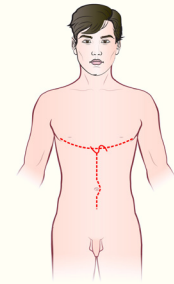
Starts at b/l mastoid process, meets at xiphoid
& ends at pubic symphysis.

Inverted Y incision :

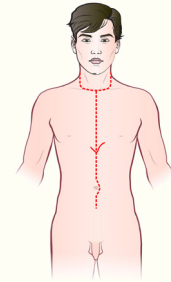
- Done in **newborns**.
- Starts from the chin upto umbilicus,
bifurcates to b/l mid inguinal point.

X incision :

- In **custodial deaths**.
- Incision applied on the back of the body.
- Assesses deeper injuries.



Y shaped incision



modified Y shaped incision

Techniques of Organ Removal

00:10:17

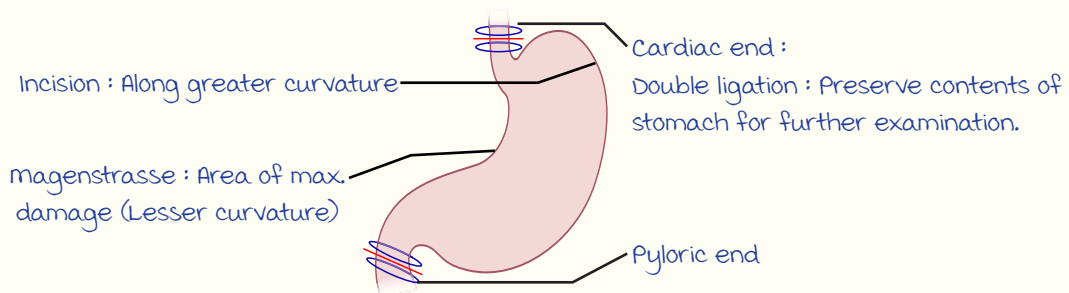
	Virchow	Letulle's	Ghons	Rokitansky
method	Organ by organ	En masse	Block (Eg : Cervicothoracic/ abdominal/urogenital block)	In situ
Other points	m/c	<ul style="list-style-type: none"> • Rapid removal • Inter-organ relationship can be studied 	-	In infectious diseases (HIV, Hep B, Covid)

Individual Organ Dissection :

Heart dissection : Inflow - outflow method.

- Along the direction of blood flow.
- Right atrium → Right ventricle → Left atrium → Left ventricle

Stomach dissection :



Note : Disappearance of evidence → Punishable under 238 BNS.

Exhumation (Disinternment) :

Lawfully digging the body out of earth.

Authorized by : magistrate.

Time limit : No maximum limit in India.

Preservation of soil :

- To differentiate from post mortem inhibition.
- Absorption of metallic poison from soil into body post death :
Arsenic (m/c), endrin.

----- Active space -----

Post Mortem Changes

00:19:53

Thanatology : Study of death.

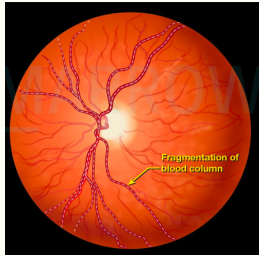
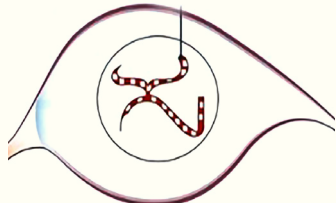

Taphonomy : Study of post mortem resorption of body.

Immediate changes (Somatic death)	Early changes	Late changes (Decomposition)
<ul style="list-style-type: none"> • Loss of voluntary movement • Irreversible stoppage of circulation & respiration 	<ul style="list-style-type: none"> • Eye changes • Algor mortis (Cooling) • Livor mortis (Staining) • Rigor mortis 	<ul style="list-style-type: none"> • Autolysis : Lysosomal enzymes • Putrefaction : Bacterial enzymes

Putrefaction : D/t bacterial enzymes.

- Source of bacteria : GIT, trauma site.
- Route of spread : Blood vessels.
- Chief agent : **Clostridium welchii** (**Lecithinase** enzyme).

Eye changes :

	Features	Time since death (TSD)
Retina	Kevorkian sign/railroad sign/ cattle trucking sign (Fragmentation of blood vessels)	Few minutes  
Sclera	Triangle shaped opacities on either side of cornea ↓ Tache noire sclerotica.	3 - 6 hours 

----- Active space -----

ALGOR MORTIS/POSTMORTEM COOLING

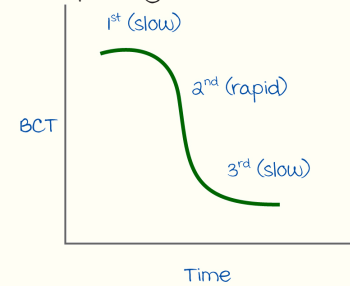
Feature	About
Site	Rectum m/c except in sodomy cases, subhepatic space ideal, nose, ear, lower end of esophagus
Instrument	Thanatometer/chemical thermometer
Rate	0.4°C - 0.7°C/hr

Post mortem calorificity :

- Body remaining warm after death (D/t high BCT).
- Causes :
 - Heat stroke.
 - Pontine hemorrhage.
 - Septicemia.
 - Tetanus/strychnine poisoning.

Note : Postmortem calorificity is not seen in burns.

Graph : Sigmoid/inverted S

3 phases of fall of BCT
(Body core temperature)**LIVOR MORTIS**

- Cadaveric or Postmortem lividity/Pm staining/
Pm hypostasis/**sugillation**/coagitation.
- Bluish discoloration on dependent areas d/t hypostasis of blood.
- Distribution based on position :



Supine position :

Back of head, chest, abdomen, legs



Prone position :

Front of head, chest, abdomen, legs



Vertical position :

Glove & stocking pattern

- Hypostasis not seen if body is in a flowing river or in hypovolemic shock.
- Change with time :
 - Onset : **30 min.**
 - max : **6-12 hrs.**
 - merges with putrefaction color.

• **Fixation :**

- Happens at 6-12 hrs (**8 hrs**).
- Pressing on fixed hypostasis **will not blanch**.



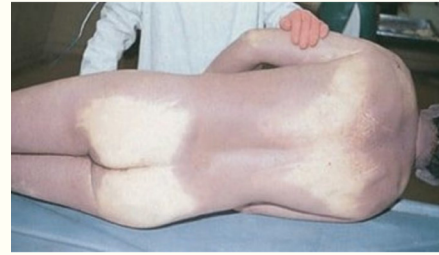
Not fixed : Blanching

- movement of body
 - Before fixation → Hypostasis also moves.
→ **Secondary lividity.**
 - After fixation : No change in hypostasis.

- **Contact pallor** : Areas in tight contact with a surface → Pallor, no staining.
- Color :

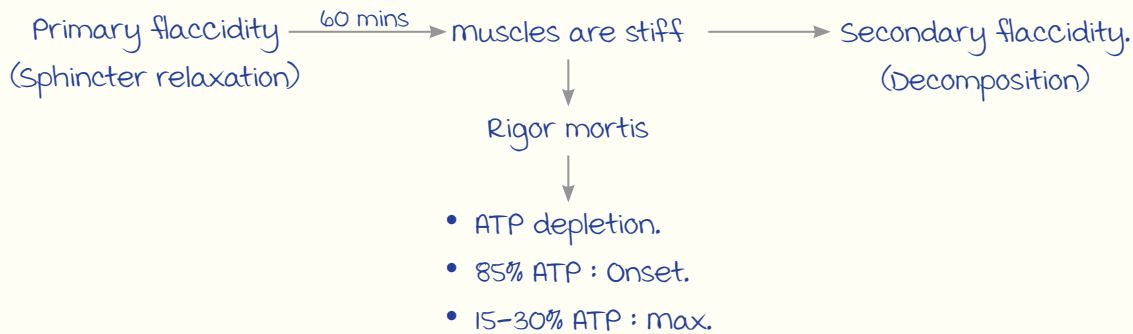
----- Active space -----

Color	Cause
Carbon monoxide	Cherry red
Cyanide	Bright red
Phosphorus	Dark brown
Aniline	Deep blue/brown
Nitrate	Reddish brown
Opium	Black
Hydrogen sulfide	Bluish green



Contact pallor

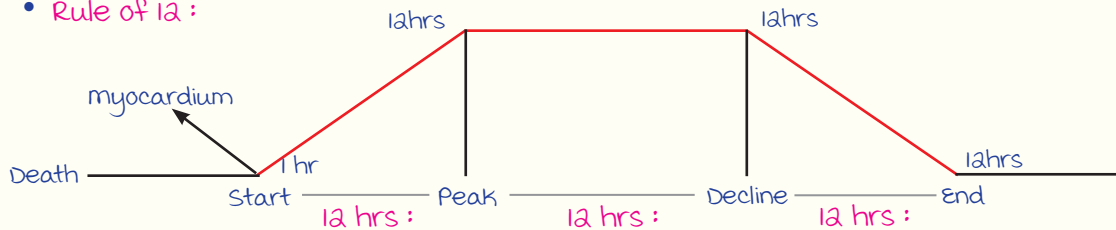
RIGOR MORTIS



- First seen : Involuntary > Voluntary muscles.
- First site : myocardium.
- Externally, **Nysten's rule** :

Eye lid > neck > jaw > face > thorax > upper limb > abdomen > lower limb > fingers & toes

- **Rule of 12 :**



- Appears throughout.
- Ascending pattern.
- Remains.
- Disappears.
- Descending pattern.

Cadaveric spasm/instantaneous rigor/cataleptic rigidity :

- **No primary relaxation.**
- Always antemortem.
- Drowning, electrocuting, suicidal gunshot.



Cadaveric spasm

----- Active space -----

- Conditions mimicking rigor mortis :
 - Heat stiffening : Burn.
 - Cold stiffening.
 - Gas stiffening : Decomposition.
 - Cadaveric spasm.

LATE CHANGES (DECOMPOSITION)

Putrefaction :

- Color change.
- Gas production.
- Liquefaction of tissues.
- Takes 5-10 days.

Color :

- 1st site : Aorta.
- 1st external site : Right iliac fossa (Greenish) → Time since death :
 - Summer : 12-18 hr.
 - Winter : 1-2 days.

• marbling :

- D/t sulfhemoglobin deposition of vessel walls.
- Greenish > Reddish blue color.
- Time since death : 36-72 hr.



marbling

Gas :

- Hydrogen sulphide.
- Gas stiffening : Completely bloated.
- Pm purge : Bleeding from nostrils & mouth.
- Blisters.



Gas stiffening

Note :

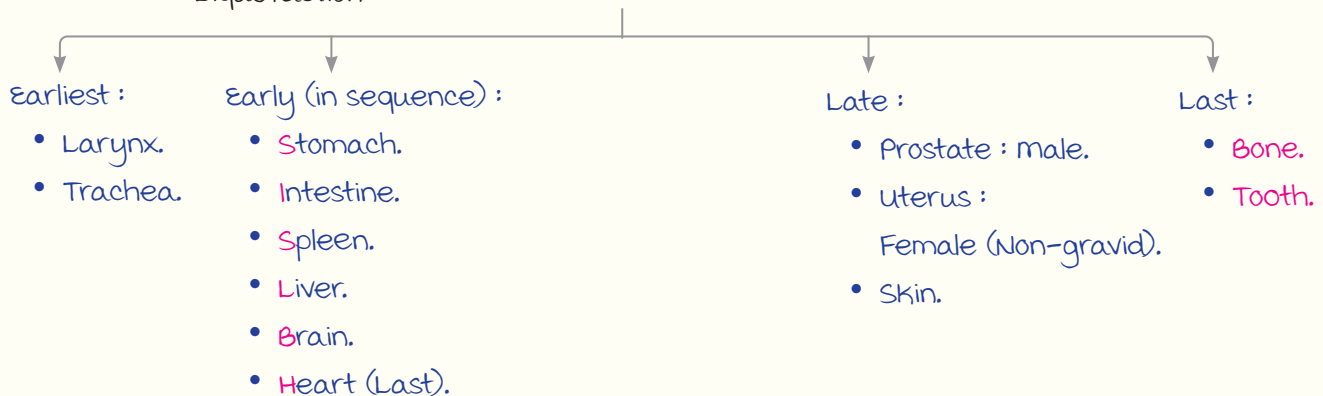
Pm vs Am blisters :

	Postmortem (Putrefaction)	Antemortem (Burns)
Content	Gas	Inflammatory fluid
Base	Pale	Reddish



Pm blisters

Liquefaction :



Casper's Dictum :

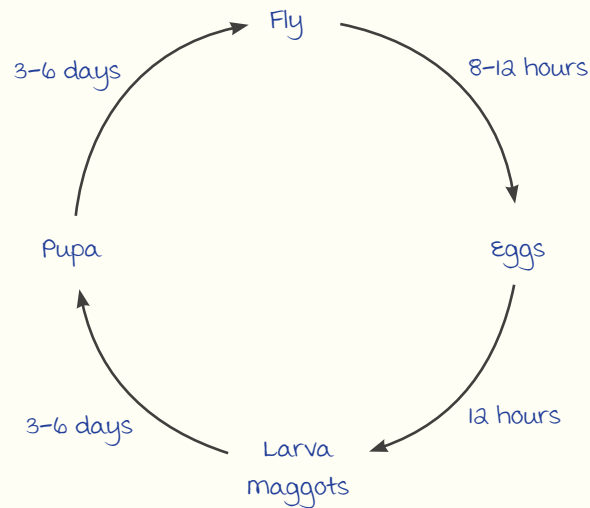
Rate of putrefaction : Air (Fastest) > water > Earth (Slowest).

1 2 8

----- Active space -----

Entomology :

- Study of insects.
- Time since death.
- Identify poison (From insects).
- Place of disposal
(Based on species of insect).



modified Forms of Putrefaction :

	Adipocere/grave wax/saponification	mummification
Condition	Warm climate, water, Clostridium welchii	Dry and hot
Mechanism	Fat $\xrightarrow[\text{Hydrogenation}]{\text{Hydrolysis}}$ Fatty acid (pH acidic) ↓ Bacteria ↓ ↓ Body preserved	Drying and dehydration ↓ Shrunken body : >70 % body weight loss
Duration	3 weeks - 3 months	3 months - 1 year
Smell	Ammoniacal	Odorless
Can comment on	Identification, Time since death, Place of disposal	
Image		

----- Active space -----

Viscera Preservation for Chemical Analysis

01:03:54

For poison detection.

Routinely sent samples :

- Blood (most **reliable**) : Circulation (Peripheral → Femoral vein).
- Stomach & contents : Storage.
- Small intestine (upper 30cm) : Absorption.
- Liver (500gm) : metabolism.
- Kidney (Half of each) : Excretion.

Samples sent for specific poisons :

Poison	Specimen
<ul style="list-style-type: none"> • Strychnine • Gelsemium 	Spinal cord
<ul style="list-style-type: none"> • Aconite • Digitalis 	Heart
<ul style="list-style-type: none"> • Gas 	Lungs
<ul style="list-style-type: none"> • Pesticides 	Adipose tissue

Poison	Specimen
<ul style="list-style-type: none"> • Carbon monoxide • Cyanide 	Spleen
<ul style="list-style-type: none"> • Barbiturates • Alcohol 	Brain
<ul style="list-style-type: none"> • Alcohol 	CSF
<ul style="list-style-type: none"> • metals 	Bone, hair, nail

Preservative :

- Saturated sodium chloride solution (m/c).

Avoided in :

- Aconite poisoning.
- Corrosives except **carbolic acid**.

- Rectified spirit (Ideal).

Avoided in :

- Formalin poisoning.
- Phosphorus poisoning.
- Alcohol poisoning.

- No preservative : Bone, hair, nail, teeth, lung.
- Formalin as preservative : **Never** used (Extraction of poison very difficult)

Specimen	Preservatives
Blood	Sodium fluoride + potassium oxalate
urine	Sodium fluoride, thymol
vitreous/CSF	Sodium fluoride
virology	Glycerol

Samples sent for DNA analysis :

- Fresh dead body : Blood → **EDTA preservative**.
- Early decomposition : Spleen/muscle.
- Advanced decomposition : Bone/hair/teeth.

HUMAN IDENTIFICATION

----- Active space -----

Corpus delicti : Body of offense/Body of crime.

Types of identification :

Presumptive identification :

- Race : Skull (Best).
- Sex : Pelvis (Best).
- Age.
- Stature.
 - Femur 27% (Best).
 - Tibia 22%.
 - Humerus 20%.

Definitive identification :

- Dactylography : most reliable.
- DNA fingerprinting (Same for identical twins).
- Scars.
- Tattoo marks.
- Superimposition.

Identification of Race & Sex

00:02:30

Race :

3 major races : Negroid, Caucasoid, mongoloid.

Indices for race determination :

Mnemonic : **BCCI**.

- Brachial index : From upper limb.
- Cephalic index : From cranium (Best).
- Crural index : From lower limb.
- Intermembral index : Compare upper & lower limb.

Cephalic index :

- Cephalic index = $\frac{\text{max breadth of skull}}{\text{max length of skull}} \times 100$.
- 70 - 75 : Dolicocephalic → Aryans/Africans.
- 75 - 80 : mesocephalic → Indian/Chinese/Europeans.
- 80 - 85 : Brachycephalic → Japanese.

----- Active space ----- **Sex :**

General features :

Character	male	Female
Muscle marking	more prominent	Less prominent
Shape (Skull, orbit, etc.)	Square	Round
Higher value of index	Corporobasal index	Sternal/Sciatic/ Ischiopubic
Angle : • mandibular • Subpubic	< 120° < 90°	> 120° > 90° } more obtuse
Ischial tuberosity	Inverted	Everted
Greater sciatic notch (Best)	Deep and narrow	Wide and shallow
Forehead	Sloping in males	Vertical
Pelvic inlet	Heart-shaped	Circular

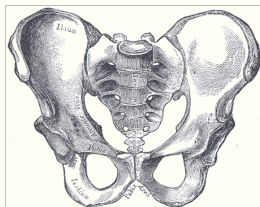
Exceptions :

- Frontal and parietal eminence : Skull
- Pre-auricular sulcus : Pelvic bone

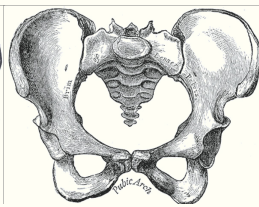
	Obturator foramen	Pubis
male	Large, oval	Triangular
Female	Small, triangular	Square



Pre-auricular sulcus :
Deeper in females



male



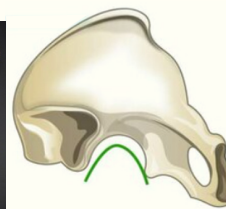
Female

Pelvic inlet

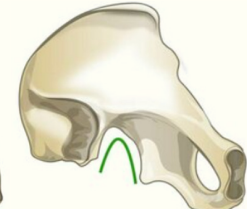


Female

male



Female



male

Greater sciatic notch

$$\text{Corporobasal index} = \frac{\text{Breadth of body of } S_1}{\text{Breadth of base of sacrum}} \times 100 \rightarrow \text{more in males.}$$

Specific bone used to determine sex :

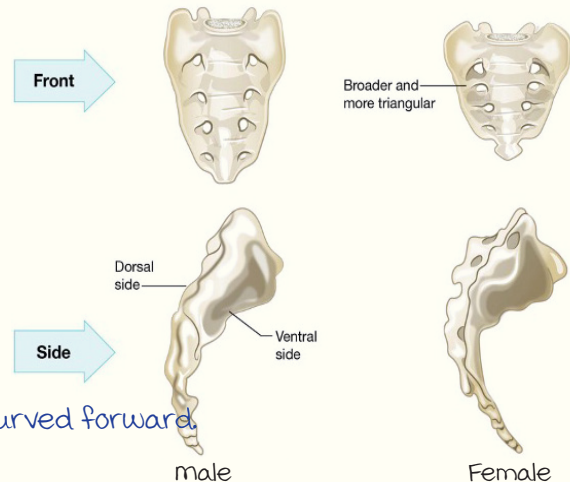
Sacrum :

• male :

- Longer.
- Uniform curvature.
- Promontory prominent.

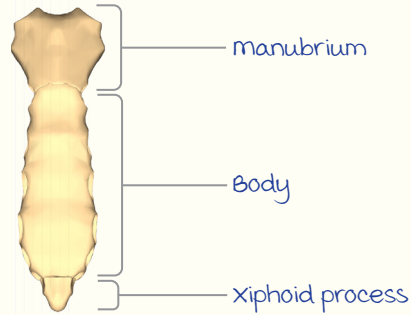
• Female :

- Shorter/wider.
- Upper half straight, lower half curved forward.
- Promontory less prominent.



Sternum :

- Ashley's rule of 149 :
- Sternal length = manubrium + Body.
 - > 149 mm = male.
 - < 149 mm = Female.



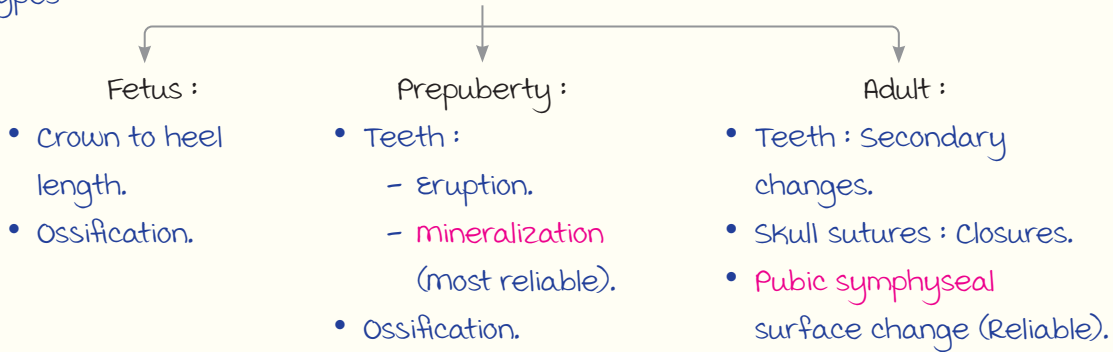
----- Active space -----

Accuracy of sex determination from bones/Krogman's accuracy :

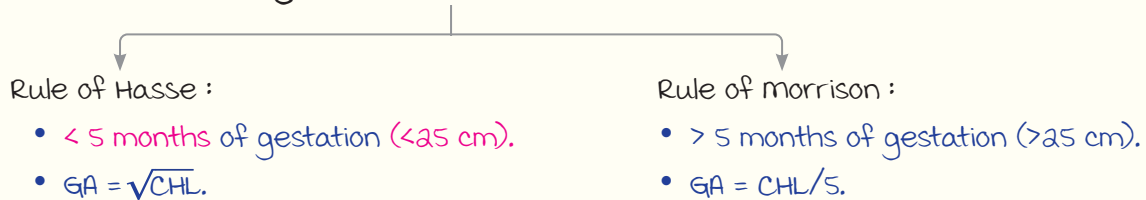
- Pelvis : 95% (Best), even in children.
- Skull: 90%.
- Long bones : 80%.
- Pelvis + skull : 98%.
- Pelvis + long bones : 98%.
- Complete set : 100%.

Age Estimation :

Types :



Crown to Heel Length :



Note : CHL = Crown rump length (CRL) x 1.5.

Ossification Centre

00:18:05

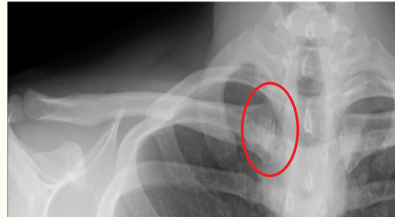
Ankle joint :

Centre	Age of appearance
Calcaneum	5 th month IUL (Before viability)
Talus	7 th month IUL
Femur (Lower end)	36 weeks IUL
Talus (upper end)	38 weeks IUL
Cuboid	At birth

----- Active space -----



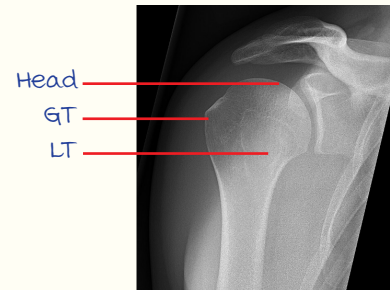
mandible :
2 halves fuse at 1 - 2 yrs



medial end of clavicle : 18 - 22 yrs
 • Appear at : 18 - 19 yrs
 • Fuses at : 21 - 22 yrs

Humerus :

	Age of appearance	Age of fusion
Head	1 yrs	18 yrs
Greater tubercle	3 yrs	
Lesser tubercle	5 yrs	
Tip of acromion	15 yrs	17 - 18 yrs



> 18 yrs

Elbow joint : mnemonic CRITOE.

	Age of appearance	Age of fusion
Capitulum	1	16 - 17 yrs
Radius head	5	
medial epicondyle (i)	6	
Trochlea	9	
Tip of olecranon	9	
Lateral epicondyle (e)	11	



> 16 yrs



- All 6 centres appeared.
- Not fused.
- 11 - 16 years.

Wrist joint :

- Best way to find if adult (> 18 years).

	Age of appearance	Age of fusion
Lower end of radius	2 yrs	18 - 19 yrs
Lower end of ulna	5 yrs	17 - 18 yrs



> 18 y

Order of appearance of carpal bones :

1. Capitate : 2 months.
2. Hamate : 3 months - 1 y.
3. Triquetral : 3 y.
4. Lunate : 4 y.
5. Scaphoid : 5 y.
6. Trapezium/Trapezoid : 5 - 6 y (Twin bones).
7. Pisiform : 9 - 12 y.



----- Active space -----

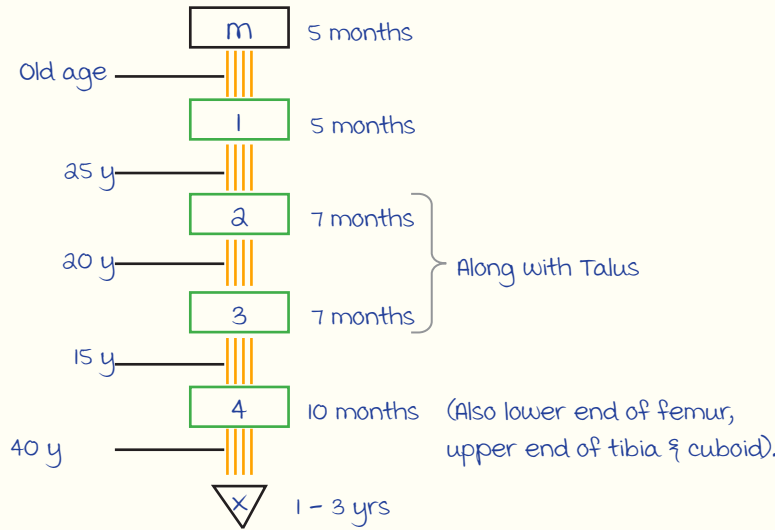
3 yrs - 4 yrs
Capitate, hamate, triquetral, radial end appeared.

Skull :

- Posterior fontanelle (Lambda) : 3 - 6 months.
- Anterior fontanelle (Bregma) : 18 months.
- metopic suture : 9 months - 2 years.
- Sphenooccipital suture (Base of skull) : 18 - 21 years.

Sacrum : 22 - 25 years.

Sternum :



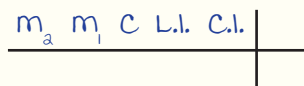
Dentition

00:39:57

Types of teeth :

Primary (milk teeth) :

- Temporary : 20.
- Order of eruption :
 - 1 : 6 months (First : Lower CI)
 - m_1 : 12 months.
 - C : 18 months.
 - m_a : 24 months.



----- Active space -----

Secondary :

- Permanent : 32.
- Order of eruption :

m_3	m_a	m_1	Pm_a	Pm_1	C	L.I.	C.I.
-------	-------	-------	--------	--------	---	------	------

 - m.l. : 6 years.
 - C.I. : 7 years.
 - L.I. : 8 years.
 - Pm_1 : 9 years.
 - Pm_a : 10 years.
 - C : 11 years.
 - m_a : 12 - 14 years
 - m_3 : 17 - 25 years (Wisdom tooth)

- Time gap for spacing of jaw.
- Failure : Impacted tooth (m_3 : m/c).

Successional teeth : Ones replacing temporary set.

Super added teeth : Additional ones (All permanent molars).

Period of mixed dentition :

- Period with both temporary & permanent teeth.
- 6 - 11 years.
- Total number constant = 24.
- Permanent teeth = $(Age - 5) \times 4$.

methods of estimation :

- Gustafson's method :

mnemonic : APSRTC.

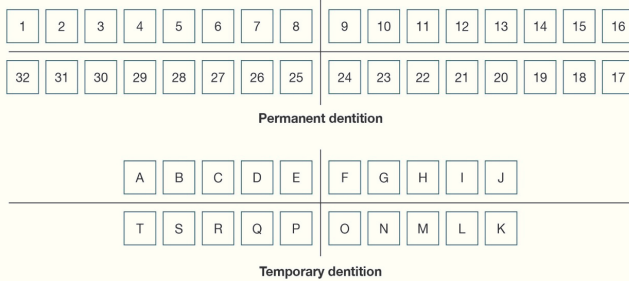
 - Attrition.
 - Parodontosis.
 - Secondary dentin (2nd reliable)
 - Root resorption.
 - Transparency of root (most reliable).
 - Cementum apposition.
- Stack's method :
 - From the height and weight of the tooth.
 - useful for infants.
- Boyde's method :
 - For children.
 - Counting microscopic incremental lines in teeth.
 - First line (Neonatal line) : Day 2/3 (Sign of live born).
 - Every day, one line.

Anterior → Posterior : Reliability ↓
(C.I. most, m_3 least reliable)

DENTAL CHARTING

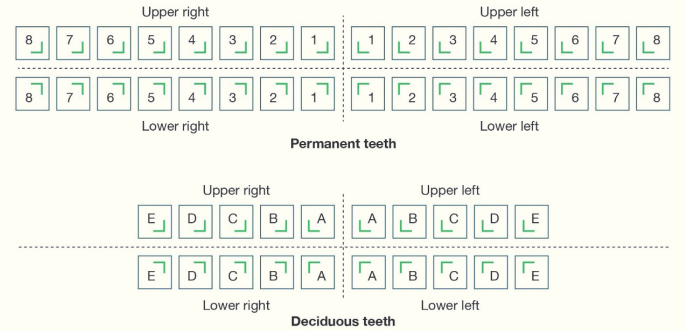
Universal method :

- Continuous numbering 1 - 32.
- Starting right upper and clockwise.



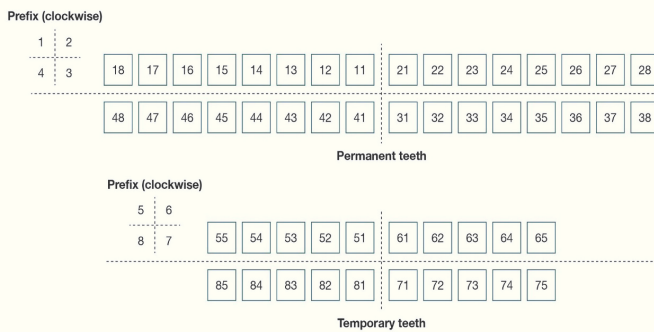
Palmer's Notation :

- Count medial → lateral.
- With symbol for quadrants.



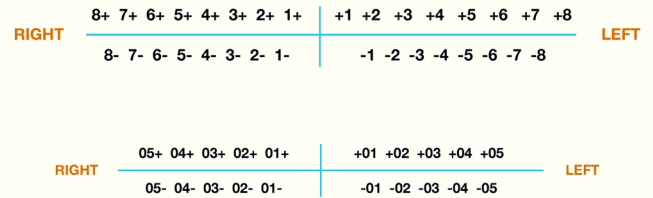
FDI method :

- Permanent teeth prefix : 1, 2, 3, 4 each for specific quadrant in clockwise.
- Counting teeth 1 - 8, medial → lateral.
- Temporary teeth prefix : 5, 6, 7, 8.
- 2 digit system.
- Worldwide mostly used.



Haderup's Notation :

- ⊕ maxillary, ⊖ mandibular teeth.
- ± On right : Right side.
- ± On left : Left side.



Stature :

- Regression formulae.
- multiplication factor.
- Percentile formula.

Dactylography and Other Methods

00:48:46

- Best method.
- Galton's system.
- Different even in twins.
- Not inherited.
- Develop in intrauterine life :

- Starts : 12 - 16th week (3 - 4 m).
- Completed : 20 - 24th week (5 - 6 m).

----- Active space -----

Patterns :

Loop :

Starts, go to top,
end same side, m/c.

>



Whorl :

Concentric
circles.

>



Arch :

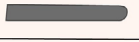






Start & end in
opposite sides.

>

Composite :
mixed pattern, 1/c.

Analysis :

- By comparing **minutiae**.
- > 12 - 16 matching points.
- more matches, the better.

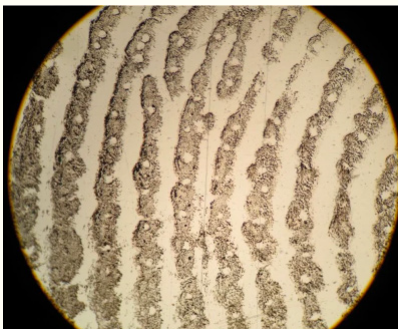
	Termination
	Bifurcation
	Lake
	Independent ridge
	Point or island
	Spur
	Crossover

Fingerprint Abnormalities :

- Atrophy :
 - Celiac disease (Complete).
 - Dermatitis (Partial).
- Permanent alteration :
 - Leprosy.
 - Electrocution.
 - Radiation.
- Complete absence :
 - Adermatoglyphia.
- ↑Space b/w ridges : mnemonic **AIR**.
 - **A** cromegaly.
 - **I** nfantile paralysis.
 - **R** ickets.

Other methods :

Poroscopy.

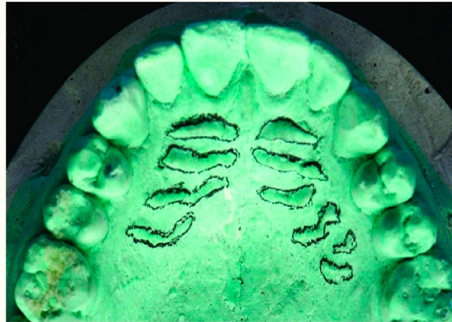


Arrangement of
sweat pores :
Locard's poroscopy

Cheiloscopy : Suzuki classification used.

Rugoscopy/Palatoscopy : Anterior hard palate is evaluated.

----- Active space -----



Tattoo marks :

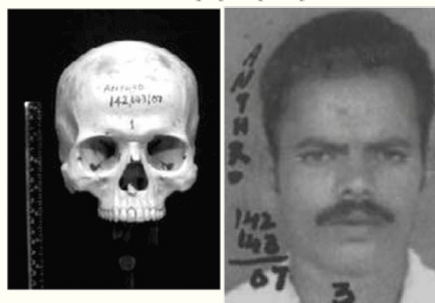
Faint tattoo visualized by :

- magnifying glass.
- Infrared photography.
- uv light.
- Regional LN examination (Pigment).

Superimposition :

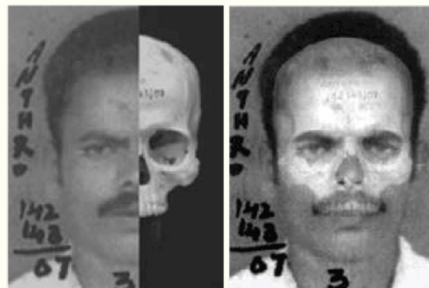
- matching the skull & antemortem photograph of missing person.
- Look and match :
 - Inner, outer canthus.
 - Alveolar margin, etc.
- **Negative value tests** : Helps with exclusion.

Skull-Photograph Superimposition



1. (a) Skull

1.(b) Photograph



1.(c) Wiped image

1.(d) Mixed image

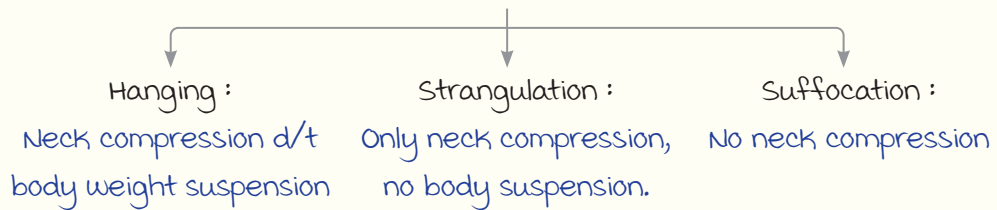
ASPHYXIAL DEATHS

----- Active space -----

Asphyxial triad : mnemonic → **CPC**.

- **C**yanosis
- **P**etechial hemonhage.
- **C**ongestion of viscera.

Types Based on Mechanism :



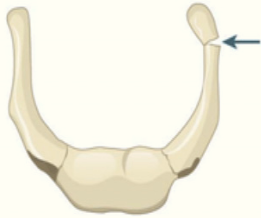
Hyoid Bone Fractures :

m/c cause of hyoid bone fracture (#) : **Throttling** > Hanging > Ligature strangulation.

Types :

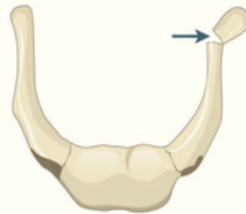
1. Adduction # (m/c) :

- Inward compression.
- Seen in throttling.



2. Abduction # :

- Outward compression.
- Seen in hanging.



3. Side to side compression # :

- One end displaced outwards & other inwards.
- Seen in hanging.

Hanging

00:04:36

Types :

Based on position of knot —> Typical hanging : Knot in occiput.
 —> Atypical hanging : Knot anywhere other than occiput.

Based on suspension :

----- Active space -----

Complete hanging	Partial hanging (Incomplete hanging)
Whole body suspended	Partial body suspended
No body part touches ground	Body part is touching the ground (Eg. Leg, knee)
Constricting force : whole weight of the body	Constricting force : Partial weight of the body
Faster death	Slower death (Suicidal)

Autopsy Findings :

Order of autopsy :

- Cranium : Opened first → To avoid Prinsloo's Gordon artefact.
- Neck : Opened last → To facilitate bloodless dissection of neck.

Hypostasis : Glove & stocking pattern.

- Implies body was in vertical position.
- Does not imply hanging.

Face :

- Pale/congested
 - Dribbling of saliva.
 - La facie sympathique.
- } Indicates antemortem hanging.



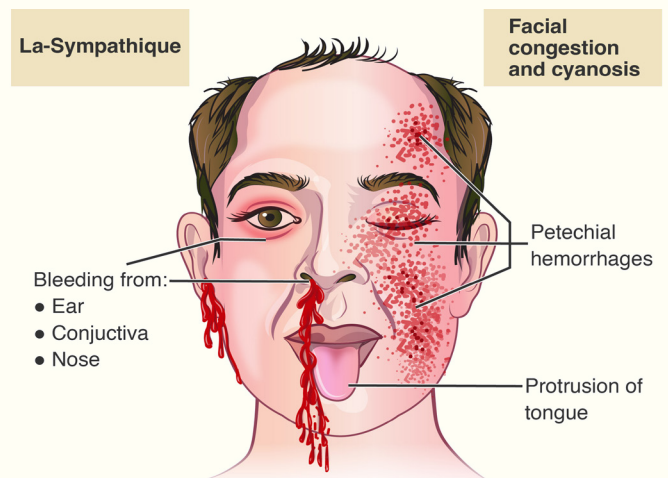
Hanging victim :
Dribbling of saliva

Dribbling of saliva :

- Surest sign of antemortem hanging.
- Opposite to knot side.

La facie sympathique :

- Pressure on cervical sympathetic chain
- ↓
- 1/L opening of eyelids + 1/L pupillary dilatation
 - Sign of antemortem hanging.



Antemortem hanging : Findings in the face

Ligature mark :

- Features :
 - Oblique
 - Incomplete
 - Above thyroid.
- Transverse ligature mark : Seen in
 - Partial hanging (D/t low point of suspension).
 - Slip knot with running noose.

----- Active space -----

Suspension peak
(Inverted V shape)

Ligature mark : Oblique, incomplete, above thyroid

Pale, dark brown,
parchment-like

Ligature mark : Pressure abrasion



Ligature mark in hanging

Internal findings :

1. Hyoid bone # :

- Seen in 15-20% of hanging cases.
- >40 years (↑ Risk of fracture)

2. Carotid artery : Amussat sign (Transverse intimal tear).

3. Vertebra :

- C_2 fracture (Hangman's #), C_3 & C_4 (Rare).
- Simon's hemorrhage (Intervertebral disc hemorrhage).

} Seen in hanging
with long drop.
(Judicial hanging)

Manner of Hanging :

Suicidal :

- m/c method of suicide : Hanging > Poisoning.
- Painless death, ↓ fatal period.

Homicidal :

- Judicial hanging.
- Lynching/extrajudicial hanging : Homicidal hanging by a mob, punishable offense.



Lynching

Accidental :

Autoerotic/sexual asphyxia :

- AKA hypoxiphilia/asphyxiophilia/kotzwarism.
- Asphyxiation → Sexual gratification (Erotic hallucinations).
- m/c in male perverts.
- Form of masochism.
- Other signs at scene of crime : Transvestism.



Sexual asphyxia

- Naked body.

- No suicidal note.

- Pornographic material.

- Transvestism.

Strangulation

00:21:20

----- Active space -----

methods of strangulation :

- Ligature strangulation.
- manual strangulation/Throttling.
- mugging (Elbow/forearm).
- Bansdola (Bamboo).
- Garrotting (Ligature cord).

Ligature Strangulation :

Ligature mark :

- Transverse
- Complete
- Below thyroid cartilage.
- underlying skin shows extensive extravasation of blood.
- Bruising around ligature mark ⊕.

Throttling :

external findings :

- Nail marks.
- Six penny bruises.

Internal findings :

- Extensive soft tissue contusion.
- Adduction # of hyoid.
- Cricoid cartilage #

mugging :

Compression with → Elbow → Carotid choke.
 → Forearm → Air choke (Trachea occluded).



Strangulation ligature mark



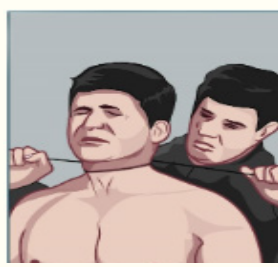
Six penny bruises



Tissue contusion in throttling



mugging



Garrotting



Spanish windlass
(Garrotting variant)



Bansdola
(Bamboo sticks used)

----- Active space -----

Suffocation

1. Smothering :

Closure of mouth & nostrils together.

Accidental :

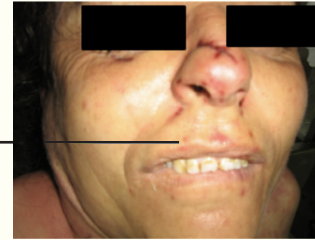
- Children playing with plastic bag.
- Adult falls into pile of sand/mud.

Homicidal :

Intentionally smothering with pillows/hands.

If hands are used, it lead :

1. **Perioral injuries** (Abrasion/bruises)
2. Lip injuries.



2. Gagging :

Thrusting of cloth/pad into mouth

↓
Obstruction of pharynx

↓
Asphyxia



Gagging

3. Choking :

mechanism :

Entry of foreign body into airway

↓
Respiratory distress (Air hunger, gasping)

↓
Asphyxia

management : Heimlich maneuver.



Heimlich maneuver

Cafe coronary syndrome :

- Entry of food bolus into airway → Sudden collapse & death.
- mimics myocardial infarction.
- Risk factors :
 - Elderly
 - Intoxication
- Cause of death : **vagal inhibition** of heart.

4. Traumatic & Positional Asphyxia :

----- Active space -----

Traumatic asphyxia :

- D/t heavy weight on person's chest.
- **masque ecchymotique** : Pale chest with cyanosed face (D/t ↓ venous return)
 - Cyanosis
 - Petechial hemorrhage.
 - Subconjunctival hemorrhage.

Restriction of chest movements

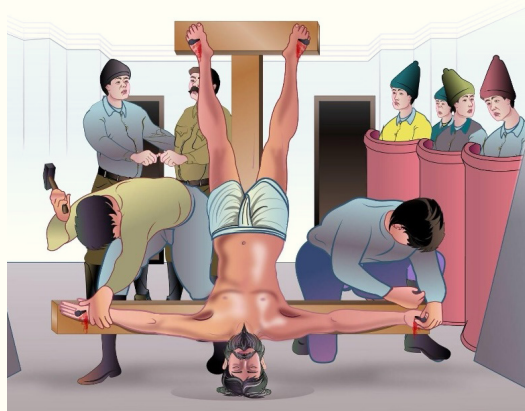
Asphyxia

Positional asphyxia

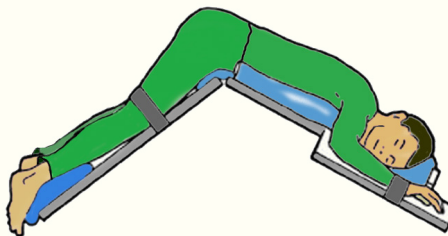
- D/t abnormal position.
- Types :
 - a. **Jack knife.**
 - b. Inverted crucifixion.
 - c. Burking (Smothering + traumatic asphyxia).
 - d. Overlaying



masque ecchymotique



Inverted crucifixion



Jack knife position



Overlaying



Burking

Drowning

00:34:48

most deaths : Accidental.

Types :

Dry drowning : Reflex vocal cord spasm → Blocks air entry.

Wet drowning : Water enters the lung.

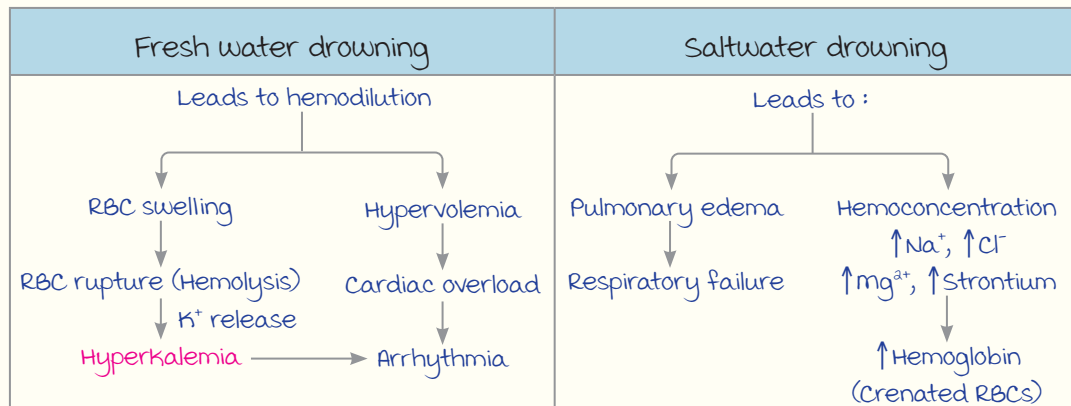
Hydrocution/Immersion syndrome :

Person falls into cold water (5°C below body temperature) → Stimulation of vagus nerve → Bradycardia → Cardiac arrest.

----- Active space ----- Secondary drowning/Post immersion syndrome :
 Person rescued from drowning & then dies d/t complications :

- Electrolyte imbalance.
- Hypoxic ischemic encephalopathy.
- metabolic acidosis.

Mechanism of Drowning :



Autopsy Findings in Antemortem Drowning :

Specific findings :

1. Cadaveric Spasm :
 - Presence of grass/mud tightly clenched in the hands of the victim.
 - **Surest sign of antemortem drowning.**
2. Froth in nostril/mouth : Seen only in violent respiratory struggle ⊕.
 - Features :
 - Fine.
 - Copious.
 - Tenacious (mucoid).
 - Persistent (Even after wiping).
 - **Absence of froth :**
 - Dry drowning.
 - Hydrocution.
 - Unconscious person (Absence of respiratory struggle).



Cadaveric Spasm



Frothing

Non-specific findings :

Can be seen in ante & postmortem drowning.

1. Cutis anserina (Also seen in rigor mortis of erector pili).
2. Washerwoman's hand/feet : Imbibition of water into skin.

- Features :
 - Wrinkling.
 - Bleaching
 - Peeling of cuticle.
 - Soddening
- Indicative of only time since immersion.



Cutis anserina



Washerwoman's foot

Lung changes :

----- Active space -----

Emphysema aquosum : Conscious drowning.

- Voluminous
- Crepitant
- Ballooning out.
- mud particles in lower airway (Specific).

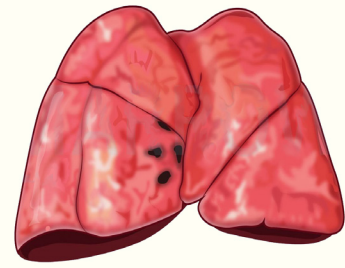
- **Paltauf hemorrhages** : D/t rupture of alveolar wall.
- Emphysematous bullae.
- Frothing (+).

Oedema aquosum : Unconscious drowning.

- Lung edema (+)(+)(+)
- ↓ Frothing

Other findings :

1. Presence of water in
 - Stomach/Intestine
 - Sinuses
 - middle ear
2. middle ear hemorrhages.



Paltauf hemorrhage

Tests for Drowning :

Gettler's test :

Principle : Compare Cl^- concentration of blood in right and left heart chambers.

Inference :

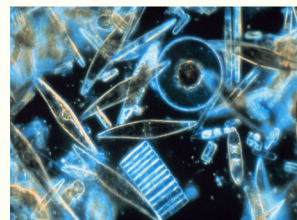
- Normal : Left = Right (Cl^- concentration)
- Wet Drowning : >25% difference between left & right side.

Cl^- concentration	Effect	Drowning type
Rt > Lt	Hemodilution	Freshwater
Lt > Rt	Hemoconcentration	Salt water

Diatom test :

Features of diatom :

- unicellular algae.
- Outer wall has silica : Resistant to heat acid & putrefaction.



Diatoms : microscopy

Microscopy :

- Observation : Presence of diatoms in spleen, heart, bone marrow.
- Inference : Antemortem drowning (Diatoms entered d/t intact circulation).

Drawback : Gettler's & Diatoms test not useful in

1. Dry drowning.
2. Hydrocution.

SEXUAL JURISPRUDENCE AND TRACE EVIDENCE

Terminology :

male	Impotency Inability to achieve & maintain penile erection.	Satyriasis Excessive sexual desire.	Impotence quad hanc Impotence towards one particular woman (Psychological)
Female	Frigidity Sexual coldness.	Nymphomania Excessive sexual desire.	-

Sterility (m/F) : Inability to beget children.

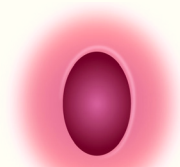
Fecundation ab extra : Conception in a female without penile penetration.

Hymen & Terminologies Related to Pregnancy

00:02:06

Hymen :

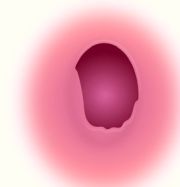
Types :



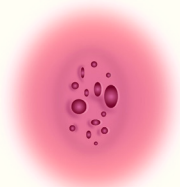
Annular



Septate

Fimbriate :
mistaken for tear.

Semilunar (m/c)



Cribriform



Imperforate

Glaister Keen rods is used for examination of hymen.

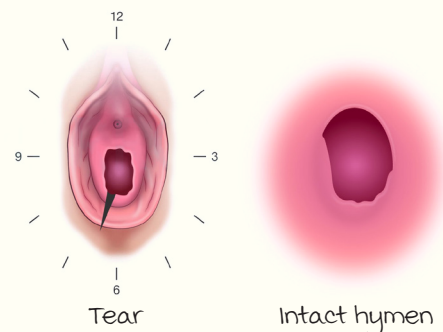
Hymen tear :

- Posterolateral : Penile penetration.
- Anterior : Digital/Foreign body.

Intact hymen :

Intact even after intercourse :

- False virgin : Too elastic/loose/thick.
- Female child : Deep seated.



Terminologies Related to Pregnancy :

----- Active space -----

Phantom/Spurious pregnancy/Pseudocyesis :

- Female believes she's pregnant.
- Presentation :
 - Amenorrhea (D/t hormonal imbalance).
 - Abdominal distension (D/t fat).
 - morning sickness.
- No confirmatory signs.
- On USG :
 - No fetal parts/heart sound.
 - Empty uterus.

Superfecundation vs. Superfetation :

	Superfecundation	Superfetation (Rare)
Fertilisation of	2 ova	2 ova
Ovulatory cycle	Same	Different
Acts of coitus	2	2

Supposititious/Fictitious/Substituted/Forged child :

Female may feign pregnancy & claim some other child as her own.

Atavism : Child resembling grand parents.

Posthumous : Child born after the death of father.

Lochia :

- Sign of recent delivery.
- Lochia rubra → Lochia serosa → Lochia alba.

Infant Death

00:09:50

- under 103 BNS : Amounts to murder.
- Killing of
 - Infant (<1 yr) : Infanticide.
 - Fetus by parents : Filicide.
 - Fetus : Foeticide.
 - Neonate (<24 hr) : Neonaticide.

SIGNS OF A BABY BORN DEAD

External Signs :

- Rigor mortis.
- macerated.
- mummification.

maceration :

- Aseptic autolysis.
- Skin reddening/slippage (Earliest sign : 12 hrs).
- Sweetish disagreeable odour.

----- Active space -----

Radiological Signs :

- **Robert sign** : Gas shadow in great vessels (Aorta, heart : 12 hrs).
- **Ball's sign** : Hyperflexion of spine.
- **Spalding sign** : Overriding of cranial vault bones.

Postmortem Examination :

Autopsy : Abdomen opened first then thorax.

	method	Not respired	Respired
Diaphragm	Check level	3 rd -4 th rib	5 th -6 th rib
Fodere's test	Lung weight measured	30 g	60 g
Plocquet's test	$\frac{\text{Lung weight}}{\text{Baby weight}}$ measured	1 : 70	1 : 35
Wreden's test	middle ear content checked	Gelatinous tissue	Air
Breslau's second life test	Stomach is perforated in water	No air bubble	Air bubble
Raygat's/Hydrostatic test	Lung cut in pieces and put in water	Sink	Floats
	Specific gravity measured (Residual air)	1 : 040	1 : 940

Sexual Offenses

00:18:40

Rape :

- 63 BNS : Definition of rape.
- 64 BNS : Punishment of rape, 10 yrs imprisonment.

Definition :

1. Penetration of penis to → vagina, urethra, anus or mouth.
2. Insertion of object/body part to → vagina, urethra or anus.
3. manipulates any body part of woman to cause penetration to } → vagina, urethra, anus or part of body.
4. Application of mouth to or makes her to do so to } → vagina, urethra, anus of a woman.

- i. Against her will.
- ii. Without her consent.
- iii. Consent obtained due to fear of death or hurt.
- iv. Consent due to misrepresentation of facts/fraud/impersonation.
- v. Consent due to unsoundness of mind or intoxication/stupefying substance.
- vi. Age <18 y.
- vii. When she is unable to communicate consent.

Statutory rape : victim age <18 yr (minimum age of consent).

----- Active space -----

In-camera trial :

- Closed court room proceedings for rape cases.
- Under 366 (a) BNSS.

Medical Examination :

	Accused	Victim
Section	52 BNSS	184 BNSS
Consent	Not mandatory	mandatory
Tests	Lugol's iodine test : <ul style="list-style-type: none"> • Detects vaginal epithelial cells. • Swab from penis shaft is exposed to iodine paper : Brown color. • upto 4 days. 	<ul style="list-style-type: none"> • Toluidine blue test : Recent microinjuries. • motile sperm (6-12hr) : Recent rape.

• Preservation of samples :

- Sperm : 3 days.
- Semen : 4 days.

• <18 yrs : Only by female medical practitioner in the presence of guardian/parent.

Unnatural Sexual Offenses :

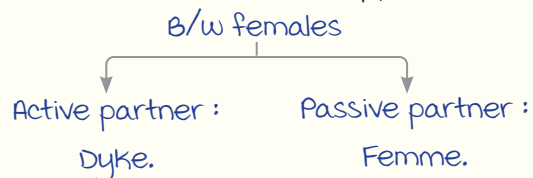
Not punishable under BNS now.

Incest :

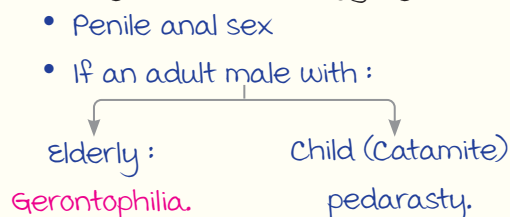
Sex b/w family members, not punishable in India if consensual b/w adults.

- Oedipus complex : mother & son.
- Electra complex : Father & daughter.
- Pharoan complex : Brother & sister.

Lesbianism/Tribadism/Sapphism :



Sodomy/Greek love/Buggery :



Buccal coitus/Oral sex/Sin of Gomorrah :

Oral stimulation of :

- Penis : Fellatio.
- Vagina : Cunnilingus.

Bestiality : Intercourse with lower animals.

----- Active space -----

Sexual Perversions :

Sexual gratification without intercourse.

Paraphilia	mode of sexual gratification	
Sadism/Allogagnia	By inflicting pain/physical cruelty.	
Masochism/Passive algolagnia	By receiving painful stimulus from opposite partner.	
Lust murder	By killing victim.	
Bondage	Sadist + masochist.	
Transvestism/Transexism	By wearing dress of opposite sex.	
Exhibitionism	<ul style="list-style-type: none"> • Recurrent, intense, sexual urge to expose ones genital to an unsuspecting stranger. • Punishable under 296 BNS : <ul style="list-style-type: none"> - Streaking : Publicly runs nude. - mooning : Shows gluteal region. - Flashing : Suddenly undressing & exposing private parts. 	
voyeurism/Scotophilia	<ul style="list-style-type: none"> • Watching private acts of unsuspecting female (Peeping tom) • Punishable under 77 BNS. 	
Fetichism	with inanimate objects/non-living things.	
Frotteurism	<ul style="list-style-type: none"> • Rubbing genitalia against non-consenting person in public. • Punishable under 75 BNS. 	
Scatalogia	Talking obscenity.	
Klismaphilia	Taking enema.	
urophilia/undinism	Sight/smell/thought of wine.	
Coprophilia	Sight/smell/thought of feces.	
Ecouterism	Listening to sounds a/w sexual intercourse.	
Necrophilia	Intercourse with dead body.	Punishable under 301 BNS.
Necrophagia	Eating dead body.	

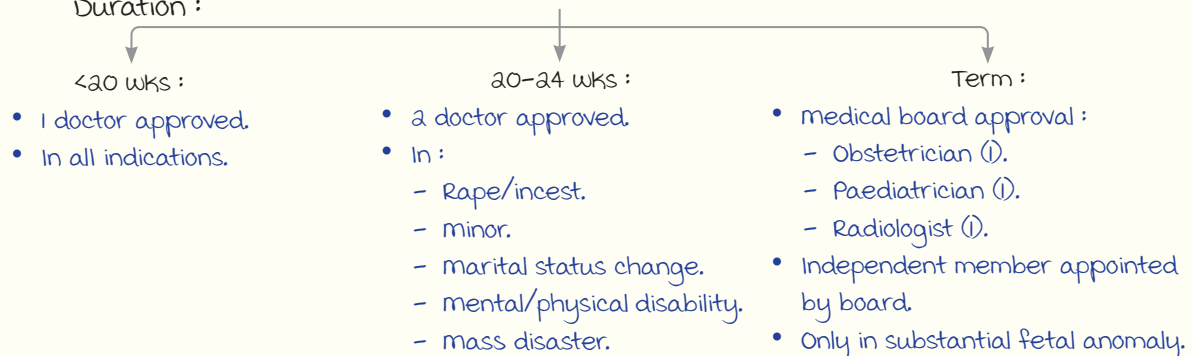
MTP (Amendment) Act 2021

00:34:34

Indications :

- Eugenic : Fetal abnormalities.
- Therapeutic : maternal disease.
- Social : Failure of contraception.
- Humanitarian : Rape/Incest.

Duration :



MTP records :

- Preserve it for 5 years.
- To be forwarded monthly to district CMO.
- Strictly confidential : violation punishable.

Consent for MTP :

- min age >18 yrs.
- <18 yrs/mentally ill : Consent of guardian.
- No need for spouse consent.

----- Active space -----

Criminal abortion/unlawful abortion/voluntary miscarriage :

- 88 [P] : **with** consent of female.
- 89 [P] : **without** consent of female.
- 90 [P] : with/without consent, resulted in **death** of female.

Evidence Collection

00:41:20

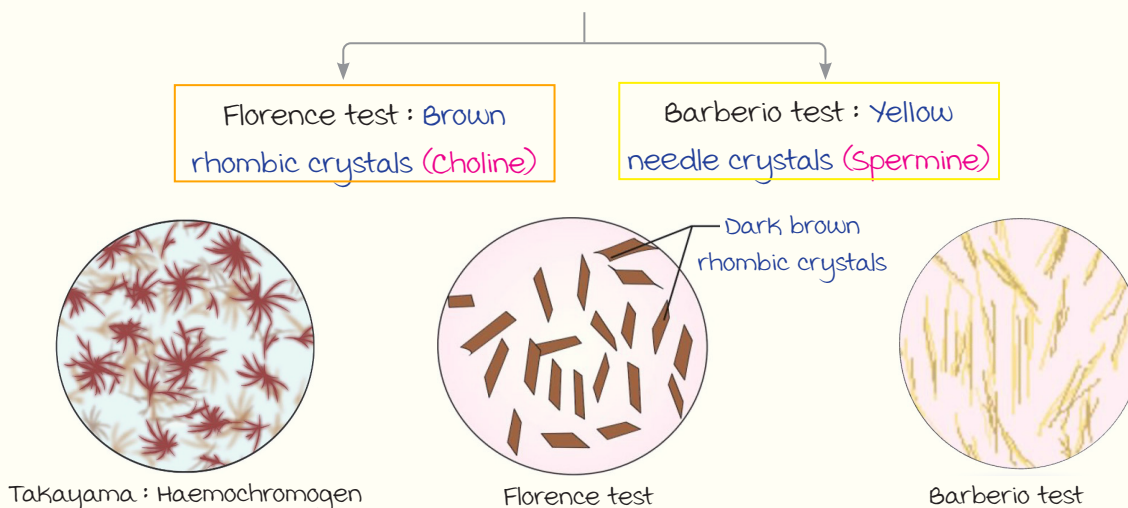
Test for Blood Stains :

Presumptive tests		Confirmatory test
Color test	Luminescent test	
<p>Benzidine test : Blue color → (+)</p> <p>Phenolphthaleins test/Kastle myer test : Pink color → (+)</p>	<p>To detect blood even if it has been washed off :</p> <ul style="list-style-type: none"> • Luminol spray. • uv light. 	<p>Teichman's test : Brown rhombic crystal (Haemin).</p> <p>Takayama test : Pink feathery crystal (Haemochromogen)</p> <p>Absorption spectrometry (most reliable) : Recent/old stains</p>

Species/Origin of sample :

- **Precipitin test.**
- DNA analysis.

Tests for Seminal Stains :



TOXICOLOGY : PART 1

Toxicology : Study of poisons.

Toxinology : Study of toxin (Biological substance).

Poisoning

00:01:00

Identification of Poisons Based on Smell :

Autopsy performed by opening cranial cavity first (Helps identify poison by smell).

Smell	Poison
Garlic	Arsenic/Phosphorus/Aluminium phosphate/OPC
Bitter almond	Cyanide
Burnt rope	Cannabis
Acrid pear	Chloral hydrate
Fruity	Alcohol/Acetone
Rotten egg	Hydrogen sulphide
Kerosene	Organophosphorous Compounds (OPC) : Smell d/t aromax

Duties of a Doctor in Poisoning Case :

Legal duties :

- Compulsory duty.
- Preserve the evidence.
- Police intimation (33 BNSS).

Punishments :

- Disappearance of evidence : [P] 238 BNS.
- Failure to inform police : [P] 211 BNS.
- False information provided : [P] 212 BNS.

medical duty :

Done 1st and then legal duties are taken up.

Stabilization & treatment :

- **Decontamination** : Removal of **unabsorbed poisons**
 - ↓
 - Gastric lavage : Oral poisons & morphine.
- Removal of **absorbed poisons** :
 - Hemodialysis.
 - ↑ urinary excretion of poisons.
 - **Multidose activated charcoal** : For drugs undergoing enterohepatic circulation.
- **Antidote** : Neutralize poison.

Note :

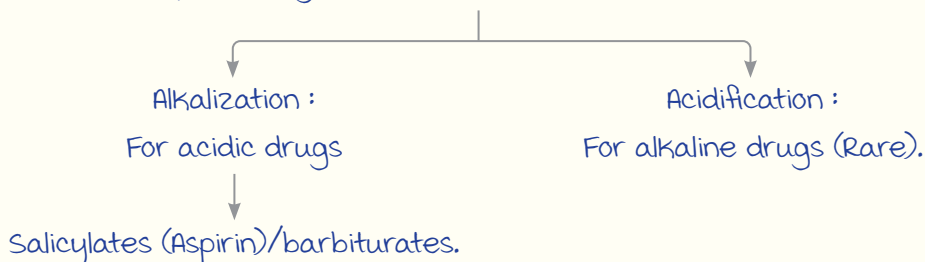
most rapid route of absorption of poison : Inhalational.

Gastric lavage :

----- Active space -----

- Absolute contraindication :
Corrosives → D/t perforation (Except carbolic acid : Leathery mucosa).
- Relative contraindications :
 - Coma.
 - volatile (Kerosene, hydrocarbon). } Aspiration pneumonitis
 - Convulsant (Strychnos) : Precipitate convulsion (Can use once stabilized).

Urinary excretion of poisons by :



Antidotes :

Poison	Antidote
Arsenic	BAL (Dimercaprol), DMSA
Copper	D-penicillamine, DMSA
Iron	Desferrioxamine
Lead	mild - moderate EDTA
	Severe EDTA + BAL/DMSA
mercury	DMSA, BAL
Cadmium	DMSA
Cocaine	Amyl nitrite
Beta blocker	Glucagon
Carbon monoxide	moderate High flow oxygen
	Severe Hyperbaric oxygen (Causes barotrauma)
Cyanide	Hydroxocobalamin (DOC), Nitrates (Induces methHb)
Digitalis	Digibind
morphine	Naloxone sodium
methanol	Fomepizole + Ethanol
Ethylene glycol	

EDTA :

- ↑ Renal excretion of poison.
- C/I in renal failure.

C/I of BAL :

- Organic mercury.
- Iron.
- Cadmium.

Eli Lilly's Kit :

- Amyl nitrite.
- Sodium nitrite. } methHb
- Sodium thiosulphate.

morphine poisoning features :

- Coma.
- Pinpoint pupil.
- Respiratory depression.
- Hypothermia.
- Hypotension.

----- Active space -----

Poison	Antidote
OPC (⊖ AChE irreversibly)	Atropine + Oxime
Carbamates (⊖ AChE reversibly)	Atropine
Organochlorine (Endrin, DDT)	Only supportive
Pyrethroids	
Oxalic acid ($\downarrow Ca^{2+}$)	IV calcium gluconate
Hydrofluoric acid ($\downarrow Ca^{2+}$, $\downarrow Mg^{2+}$, $\uparrow K^+$)	
Ethylene glycol ($\downarrow Ca^{2+}$)	
Benzodiazepine	Flumazenil
Acetaminophen	N-acetyl cystine

OP Poisoning :

- Oximes can only be given with atropine (worsen poisoning if given alone).
- Atropinisation (Airway secretions are dried & clear) : Stop atropine.

Celphos : $\downarrow mg$.

Barium carbonate : (Rat poison).

- White, odourless.
- $\downarrow K^+$.

Corrosives

00:26:40

Acids \rightarrow Coagulative necrosis

(except hydrofluoric acid)

Alkali : Liquefactive necrosis.

Sulphuric Acid :

- Carbonisation : Black necrotic tongue, stomach mucosa, skin.
- Hygroscopic action : Chalky white teeth.



Phenol

Nitric Acid :

- Nitric acid + tissue \rightarrow Picric acid.
(xanthoproteic reaction)
- Yellow discoloration of skin, teeth, mucosa

 H_2SO_4 

Nitric acid

vitriolage :

- Acid attack, punishable under 124 BNS.
- Free first aid/ treatment compulsory.
- Police intimation to be done.

Failure, punishable
under 397 BNSS

Failure to Rx victims of :

- Acid attack
- POCSO
- Rape

Carbolic Acid/Phenol :

- Absorbed by all routes.
- Disinfectant : Delay in putrefaction
- Ingestion $\xrightarrow[\text{Stomach mucosa}]{\text{Leathery/buff white}}$ Liver metabolises

CNS depression/convulsion,
constricted pupil.

- Pyrocatechol
- Hydroquinone

- Urine : Carboluria (Olive green).
- Renal tubular damage.

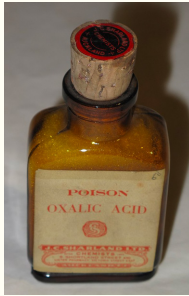
Black tissue deposits : Ochronosis.

Oxalic Acid :

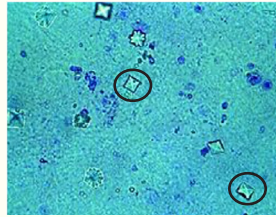
----- Active space -----

- Acid of sugar.
- Seen in ink/stain remover.
- Oxalic acid + calcium (In the blood)
 - Hypocalcemia → Tetany
 - Calcium oxalate crystals

• Oxaluria
 • Renal tubular necrosis
 } D/t cast in urine.



Oxalic acid



Dumbbell/postal-envelope shaped casts

Irritants : Non-metallic, metals, plants, animals.

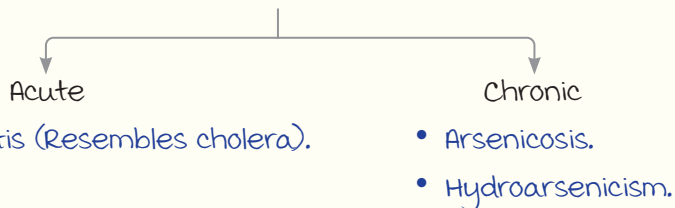
Metallic Irritants

00:37:03

- Accumulate in body.
- Removed by chelating agents.
- m/c acute heavy metal poisoning : Arsenic.
- m/c chronic heavy metal poisoning : Lead.
- Lead poisoning route :
 - Children : Oral.
 - Adult : Occupational inhalation.

Arsenic :

- metalloid.



Arsenicosis

mnemonic : **ARSENIC** Poisoning.

- Aldrich mees lines : Transverse white line in nail (Also in thallium).
- Alopecia.
- Raindrop pigmentation : In skin flexors.
- Skin eruption : Hyperkeratosis in palms & soles.
- Neuropathy : Symmetrical, peripheral, sensory motor polyneuropathy.
- Ischemia (Periphery) : Gangrene (Black foot disease).



Aldrich mees line



Pigmentation

----- Active space -----

- Carcinogenic.
- Pancytopenia : Bone marrow suppression.

Samples :

- Urine (Reliable) > Blood.
- Bone, nail, hair.
- Detected in exhumed bodies, cremated remains, decomposed bodies.

Tests :

- March test.
- Reinsch test.
- Neutron activation analysis.
- Atomic absorption spectrometry. } New

Note : Endrin poison is also detected in exhumed bodies.

Mercury :

Occupation : Hatters, Glassblowers.

Types :

Elemental :

- Not orally absorbed.
- Vapour : Toxic.

Toxicity :

- Slate grey stomach mucosa.
- Chronic toxicity/Hydrargyris (mnemonic : METAL).
 - Minamata disease : Fish consumption (methyl Hg).
 - Erethism : Neuropsychiatric (mad hatter syndrome).
 - Tremors : Coarse intentional tremors (Glassblowers/hatters shakes).
 - Acrodynia : Pink disease (Calomel/swift fever disease).
 - Lentis : Anterior capsule brownish deposit (malt brown reflex) → vision isn't affected.



Acrodynia

- Pink, peeling.
- Painful peripheries.
- Calomel/swift fever disease.
- Usually paediatric.

Note :

Blue stomach :

- Copper sulphate.
- Sodium amygdal.

Lead :

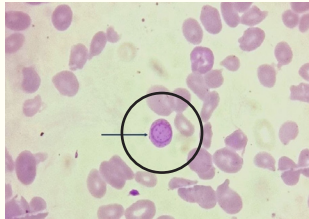
Chronic lead poisoning/Saturnism :

Mnemonic : ABCDEFG

- Anemia : ⊖ Heme synthesis (microcytic hypochromic anemia)
 - (⊖ ALA dehydratase, ⊖ Coproporphyrinogen oxidase, ⊖ Ferrochelatase).
- Basophilic stippling of RBC : ⊖ 5 pyrimidine nucleotidase.

----- Active space -----

- **Burtonian lines** : Bluish deposition in gums of caries teeth.
- **Bone line (Calcium deposition)** : **metaphyseal** dense opacity.
- **Colics, constipation** : **Painter's colic/Saturnine colic/Dry belly ache.**
- **Cabot ring** : Inclusion body.
- **Drop (motor nerve palsy)** : wrist drop, foot drop.
- **Encephalopathy.**
- **Facial pallor (Circumoral)** : **most consistent finding.**
- **Gout** : **Saturnine gout.**



Basophilic inclusions



Burtonian lines



Bone line

Sample : Blood (Reliable) > urine.

Note : Burtonian lines also in

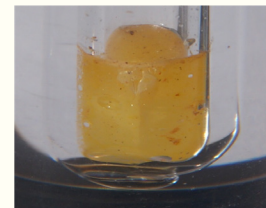
- mercury.
- Copper.
- Lead.

Non Metallic

00:52:37

White Phosphorus :

- Toxic
- Emit fumes : **Spontaneous combustion**
- Luminous
- Garlic odor



white phosphorus

Red Phosphorus :

Not toxic.

Acute poisoning :

- **Smoky stool** syndrome.
- vomitus and stool **luminescent.**



Red phosphorus

Chronic poisoning:

- **Phossy jaw/Glow jaw/Lucifer jaw.**
- Occupational inhalational disease.
- Osteomyelitis → Osteonecrosis of jaw.
 - Painful.
 - Swelling.
 - multiple discharging sinus : **Garlicky odor.**



Phossy jaw

TOXICOLOGY : PART 2

----- Active space -----

Plant Toxins

00:00:18

Toxic Seeds :

Plant/Seed	Active principle	Features
Ricinus communis Castor/Arandi	Ricin (Biological weapon)	Crushed seeds : • Oil not toxic • Residue (Toxic)
Abrus precatorius • Gunchi • Rati seeds • Rosary • Crab's eye	• Abrin • Abralin • Abrine • Abric acid	• Powdered seeds ↓ Sui/sin needles • Ideal cattle poison (Resembles viperine bite)
Semicarpus anacardium • Bhilawa • marking nut • Dhobi's nut	• Semecarpol • Bhilawanol	• Crushed seed : Black juice. • Used for malingering : Artificial bruise (Develop blisters).
Croton tiglium Jamal gota	• Crotin • Crotonoside • Crotonic acid	• Crushed seed : Oil & residue both toxic. • Acute onset diarrhea. • Gastroenteritis.
Calotropis madar/Akdo	• Calotropin • Calotoxin • Calactin	All parts toxic
Capsicum annum	• Capsicin • Capsaicin	• Hunan's syndrome : Contact dermatitis (Occupational).



Calotropis



Capsicum annum



Papaver somniferum



Seeds (Non toxic)



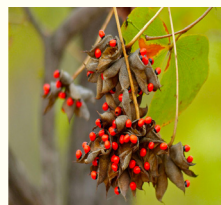
Unripe capsule



Semicarpus anacardium



Croton tiglium



Abrus precatorius



Ricinus communis

True vs. Artificial bruise :

	True	Artificial
Vesicles	Absent	Present
Colour	Changes with time	-
margins	Diffuse irregular	Regular
Itching	⊖	⊕



True bruise



Artificial bruise

----- Active space -----

Somniferous Plants :

Papaver somniferum (Opium) :

- AKA **AFm**/madak.
- Sleep-inducing.
- milky exudate from **unripe capsule** → crude opium.
- morphine poisoning features.
- Antidote : **Naloxone sodium**.

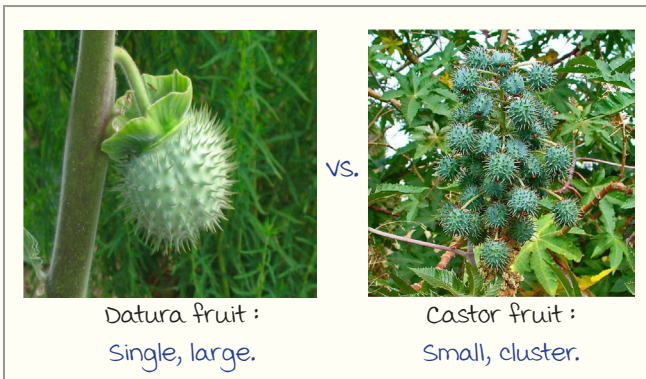
Heroin :

- AKA **Smack**/junk/brown sugar/tar.
- Constituent : **Diacetyl** morphine.
- Semisynthetic derivative of morphine.
- Highly addictive.
- Routes of abuse :
 - Inhaling vapour : Chasing the dragon.
 - Inject into vein : main lining.
 - Inject to skin : Skin popping.
 - **Speed ball** : CNS stimulant (Cocaine) + CNS depressant (Heroin).

Deliriant :

Datura :

- **muttering delirium**.
- Active principle :
 - **Hyoscine**.
 - Atropine.
- **Anticholinergic** symptoms :
 - Dilated pupil.
 - Dried secretion.
 - Delirium.
- Roots & seeds **most toxic**.
- Fruit : Thorn apple contains seeds.
- **Stupefying agent** :
 - Railway poison.
 - Road ride poison.
- Antidote : Physostigmine.



Datura fruit :
Single, large.

Castor fruit :
Small, cluster.



Datura seeds :

- Dark brown.
- Thick, rough.
- Kidney-shaped.
- Odourless.

Chilli seeds :

- Yellow.
- Thin, smooth.
- Oval-shaped.
- Pungent smell.

Cannabis :

- **m/c** used illegal substance.
- AKA **Grass**/Rope/Hash/Joint/Weed/Indian hemp/MJ/marijuana.
- Active principle : Tetrahydrocannabinol (**THC**).

----- Active space -----

Part of plant	Preparation	Active principal %
Dried leaves	Bhang	< 15 %
Dried flower (Female plant)	Ganja (Joint/Reefer)	15 - 25 %
Dried resin	Charas/Hashish	25 - 40 %
Resin	Hash oil	60 - 70 %



Cannabis

- Chronic cannabis abuse :

Mnemonic : **AIR**.

- Amotivational syndrome.

- Insanity : **Hashish/Hemp** insanity. } Not criminally liable : **22 BNSS**.

- **Run amok** : Homicidal impulse.

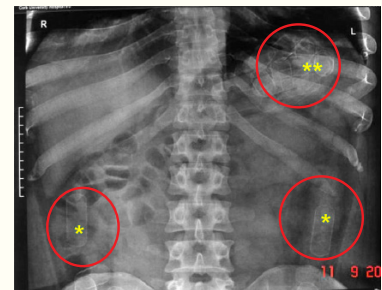
Cocaine :

- Excited delirium**.
- AKA Coke/snow white lady/she/crack smokable.
- m/c route of abuse : Snorting.
- Acute poisoning : **Body packer** syndrome.
 - Accidental rupture of swallowed cocaine (Smuggling).
 - Sympathomimetic** action (↑HR, ↑BP, ↑temp, ↑sweating, **dilated pupils**).
 - Feeling of well-being.
- Chronic abuse :
 - Septal perforation (snorting).
 - Black staining : Tongue/Teeth.
 - Peripheral gangrene (peripheral vasoconstriction).
 - Cocaine bugs/magnan** syndrome/**formication**.
 - Tactile hallucination.



Erythroxylum coca leaves

↓
Cocaine powder



CT : Cocaine packets

Inebriant

00:23:18

- CNS depressants.
- Order of toxicity : Ethanol < methanol < Isopropyl alcohol.
- Effects : male < Female (D/t ↓water, ↑fat).

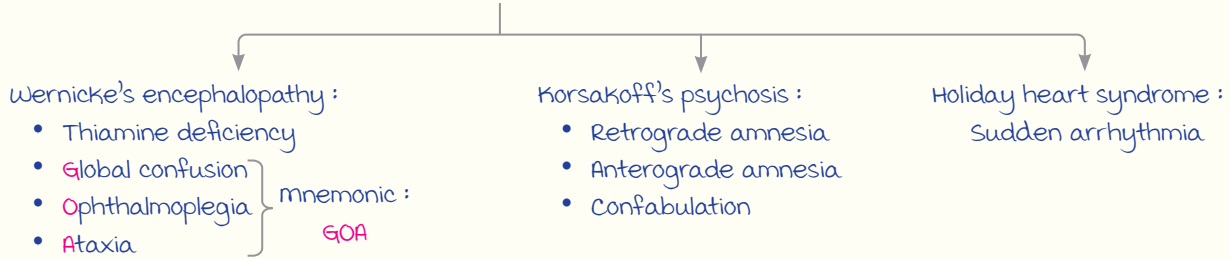
Ethanol :

----- Active space -----

Issue of drunkenness certificate :

Smell of alcohol	motor coordination	Opinion
⊖	Normal	Not consumed alcohol
⊕	Normal	Consumed alcohol but no influence
⊕	Abnormal	Consumed alcohol and under influence

Complications of chronic alcohol consumption :



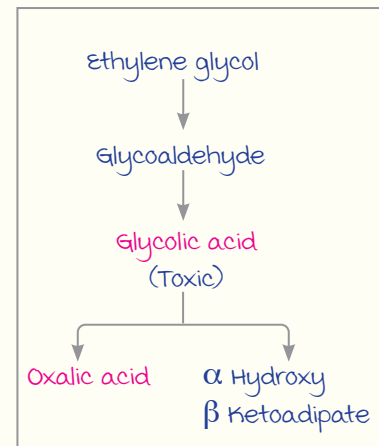
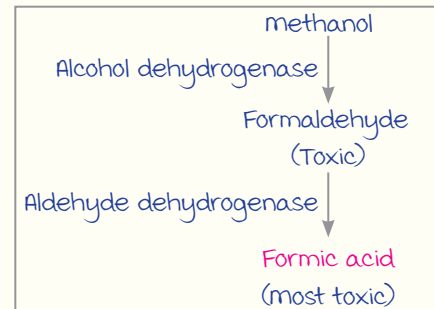
Note :

Punishment for crime under :

- Involuntary intoxication → Not liable : 23 BNS.
- Voluntary intoxication → Liable : 24 BNS.

methanol :

- Illicit liquor, AKA wood alcohol.
- mass poisoning : Hooch tragedy.
- Symptoms :
 - Abdominal pain/vomiting.
 - Blurring of vision.
 - Blindness (Optic atrophy).
- High anionic gap metabolic acidosis (HAGMA).
- Antidote :
 - Fomepizole (⊖ Alcohol dehydrogenase).
 - Ethanol.



Ethylene Glycol :

- Anti-freeze solution.
- Oxalic acid :
 - Hypocalcemia.
 - urine cast.
 - Renal tubular damage.
- Treatment :
 - Fomepizol.
 - Ethanol.
 - Calcium gluconate.

----- Active space -----

Spinal and Cardiac Poisons

00:31:13

Spinal Poison :

Strychnos Nux Vomica :

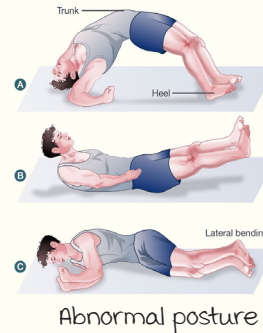
- AKA Kuchila.
- Even 1 crushed seed is fatal.
- Active principle :
 - Strychnine (most potent).
 - Brucine.
 - Loganine.
- Acts on anterior horn cell (\ominus Glycine) \rightarrow muscle convulsions \rightarrow Post-mortem (Resembles tetanus) clonicity (Autopsy).
- Alternate spells of convulsions $\&$ relaxation with progressive \uparrow in convulsions $\&$ \downarrow in relaxation period.
- Consciousness intact.
- Presentation :
 - Risus sardonius.
 - Opisthotonus (m/c) (A) : Backward hyperextended spine.
 - Emprosthotonus (B) : Forward hyperflexed spine.
 - Pleurosthotonus (C) : Lateral flexion of spine.



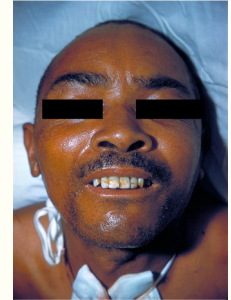
Seed



Flower



Abnormal posture



Risus sardonius

Cardiac Poisons :

Mnemonic : Car DONA (Digitalis, Oleander, Nicotine, Aconite).

Aconite :

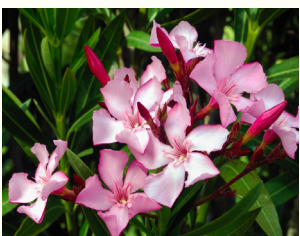
- AKA blue rocket/mita zaher/Devil's helmet.
- Active principle : Aconitine.
- All parts toxic, most toxic : Root.
- Perioral paraesthesia.



Aconite plant



Roots of aconite



Nerium odorum : Pink oleander



Cerbera thevetia : Yellow oleander



Digitalis : Fox glove

Asphyxiants

00:37:30

----- Active space -----

Chemical Asphyxiants :

Carbon monoxide (CO), Cyanide, Hydrogen sulfide.

	CO	Cyanide
About	Gas, lighter than air.	<ul style="list-style-type: none"> Hydrogen cyanide (gas) : most rapid onset of action. Hydrocyanic acid (liquid). Potassium & sodium cyanide (salts).
Smell	Odorless.	Bitter almond smell.
Pathology	most affinity to Hb ↓ ↓ Oxygen binding to Hb ↓ Anemic anoxia.	more affinity to Fe ³⁺ ↓ ⊖ Cytochrome oxidase (ETC) ↓ Histotoxic anoxia
Treatment	High flow/ Hyperbaric oxygen.	<ul style="list-style-type: none"> Hydroxycobalamine. Nitrites (Lily's kit).
Color of hypostasis	Cherry red	Brick red

Snake Venom

00:42:53

Ophiology : Study of snakes.

Ophiotoxemia : Envenomation (By snake venom).

Venomous vs Non-venomous Snake :

	Venomous	Non-venomous
Head scales	Usually small Except cobra & krait	usually large
Belly scales	Large & cover entire breadth of the belly	Small & never cover entire breadth of the belly
Tail	Compressed	Not markedly compressed
Bite	2 long marks	Small teeth marks in a row
Lives	Nocturnal	Diurnal

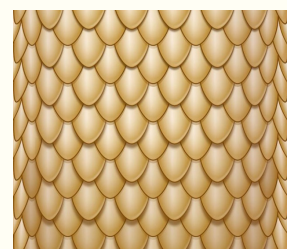
Note :

Large scaled venomous snake :

- Cobra : 3rd supra labial scale largest.
- Krait : 4th infra labial scale largest.



Venomous snake belly scale



Non-venomous snake belly scale

----- Active space ----- Venomous snakes :

	Elapidae	Viperidae	Hydrophidae
Snakes	<ul style="list-style-type: none"> King cobra Common cobra Krait 	<ul style="list-style-type: none"> Russell's viper Saw scaled viper 	Sea snake
Venom	Neurotoxic	Haemotoxic	myotoxic
Clinical	Neuromuscular paralysis	Disseminated intravascular coagulation	<ul style="list-style-type: none"> myonecrosis/Renal failure Hyperkalemia



Naja naja :

- Common cobra.
- Short (4 feet).
- Spectacle mark near hood.



Ophiophagus hannah :

- King cobra.
- Long (20 feet).



Dabio russeli :

- Russels viper.
- Diamond shape marks, one on top, 2 on the sides.



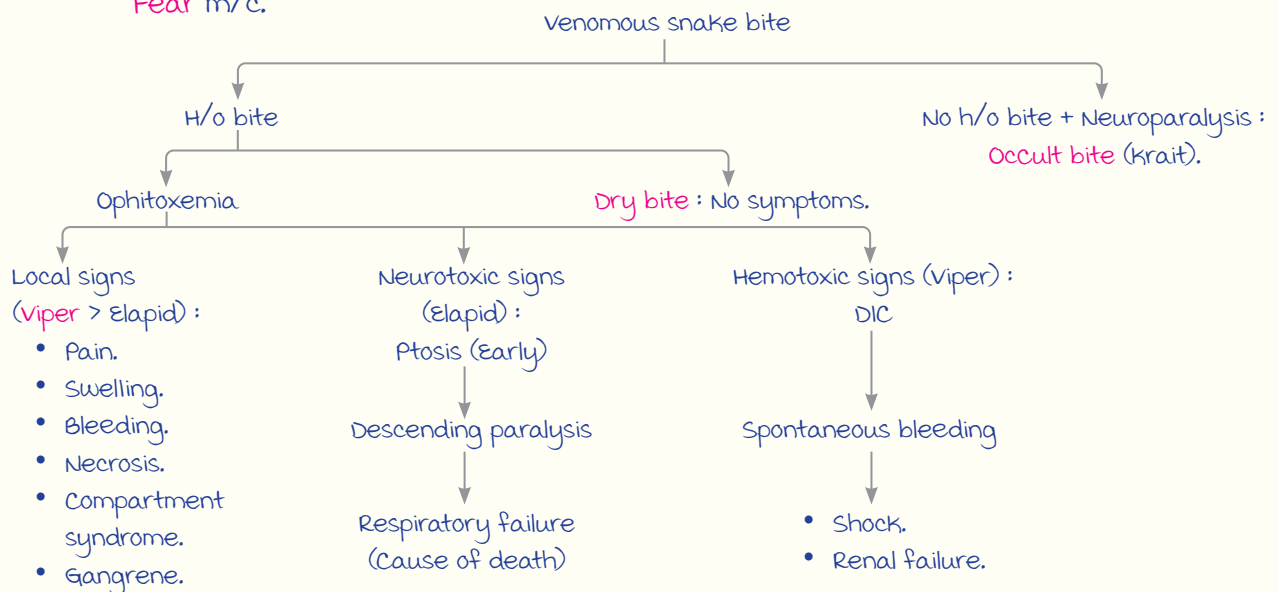
Echnis carinate :
Saw scaled viper.



Bungarus ceruleus :
• Common krait.
• Hexagonal scales.

Clinical Presentation :

Fear m/c.



20 min whole blood clotting test (WBCT) :

Collect 2ml blood in a test tube

- Normal/elapid bite : clot within 20 mins.
- Viper bite : no clot even after 20 mins.

MANAGEMENT OF SNAKE BITE

1st aid :

mnemonic : RIGHT

- Reassure patient.
- Immobilize entire limb : Sutherland's wrap / crepe bandage/cloth.
 - To occlude lymphatics.
 - Never use ligation/incision/tourniquet.
- Get to hospital immediately.
- Tell doctor about any systemic symptoms that manifested on the way.

At hospital :

- Observation
- Anti-snake venom :
 - Only if ophitoxemia (ASV can precipitate anaphylaxis).
 - No test dose (But continuous monitoring).
 - IV 8 - 10 vials.
 - Effective for "Big 4" (Common cobra, Krait, Russell's viper, Saw-scaled viper).
- IV Neostigmine + Atropine.



Ptosis in elapidae bite



Spontaneous bleeding in viper bite

----- Active space -----

Scorpion

00:58:15

Indian red scorpion > Black scorpion.

Venom : Neurotoxic & hemotoxic.

Pain : main clinical feature.

Autonomic storm (children) :

- Cholinergic :
 - Sweating, salivation.
 - Priapism.
 - Hypotension.
 - Cold extremities.



Black scorpion

----- Active space -----

- Adrenergic :
 - Hypertension.
 - Tachycardia.
 - myocardial infarction, Pulmonary edema.
 - Oliguria.
- Treatment :
 - Prazosin.
 - Anti-scorpion venom.



Red scorpion

Organophosphorous (OP) Poisoning

01:01:20

Cholinergic syndrome (< 1 day) :

- Muscarinic :
 - mnemonic : **DUMBELS**
 - Diarrhea.
 - Urination.
 - miosis.
 - Bradycardia.
 - Bronchorrhea/spasm.
 - Emesis.
 - Lacrimation.
 - Salivation.
- Nicotinic :
 - Irritability.
 - Confusion.
 - Convulsion.
 - muscle paralysis
- Treatment :
 - Atropine (Specific).
 - Oxime.

D/t incomplete treatment Slow release of OP back to system
from adipose tissue

Intermediate syndrome (1 - 4 days) :

- Proximal muscle weakness
- Cranial nerve palsy

Delayed syndrome (1-4 weeks) :

Distal neuropathies.

Ix : **RBC cholinesterase** >
Pseudocholinesterase.
Rx : Supportive measures.

LEGAL SECTION

----- Active space -----

Key : [P] → Punishment; [D] → Definition.

BNS : Bharatiya Nyaya Sanhita (Definition & punishment of offense).

BNS : Bharatiya Nagarik Suraksha Sanhita (Procedure).

Criminal Responsibility, Consent & Male Offenses

00:00:37

Criminal Responsibility :

20 : Crime done by person <7 years → Not liable.

21 : Crime done by person 7-12 years → Punishable only if mentally mature.

22 : Crime done by insane person → Not liable (Mc Naughton's rule).

23 : Crime done under involuntary drunkenness → Not liable.

24 : Crime done under voluntary drunkenness → Liable.

Note :

Rules a/w criminal responsibility for mentally ill :

- McNaughten's rule.
- Durham's rule.
- Curren's rule.
- Irresistible impulse test.
- American law institutes.

Consent :

min age : 12 yrs.

For major procedures : 18 yrs.

Act done in good faith for benefit of a person without consent : Emergency
(BNS 30).

male Offenses [P & D] :

74 [P] : Indecent assault (Act outraging modesty of a woman), punishable.

75 [D & P] : Sexual assault (Touching female inappropriately, forcibly showing pornography, demanding sexual favors).

77 [D & P] : Voyeurism.

78 [D & P] : Stalking.

80 [P] : Dowry death.

----- Active space -----

Homicide, Hurt & Medical Negligence

00:03:54

Homicide :

100 [D] : Culpable homicide.

101 [D] : Culpable homicide.

- Amounting to murder.
- Not amounting to murder.

103 [P] : murder.

106 [P] : Patient dies due to medical negligence.

Hurt :

114 [D] : Hurt.

115 [P] : voluntarily causing hurt.

116 [D] : Grievous hurt

- a. Emasculation.
- b. Permanent privation of the sight of either eye.
- c. Permanent privation of the hearing of either ear.
- d. Privation of any member or joint.
- e. Destruction or permanent impairing of any member or joint.
- f. Permanent disfiguration of the head or face.
- g. Fracture or dislocation of bone or tooth.
- h. Any hurt which :
 - Endangers life or
 - which causes the sufferer in severe bodily pain or unable to follow his daily ordinary pursuits for **15 days**.

117 [P] : voluntarily causing grievous hurt.

118 (1) [P] : voluntarily causing hurt with dangerous weapon/means.

118 (2) [P] : voluntarily causing grievous hurt with dangerous weapon/means.

124 [P] : vitriolage (Acid attack).

medical Negligence :

271 [P] : Negligent act resulting in spread of fatal infections.

272 [P] : malignant act resulting in spread of fatal infections (Intentional).