Medicolegal Autopsy:

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Autopsy / Necropsy: postmortem examination of a body.

→ autopsy must always be complete ⇒ all body cavities should be opened & every organ must be examined.

Types of Autopsy:

1] Pathological Autopsy / Hospital Autopsy:

→ done for academic / research, etc.

→ no legal issue involved.

→ permission of relatives is required.

2] Medicolegal Autopsy:

→ done in case of legal issues (homicide / accident / suicide / suspicious death)

→ any registered medical practitioner (RMP) can conduct a medicolegal autopsy on the request of the investigating officer.

→ permission of relatives is not required.

Objectives of Autopsy:

1] To find out the cause of death (natural / unnatural).

2] To find out how the injuries occured.

3] To find out the manner of death (accidental / suicidal / homicidal).

4] To find out the time since death.

5] To establish identity when not known.

6] To collect physical evidence in order to identify the object causing death & to identify the criminal.

7] To retain relevant organs & tissues as evidence.

8] In newborn infants → determining live birth & viability.

Skin Incisions: 3 types of primary incisions:

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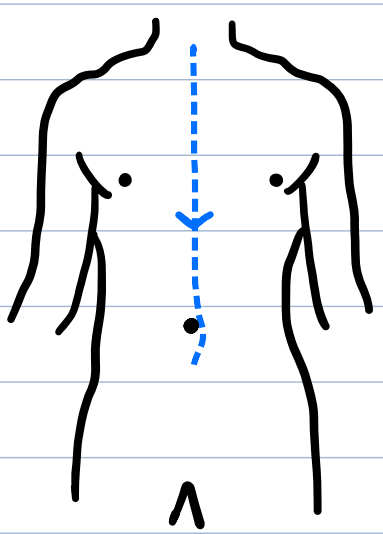
1] I-shaped Incision: from chin to symphysis pubis, passing either to the left/right of umbilicus.

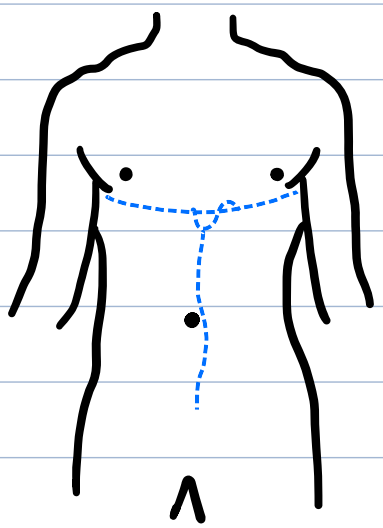
2] Y-shaped Incision: begins at a point close to the acromial process → extends downwards below the breast & across the xiphoid process → similar incision on the opposite side of the body → incision is carried downward from xiphoid process to pubic symphysis.

3] Modified Y-shaped Incision: incision in midline from suprasternal notch to pubic symphisis

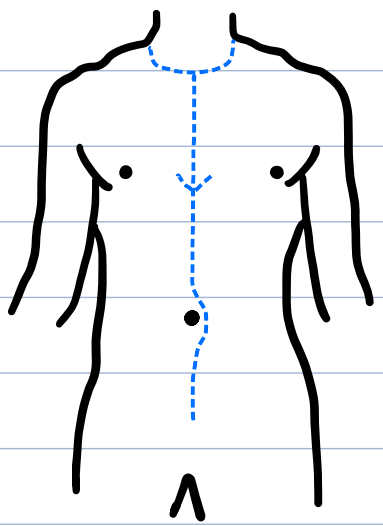
→ incision extends from suprasternal notch over the clavicle to its centre on both sides & then passes upwards over the neck behind the ear.



I-shaped



Y-shaped



Modified Y-shaped

Method of Removal of Organs:

1] Virchow's technique: individual organs are removed one by one.

→ cranial cavity is exposed first → thoracic → cervical → abdominal organs

→ anatomico-pathologic relations are not preserved.

2] **Rokitansky's technique:** involves in-situ dissection in part combined with en block removal.

→ preferred choice in patients with highly transmissable diseases (HIV, Hep B.)

3] **Lettulle's technique:** Cervical, thoracic, abdominal & pelvic organs are removed en masse & dissected as organ block.

→ It has the advantage of leaving all attachments intact.

4] **Ghon's technique:** cervical, thoracic, abdominal organs & urogenital system are removed as organ blocks.

→ Neuronal system is removed as another block.

Examination of Organs: en masse chest & abdominal organs are kept on a wooden board with posterior surface upwards & the tongue facing the operator.

Description of an Organ: clear, concise, objective description of shape, colour & consistency & presence/absence of any lesions.

→ microscopic description may be limited to the positive findings.

1] **Size:** measured by tape.

→ In liver: • blunting of inferior border ⇒ enlargement
• sharpness of border ⇒ atrophy
• tense capsule ⇒ enlargement.

→ In heart: • straight course of superficial vessels ⇒ ↑ed size
• undue tortuosity ⇒ ↓ed size.

2] **Shape:** note any departure from normal.

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3] Surface: look for any thickening, roughening, dullness or opacity.

4] Consistency: soft / firm / hard

5] Cohesion: strength within the tissue that holds it together.

→ judged by resistance of the cut to tearing, pressure or pulling.

6] Cut Surface:

A] Colour: every organ (except brain) ⇒ greyish shades.

→ yellow ⇒ jaundice / fatty infiltration

brown ⇒ lipofuscin / hemosiderin

grey-brown ⇒ malarial pigment

pallor ⇒ anemia.

B] Structure: ex ⇒ cortex & medulla of kidney become indistinguishable in disease of the kidney.

Autopsy of Heart:

i) External examination for adhesions, pericarditis, discolourations of any underlying infarct, aneurysms

ii) Pulmonary artery is palpated for any thrombi / emboli.

→ If thrombus is felt:

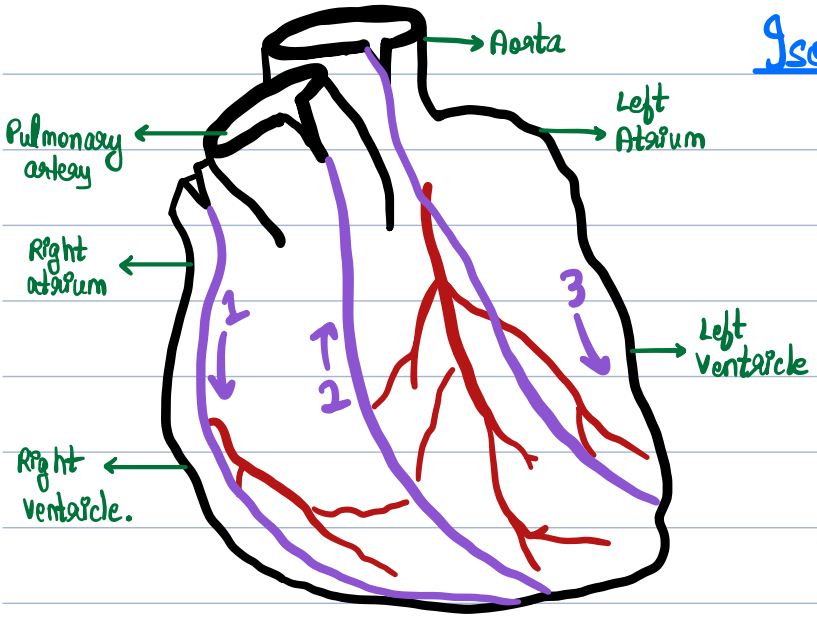
- right ventricle & pulmonary trunk are opened in situ & size & extent of thrombus is noted.
- pink in colour, firmly adherent to vessel wall
- postmortem clot ⇒ soft, friable, yellow / red.

iii) Examination of SVC & IVC for thrombi / emboli.

iv) Pericardium is examined & incised with the tip of the scissors to expose the heart.

v) Heart is held at the apex & lifted upwards.

vi) Pulmonary vessels, SVC, IVC, ascending aorta are cut as far away as possible from the base of the heart.



Isolated heart is studied as follows:

→ opened in the direction of the blood flow (inflow - outflow method) ⇒ 1 → 2 → 3 [cut with enterotome]

→ RA: cut between openings of SVC & IVC (through the tricuspid orifice).

- small secondary incision is made to open the auricular appendage to detect thrombi.

→ circumference of an intact valve of heart can be measured by inserting graduated cones.

→ To check the competence of the pulmonary valve: heart is held in the palm of the hand so that the pulmonary valve is horizontal (neither collapsed nor stretched) → stream of water is directed onto the valve to wash away the blood → observe how well the cusps come into apposition & whether water leaks into the already opened ventricle.

→ competence of tricuspid & mitral valve cannot be satisfactorily tested postmortem.

→ RV: cut open along the lateral margin.

→ Opening pulmonary valve: heart is placed so that the apex is directed towards the examiner → enterotome is introduced into the RV close to the apex & conus pulmonalis & pulmonary valve are cut 10 mm to the right of & parallel to the interventricular septum

identified by anterior descending branches of coronary vessels crossing down the epicardium.

→ LA: cut between the openings of the pulmonary veins → cut along the lateral wall → incision extends through mitral orifice & passes along the lateral margin of LV upto apex.

- circumference of mitral valve should be measured.

→ Next incision: from apex along the interventricular septum into the aorta → open aortic valve

→ both auricular appendages should be examined for the presence of thrombi.
→ heart should be weighed after removal of clots.
→ Thickness of RV & LV should be measured.
→ In death due to ventricular fibrillation: heart is flabby.
→ Coronary arteries: examined before opening the heart by making serial cross-sections along the entire course of the major vessels about 2-3 mm apart.

Subendocardial Haemorrhages: seen in LV, on upper part of left side of interventricular septum & on opposing papillary muscles & adjacent columnae carnae.
→ haemorrhages: flame-shaped, confluent, tend to occur in one continuous sheet.
→ Non-specific findings
→ Seen in: – after sudden severe hypotension due to severe blood loss/shock.
– after intracranial damage (head injury, cerebral oedema)
– death from ectopic pregnancy, ruptured uterus, antepartum/postpartum haemorrhage.
– Arsenic & other poisoning

Antemortem thrombi: • dark red • firm but friable • dry, pale • granular
• adherent to vessel wall • c/s: alternate layers of platelets & fibrin.
• older thrombus ⟹ greyish-red

Postmortem thrombi: • dark red • glistening, soft, jelly-like, very friable

Agonal thrombi: in case of a person dying slowly with circulatory failure ⟹ firm, stringy, tough, pale-yellow thrombus
→ formed usually in the right side of the heart.
→ forms branches like a tree-like cast.

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Postmortem Clots:

- when blood clots rapidly ⟹ soft, lumpy, uniformly dark-red, slippery, moist clot ⟹ red currant jelly.
- when red cells sediment before blood coagulates ⟹ similar clot as red currant jelly with a pale/bright-yellow layer of serum & fibrin above it ⟹ chicken-fat clot.

→ Postmortem fibrinous clots in the heart ⟹ cardiac polyps.

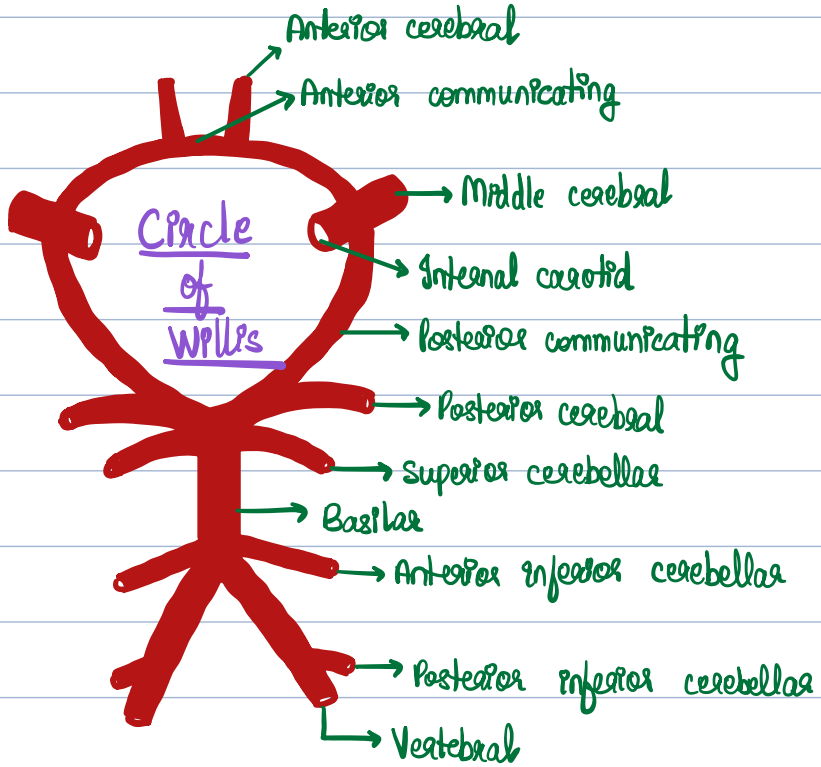
Postmortem fluidity of blood: shortly after death ⟹ blood is usually fluid.

→ when blood is removed from the body ⟹ spontaneous coagulation.

→ uncoagulable fluid blood is normally present in the limb vessels & often in the heart of any healthy person who dies suddenly from any cause.

→ in most deaths from asphyxia ⟹ blood is fluid & incoagulable.

→ Postmortem fluidity of blood is due to fibrinolysins (liberated from vascular endothelium).



Virtual Autopsy (Virtopsy): non-invasive technique of examining dead bodies to find out the cause of death.

→ it does not destroy some important evidence which may be destroyed in the usual autopsy.

→ it is a combination of CT & MRI.

→ MR spectroscopy measures metabolites formed due to decomposition ⟹ helps to estimate time since death.

Psychological Autopsy: a set of postmortem investigation procedures that help ascertain & evaluate the role that physical & psychological factors play in the death of a victim of suicide.

→ Equivocal deaths: those that do not indicate the manner of death (they were not witnessed or involved conflicting data)

→ systematic collection of psychological data through structured interviews of the deceased's family members, friends, co-workers, employers, fellow students, & anybody else who dealt with the deceased.

→ functions:
- determination of mode of death
- determining the state of mind at the time of death
- to retrieve the most honest information possible in a way that will be healing for survivors.
- to gain information that will be helpful in treating future patients.

Autopsy in a Case of AIDS & Infections:

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Cholera, rabies, tetanus, anthrax, poliomyelitis, mumps, septicaemia, typhoid, TB, hep B & C, diphtheria, CSF meningitis, HIV.

→ risk of transmission of HIV through needle prick injury during collection of blood & other body fluids, mucosal splashes & skin contact with superficial injury during autopsy on a HIV-infected body.

→ it is better to leave some organs in-situ in the cadaver rather than eviscerating en masse.

→ another method is to fix lungs & other organs whole after removal (rather than slicing them before fixation).

Universal Work Precautions:

1] All infected bodies should be wrapped & tied in double layer tough plastic bag with a red tag "Biologically hazardous" with name, age, sex, registration number, etc.

2] Workers who have exudative lesions/weeping dermatitis/external injury should not handle AIDS victims.

3] Proper protective clothing, full-sleeve overalls, water-proof plastic apron, head cap, face mask, goggles, double gloves, waterproof rubber gumboots of knee length with shoe covers.

4] Handling sharp instruments: avoid accidental pricks & cuts from needles, scalpels, etc.

→ if a cut is made in the rubber gloves / needle injury occurs ⟹ they should be removed immediately & replaced with new ones.

→ hands & skin surfaces should be washed immediately & thoroughly if contaminated with body fluids.

5] Handling specimens for laboratory examination: Mucocutaneous contact / aerosol inhalation of body fluids should be avoided.

→ specimens should be properly labelled & filled with 10% formalin solution & should be handled with gloved hands.

6] Disposal of used instruments: they should be dipped in 20% glutaraldehyde for 30 minutes, washed with soap/detergent & water, dried & then rinsed in methylated spirit & air dried.

7] All soiled gauze & cotton should be collected in a double plastic bag for incineration.

8] Aprons, towels, etc ⟹ soaked in 1% bleach for 30 minutes, washed with detergent & hot water & autoclaved.

9] Clean-up procedure: wear new intact disposable gloves.

→ wipe small blood spills/splatters with disposable towels/tissues which are discarded in special bio-hazard bags.

→ autopsy table & floor ⟹ cleaned with 1% bleach solution & then washed with soap & water.

10] Disinfectants: 1:10 dilution of common household bleach / freshly prepared solution of sodium hypochlorite.

11] In case of accidental injuries/cuts with sharp instruments contaminated with body fluids or not ⟹ wound should be washed immediately & thoroughly under running water, bleeding encouraged & then disinfected.

12] To minimise aerosol splatter, skull can be opened with an electrical oscillating saw.

13] After autopsy ⟹ all body orifices should be packed & the body wrapped in double layer heavy plastic sheet bag & secured properly (no leakage).

14] After completing autopsy ⟹ hands & face should be washed with soap & water & rinsed with 70% methylated spirit.

15] The body should be burnt/incinerated.

Preservation of Viscera in Cases of Suspected Poisoning:

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→ viscera preserved if:

- death is suspected due to poisoning by the police / doctor.
- deceased was intoxicated or used drugs (habitual drug user).
- cause of death not found after autopsy.
- unusual smell / colour or unidentifiable material detected in stomach contents.
- anaphylactic detahs.
- death due to burns.
- advanced decomposition.
- accidental death involving drivers of a vehicle or machine operator.

→ viscera preserved in all fatal cases of suspected poisoning:

1] Stomach & its contents } 1 bottle
2] Upper part of small intestine: ~ 30 cm length }
3] Liver: 200-300 gm } cut into slices of 0.5-1 cm thickness
4] Kidney: half of each kidney. } 1 bottle
5] Blood: 30 ml (minimum = 10 ml.)
6] Urine: 30 ml.

→ levels of drugs in the muscle more accurately reflect blood levels than the liver / kidney.

→ poison found in the urine (unless added with evil intention) is a proof of absorption & excretion.

→ Stomach contents: of primary value for estimating quantity ingested in acute overdoses & qualitatively, in identifying substances which have been recently ingested.

Containers Used: glass bottles of 1L capacity ⇒ clean, wide-mouthed, white & fitted with glass stoppers.

→ glass containers should be cleaned with sulphuric acid - chromate solution, rinsed with distilled water & dried.

→ blood should be collected in a screw-capped bottle of about 30 ml.

→ bottles should be labelled with name of victim, age, sex, autopsy number, crime number, organ it contains, date & place of autopsy, preservative used. (mention clearly if contents are infectious).

Preservatives:

1] Saturated sodium chloride solution (except in poisoning from corrosive acids, alkalis, corrosive sublimate & aconite).

2] Rectified spirit (except in cases of suspected poisoning by - alcohol, kerosene - chloroform, ether - formic acid, formaldehyde, acetic acid - phenol - phosphorus - paraldehyde)

3] 10 mg/ml of sodium/potassium fluoride & 3mg potassium oxalate (for blood).

→ sample of preservative used is separately kept in a bottle & sent for analysis.

→ Preservative is not necessary if:

- viscera can be analysed within 24 hours.
- if sample can be kept in a refrigerator/ice box.
- bone, hair, nails
- lungs for detecting inhaled poisons.

Additional Viscera Preserved: (in specific cases of poisoning).

1] Heart	strychnine, digitalis
2] Brain (100 gm cerebrum / cerebellum)	alkaloids, OP compounds, opiates, barbiturates
3] Spinal cord	strychnine, gelsemium
4] CSF	Alcohol
5] Bile	Narcotic drugs, cocaine
6] Vitreous humour	Alcohol, chloroform, tricyclic antidepressants
7] Lung (tie trachea, bronchial air)	gaseous poisons
8] Skin	in case of absorption of poison through skin, corrosives
9] Bone (10 cm of shaft of femur)	Subacute / chronic poisoning by As, Sb, Thallium, radium.
10] Hair (20-30 head hair)	-
11] Nails (use Spencer-Wells forceps)	-
12] Uterus	Criminal abortion
13] Muscle (if internal organs are badly putrefied) ⇒ 3 x 3 cm (thigh)	-
14] Fat 10g from abdominal wall or posinephaic region)	Pesticides / insecticides.

Autopsy of Decomposed Bodies:

All human remains should be examined, even when they are not likely to provide information ⇒ Fundamental rule of forensic pathology.

→ localised area of redness ⇒ antemortem injury.

→ fractures are easily detected.

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Examination of Mutilated Bodies / Fragments:

→ Mutilated bodies = bodies which are extensively disfigured, or in which a limb or a part is lost, but the soft tissues, muscles & skin are attached to the bones.

1] Human or Animal: recognition by shape, structure
→ Precipitin test or anti-globulin inhibition test using blood or any other soft tissue.

2] One or more Bodies: determined by fitting together all separate parts

3] Sex: presence & distribution of hair, characters of the pelvis & skull, etc.
→ recognition of prostatic / uterine tissue under a microscope (these tissues are resistant to putrefaction).

4] Age: general development, skull, teeth, ossification of bones.

5] Stature: measurement of long bones

6] Identity: fingerprints, tattoo marks, scars, moles, hair, articles of clothing, superimposition, etc.

7] Manner of Separation of Parts: examining the margins of parts

8] Time since death: determined from the condition of parts.

9] Cause of death: evidence of fatal injury / burns / fractures

10] Antemortem / Postmortem: examining margins of parts for evidence of vital reaction.

Examination of Bones:

Forensic anthropology: branch of physical anthropology which for forensic purposes deals with the identification & analysis of skeletonised remains known to be or suspected of being human.

General Description: bones kept in anatomic position

→ list of bones present

→ acetone is used to remove dirt

→ if soft tissues are attached ⇒ bones are boiled in water for 5-6 hours or
⇒ immersed in a dilute aqueous solution of Na_3PO_4 & household detergent (sodium hypochlorite 5-6%).

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1] Are the remains actually bones? examine normal anatomical shape & structure.

2] Human or Animal: precipitin test is useful if bone is fairly fresh & some blood constituents are still present.

→ DNA analysis can be done if bones are fresh

→ chemical analysis of bone-ash

3] One or more Individuals: can be determined by reconstructing the skeleton

→ check for disproportion in size of various bones, reduplication.

→ if commingling (mixing) of bones from more than one skeleton is suspected ⟹ they can be separated by the use of a short-wave UV lamp. (different colours are emmitted from bones of different individuals).

4] Sex: recognisable sex differences are not present before puberty.

→ After puberty, sex can be determined from examination of pelvis, skull, femur, humerus

→ in parous women ⟹ dorsal border of pubic symphysis becomes irregular &/or undermined due to trauma during child-bearing (scars of parturition).

5] Age at death: examination of teeth, ossification centres, epiphyseal union, pubic symphysis, closure of skull sutures, osteoporosis, calcification.

→ Age estimation by resorption patterns in the cortex of long bones:

• Infancy	maximum resorptive activity in the medullary third of the cortex.
• Childhood	scattered throughout the thickness of the cortex.
• Adolescence	most marked just under the periosteal surface.
• Young adulthood	very little resorption
• Sixties	increasing resorption in medullary third of the cortex, with thinning of cortex from within.

If bone is completely dry & non-foul smelling ⟹ time since death is > 6 months - 1 year.

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6] Race: chief racial differences are in the skull, teeth & lower extremities.

7] Stature: calculated by a formula using the length of long bones (long bones are measured using the Hepburn's Osteometric Board).

Osteometric Board of Hepburn: has a rectangular base with a ruler fixed along one of its long sides.

→ an upright is fixed at one end of the board & the other one slides along the board.

→ long bone lengths measured:

• Femur	head to medial condyle
• Tibia	lateral condyle to tip of medial malleolus
• Fibula	tip of head to tip of lateral malleolus
• Radius	medial margin of head to tip of styloid process
• Ulna	top of head to tip of styloid process
• Humerus	trochlea to head.

→ Rule of thumb: Humerus = 20 %
Tibia = 22 %
Femur = 27 %
Spine = 35 %
} of total height of individual.

8] Identification: from teeth, disease & deformities of bones, healed/healing fractures, congenital defects, etc.

→ superimposition technique, dental charts, dental radiographs.

→ X-ray comparison of trabecular patterns, Neuron activation analysis.

9] Nature of Injury: examining ends of long bones.

10] Time since Death: from appearance of skeletal remains, presence/absence of ligaments & cartilages

11] Cause of Death: cannot be made out unless there is evidence of fracture/injury

→ metallic poisons (As, Sb, Pb, Hg) can be detected even in burnt bones.

Exhumation: Legal digging out of an already buried body legally from the grave

→ there is no limit for exhumation in India.

→ Autopsies are performed on exhumed bodies in the following situations:

i) In criminal cases: • homicide • suspected homicide disguised as suicide • suspicious poisoning • death due to criminal abortion

ii) In civil cases: • accidental death claim • insurance • workmen's compensation claim • liability for professional negligence • inheritance claims • disputed identity

Authorisation: body is exhumed only when there is a written order from the Executive Magistrate.

→ body can be exhumed by any government doctor.

Procedure:

i) detailed information about the alleged deceased & clothes worn at the time of burial

ii) body is exhumed under the supervision of a medical officer & Magistrate in the presence of a police officer.

iii) Magistrate should inform the relatives of the deceased & allow them to remain present at the enquiry.

iv) Grave site should be positively identified with identifying features (distance of the grave from some permanent object like tree/rock, details of headstone & gravemarker).

v) The burial should be uncovered 10-15 cm at a time

vi) Note the condition of the soil while uncovering & separate soil samples to be taken from all sides of the grave.

vii) Measure the depth of the grave from the surface to the skull & from the surface to the feet.

viii) Dirt must be removed from the body using a soft brush / whisk.

ix) The corpse must be photographed in top view in the position in which it was found.

x) A drawing of the grave with its dimensions should be made with details of the direction of head & feet of the body.

xi) The body is taken out & placed on a plastic / canvas sheet at the level of the earth.

xii) Any fluid / debris in the coffin should be collected.

xiii) Body should be identified by close relatives & friends.

Second Autopsy: doctor should obtain all the available documents relating to the case before performing the second autopsy

→ If possible, the first autopsy pathologist should be called to correlate all the findings.

→ findings should be documented in great detail.