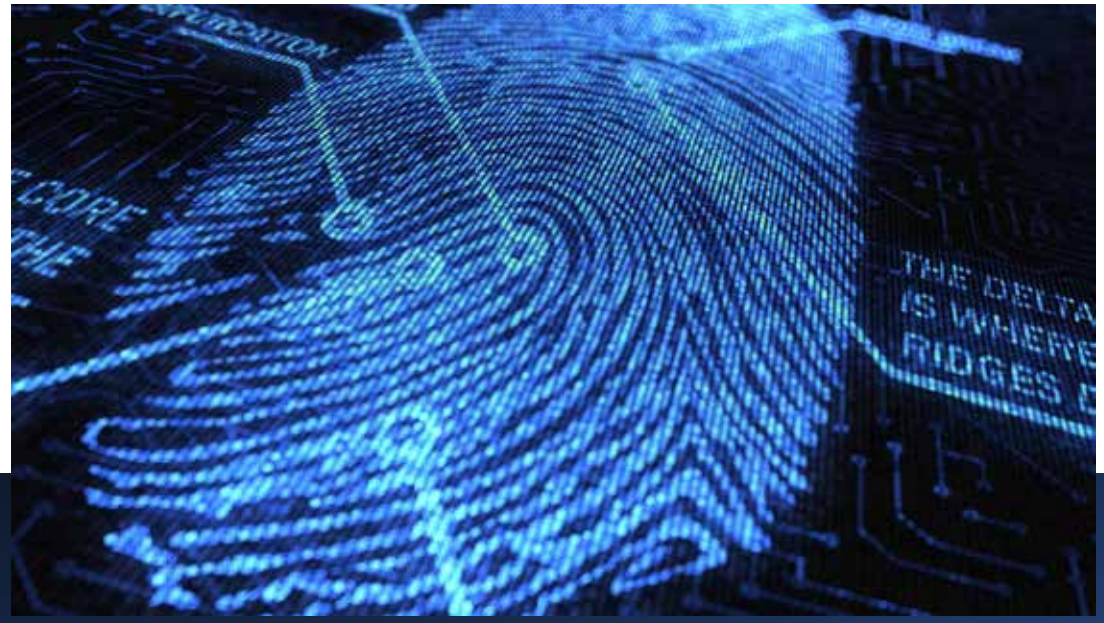
Forensic Evidence



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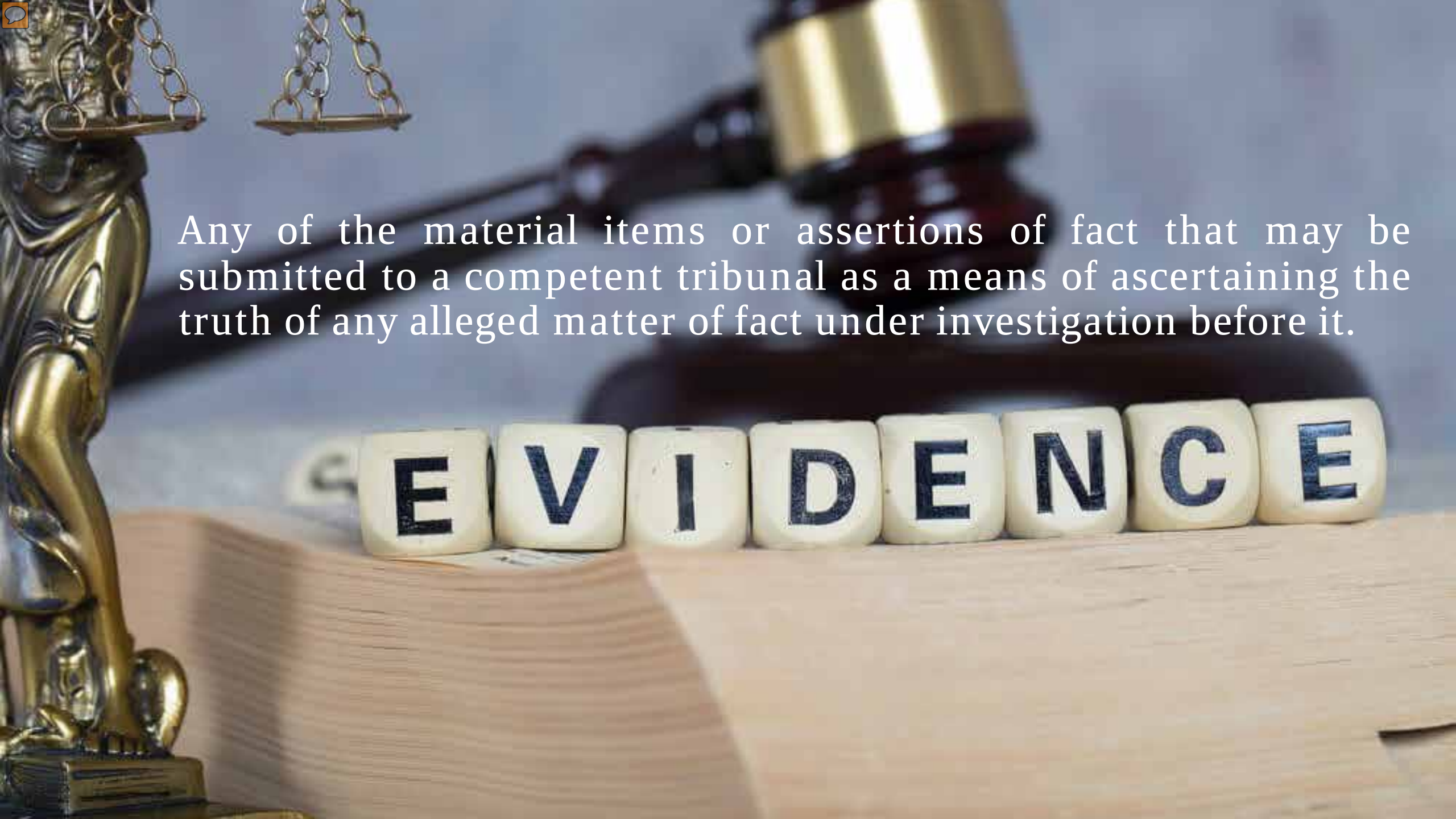


Any of the material items or assertions of fact that may be submitted to a competent tribunal as a means of ascertaining the truth of any alleged matter of fact under investigation before it.

Types of Evidence

1. Oral Evidence
2. Documentary Evidence
3. Primary Evidence
4. Secondary Evidence
5. Real Evidence
6. Hearsay Evidence
7. Judicial Evidence
8. Non-Judicial Evidence
9. Direct Evidence
10. Circumstantial Evidence or Indirect Evidence

21 different Types of Evidence (and How they effect a case)

DETAILS OF 21
YPES OF EVIDENCI

Medicolegal means

Something that involves both medical and legal aspects, mainly:

- Medical jurisprudence, a branch of medicine
- Medical law, a branch of law

Medicolegal Case (MLC)

A medical case with legal implications for the attending doctor where the attending doctor, after eliciting history and examining the patient, thinks that some investigation by law enforcement agencies to fix the responsibility regarding the causation of the said injury or ailment is essential in accordance with the law of land.

WHOSE DECISION

- The casualty doctor (emergency physician) attending the case has the independent authority to label the case as medico-legal or not.
- Patients' or their relatives' request or any external pressure to label a case medico-legal, should not influence the doctor's decision.
- When the patient is admitted in the ward, indoor treating doctors can also make a case medico-legal if they think after obtaining additional information, that it should have been made MLC, but it was not made at the time of admission.

TIME LIMIT FOR REGISTERING AN MLC

- A medico-legal case should be registered as soon as a doctor suspects foul play or feels it necessary to inform the police at arrival, or at any time after admission.
- There should not be any unnecessary delay in doing so.
- A case may be registered as an MLC even if it is brought several days after the incident if suspected

List of MLC

- Suspected or evident cases of suicides or homicides (even attempted cases).
- Confirmed or suspected cases of Poisoning.
- Burns.
- Cases of injuries with likelihood of death.
- Sexual Offences.
- Suspected 0r evident Criminal Abortion.
- All patients brought to the hospital in suspicious circumstances/ improper history (e.g.: found dead on road).

- Unconscious patients where cause of unconsciousness is not clear.
- Child Abuse.
- Domestic Violence.
- Person under Police Custody or Judicial Custody.
- Patients dying suddenly on operation table or after parenteral administration of a drug or medication.
- Case of Drunkenness.
- Brought Dead.
- Natural Disaster.

What are the incidents that do not come under MLC?

- Battle Casualties (BC) and Battle Accidents (BA) are not to be reported as MLCs. The medical cause of death in these cases may however be certified by the RMO.
- Death of a service person, in an accident involving a military aircraft will not be reported as an MLC to the civil police. The enquiry conducted by the competent military authorities will suffice.

REGISTRATION AND REPORTING

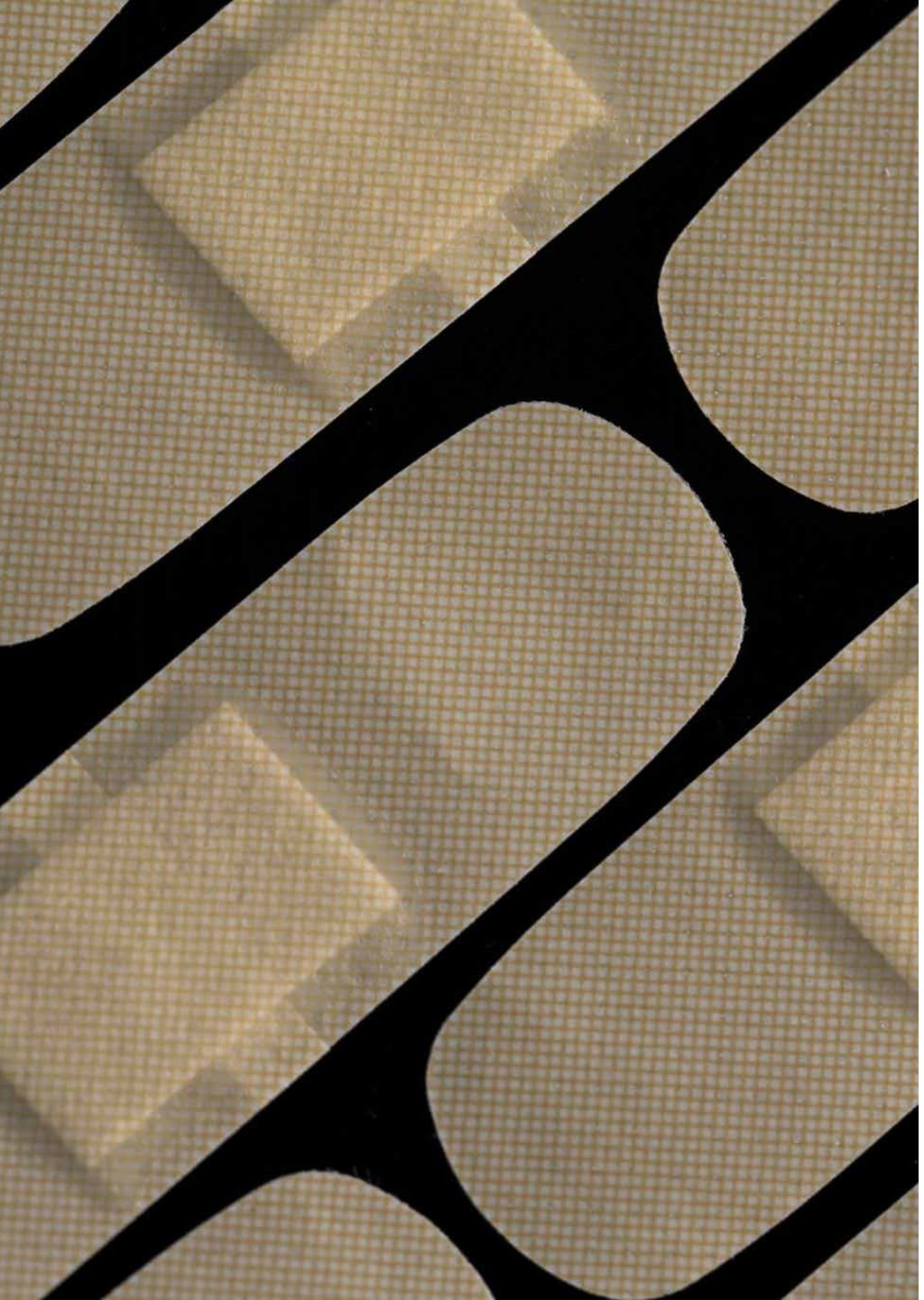
33 BNSS, 2023 (Bhartiya Nagarik Suraksha Sanhita)

The attending doctor is duty bound to inform the police about the Case.

Section 211 BNS (Bhartiya Nyaya Sanhita) :

Provides for prosecution of the doctor for the failure to inform.

Police informed again when patient dies or is discharged from hospital.



INJURY AND HURT

Section – 2 (14) of the Bhartiya Nyaya Sanhita (BNS) :

Injury : means any harm whatsoever illegally caused to any person in body, mind, reputation or property.

Medical Definition: - Breach in natural continuity of any of the tissues of the living body.

Section - 114 of the Bhartiya Nyaya Sanhita (BNS) :

Hurt : whosoever causes bodily pain, disease or infirmity to any person is said to cause hurt.

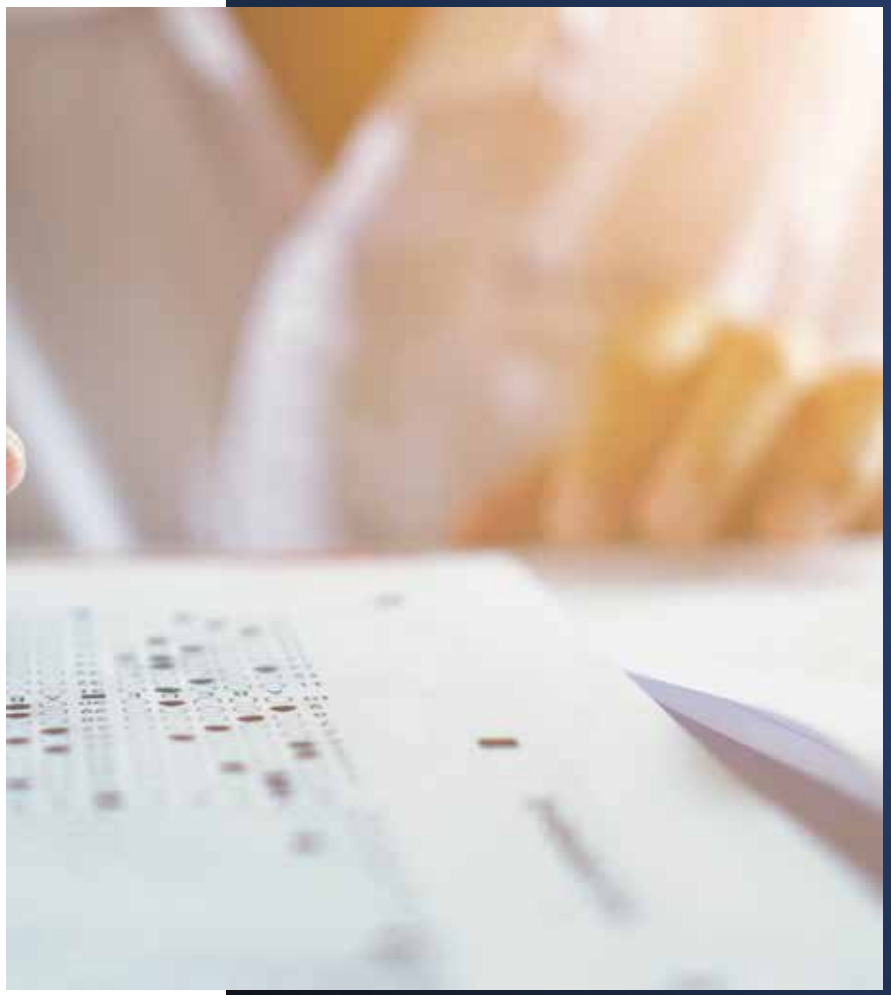
GRIEVOUS HURT (SECTION 116 OF BNS)

1. Emasculation.
2. Permanent privation of the sight of either eye.
3. Permanent privation of the hearing of either ear.
4. Privation of any member or joint.
5. Destruction or permanent impairing of the powers of any member or joint.
6. Permanent disfiguration of the head or face.
7. Fracture or dislocation of a bone or tooth.
8. Any hurt which endangers life, or which causes the sufferer to be during the space of fifteen days in severe bodily pain or unable to follow his ordinary pursuits.

Informed consent

Includes information that

- the examination to be conducted would be a medico legal one
- and would culminate in the preparation of a medico-legal injury report.
- call relevant investigations needed for the said purpose would be done.
- the findings of the report may go against the patient if they do not tally with the history given.



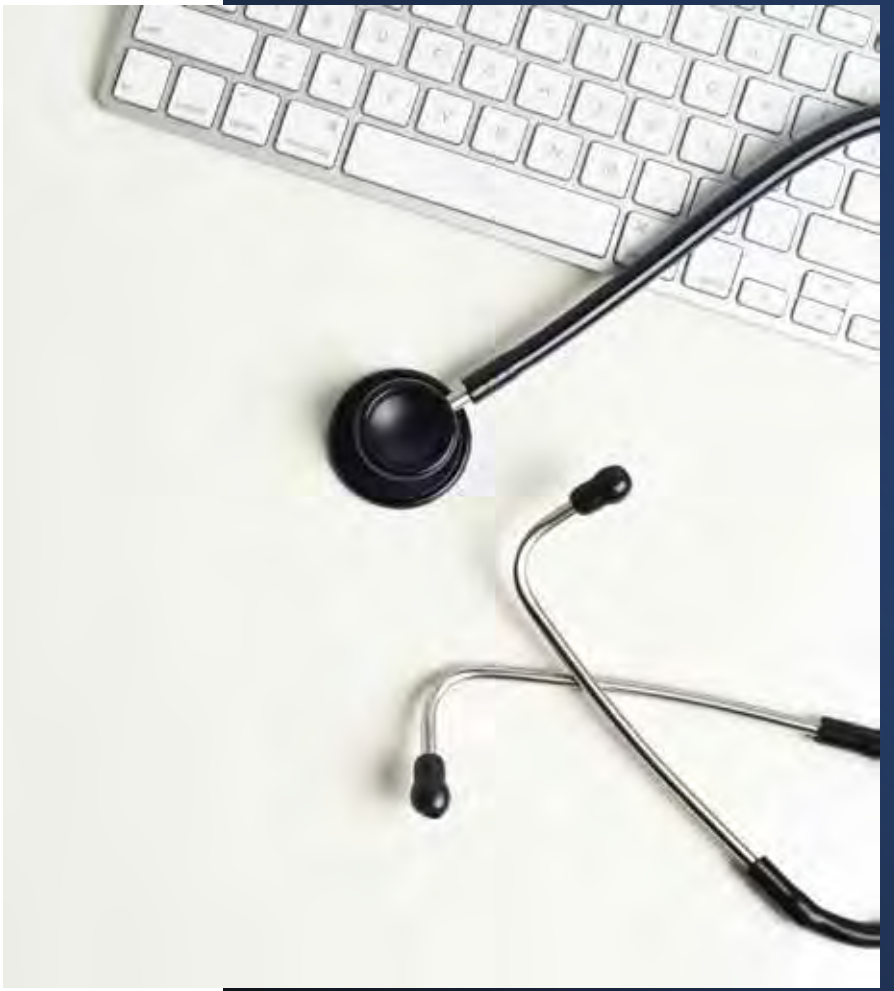
Consent not required in

- Medical Emergencies.
- Notifiable diseases.
- Immigrants.
- New admission to prisons.
- Court orders for examination & treatment.
- Under section 53 (1) of Cr.P.C., a person can be examined on request of the police by use of force.
- Members of Armed Forces on request of competent authority in writing.
- Consent is not required from relative for conducting medicolegal postmortems.

An MLR comprises of three parts

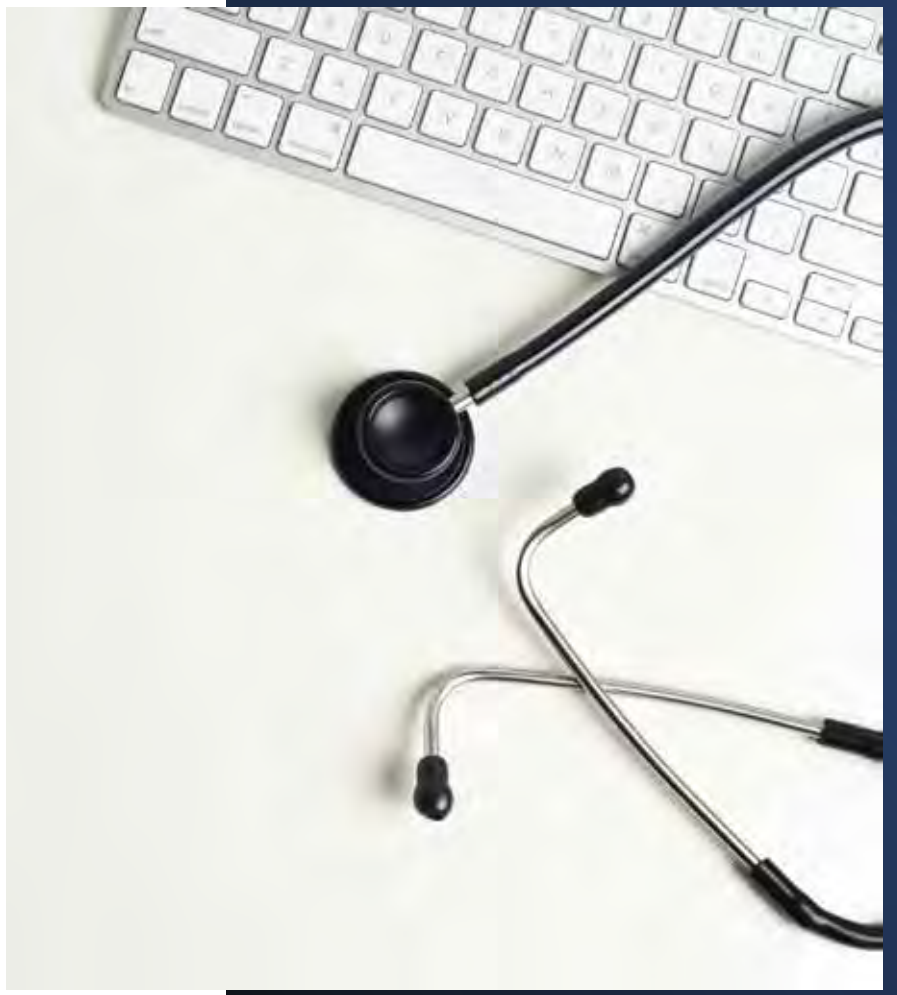
Preamble: includes

- Date, time and place of examination.
- Name of the patient.
- Residential address.
- Occupation.
- Name of the person(s) /police official accompanying,
- DDR/FIR No., informed consent of the person being examined.
- Two marks of identification, etc, wherever applicable.



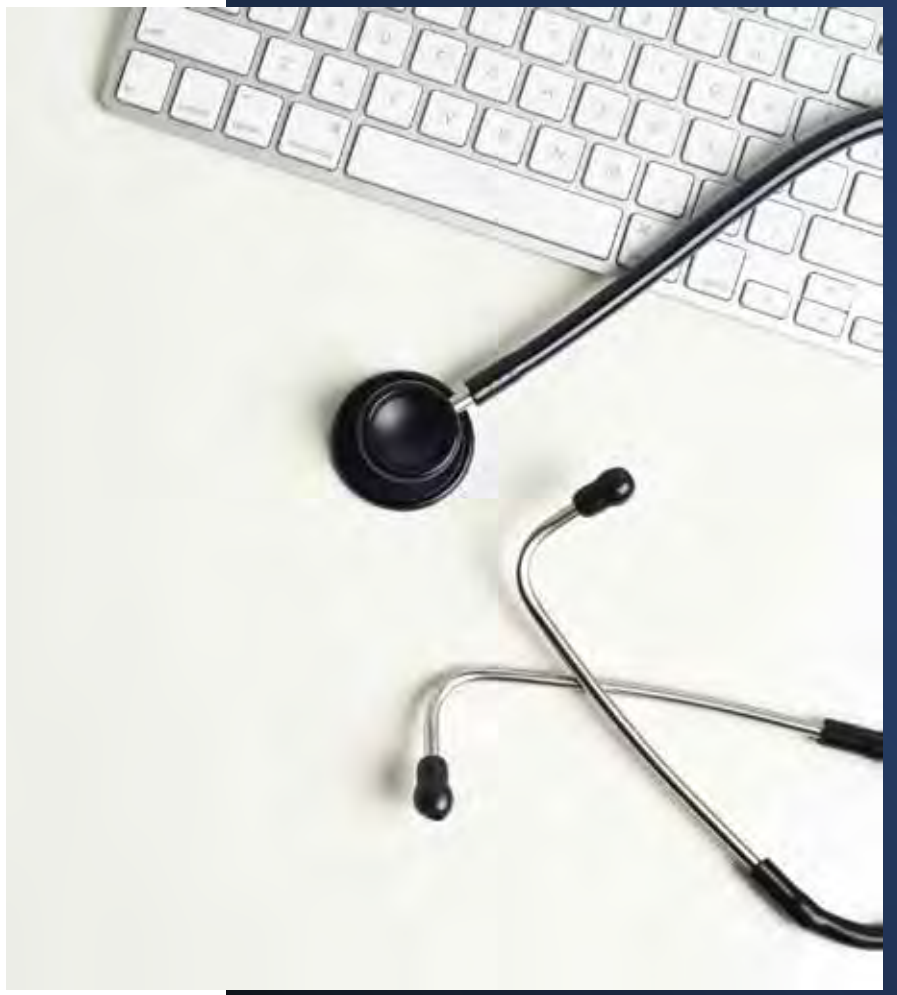
Body (Findings/Observations): Includes

- a complete description of the injuries/any other findings present.
- any investigations/ referrals, etc, asked for.



Post-amble (Opinion): Includes

- Nature of the injury--whether simple or grievous.
- Weapon/Force used--whether blunt or sharp or fire-arms or burns, etc.
- Duration of the injuries- based on the characteristics of the external injuries.
- To be signed with full name of attending physician in capital letter.



1	2	3	4	5	6
Nature of injury whether incised wound, bruise, burn facture or dislocation, etc.	Size of each injury in centimeters that is length, breadth and depth.	On what part of the body inflicted.	Simple grievous or dangerous.	By what weapon inflicted or how caused-blunt/sharp force, fire etc.	Remarks (Age of each injury X-rayed admitted under observation, where referred for further examination/report/treatment, any other relevant information).

INJURY REPORT

- Details of the patients and person bringing him for examination.
- Consent.

FINAL OPINION

- Final opinion to be given on the original MLC sheet by the same doctor preparing record depending on investigation findings or treating physician in admitted case.
- Final opinion in the MLC to be given by the hospital where MLC has been made after obtaining a case summary from referred hospital. After discharge of the patient or death the MLC record to be sent to MRD for preservation.
- The doctor needs to give a witness in court as expert witness, if summoned by the honorable court.
- At that time, he may have to produce the case record or final opinion in front of the magistrate.

MEDICO LEGAL EVIDENCE/ARTICLES

In all medico legal cases where the medico legal evidence like patient's clothes with blood-stain marks, stab injury, cut mark and bullet holes mark should be encircled, sealed and must be signed by the examining doctor and must be preserved.

In case gastric lavage has been collected it should be collected in proper container and the bottle should be sealed and signed and it must be preserved.

Any foreign body recovered from the patient after operation like bullets etc. or otherwise must be sealed and preserved.

Further at the onset of examination, any document, money whether currency notes or coins or other precious material like gold ornaments must be taken in the possession, sealed and preserved.

All these above evidences must be entered in the MLC sheet of the patient and must be signed by the doctor examining the case and police personnel taking possession of these articles.

In case some of the articles/ evidence are essential for the police they may be handed over to the investigating police officer as and when proper requisition is received through Medical records deptt.

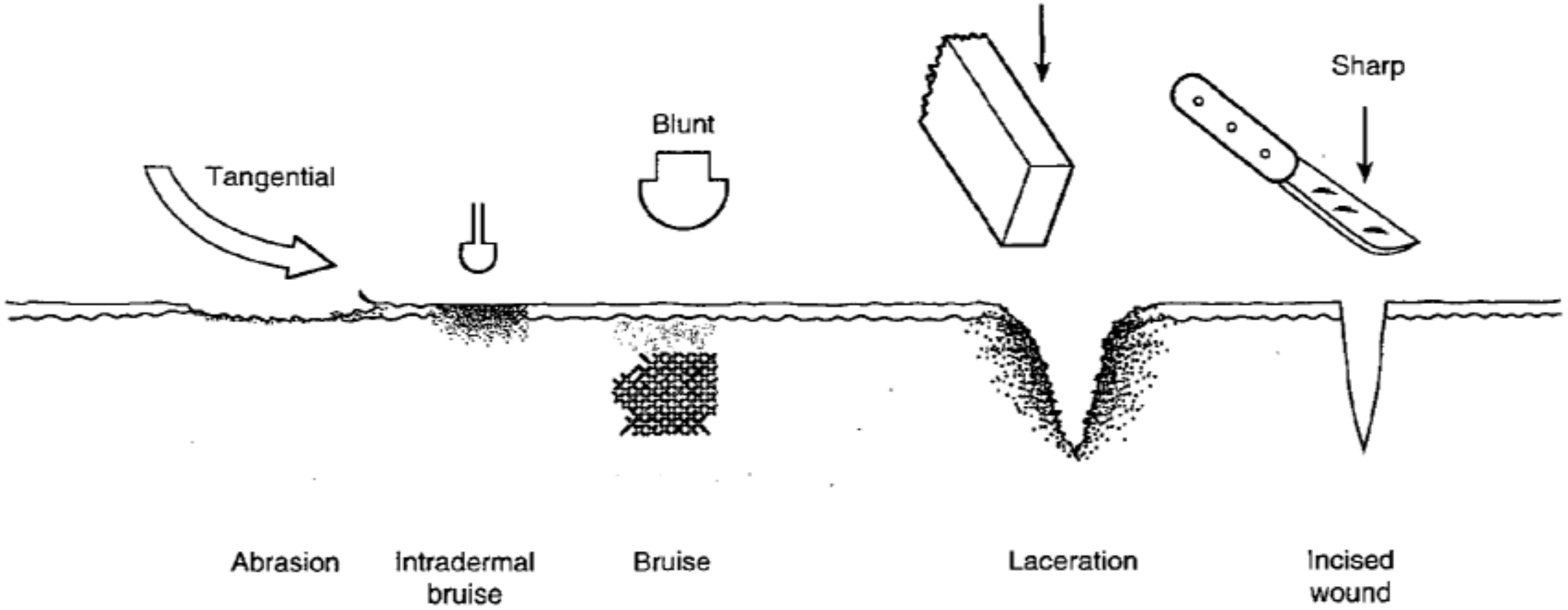
Other belongings, which are not essential for the legal procedure, may be handed over to the nearest kith and kin of the patient as and when it is demanded and certified by the concerned police station.

INJURY

Sections of Bhartiya Nyaya Sanhita, 2023 related to Injury

100 to 105 and 107 to 110	-	Offences affecting life.
88 to 92	-	Abortion and childbirth
93	-	Abandonment of Child
114 to 119	-	Offences related to causing hurt
74 and 128 to 136	-	Related to assault
309 to 311	-	Hurt and death during robbery or, dacoity
331	-	Hurt during lurking house
85	-	Cruelty to married women

Types of wounds



Factors influencing the nature & Extent of wounds

- Nature of object used
- The amount of kinetic energy discharged
- Conditions under which it is discharged
- Nature of affected tissues

Classification of wounds

- According to causative factors
- According to severity of injury
- From medico legal angle
- In relation to moment of death

According to Causative factors

CLASSIFICATION

MECHANICAL INJURIES

I. BLUNT FORCE INJURIES
   - A. ABRASIONS
   - B. CONTUSION
   - C. LACERATION
   - D. FRACTURE

II. SHARP FORCE INJURIES
   - A. INCISED WOUND
   - B. STAB WOUND

III FIREARM INJURIES

INJURIES CAUSED BY PHYSICAL AGENTS

I. THERMAL INJURIES
   - A. DUE TO HEAT
     - i. DRY HEAT BURNS
     - ii. MOIST HEAT: SCALDS
   - B. DUE TO COLD
     - i. FROST SITE
     - ii. TRENCH FOOT

II. ELECTRICAL INJURIES

III. CHEMICAL INJURIES

IV. RADIATION INJURIES XRAYS, UVRAYS

I. Mechanical / Physical injuries

1. ABRASION

A simple injury is in which destruction of superficial layers of skin

- SCRATCH
- GRAZE
- PRESSURE ABRASION
- IMPACT ABRASION

Abrasions

It is the most superficial type of injury

that does not penetrate the full thickness of the skin (usually confined to the epidermis).

Usually caused by blunt force trauma.

Characteristics

- They are usually not life threatening although they are painful.
- They heel without scaring.
- Bleeding/Exudation is slight and leads to crust/scab formation.
- Might be associated with bruising and laceration

Types of abrasions

1) Direct vertical impact:

- The force is usually applied vertically onto the skin and causes crushing of the epidermis.
- The causative object may stamp it's shape on the skin.

Examples:

fingernail impression and bite mark, and marks of a vehicle radiator on a pedestrian victim or the pattern of a floor grid on to which a person fallen.

Types of abrasions

2- Tangential impact(brush abrasions) :

Loss or scraping of the epidermis due to friction against a rough surface (graze) or a sharp surface (scratch)

Broader surface

- Example of a brush abrasion of the abdomen by scraping along a rough sooted and rusty surface of a metal tank during a fall.

This example of brush abrasions .It illustrates a motorcycle fatality, where the victim has come in contact with the road surface.

Types of abrasions

3- Fingernail abrasions

These are important because of their frequency in assaults especially child abuse, sexual attacks and strangulations.

Often associated with focal bruises. Fingernails abrasions are most often seen on the neck, face, and the upper arms and the forearm.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Types of abrasions

4- Post mortem abrasions:

Unlike post mortem bruises, artefactual abrasions are common.

They may have been inflicted after death from a variety of causes, including dragging a corpse or buffering in moving water. Some post mortem animal injuries resemble abrasions such as insect bites.

- **Importance of abrasions in Forensics**

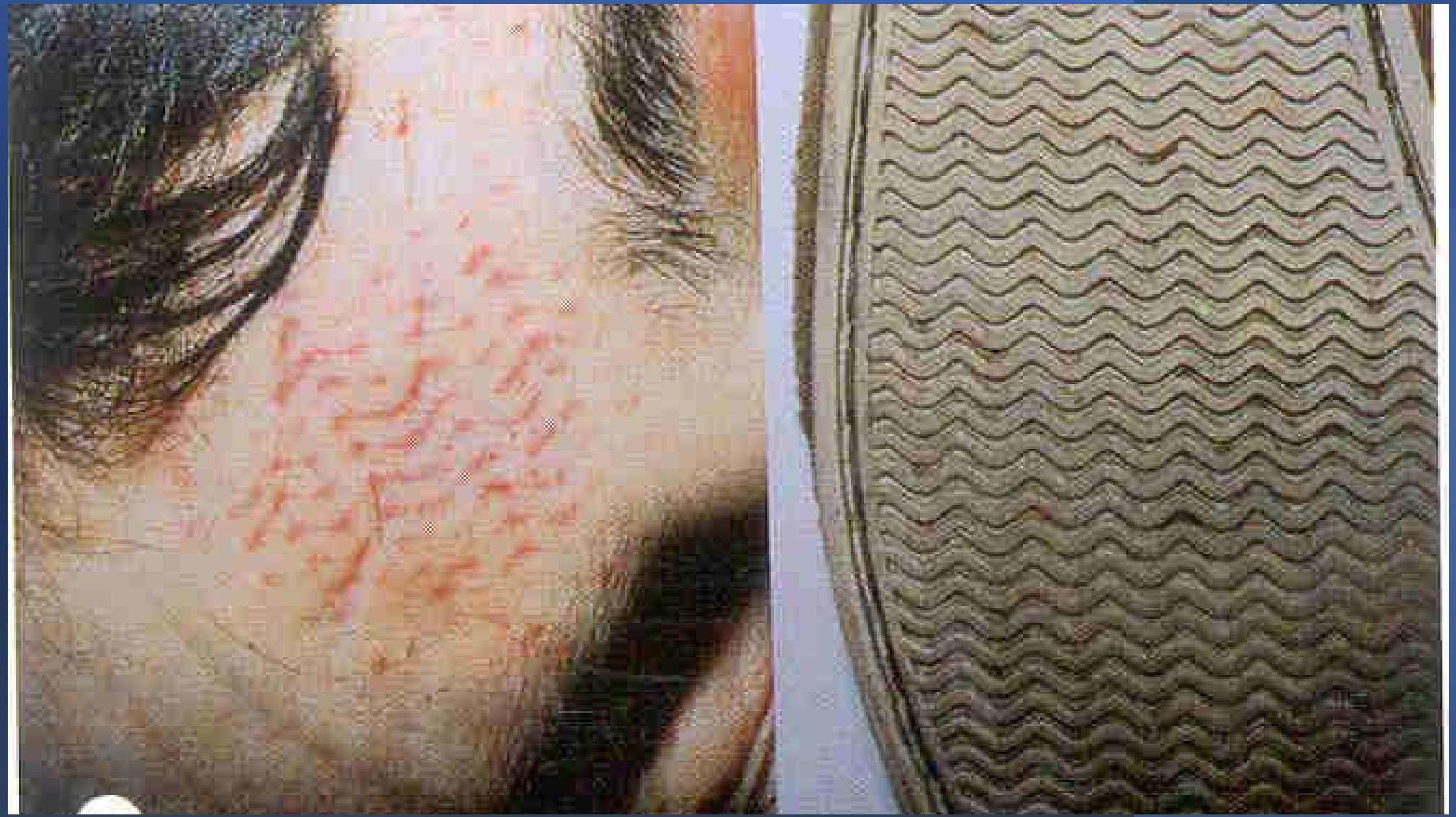
- Always reflects the site of impact.
- Often indicates the causative agent.
- Often indicates the direction of impact.
- Helps in determining the time of injury.

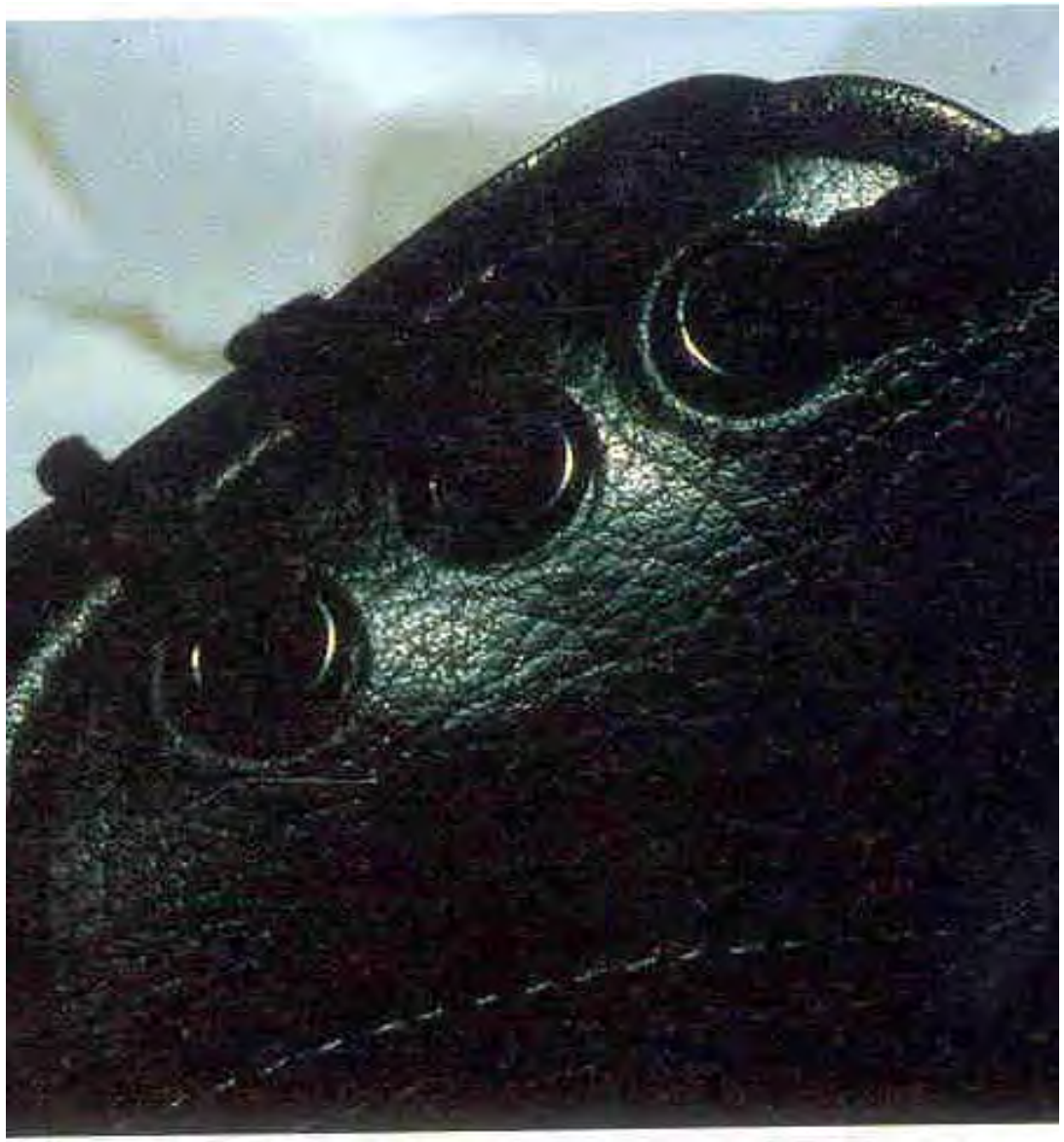
SCRATCH

GRAZE

PRSSURE ABRASION

IMPACT ABRASION





Antemortem and Postmortem abrasion

	Antemortem	Postmortem
Site	Anywhere	On Bony prominences
Color	Bright Red	Yellowish
Signs of healing	Present	Absent

2. CONTUSION (BRUISE)

A contusion is an effusion of blood into the tissues, due to the rupture of blood vessels, caused by blunt trauma.

Characteristics

- a painful swelling.
- crushing of subcutaneous tissues
- continuity of skin
- lighter color in the center

Two Types:

- Ecchymosis:

  Smaller blood vessel get ruptured causing effusion radially.

- Haematoma:

  Larger blood vessel is injured, a tumor like mass is formed.

SIZE:

Slightly larger than the surface of the weapon which caused it, as blood continues to escape in the surrounding area.

General Rule: Greater the force – extensive bruises

Size and shape are modified by following factors:

- AGE
- SEX
- TYPE OF TISSUE
- COLOUR OF SKIN
- NATURAL DISEASE
- GRAVITY SHIFTING OF BLOOD

Fracture of Jaw (appearing in the neck)

Pelvis fracture (appearing in the thigh)

Femur fracture (appearing on the outer side of lower thigh)

BRUISE PATTERN

- Usually Round
- Elongated and irregular (length of stick hitting body)
- Linear hemorrhage (solid rod hitting the body, two parallel lines formed)
- Parallel line separated by normal tissues (broad flat weapon, plank)
- Imprint (straps, belts, chains)
- Elliptical (love making, upper and lower lips)
- Intradermal (compression of sole or heel of the shoe

- Initial color of the bruise is the product of natural skin pigment, the color of pigment in the extravasated blood and any color added by the inflammatory reaction.
- Such discoloration changes in color, shape and location as the blood pigment is broken down and resorbed.
- In some cases, although blood vessel may be damaged, there may be no visible evidence on the skin.
- In certain cases, it may take hours or days for a bruise to become apparent (as the blood diffuses through damaged tissue)

- Bruise after I.V. injection taken 24 hours after injection

- The site of the bruise does not necessarily indicate the site of impact as gravity, and other factors such as the presence or absence of tissue planes will allow blood to track to sites remote from the initial impact .

- The site of bruising doesn’t necessarily reflect the site of trauma because blood tends to spread out in diffused manner from the site of injury, for example a deep bruise in the mid thigh may later appear at the knee and a black eye may be to high scalp (intra dermal bruises provide an exception to this rule).

Factors that affect the appearance of a bruise

- The severity of the force applied to the area.
- Conditions that affect the fragility of blood vessels.
- Conditions which slow or prevent blood clotting Including :

  Øunderlying disease (e.g. Hemophilia)

  Ødrugs (anticoagulants, aspirin, steroids)
- Age: Advanced age may predispose to an increased tendecy to bruise, as will as relatively young age.

Factors that affect the appearance of a bruise

- Alcoholism
- Hepatobiliary dysfunction: If necessary, clotting studies or liver function test should be undertaken.
- Skin color: Bruising is more visible in pale skin.
- Gender. (Females more)
- Obesity. (more in obese)

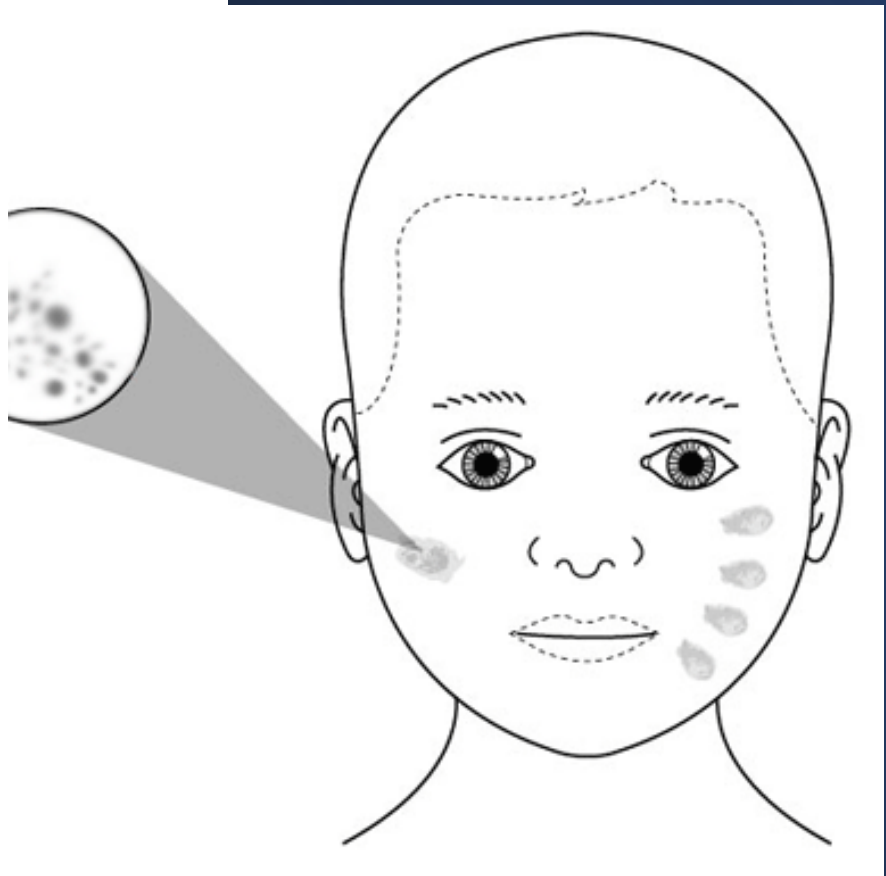
Types and patterns

- **Hand marks**
- Finger bruises consisting of circular or oval bruises from squeezing, poking, gripping or grabbing injuries.
- Upper arm of a male who was gripped hard.
- Sometimes clean pattern of four-finger or Fingertip bruises and a thumb bruise on the opposite side of the arm may be seen.
- In this case, abrasions are also evident from fingernail scratches.

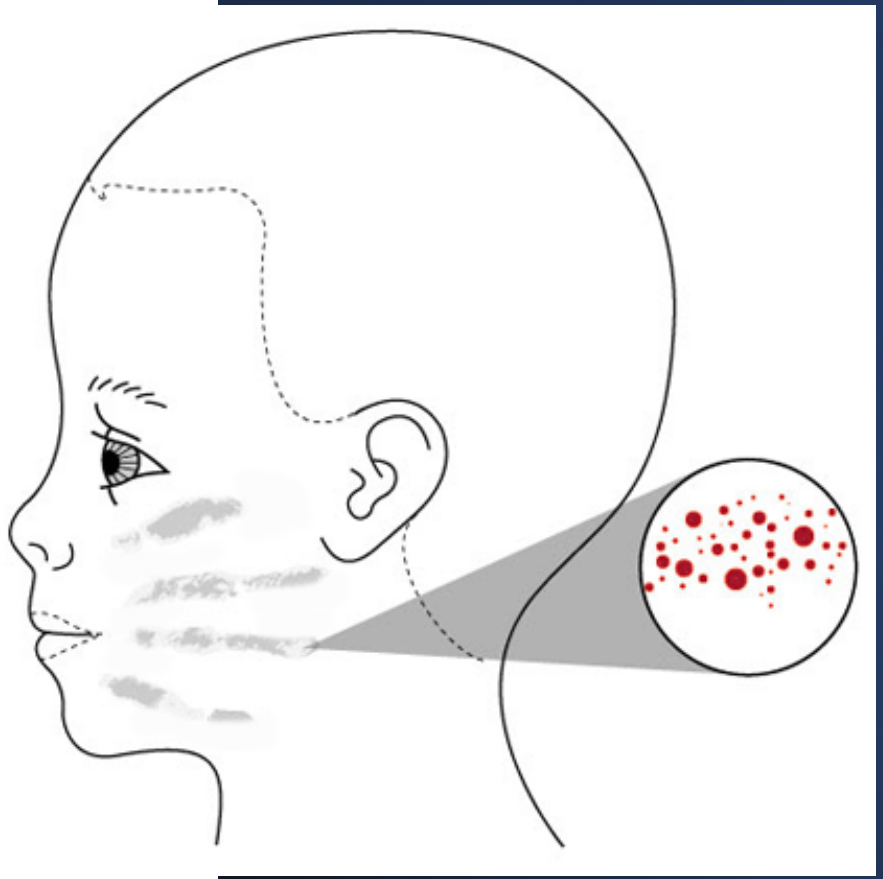
Grip marks such as may be present when a young child has been gripped and force fed.

Note the round thumb imprint on one cheek with 3 or 4 finger-tip bruises on the other.

One should also examine for intra-oral injuries.



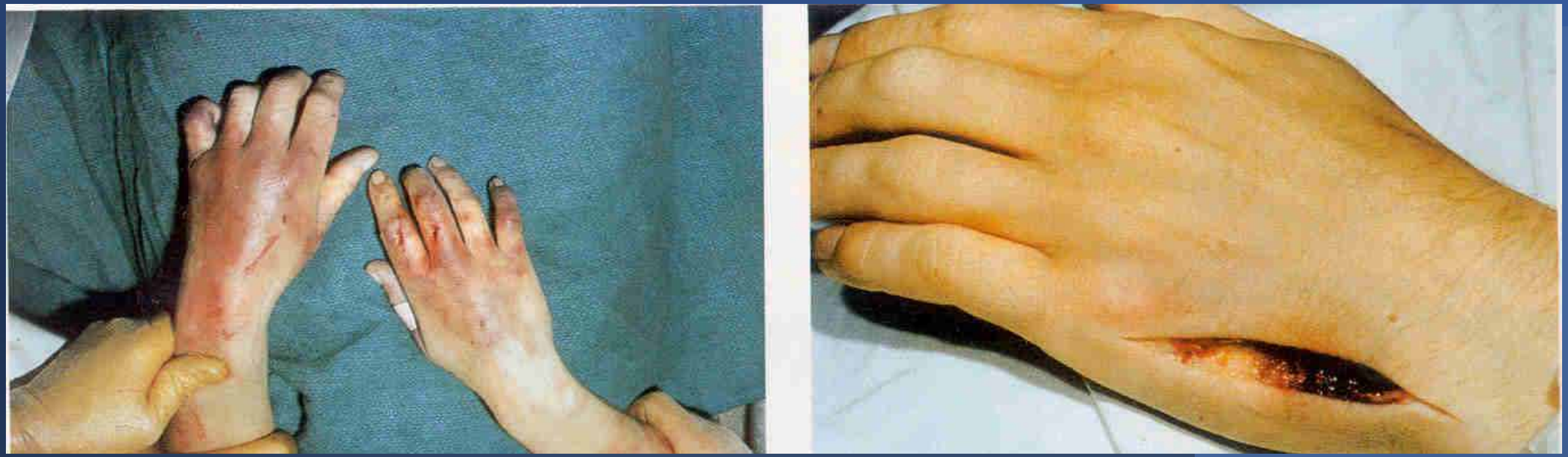
- Linear petechial bruises in the shape of a hand caused by capillary rupturing at the edge of the injury from high velocity impact of the hand slap.
- Note the parallel lines of petechial bruising at finger-width spacing, the marks appearing in the gaps between the fingers.



Pinch marks consisting of paired, crescent-shaped bruises separated by a white line.

Pinch mark on the leg of a 7-year-old boy at a site where accidental bruising is unlikely.

Note the two small bruises separated by a clear space.



Antemortem Bruise and Postmortem Bruise

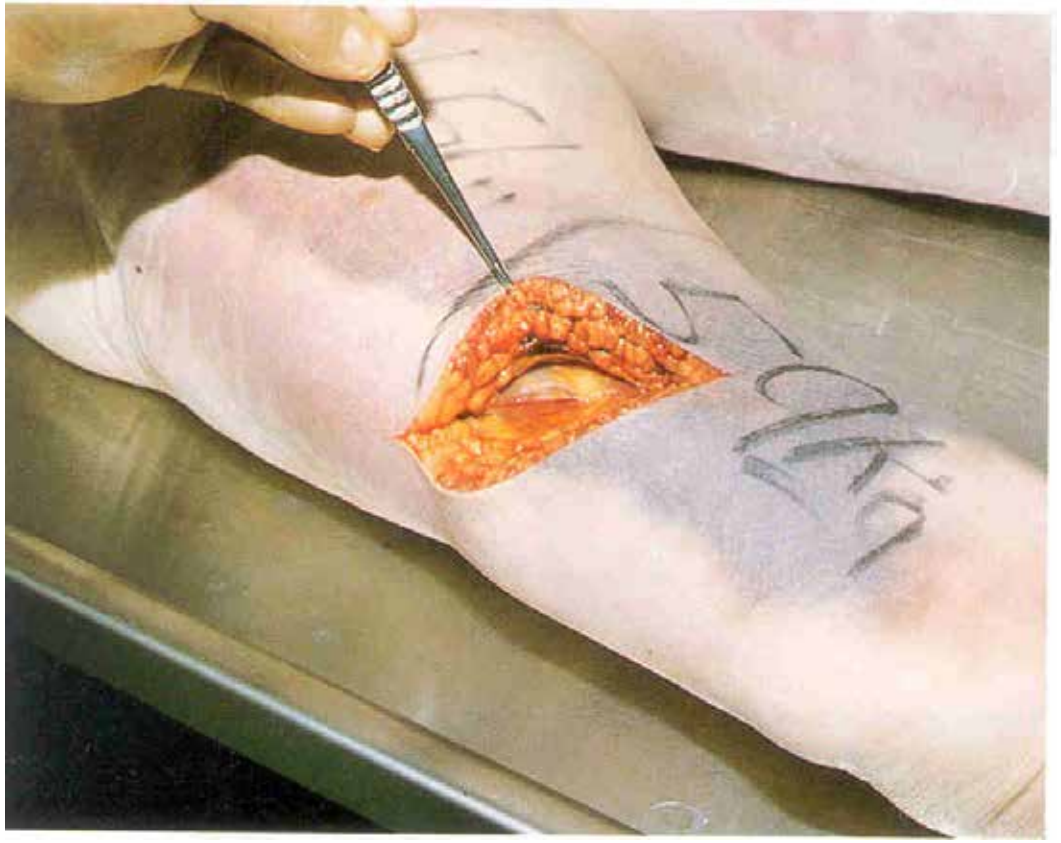
Ante-Mortem Bruise

- Presence of swelling
- Damage to epithelium
- Effusion of blood in tissues Color change
- Bruising is immediate after the impact
- Margins are less sharp

Post-Mortem Bruise

- Such signs are absent
- Small bruises can be produced up to 3 hours of death where tissues can be forcibly compressed against bone.
- Margins are sharply defined.

DIFFERENCES BETWEEN BRUISE & HYPOSTESES



Artificial Bruise and True Bruise

Artificial Bruise

- Cause: Juice of marking nut, calotropis
- Site :Exposed accessible parts
- Color : Dark-brown
- Shape: Irregular
- Margins: Well-defined, regular, covered with vesicles
- Contents : Acrid serum
- Itching: Present
- Vesicles: On fingertips/ other parts due to scratching
- Chem. Test: Positive for chemicals
- Redness/ Inflammation: seen in surrounding skin

True Bruise

- Trauma
- Anywhere
- Typical color change
- Usually round

- Not well defined, diffused and irregular, no vesicles
- Extravagated blood
- Absent
- Absent.
- Negative
- Seen in the site

SUB CONJUNCTIOVAL ECCHYMOSIS

MEDICO-LEGAL IMPORTANCE

1. Patterned bruises may connect the victim and the object or weapon like whip, chain, ligature, vehicle, etc.
2. The age of injury can be determined by color change.
3. The degree of violence may be determined from their size.
4. Character/ manner of injury may be known from its distribution.
5. In case of fall, sand, dust, gravel or mud may be found on the body.

3. Lacerated Wounds

Tissues are torn due to the application of blunt force.

- **Characteristics**
- **Margins: Ragged, irregular**
- **Bruising**
- **Fractures of Bones**
- **Hemorrhage : Little bleeding present.**

Types :

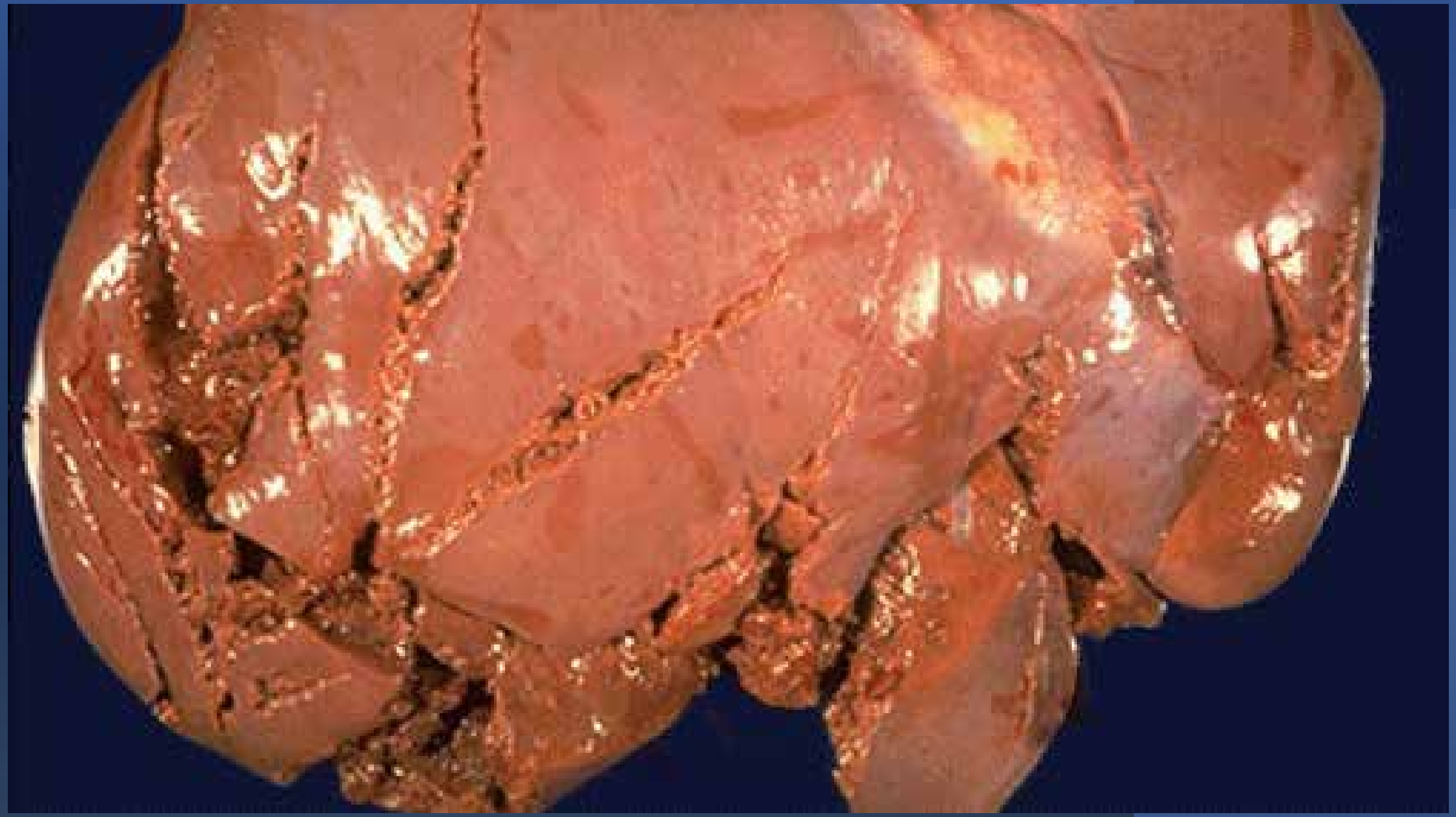
1. Split lacerations: Eg .Scalp lacerations

2. Stretch laceration: Eg. Motor vehicle accidents

3. Avulsion laceration: Grinding compression by weight like Lorry wheel passing over a limb.

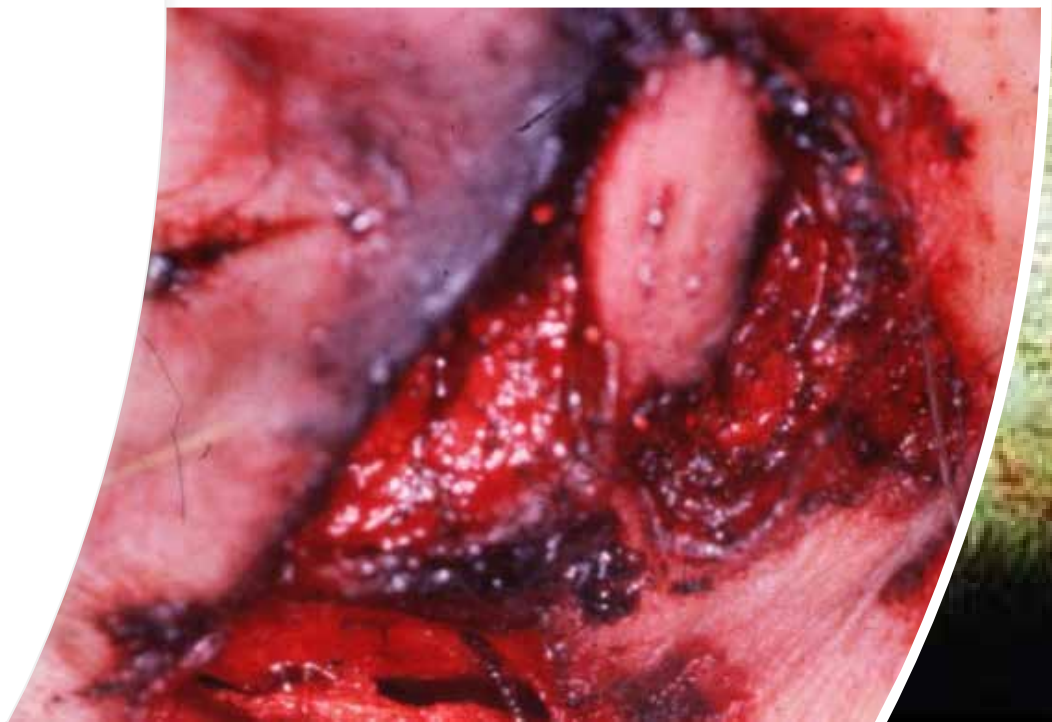
4. Tear: With irregular or sharp objects such as door handle of a car .

5. Cut laceration: with heavy sharp-edged instruments.



Characteristics

- Slightly inverted margins.
- Margins are often bruised and abraded.
- Ragged wounds caused by crushing and tearing of the skin
- Gape open



Shapes

May give some indication as to the agent responsible.

Blows to the scalp with the circular head of a hummer or a spherical knob of a poker tend to cause crescentic laceration.

Weapon with square or rectangular face such as the butt of an axe may cause laceration with a Y-shaped split at its corners.

Perineum: rape

Medicolegal Importance

1. Homicidal
2. Suicidal: Rare
3. Accidental/ Traffic accidents

4. INCISED WOUNDS

It is an Injury in which soft tissues including skin were neatly cut.

CHARACTERISTICS

01.Edges

02. Width

03. Length

04. Shape

05. Hemorrhage

06. Direction

Clean separation or division of the full thickness of skin under the pressure of a *sharp-edged* instrument (knives or broken glass).

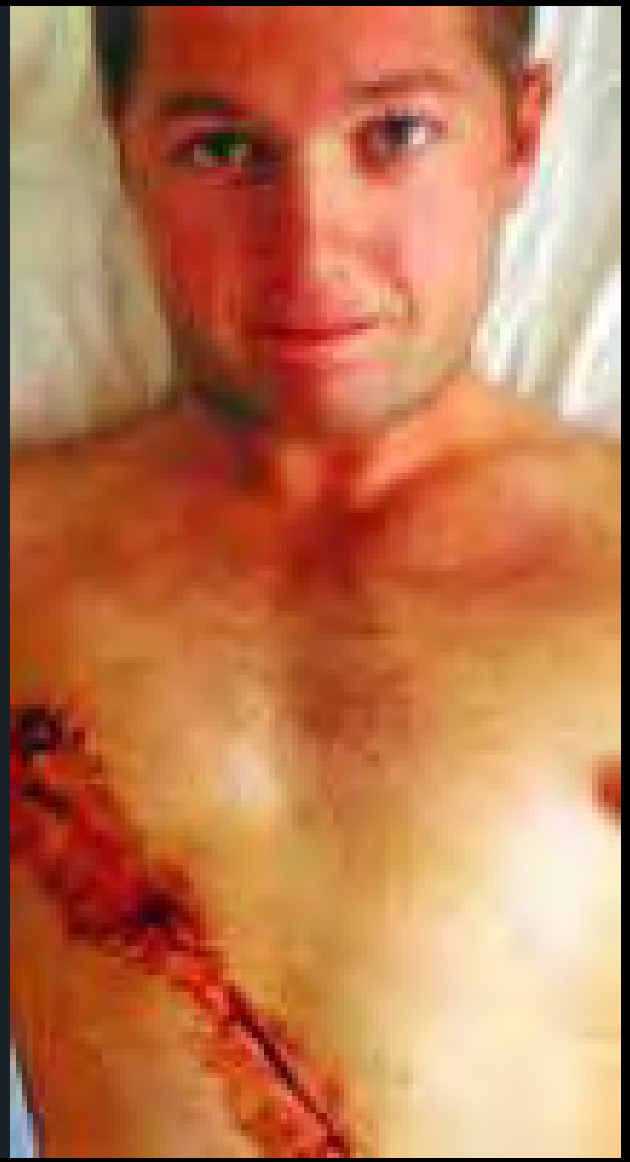
Types:

É Slash wounds:

Ð Length > depth. Generally NOT as serious as stab wounds unless it involves major *blood vessel.*

É Stab wounds:

Ð Depth > length. More SERIOUS as they tend to come in contact with *vital organs* in chest and abdomen.



Lacerations	Incised wounds
Trace evidence (rust or dirt)	Clean
Shape is NOT according to cause	Shape is according to cause
Ragged edge	Everted edge (turning outwards)
RARELY self-inflicted	May be self-inflicted

Self-inflicted injuries

- Cuts are usually superficial, multiple and parallel.
- In right handed people most of injuries are on the left side.

Features of Suicidal knife wounds

Certain sites : throats, wrists and the front of the chest are more common.

They are often multiple, but there are deep cuts.

1)Throat

- Stab wounds of the neck are UNCOMMON in suicide.

2)Wrist

- Deliberate cutting of the wrists is RARELY effective as a *sole* method of suicide but it is a COMMON injury

3)Chest

Suicidal injury of the chest are almost always stab wounds.

Defense Wounds

- Definition:
  - A wound sustained when a victim places a hand, arm or other body part to prevent or *minimize* a blow or slashing by a sharp weapon.

  - Usual Sites: The outer side of forearm.
    Back of the Hand.
    Fingers.

Medicolegal Importance

- Indicate Nature of Weapon.
- Indicate Site of impact and direction of force.
- Position and character of wound indicate mode of production. i.e. Suicide, Accident or homicide.

5. CHOP WOUNDS

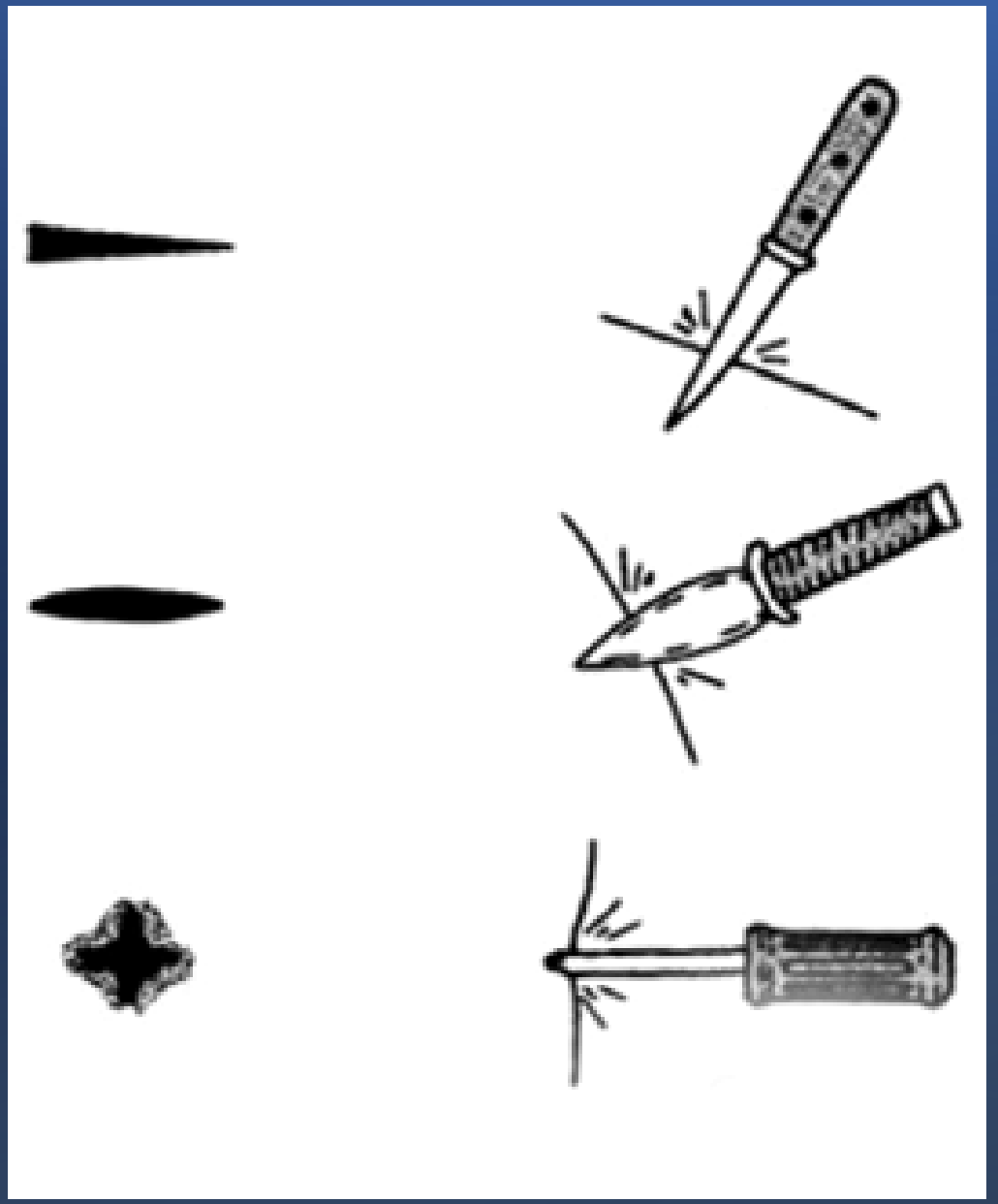
6.Punctured Wounds

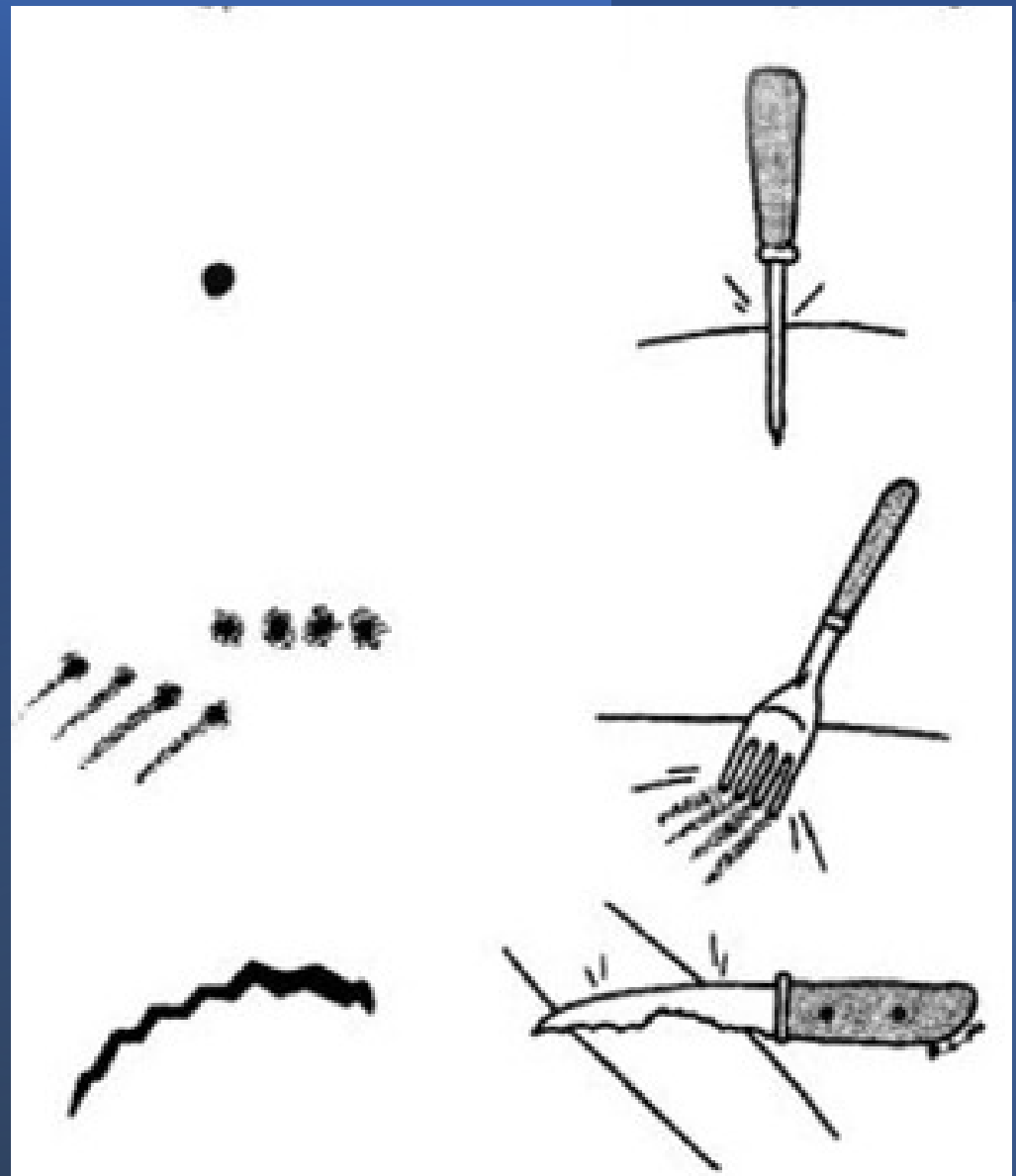
Characteristics

1. Length
2. Depth
3. Margins
4. Shape
5. Direction

Complications :

Concealed puncture wounds





Medicolegal Importance

1. Shape indicate type of weapon used
2. Depth indicate force of penetration
3. Direction: Indicate relative positions
4. Position, Number: Indicate mode of production suicidal, Homicidal or accidental
5. If broken weapon found

7. CUT THROAT WOUNDS

Difference between Homicidal and Suicidal Cutthroat Wounds

	Homicidal	Suicidal
1.Severity	Blood Vessels of both sides were cut	Cut on only one side
2.Situation	Lower part of the neck	Upper part of Neck usually front .
3.Regularity	Edges jagged irregular	Edges usually clear cut
4. Plane	Upwards or horizontal	Downwards or horizontal
5. Direction	Any direction	Obliquely from above downwards .
6. Tentative cuts	Not seen	Seen Cuts
7. Multiplicity	Multiple wounds	One severe usually
8. Other signs	Bruises or Abrasions in other parts of body present	Absent
9. Weapon	May not be recovered	Grasped firmly

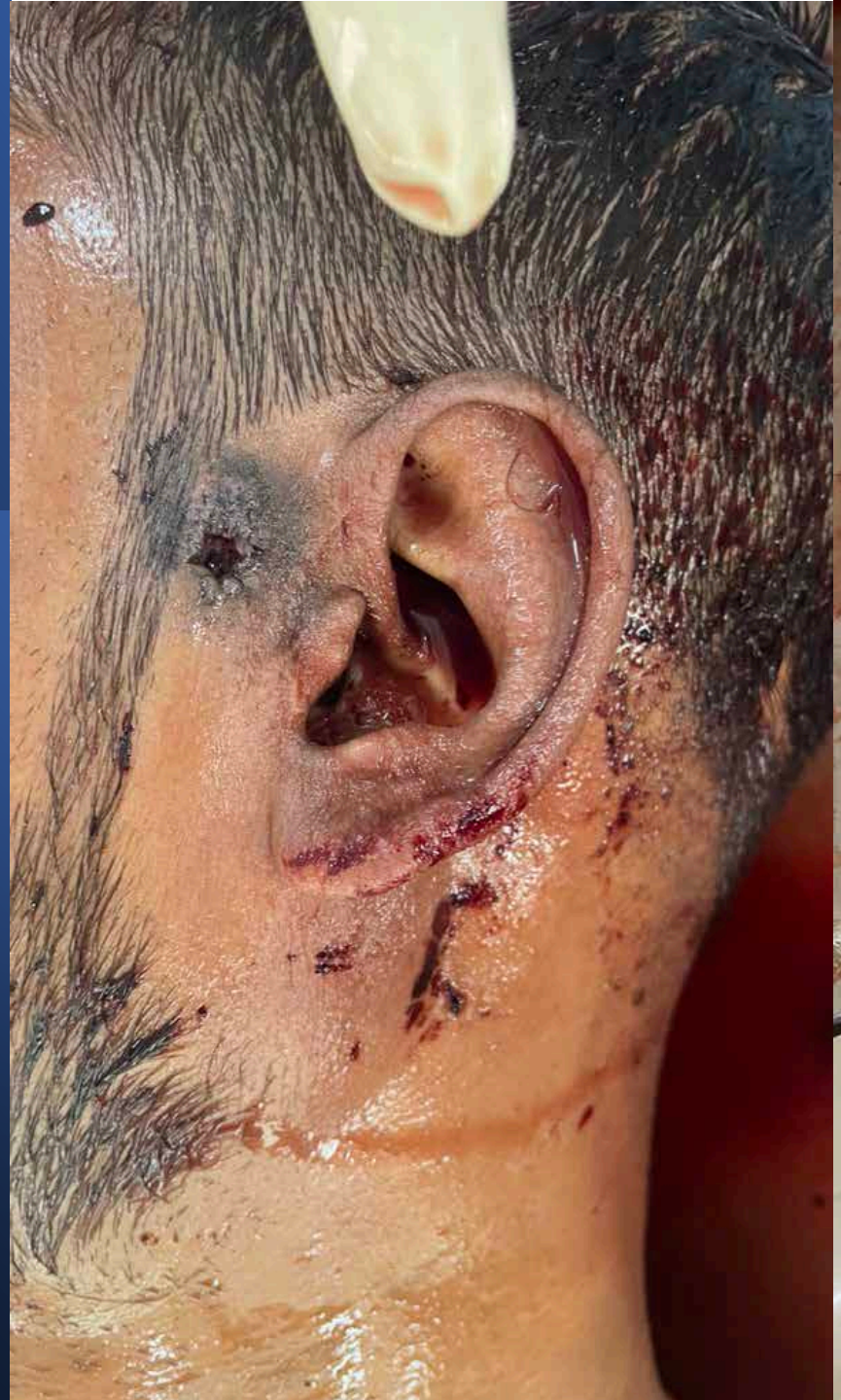
	Homicidal	Suicidal
10. Type of Weapon	Heavy cutting or Light cutting	light cutting only
11. Foreign	Broken pieces of bodies weapon may be present	Absent
12. Hemorrhage	Trailing of Blood is usually downwards backwards and strains on palms of hands may be seen	Trailing of Blood on chest as well as inner side and back of hand
13.Clothing	Cut on clothing corresponds to cut on unprotected part	On exposed parts

Ante mortem and Postmortem Wounds

	A.M. WOUNDS	P .M. WOUNDS
1.	Signs of inflammation present	Absent
2.	Color changes according to the age of the wound present	Absent
3.	Stained tissues resist washing	Washed easily
4.	Ante mortem clot is present	Absent
5.	Retraction and aversion of edges present	Absent

8. Fracture or dislocation of a bone, tooth or a joint

9. Firearm wounds



Shotgun Injuries

Effects of partly burnt gun powder, smoke, heat, fire (in cm)

Type of Gun	Unburnt/partly burnt gun powder (tattooing)	Smoke (blackening)	Heat (scorching)	Fire (burning/singeing of hair
Shot gun	50	30	25	12-15
Long barreled Rifles	50	25-30	25-30	25-30
Short barreled Rifles	40	25	20-25	20

II.Thermal Injuries

Due to Application of heat

- a. Heat hyperpyrexia(Heat stroke or sun stroke
- b. Heat exhaustion
- c. Heat cramps or Miner’s cramps
- d. Burn due to dry heat
- e. Scald (Burn due to moist heat)

Burn due to dry heat

Burn due to moist heat

ANTEMORTEM BURNS

POSTMORTEM BURNS

Due to application of cold

a. Hypothermia (Exposure to cold)

b. Frost bite (Due to dry cold)

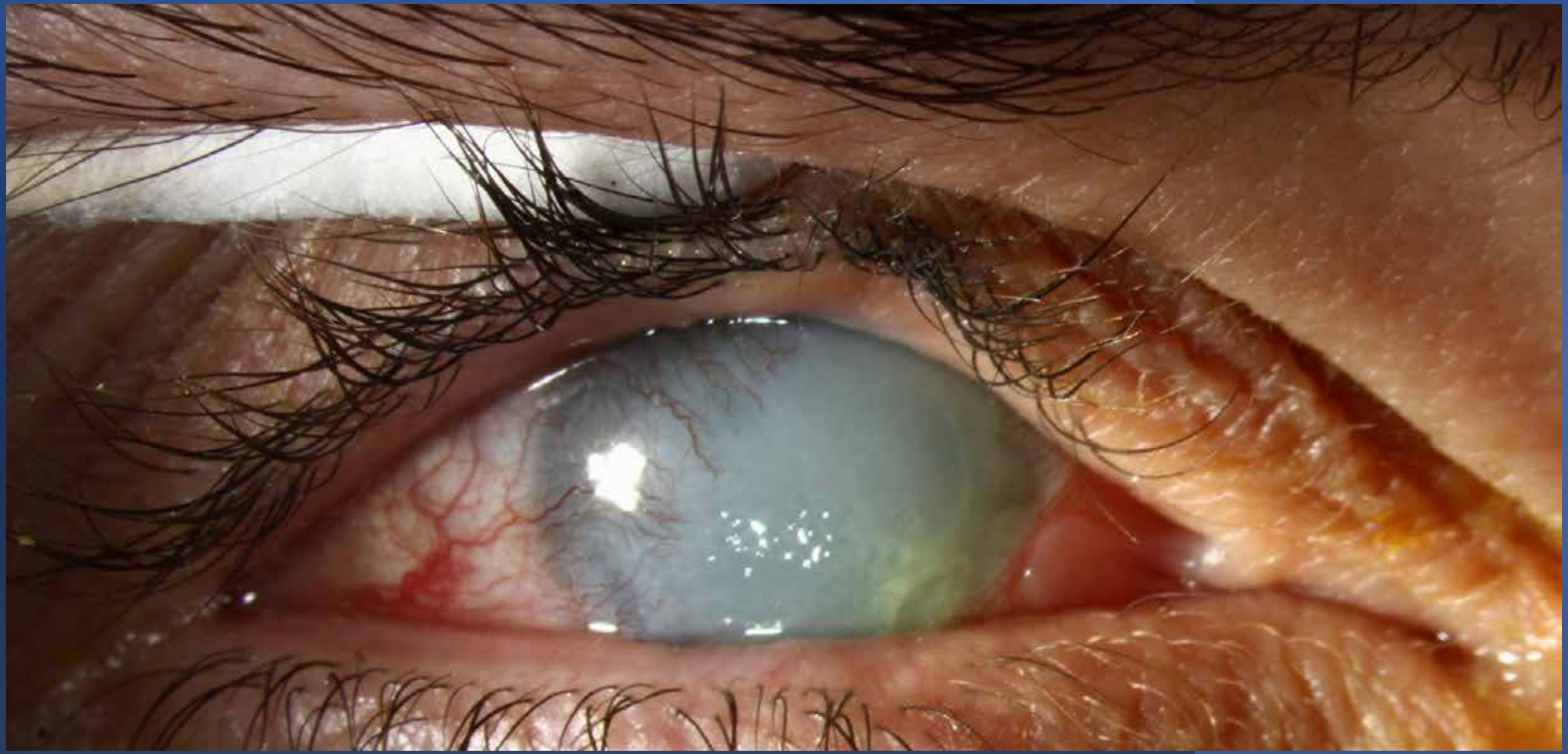
c. Trench foot (Due to moist cold)

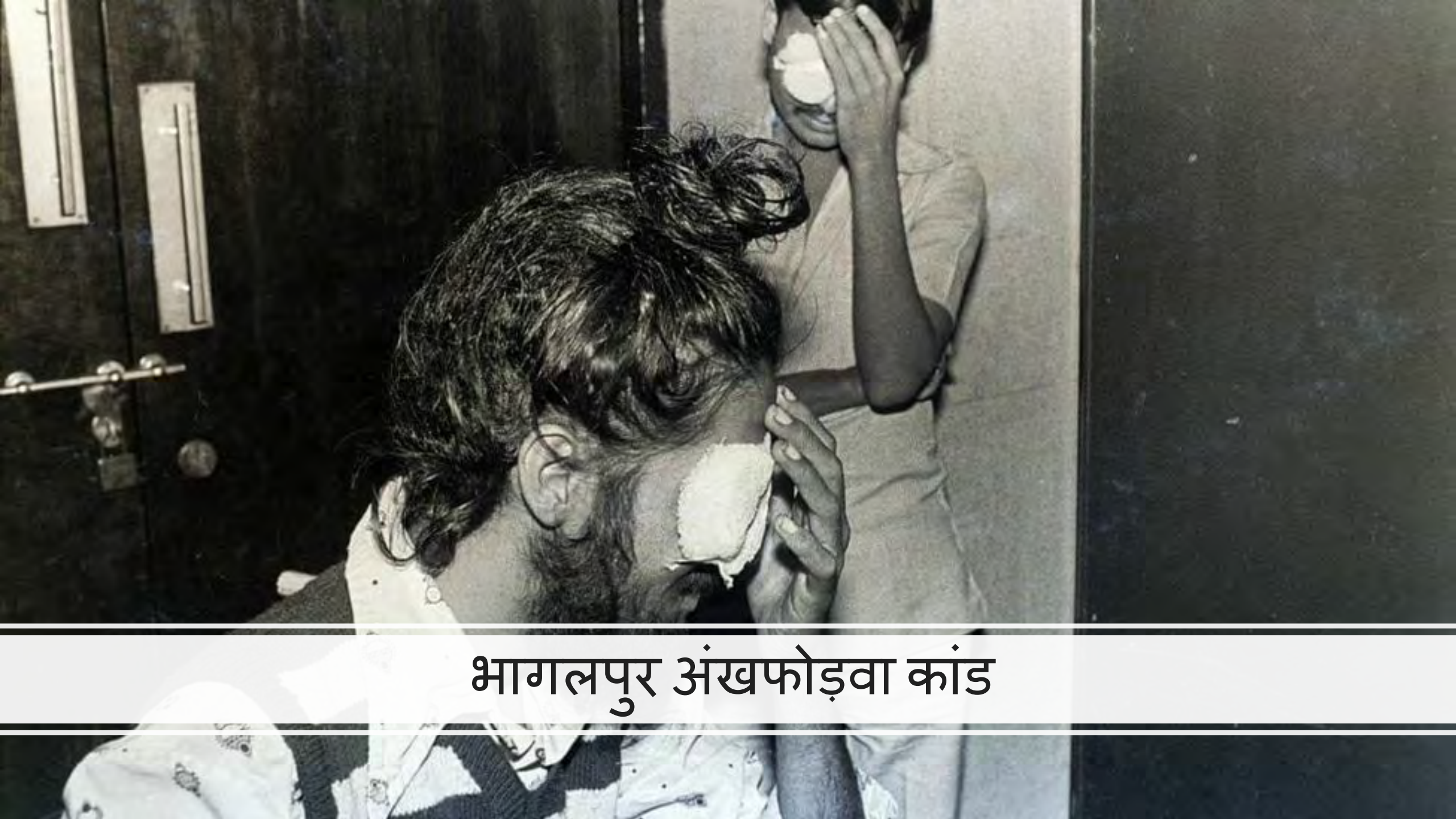
Superficial Frostbite

Deep Frostbite

III. Chemical Injuries

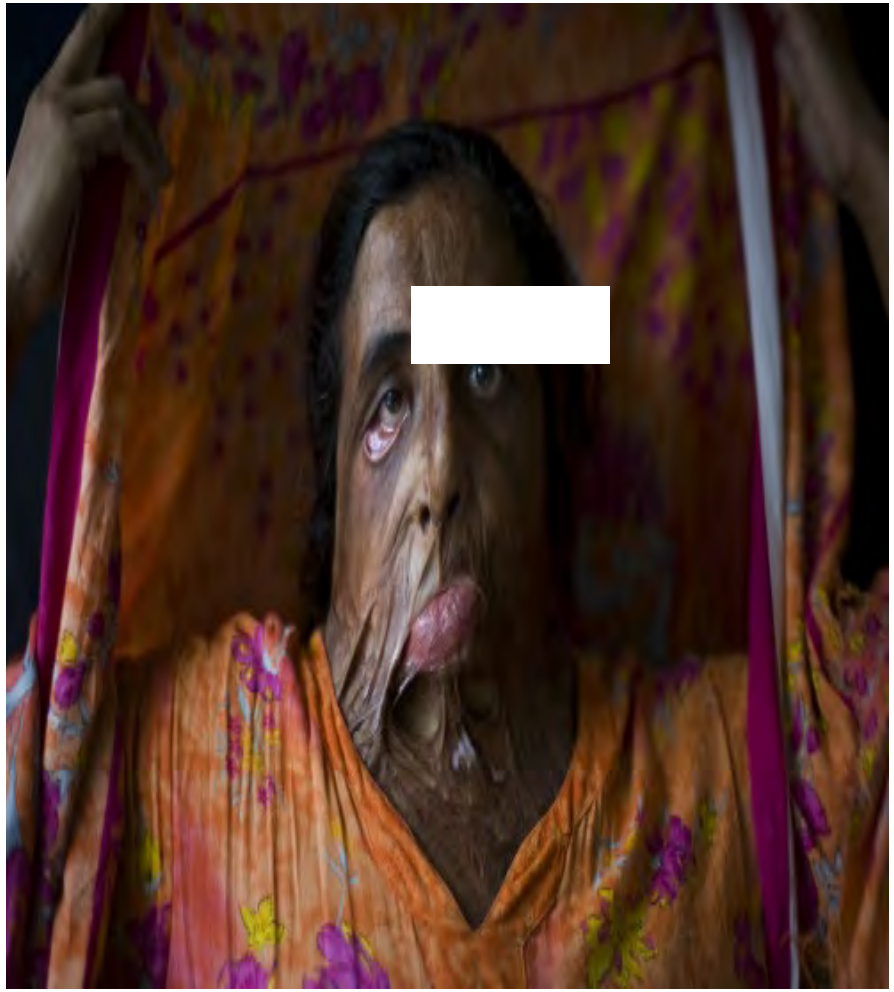
- 1. Corrosion -- strong alkalies and acids
- 2. Irritation -- weak acids, alkalies and some other chemicals or plants or animal extracts/bites.





भागलपुर अंखफोड़वा कांड

VITRIOLAGE



Miscellaneous injuries

- 1. Electrical injuries

2. Lightening

3. Blast injuries

Classification of Injuries according to severity of Injury

I. Simple

II. Grievous

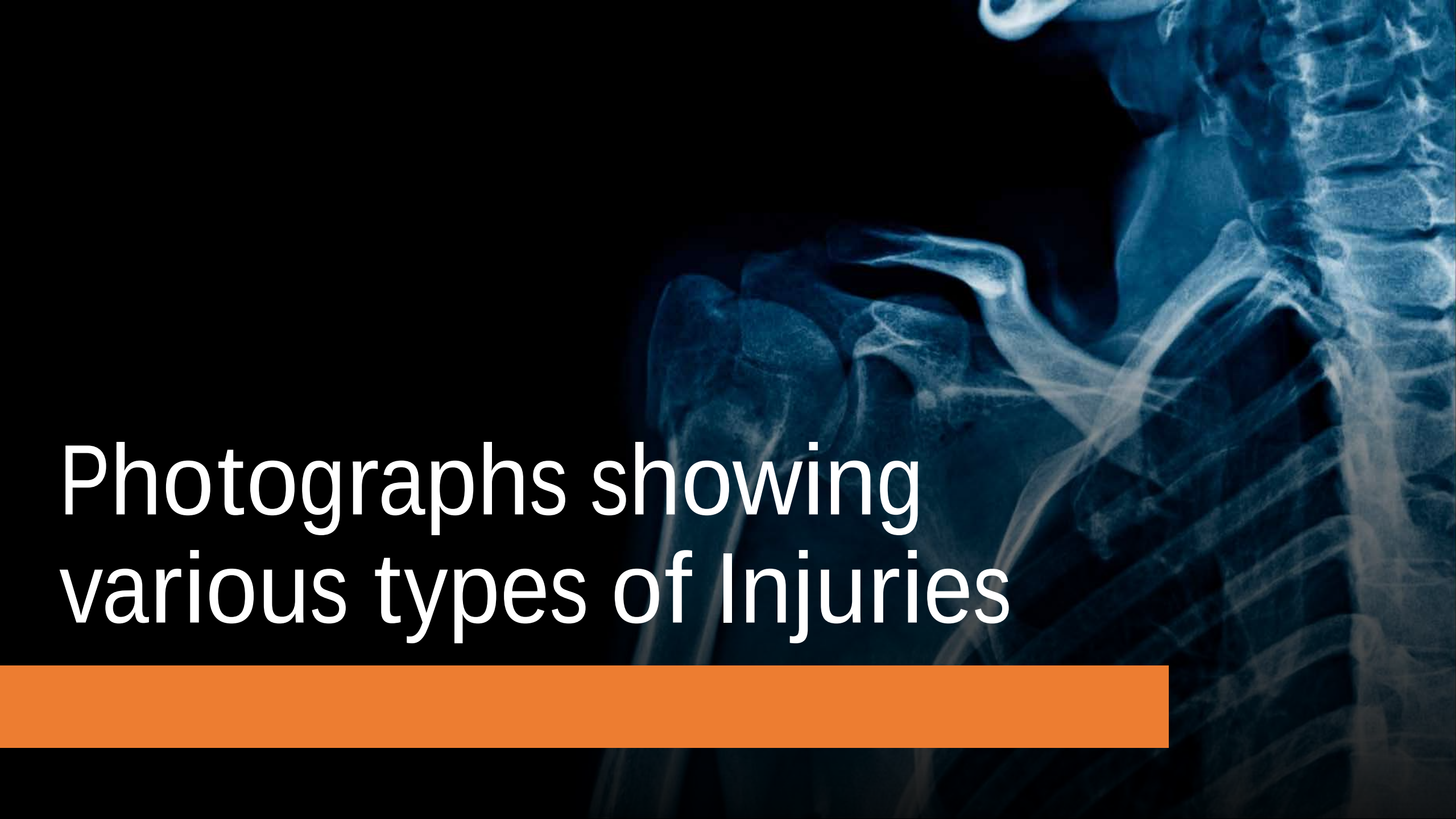
III. Dangerous

Classification of injuries from Medico Legal angle

1. Self inflicted or suicidal
2. Homicidal (Injuries inflicted by others)
3. Accidental injuries
4. Defence injuries
5. Fabricated injuries

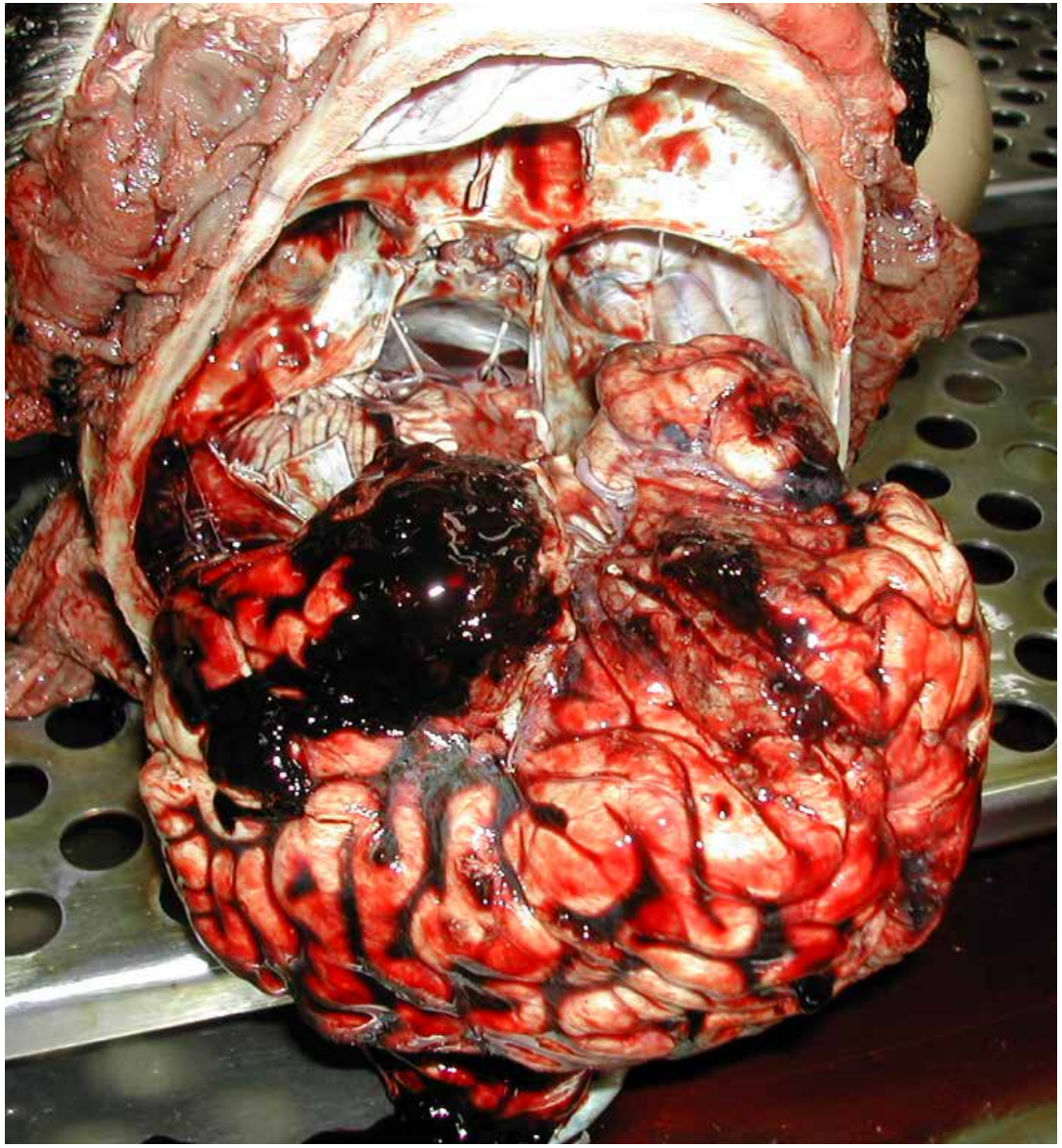
D. In relation to moment of death

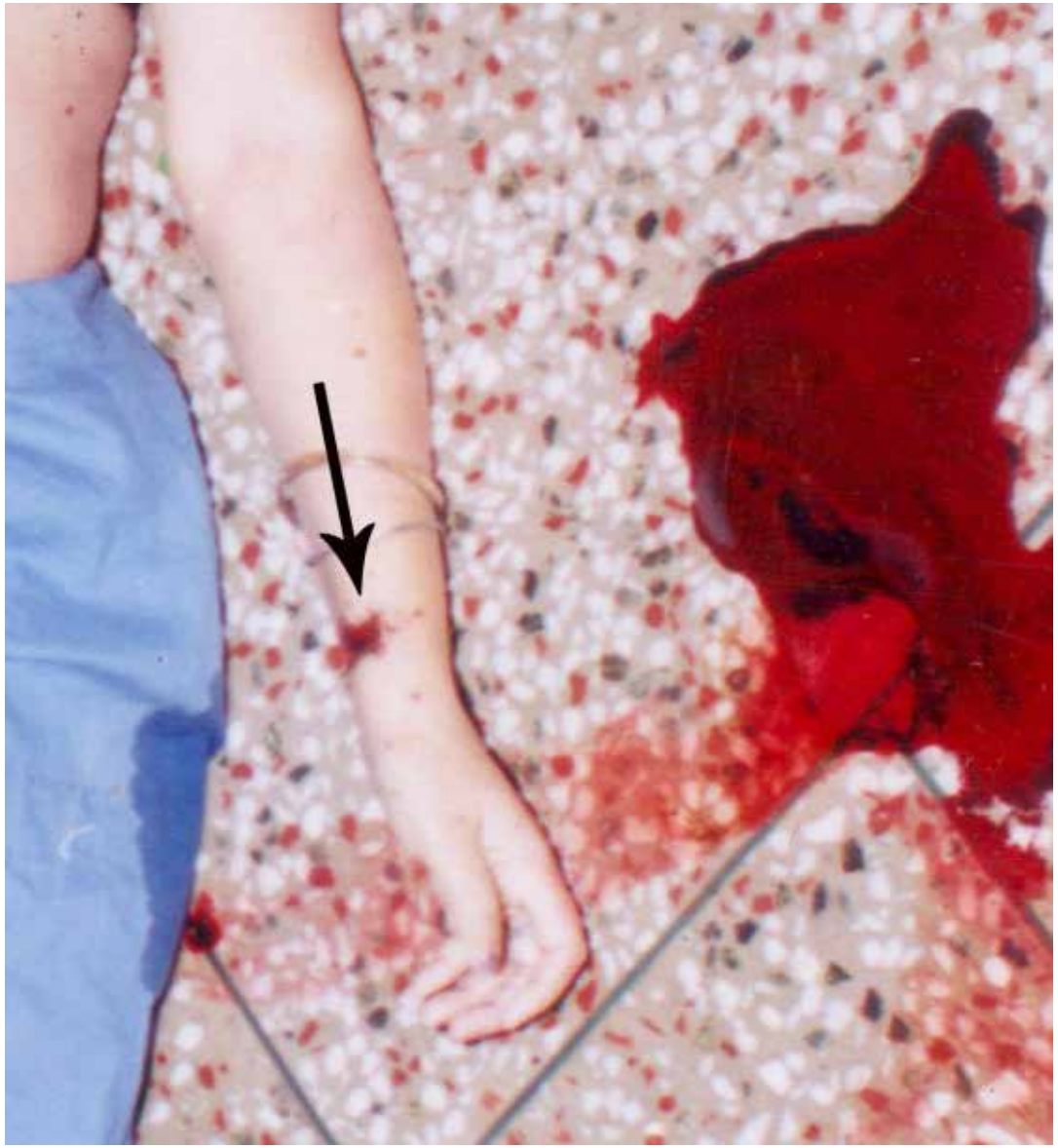
- Ante-mortem Injuries: (inflicted during life)
- Post-mortem Injuries: (inflicted after death)

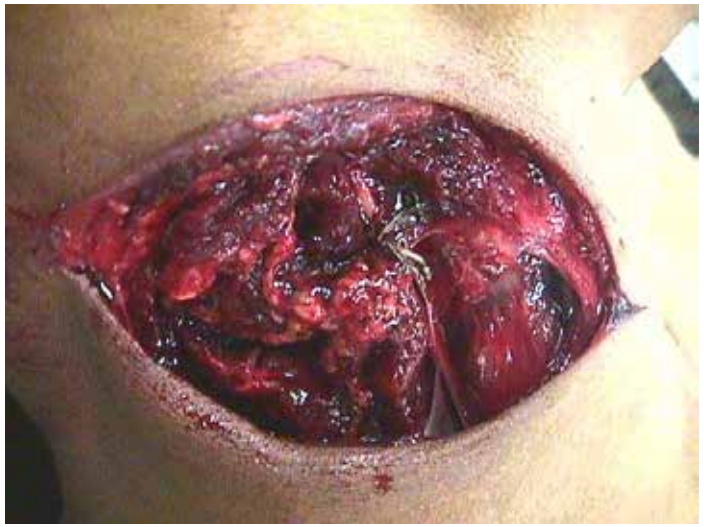


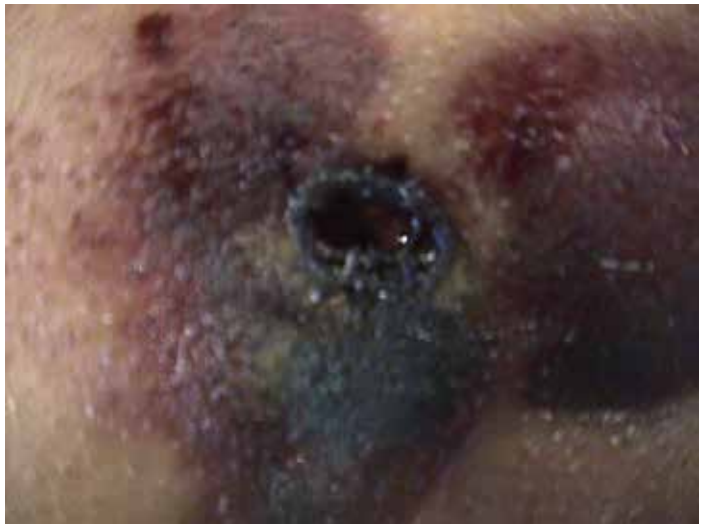
Photographs showing various types of Injuries


Dept. of. F.M
FM 58-0329
22-09-2058









ANTHROPPHAGIA BY ANTS

Age determination of Injury

AGE OF ABRASIONS/ GROSS EXAMINATION

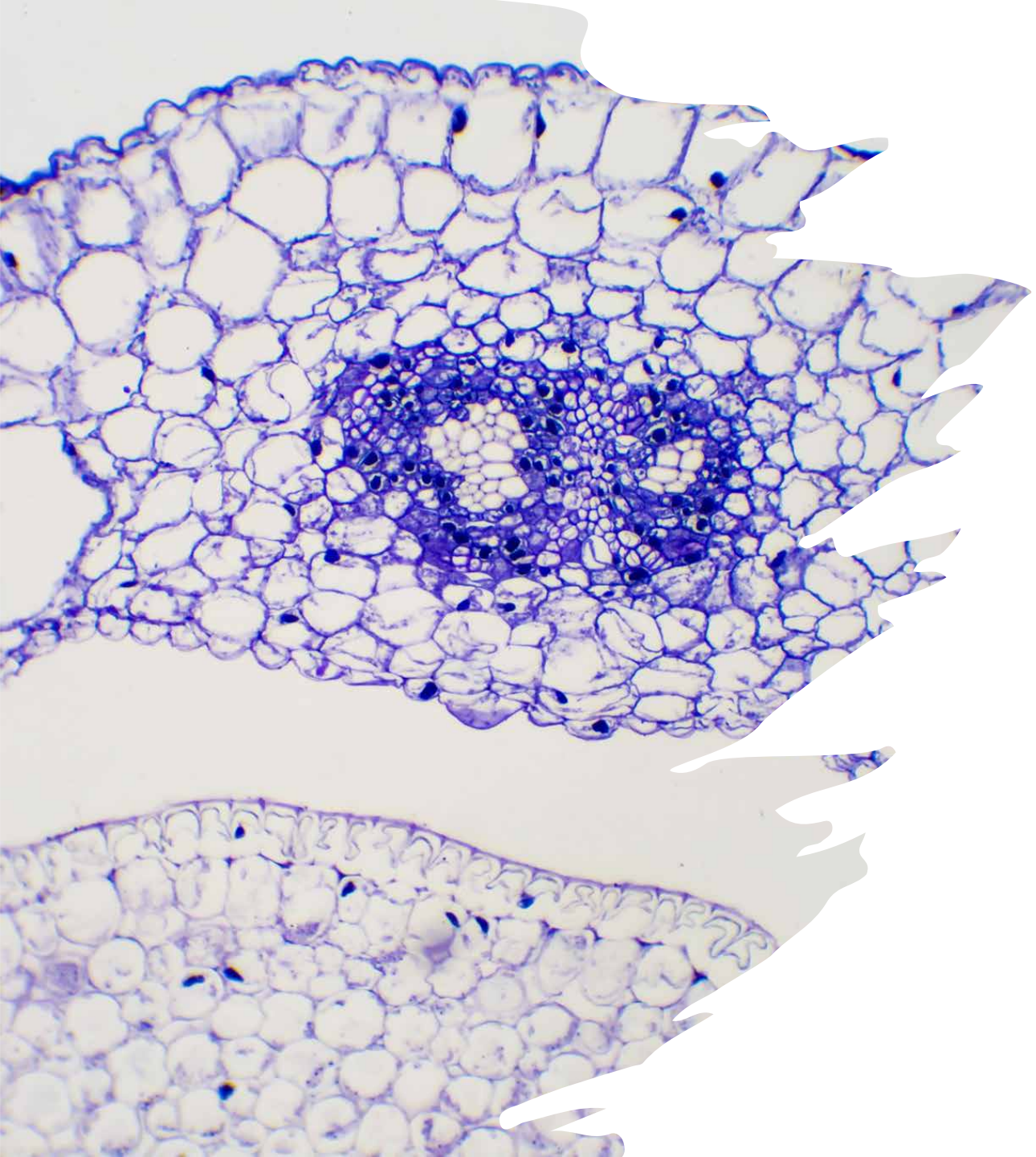
- FRESH :BRIGHT RED
- 12-24 HRS : SCAB FORMATION
- 2-3 Days : REDDISH BROWN SCAB
- 4-7 DAYS : EPITHELIUM GROWS
- AFTER 7 Days : SCAB FALLS OFF

AGE OF ABRASIONS/ MICROSCOPIC EXAMINATION

- Cellular Infiltration – 4-6 hours
- Three layers .. Surface (Fibrin + RBCs), Middle (Polymorphs), and Deep (Abnormally staining collagen) – 12 hours
- Scab well formed/ Epithelial regeneration – 48 hours
- Small abrasion/ Completely covered by epithelium – 4-5 days
- Subepithelial granulation tissue – 5-7 days
- Reticulum fibers – 8 days
- Collagen fibers – 9-12 days
- Regression/ Remodelling -- > 12 days

AGE OF BRUISE/ COLOR CHANGES

- At first : RED (OxyHb)
- Few hours to 3 days : BLUE (Hb)
- 4th day : BLUISH BLACK to BROWN (Hemosiderin)
- 5 to 6 days : GREENISH (Hematoidin)
- 7 to 12 days : YELLOW (bilirubin)
- 2 weeks : NORMAL



AGE OF BRUISES/ MICROSCOPIC EXAMINATION

- Polymorphic Infiltration – 2 hours
- Polymorphs very high, Monocytes, Fibroblasts – 1-2 days
- Polymorphs low, Monocytes very high – >2 days
- Collagen – >3 days
- Large histiocytes with coarse hemosiderin granules – 4 days
- Monocytes decrease, crystals of hemosiderin – >5 days

AGE OF LACERATED WOUNDS

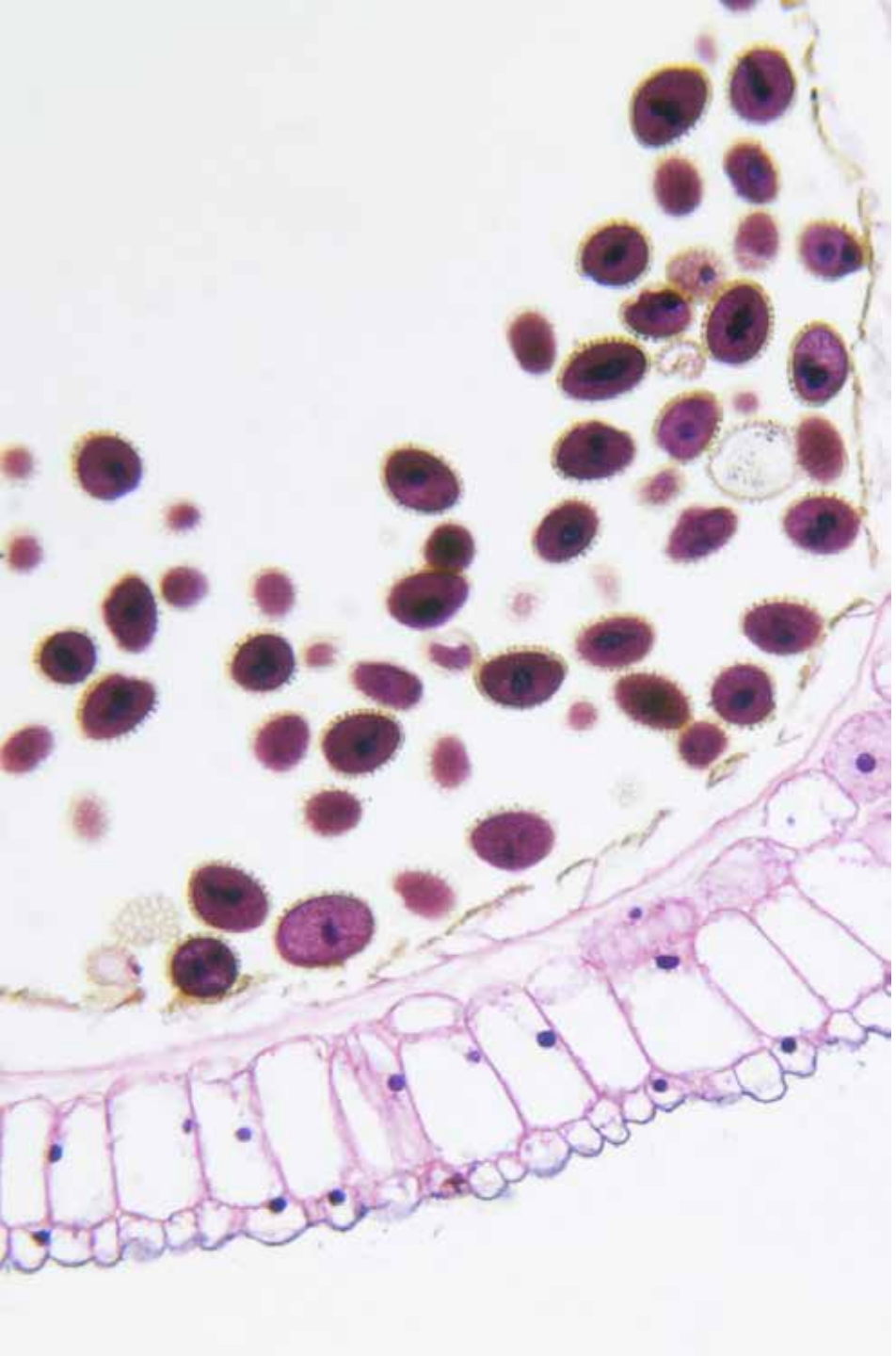
- Age determination is difficult unless clear signs of healing are present like Fibroblasts, Granulation tissue, Organizing infiltrates.

AGE OF INCISED WOUNDS/ GROSS EXAMINTION

- Fresh
- 12 hrs
- 24 hrs

- 36 hrs
- 48- 72 hrs
- 1 -2 weeks

- Haematoma formation
- Edges are red swollen
- A continuous layers of Epidermal cells cover the surface
- Capillary Network is complete
- Epidermal cells cover the area
- Scar tissue forms

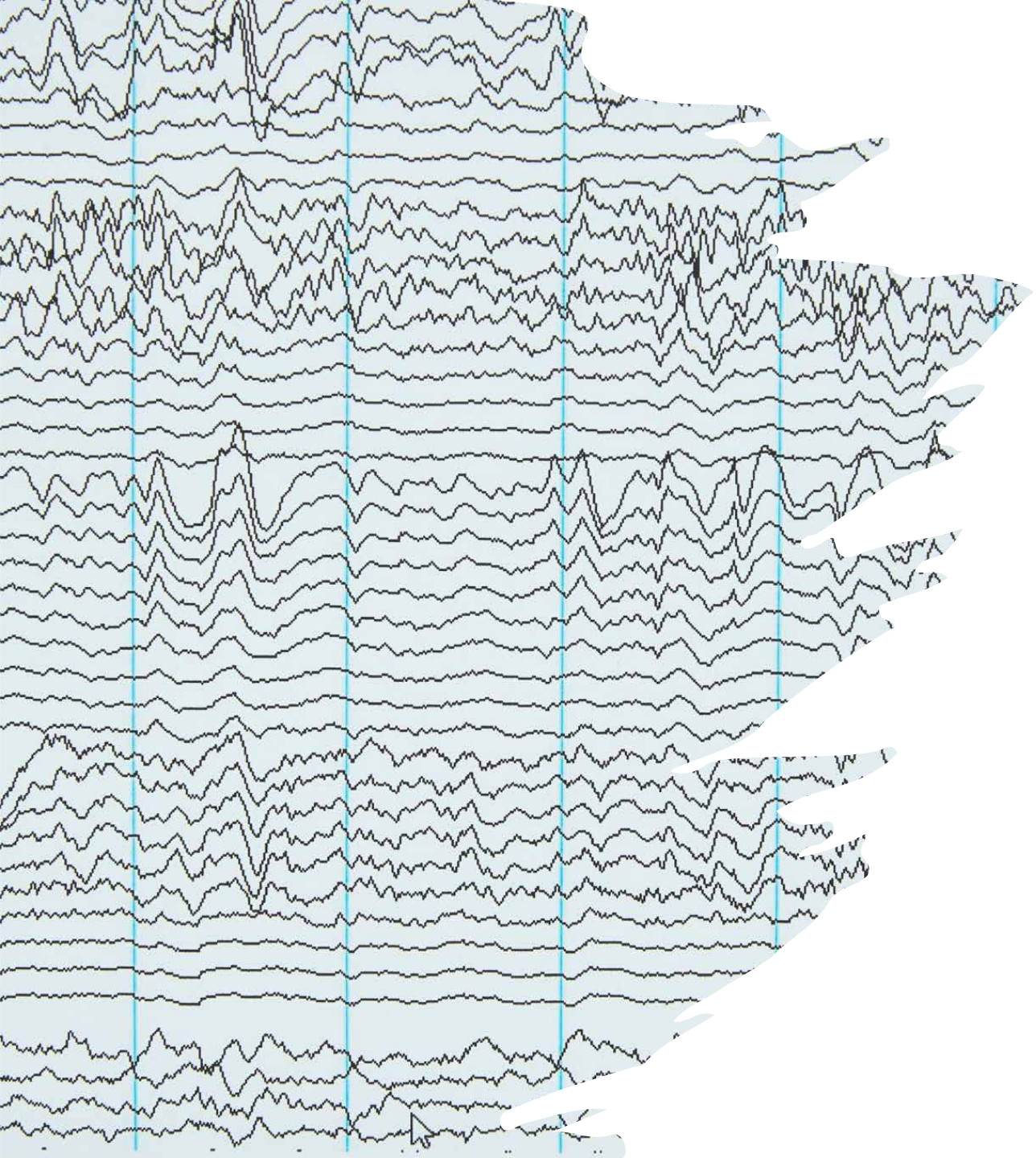


AGE OF INCISED WOUNDS/ MICROSCOPIC EXAMINATION

- Histiocytes react, Capillary dilatation, Vascular endothelium swelling, Neutrophil emigration and migration – Few Minutes
- Fibroblast's reaction, Monocytes in exudates– 12 hours
- Monocytes divide mitotically – 16 hours
- Epithelium grows at ages, continuous endothelial cells over surface, vascular buds appear– 24 hours
- Vascularized granulation tissue – 72 hours
- New fibrils– 4-5 days
- Scar in small wounds – 7 days

AGE OF BURNS/ MACROSCOPIC & MICROSCOPIC EXAMINATION

- Erythema – Immediate
- Vesication, Floor blood vessels dilated– 1 hour
- Epidermis (thinned out, deeply stained, deeper layer cells elongated, perpendicular to skin), Dermis (Neutrophil infiltration)– 6 hours
- Exudates dry– 12-24 hours
- Pus formation in dirty wounds(age estimation difficult) – 36 hours
- No Pus: Dry brown crust – 2-3 days >> Superficial slough falls – 4-6 days >> Deep slough falls – 2 weeks >> Granulation tissue covers surface – 2-3 weeks >> Scar – weeks to months >> Marjolin's ulcer – 10-25 years



AGE OF BURNS/ IMMUNOHISTOCHEMISTRY

- Increased levels of P53 have been demonstrated in antemortem burns.
- Peak levels in 1-2 days.
- Then its level gradually decreases.

AGE OF FRACTURES

- Inflammation -- < 7 days (Blood clots around fracture – 12-24 hours >> Fibrin network -- 24 hours >> Necrosis, Neutrophil Infiltration – 2 days >> Macrophage Migration – 3-4 days >> New vessels, Numerous Fibroblasts – 7 days)
- Soft callus (Connective tissue formation, angiogenesis) – 1 week to 4 week
- Hard callus (Woven bone formation, Random Fibrils, Osteocytes number high >> Clinical union) – 4 to 12 week
- Remodeling (Strong lamellar bone, few Osteocytes)– up to 2 years
- False joints/ Pseudoarthrosis – Months to years

AGE OF SKULL FRACTURES

Healing – without callus formation

External callus formation – delayed/ periosteum damaged.

Fissure fracture edges stick – 1 week

Edges eroded, inner table shows pitting and lime salt deposition -- 2 weeks

Edges slightly smooth, osseous tissue runs across fissure – 3-5 weeks

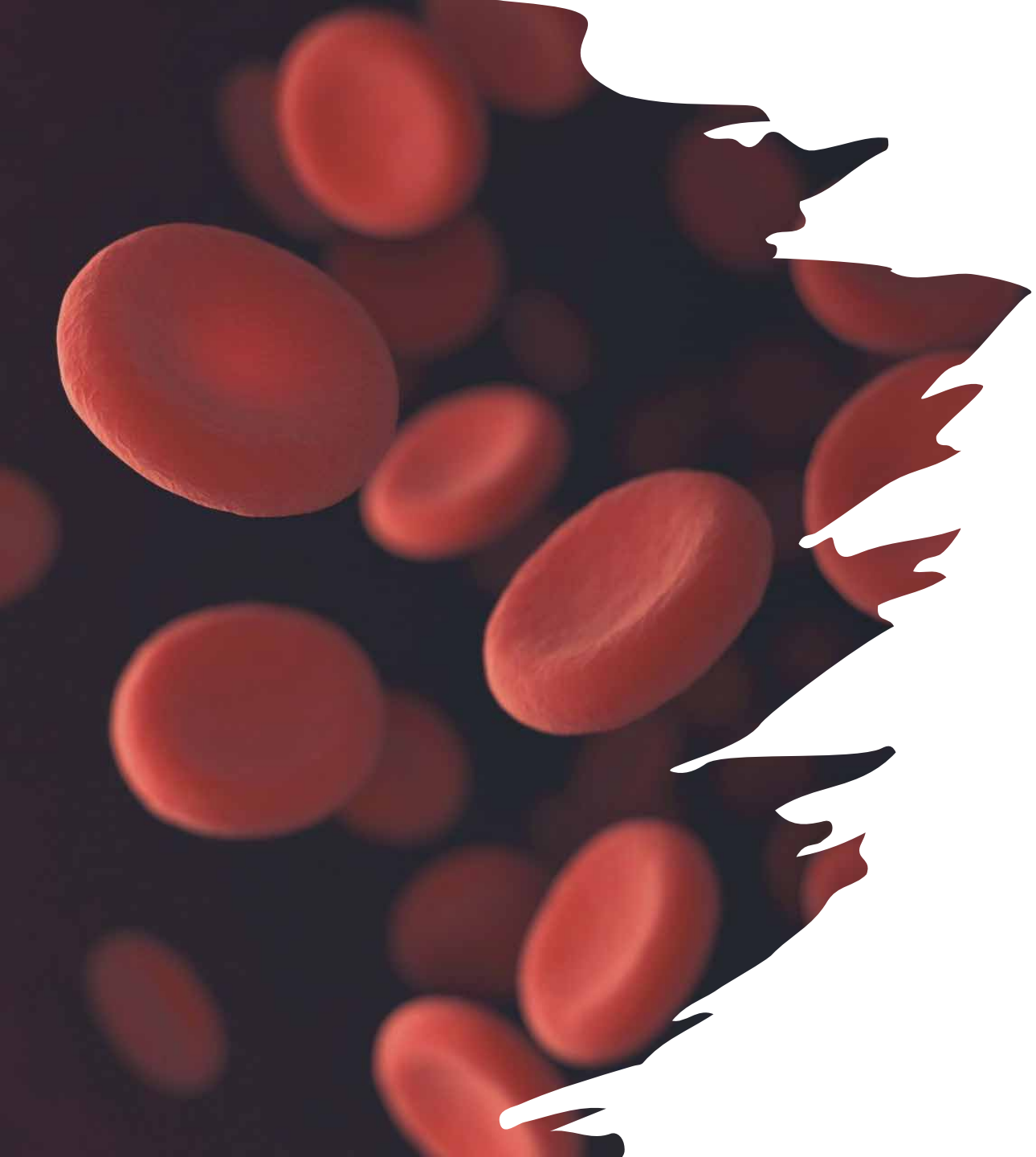
Complete healing– 3 Months

Dating of SDH

- Partially liquid, partially soft , red black, gel like clotted blood, that does not adhere to inner dural surface, No cellular reaction, RBCs Intact, Leucocytes trapped, Fibrin in discontinuous layers between dura and hemorrhage – 24 hours.
- Reddish brown, increased fibrin deposition, neutrophil invasion, fibroblast proliferation -- 24-48 hours.
- Soft clots loosely stuck to dura, resist pressure, endothelial proliferation, scattered macrophages, occasional spindle cells, Early RBC breakdown, hemosiderin granules, margins of clotted RBCs indistinct, neo membrane appears on the dural side – 2-5 days

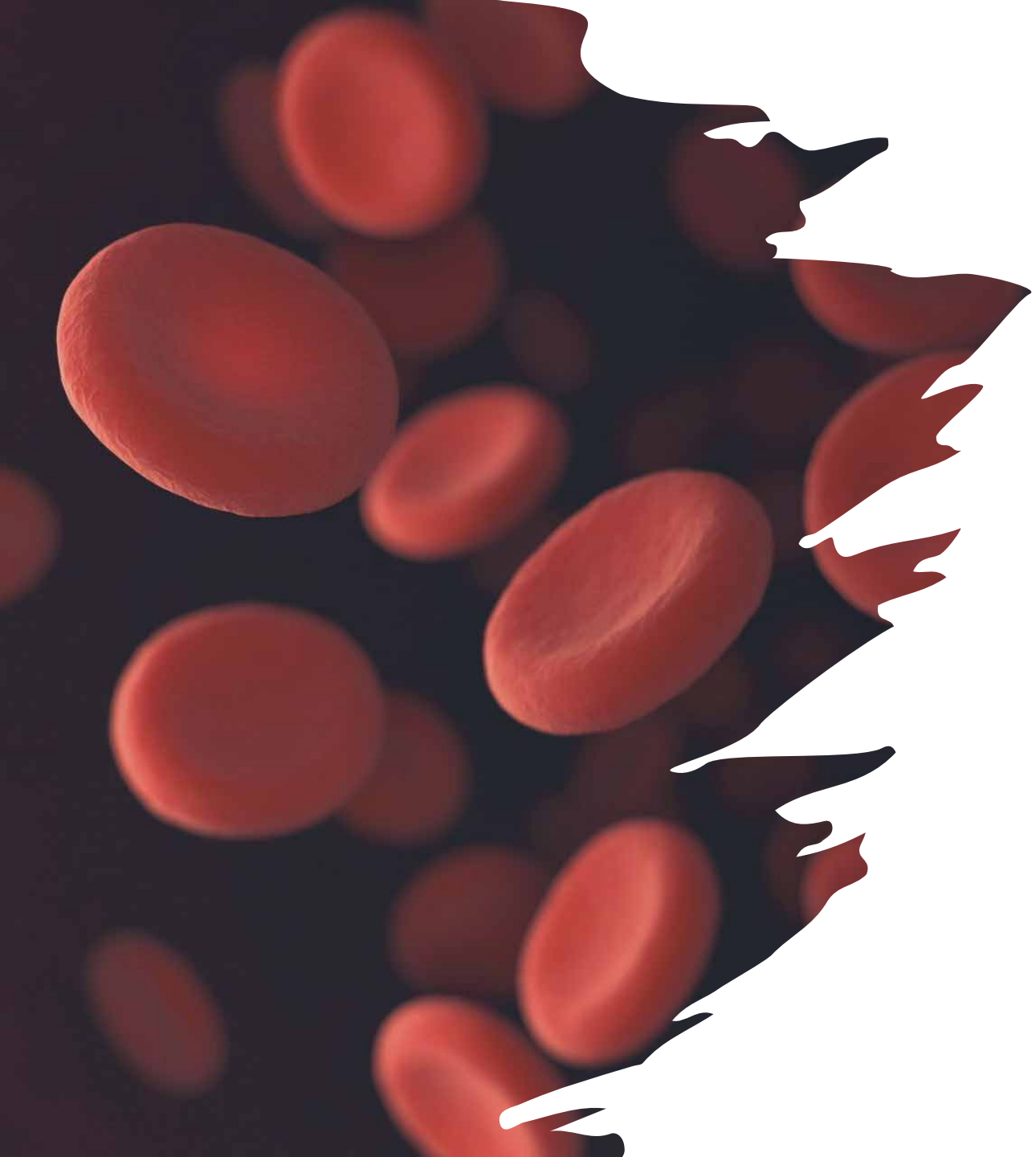
- Outer neo membrane yellow, inner not appeared, orange brown, adheres to dura, capillaries appear, abundant fibroblasts/ granulation tissue appearance, increased hemosiderin, hemolysis of RBCs – 1 week.
- Outer neo membrane thickens/ loosely arranged fibrovascular tissue, inner neo membrane thin and incomplete, vascularity increases, inner surface of clot liquifies, rare RBCs, orange to yellow brown, red black blood foci, hemosiderin laden macrophages -- 2-3 weeks.
- Outer and inner membranes complete and grossly visible, blood semiliquid and orange brown, collagen deposition, artery formation – 4 weeks.

- Rare hemosiderin laden macrophages, neo membrane and dura fuses, blood reabsorbed, thin gold colored membrane adgerent to dura, rare blood vessels – 1-6 months.
- Thin neo membrane difficult to distinguish from native dura, hemosiderin laden macrophages still present – 6-12 months.



MICROSCOPIC DATING OF SAH

- Fresh blood in Subarachnoid space -- 1 hour.
- Occasional neutrophils, some RBCs break, begin to creep down to Virchow- Robin spaces – 1-4 hours.
- Increased neutrophils, perivascular lymphocytes, rare macrophages -- 4-12 hours.
- Hemosiderin and fibrin, lymphocytes and macrophages increase – 12-24 hours.
- Lymphocytes and macrophages further increase, hemosiderin deposition – 24-48 hours



- Neutrophil infiltrates peak – up to 3 days.
- Laking of RBCs, lymphocytes increase, intense fibrin deposition separating islands of RBCs, early collagen formation – up to 5 days.

DATING OF EDH

- Bright red – Recent effusion.
- Bluish black to brown – 4th day.
- Pale brownish yellow – 12-25 days.
- Firm and laminated coagulum – Few months.

WEAPONS OF ASSAULT

DANGEROUS WEAPONS (LIKELY TO BE USED)

- Dagger, knife, barber’s knife, razor blade, axe, pickaxe, hand spade, sickle, probe, hammer, cycle chain, whip, police danda, nylon rope, coir rope, rifle cartridge, shot gun cartridge, etc.

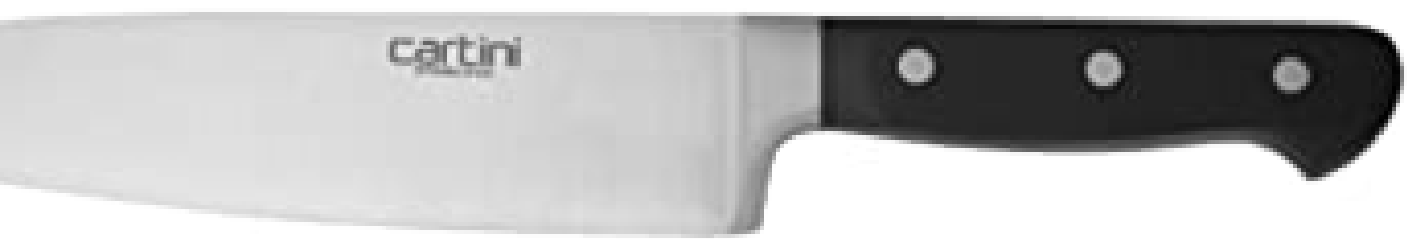
Blunt weapons like wooden club, iron rod, police lathi, etc. produce abrasion, contusion, laceration and fracture dislocation.
Sharp weapon could be light cutting weapon like hand-knife or heavy cutting weapon like chopper or axe.
Light cutting weapons like hand-knife or kitchen-knife produce incised wounds (force is tangential) or stab wounds (force is perpendicular).
Heavy cutting weapons like a long chopper produces cut wounds or chop wounds.

Single-edged knife with pointed tip:

Light sharp cutting weapon

It has a metallic blade with one sharp and one blunt edge, a tapering end and a wooden or plastic handle

- Injuries caused :-
  - Stab wound (wedge shaped)
  - Incised wounds
  - Perforating wounds
  - Penetrating wounds


cartini

Cycle chain

Flexible heavy blunt weapon with quadrangular and blunt edges

- Injuries caused:-
  - Imprint abrasion
  - Patterned contusion (bruise),
  - Split laceration
  - Fracture skull
  - Fracture and dislocation of long bones.

Barber’s blade

Light sharp unstable weapon, with a metallic blade and a plastic handle with pointed tip and plastic handle.

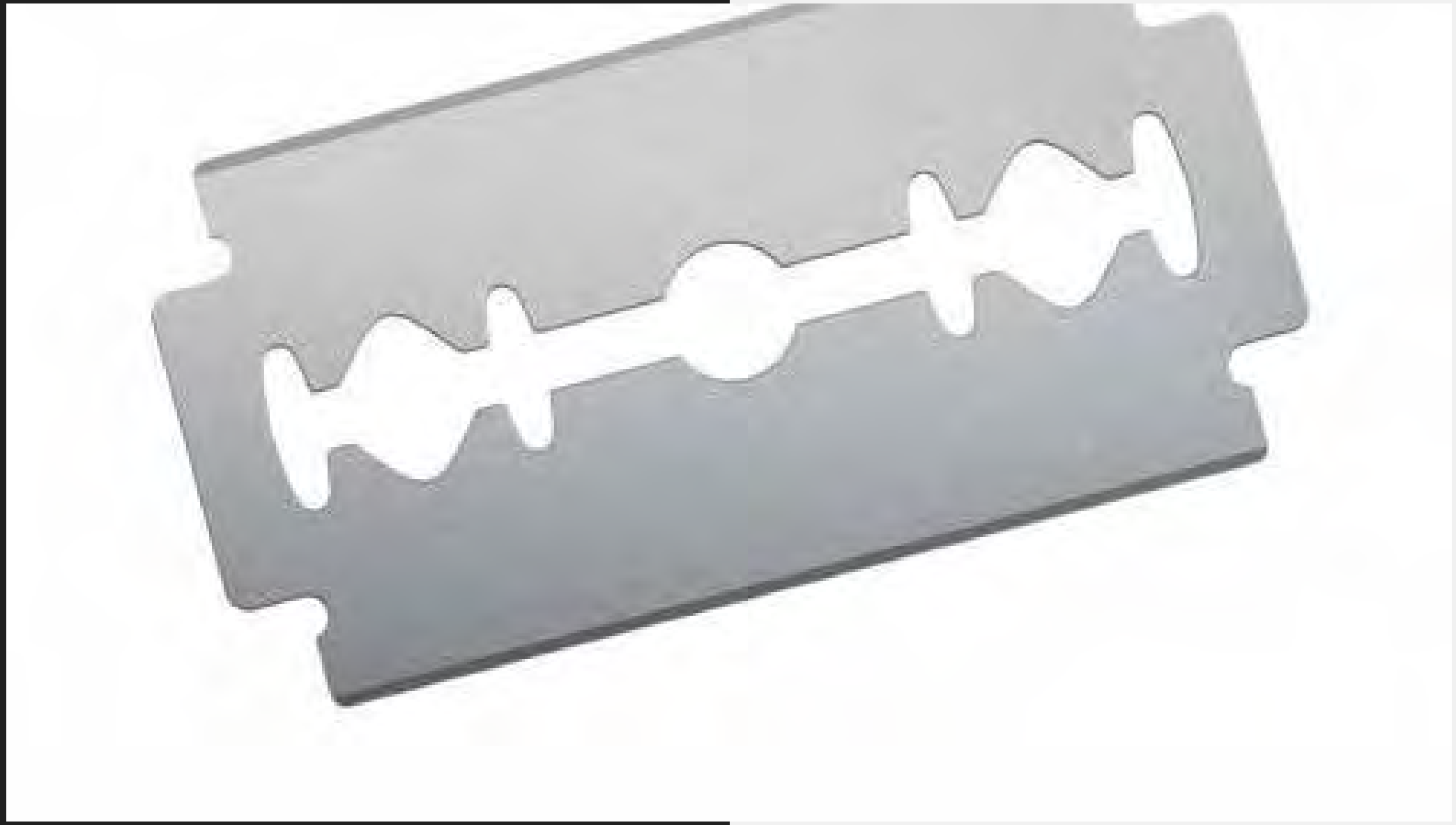
- Injuries caused:-
  - Incised wounds
  - Abrasions


BLACK WIDOW®

Razor blade

Light sharp cutting weapon, with two flat surfaces and four edges. Oppositely placed two long edges are sharp and the other two blunt.

- Injuries caused:-
  - Incised wounds
  - Abrasions



Pins

Light pointed weapon

- Injuries caused:-
- Penetrating injuries
- Perforating wounds
- Concealed wounds (Infanticide)
- Abrasions

Ice pick

Light sharp weapon, with metal head with pointed tip and plastic handle.

- Injuries caused:-
- Stab wounds
- Penetrating injuries
- Incised wounds
- Perforating wounds
- Pithing (Infanticide)
- Blunt force injuries (when the hilt is used)

Screw driver

Pointed weapon with metal head with broad tip and plastic handle.

- Injuries caused:-
- Stab wounds.
- Blunt force injuries (when the hilt is used)


STANLEY

DAGGER

It is a moderately heavy sharp weapon with three parts, a spindle shaped double edged metal blade with pointed tip, a wooden handle and a metal guard which may cause hilt injuries.

- **Type of injuries produced:** Injury is dependent on site of the body and amount of force used, and they could be as follows:
- 1. An incised wound—when the sharp edge is used.
- 2. A penetrating / perforating wound-when force is used.
- 3. Abrasions

AXE

A heavy sharp-edged weapon. It consists of a metal blade which has two surfaces with a sharp edge and four borders, and a wooden handle fitted opposite to sharp edge. Upper end of the blade is called ‘toe end’, while the lower end-‘heel end’.

- **Type of Injuries Produced**
- Injury produced always corresponds to the amount of force used and cross section/size of the blade or shape and width of the cutting edge. It also depends on the site of the body of the victim.
- **By the blade**:-
- When less force is used—Incised wounds
- When more force is used—Chop wounds, fractures.
- **By the handle** :- Abrasions, contusions, lacerations, fractures.


CRKT

SICKLE

It is a moderately heavy sharp cutting curved weapon used for cutting paddy and vegetations. It consists of a wooden handle and metallic blade with two edges, inner sharper edge and the outer blunt edge; a hilt in between and a pointed tip.

- **Type of Injuries Produced**
  - Incised wound/cuts/slashes
  - Stab wound
  - Lacerations/abrasions by the hilt.

HAMMER

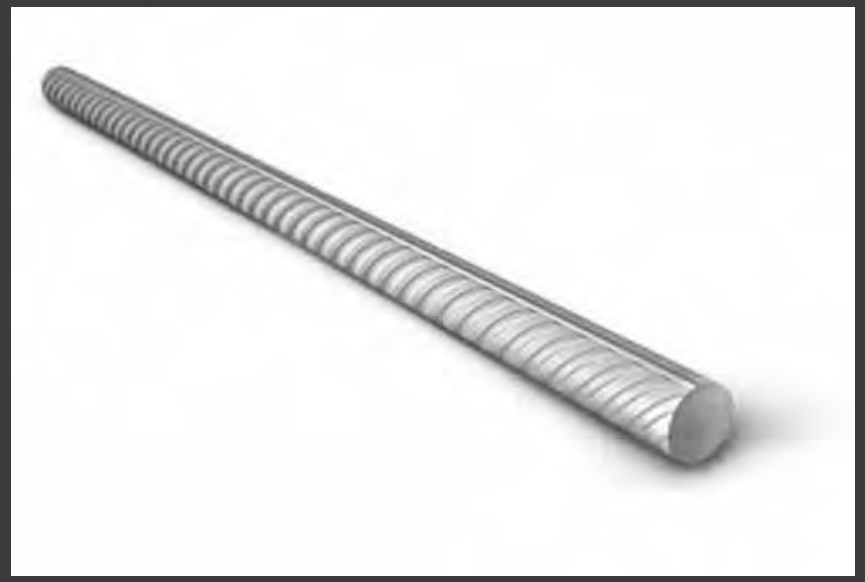
Heavy blunt weapon non- flexible weapon. It has a metallic part and a wooden handle.

- **Type of injuries produced:** Depends on force used and site injured
  - **On scalp:** Contusion, lacerations, incised like lacerations (split lacerations)
  - **On skull:** Fracture a-la Signature, comminuted fracture, etc.
  - **Intracranially:** Depending on the force used, it could be a contusion or laceration of the brain or any type of intracranial haemorrhage.

METAL ROD/ WOODEN CLUB/ POLICE “DANDA”

A metallic heavy blunt non- flexible weapon.

- **Type of injuries produced:** Depends on the amount of force used and site of injury
  - Abrasions
  - Tramline Contusions
  - Fracture of bones
  - Split Lacerations.



NYLONE and COIR ROPES

Light blunt weapon, flexible, made up of nylon material, with definite threading pattern and produces imprint abrasion (ligature mark or hanging and strangulation).

- **Type of Injuries Produced**
  - Patterned abrasions
  - Patterned contusions
  - Rope burns

Examination of Weapon

- Letter No.....
  Date.....

- TO,
  The Investigating Officer, PS. .....

- Subject-Regarding examination of given weapon/article.

- Reference-Your letter no.....,dated.....,PS. .....

- In reference to above case and PM report no....., received a seal packet bearing ..... no. of seal of PS. For examination and subsequent opinion.
- Along with sealed packet following document are submitted by police-
- Case diary.....
  PM. Report no.....
  MLC report no.....
- FSL report no. ..... Any another document.....

- Examination of weapon/ articles-
- Before opening the packet, describe seal, date, PM No., MLC No, Police Station, DD, FIR No.

- On opening the packet a .....(name of weapon and article) is recovered.

- The detailed examination is as follow:
  Name of the weapon: .....type (heavy/light)..... Made up of material .....
- Part .....
  ..... Weight .....
  ..... Blunt or sharp ..... Edges — single /double and/ or serrated/ non serrated: .....

- Pointed/ non-pointed .....hilt (present/absent).....

- In case of lathi, bamboo, rod etc.
- Length: .....width: ..... No. of nodes: ..... distance between nodes: .....

- Any other(stain, foreign material, rust, print, design etc.):

- Dimensions :As per diagram.

- OPINION: After examination of above mentioned weapon and submitted document, I am of the considered opinion that the injury.....(mention the injury no.,
- If any) found on the body of deceased as mention in the PM / Injury report could be/could not be possible with the weapon submitted by the police.
- Weapon resealed and handed over to the police.....for further investigation.

- Date: Name and Signature of MO and SEAL

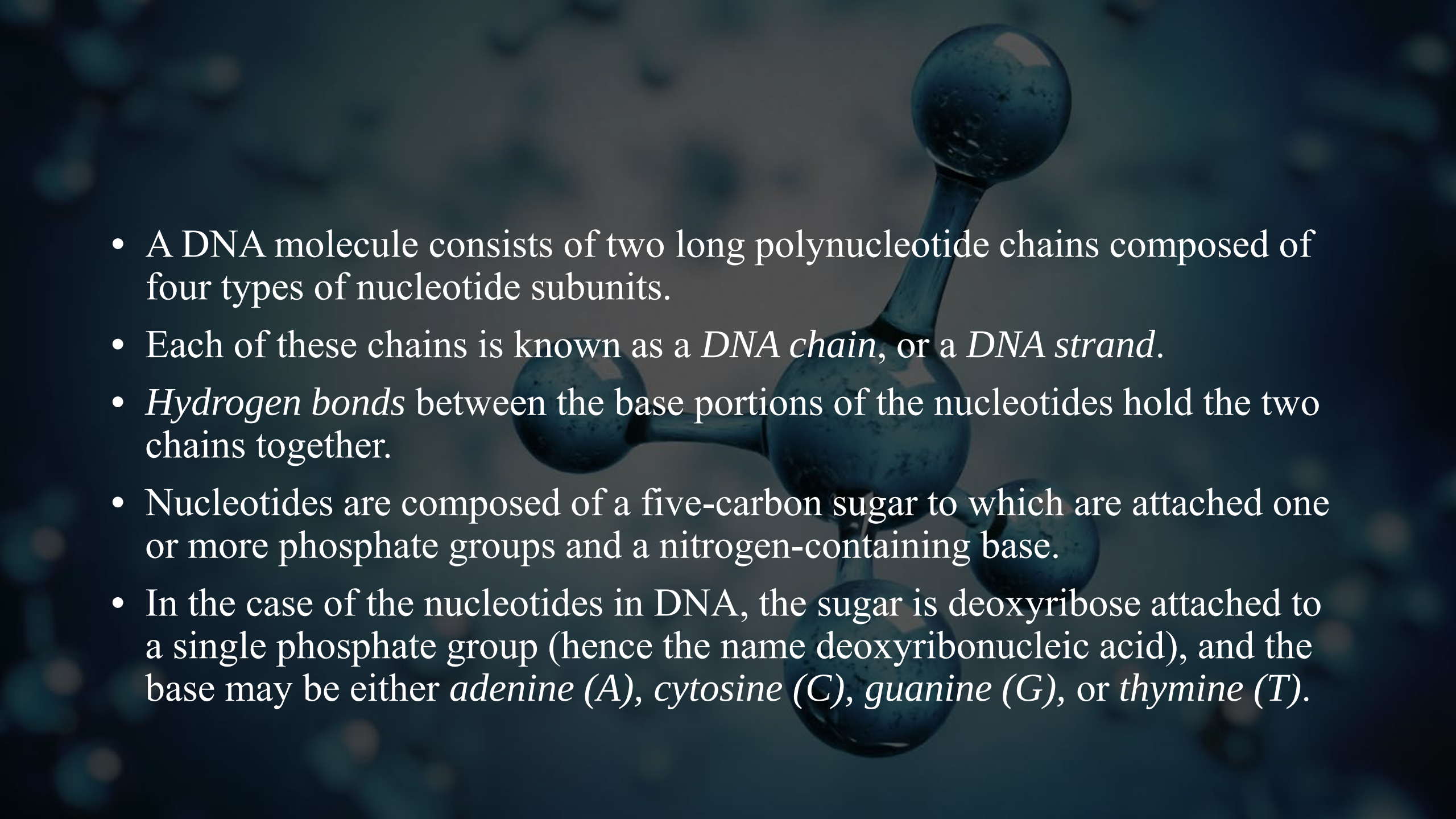
POST-MORTEM REPORT

RIMS POSTMORTEM EXAMINATION FORMAT

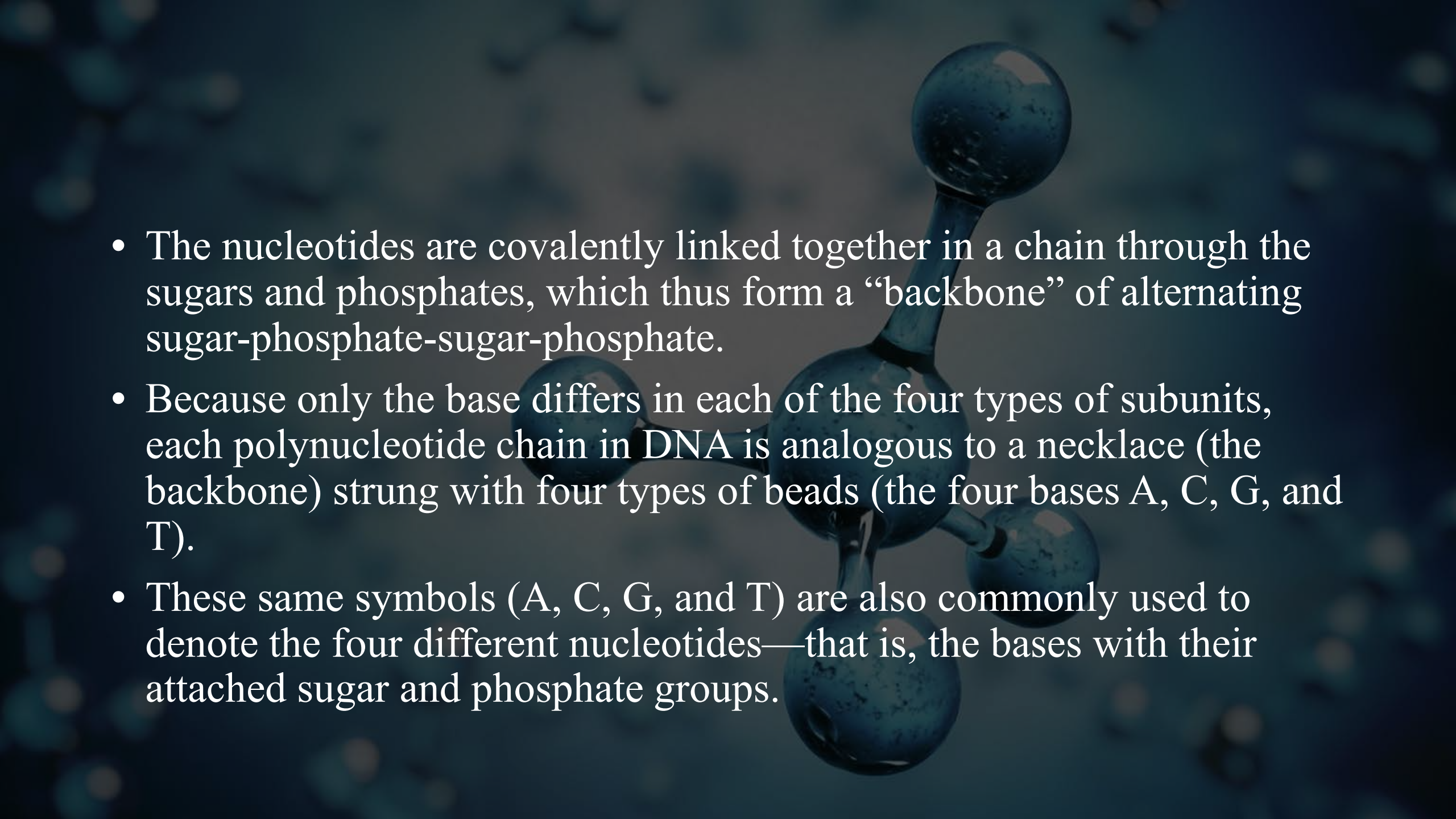
राजेन्द्र आयुर्विज्ञान संस्थान
(झारखण्ड सरकार का एक स्वायत्तशासी संस्थान)
राँची, झारखण्ड 834009
दूरभाष: 0651-2541533, फैक्स: 0651-2540629
E-mail: rimsranchi@rediffmail.com

						Large vessels

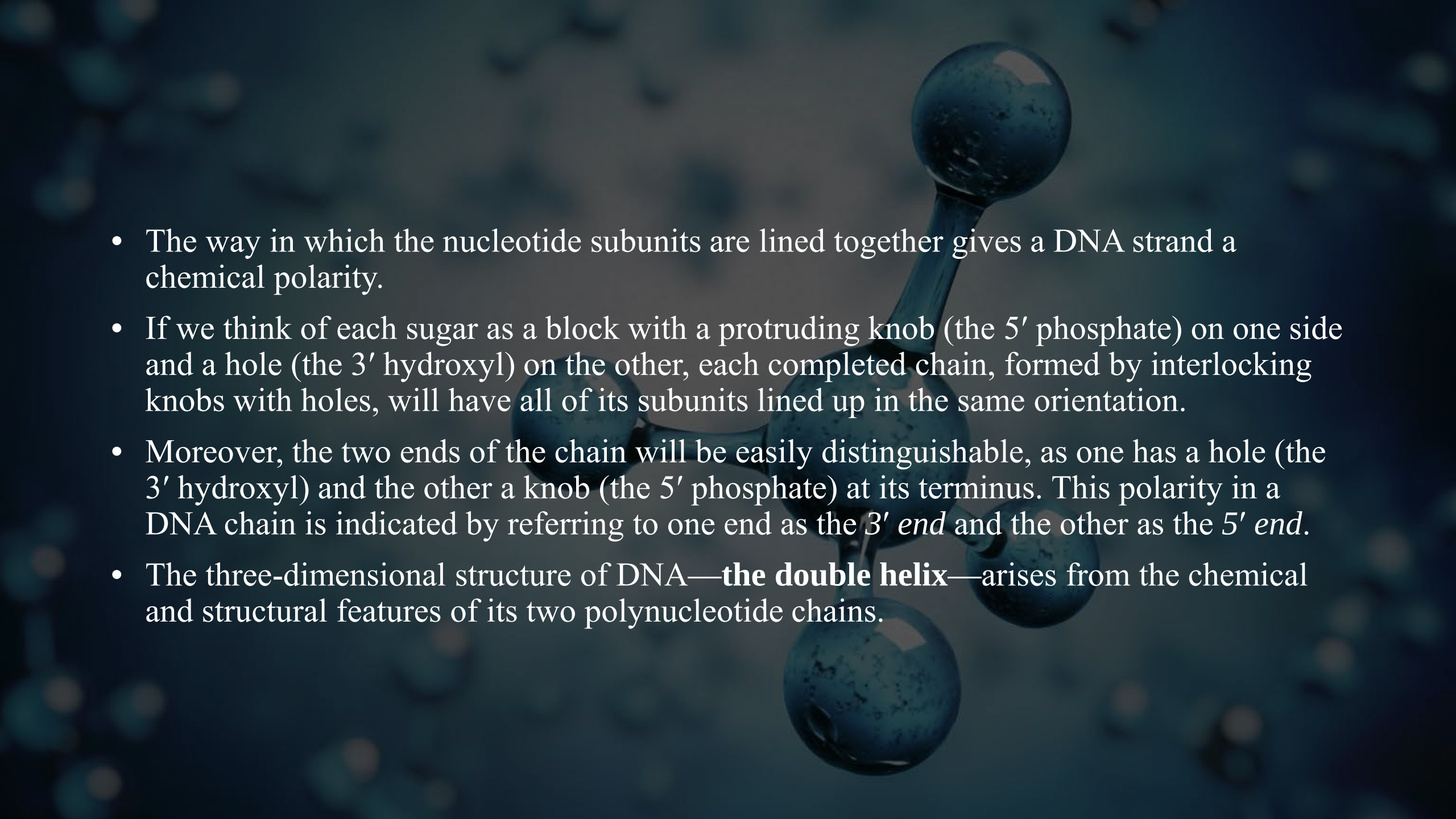

DNA



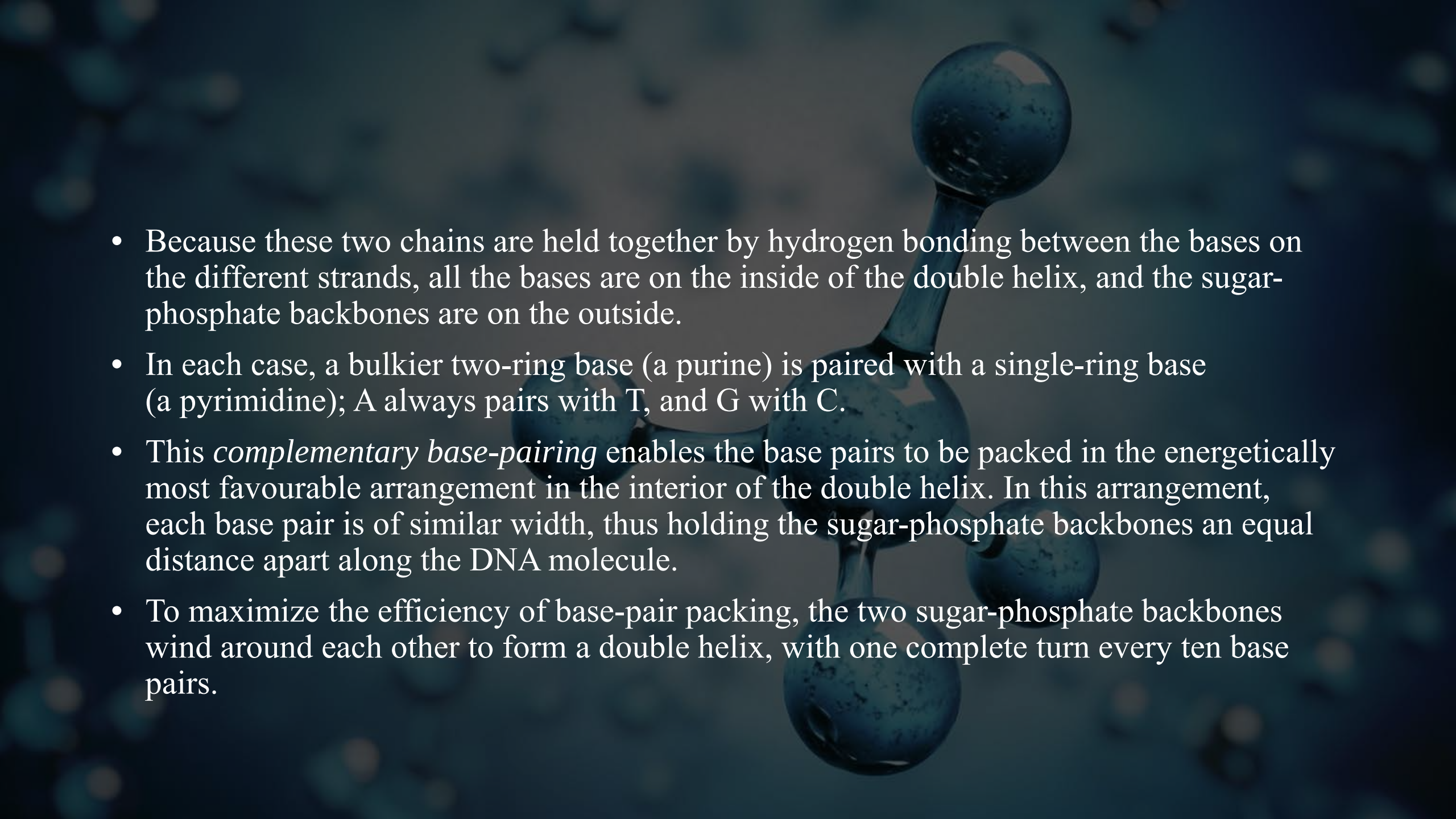
- A DNA molecule consists of two long polynucleotide chains composed of four types of nucleotide subunits.
- Each of these chains is known as a *DNA chain*, or a *DNA strand*.
- *Hydrogen bonds* between the base portions of the nucleotides hold the two chains together.
- Nucleotides are composed of a five-carbon sugar to which are attached one or more phosphate groups and a nitrogen-containing base.
- In the case of the nucleotides in DNA, the sugar is deoxyribose attached to a single phosphate group (hence the name deoxyribonucleic acid), and the base may be either *adenine (A)*, *cytosine (C)*, *guanine (G)*, or *thymine (T)*.



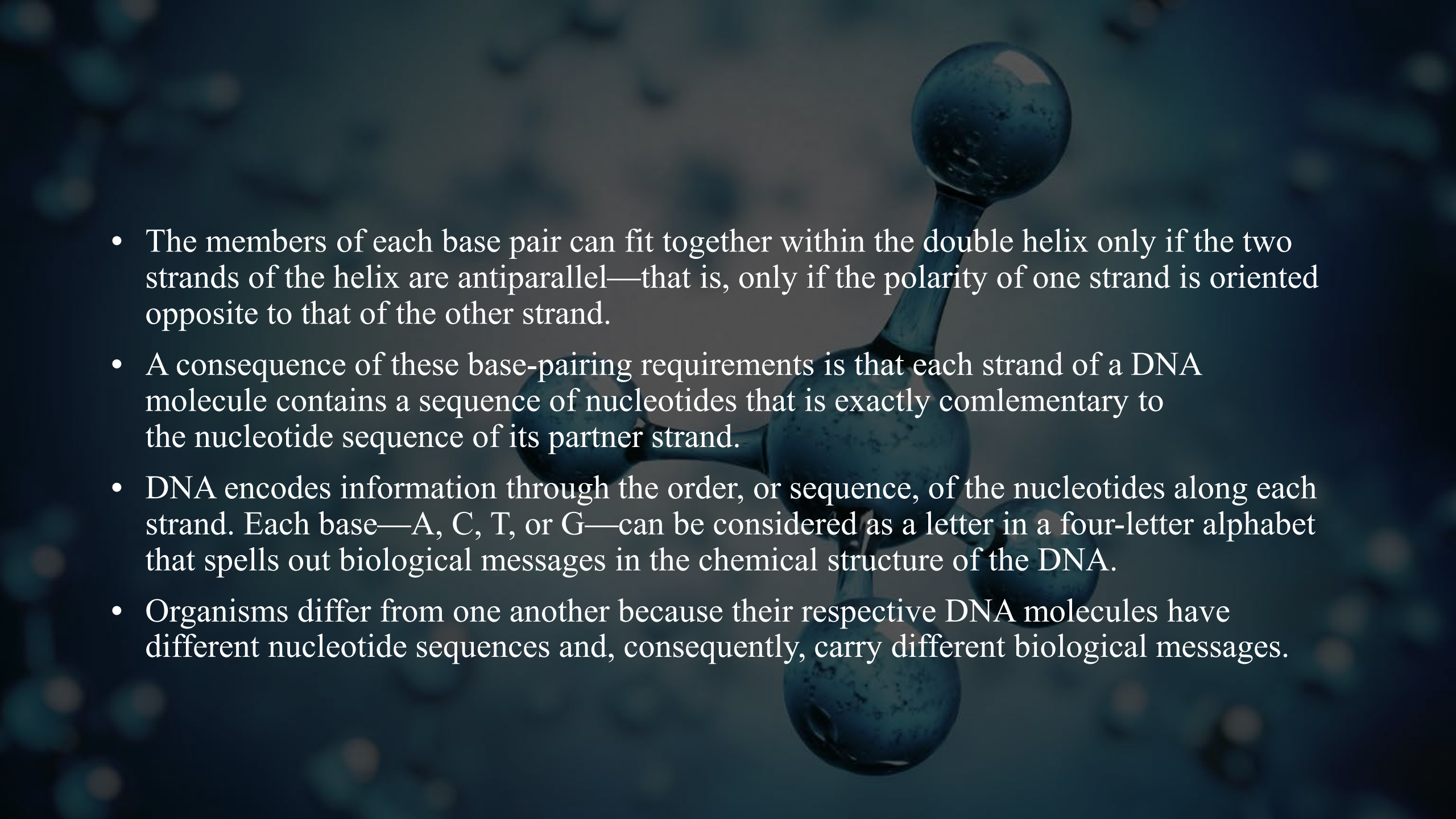
- The nucleotides are covalently linked together in a chain through the sugars and phosphates, which thus form a “backbone” of alternating sugar-phosphate-sugar-phosphate.
- Because only the base differs in each of the four types of subunits, each polynucleotide chain in DNA is analogous to a necklace (the backbone) strung with four types of beads (the four bases A, C, G, and T).
- These same symbols (A, C, G, and T) are also commonly used to denote the four different nucleotides—that is, the bases with their attached sugar and phosphate groups.



- The way in which the nucleotide subunits are lined together gives a DNA strand a chemical polarity.
- If we think of each sugar as a block with a protruding knob (the 5′ phosphate) on one side and a hole (the 3′ hydroxyl) on the other, each completed chain, formed by interlocking knobs with holes, will have all of its subunits lined up in the same orientation.
- Moreover, the two ends of the chain will be easily distinguishable, as one has a hole (the 3′ hydroxyl) and the other a knob (the 5′ phosphate) at its terminus. This polarity in a DNA chain is indicated by referring to one end as the *3′ end* and the other as the *5′ end*.
- The three-dimensional structure of DNA—**the double helix**—arises from the chemical and structural features of its two polynucleotide chains.

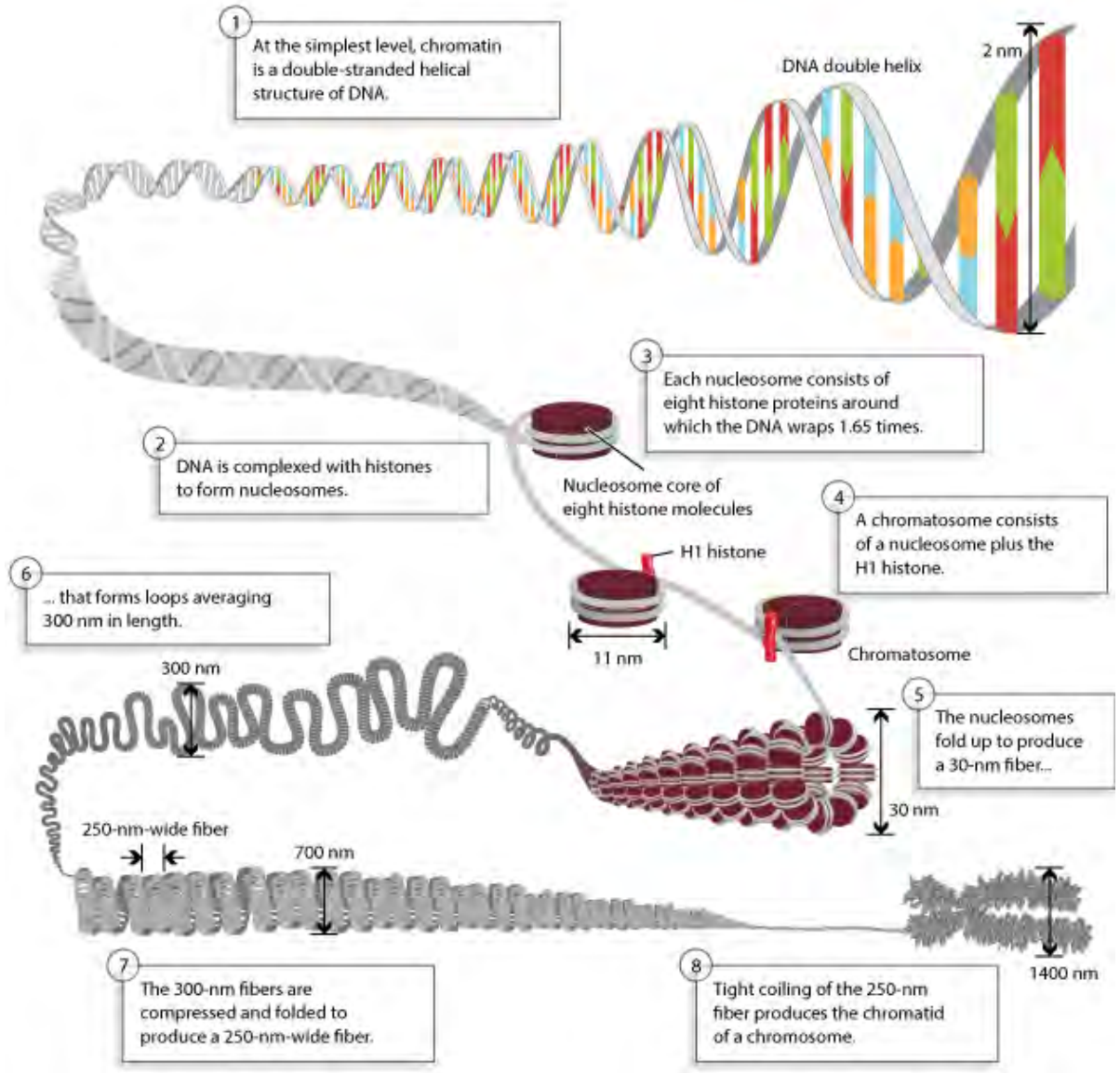


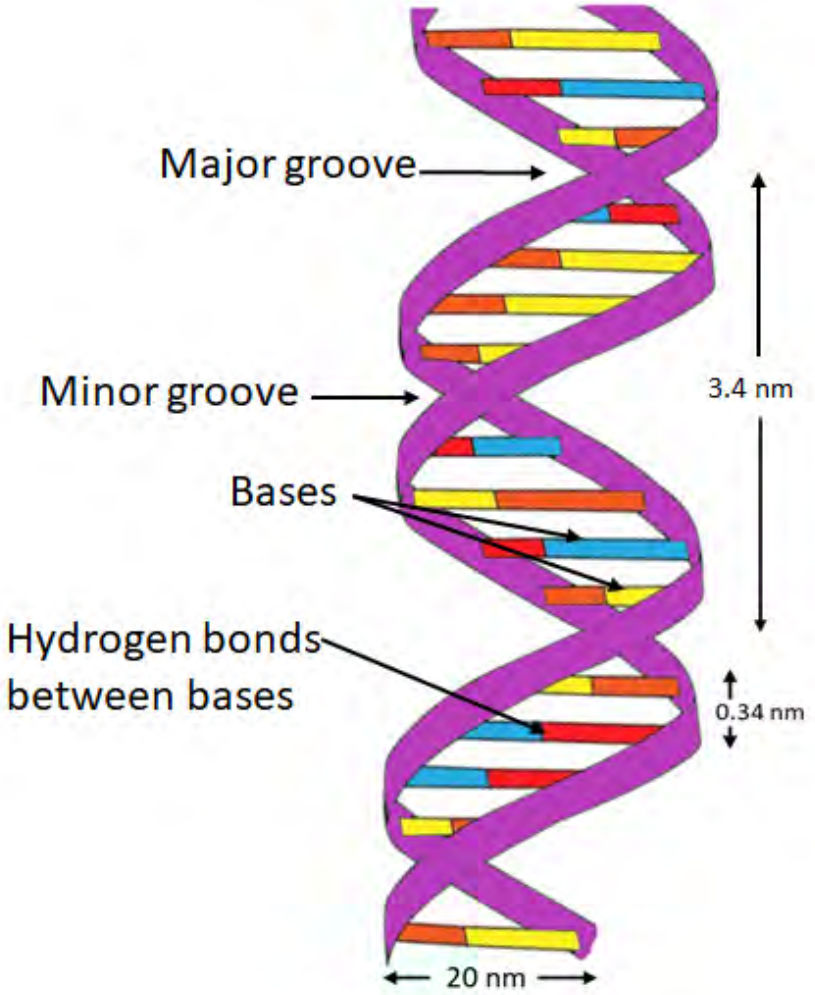
- Because these two chains are held together by hydrogen bonding between the bases on the different strands, all the bases are on the inside of the double helix, and the sugar-phosphate backbones are on the outside.
- In each case, a bulkier two-ring base (a purine) is paired with a single-ring base (a pyrimidine); A always pairs with T, and G with C.
- This *complementary base-pairing* enables the base pairs to be packed in the energetically most favourable arrangement in the interior of the double helix. In this arrangement, each base pair is of similar width, thus holding the sugar-phosphate backbones an equal distance apart along the DNA molecule.
- To maximize the efficiency of base-pair packing, the two sugar-phosphate backbones wind around each other to form a double helix, with one complete turn every ten base pairs.

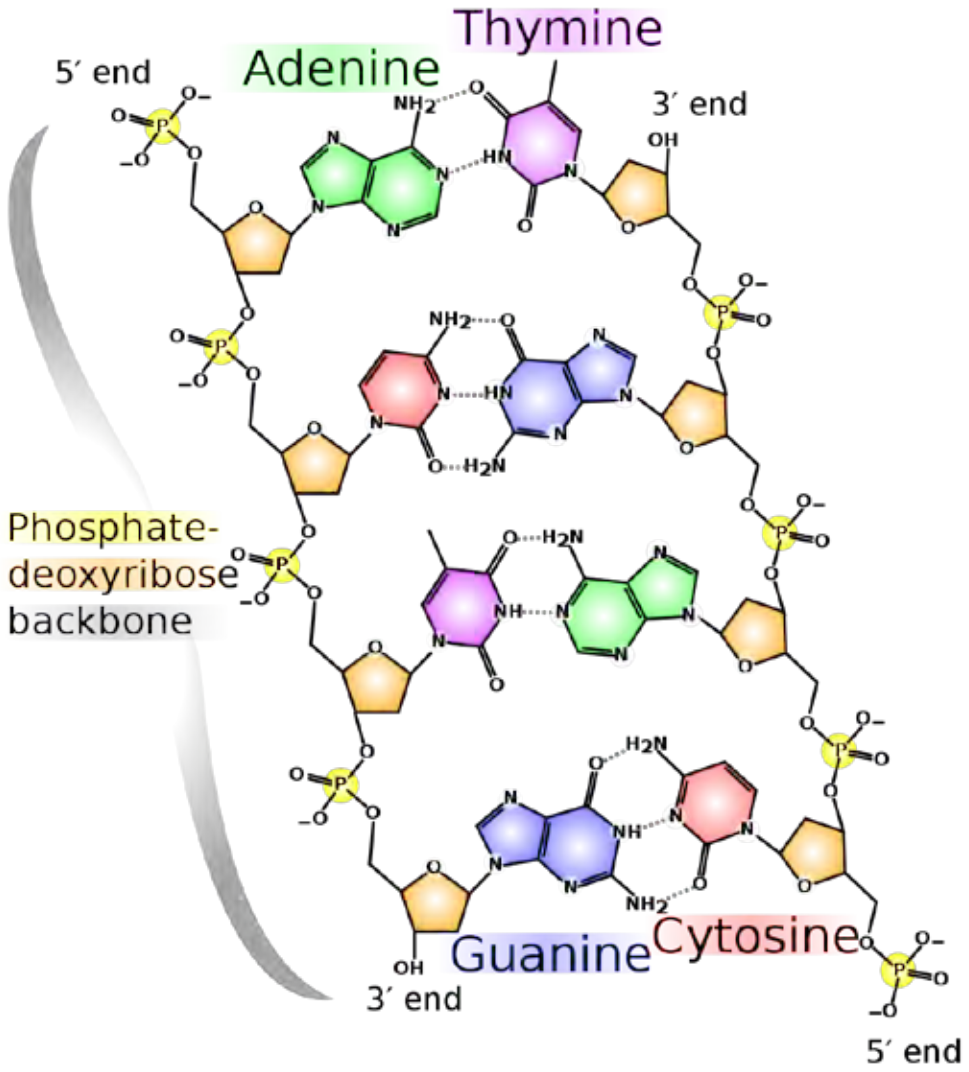


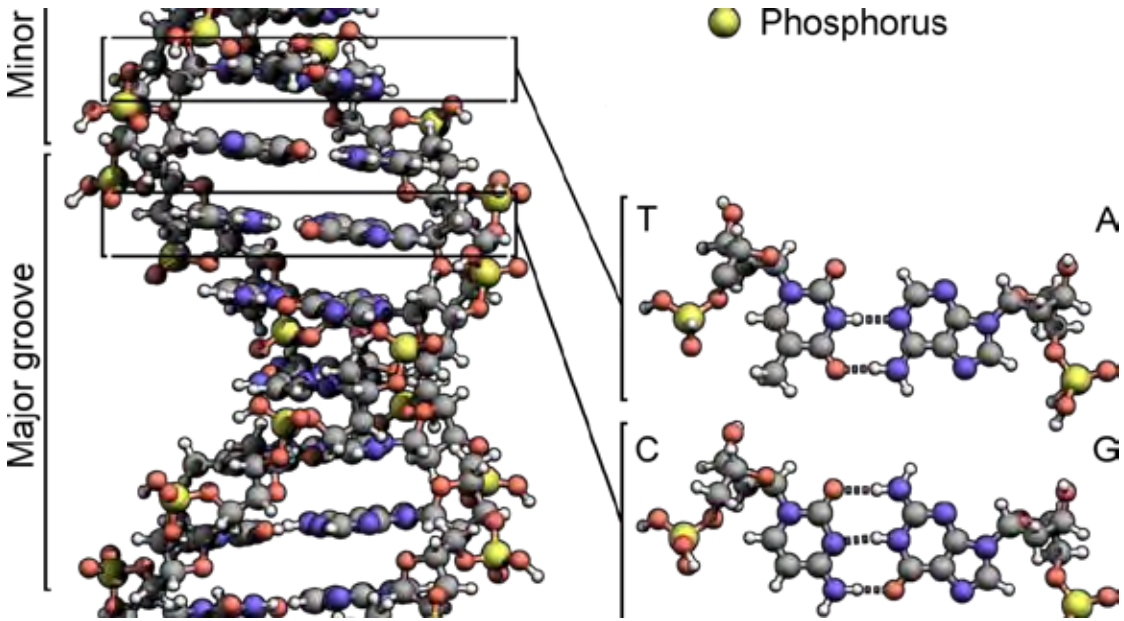
- The members of each base pair can fit together within the double helix only if the two strands of the helix are antiparallel—that is, only if the polarity of one strand is oriented opposite to that of the other strand.
- A consequence of these base-pairing requirements is that each strand of a DNA molecule contains a sequence of nucleotides that is exactly comlementary to the nucleotide sequence of its partner strand.
- DNA encodes information through the order, or sequence, of the nucleotides along each strand. Each base—A, C, T, or G—can be considered as a letter in a four-letter alphabet that spells out biological messages in the chemical structure of the DNA.
- Organisms differ from one another because their respective DNA molecules have different nucleotide sequences and, consequently, carry different biological messages.


3·4 nm
1 nm
0·34 nm
T=A
C≡G
A=T
G≡C
S
P

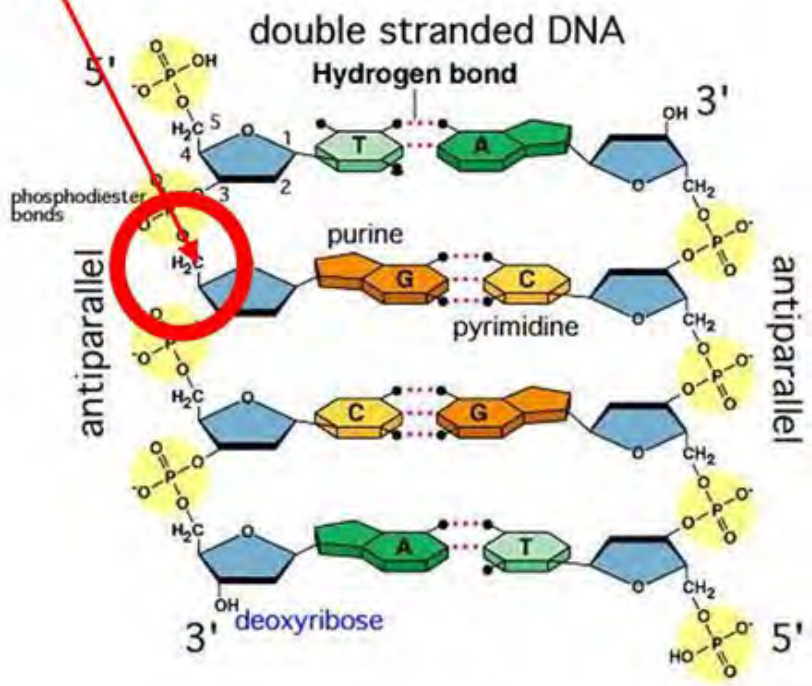

1
At the simplest level, chromatin is a double-stranded helical structure of DNA.
DNA double helix
2 nm
3
Each nucleosome consists of eight histone proteins around which the DNA wraps 1.65 times.
2
DNA is complexed with histones to form nucleosomes.
Nucleosome core of eight histone molecules
4
A chromatosome consists of a nucleosome plus the H1 histone.
H1 histone
11 nm
Chromatosome
6
... that forms loops averaging 300 nm in length.
300 nm
5
The nucleosomes fold up to produce a 30-nm fiber...
30 nm
250-nm-wide fiber
700 nm
7
The 300-nm fibers are compressed and folded to produce a 250-nm-wide fiber.
8
Tight coiling of the 250-nm fiber produces the chromatid of a chromosome.
1400 nm


Major groove
Minor groove
Bases
Hydrogen bonds
between bases
3.4 nm
0.34 nm
20 nm


5′ end
Adenine
Thymine
3′ end
Phosphate-
deoxyribose
backbone
Guanine
Cytosine
3′ end
5′ end



The nucleotides are joined together using **phosphodiester** bonds



DNA FINGERPRINTING (DNA PROFILING)

1980: - American researchers discovered non-coding regions of DNA.

1984: - Professor Alec Jeffreys developed the process of DNA Profiling.

1987: - First conviction based on DNA evidence.

Introduction of DNA Fingerprinting:

Colin Pitchfork

Infamous for being the first criminal to be convicted of murder based on DNA evidence.

On 21st November 1983, the body of a 15-year-old girl Lynda Mann was found on a lonely footpath who had set off from home to visit a friend.

Post-mortem revealed that she had been raped and strangled, and a semen sample was retrieved from her body.

Unfortunately any lines of enquiry resulting from evidence recovered reached dead ends and the case went cold.

Few years later, on 31st July 1986, another 15-year-old girl went missing, Dawn Ashworth, this time whilst walking home.

Two days later, her raped, beaten and strangled body was discovered in a wooded area.

The previous case of Lynda Mann was soon pulled back into the limelight as a semen sample was discovered on the body of Dawn.

Initially the investigators believed the rapist and murderer to be 17-year-old Richard Burkland who appeared to have knowledge of Dawn's body and even admitted to the crime under questioning.

The previous year at the University of Leicester, a promising new technique had been developed by Alec Jeffreys and his team, allowing for a unique DNA ‘fingerprint’ to be produced from a DNA sample.

Eager to put the new method to use, the DNA fingerprinting technique was utilised, however only to prove that Burkland’s DNA profile did not match that of the two semen samples.

With no further leads, a project was conducted in which 5000 local men were asked to give a blood or saliva sample for DNA testing for comparison with the suspect’s DNA profile.

Thousands of samples and six months later, no match had been found.

However a break in the case was yet to come, when local man Ian Kelly was overheard in a bar bragging about being paid £200 to give a DNA sample for one of his friends. **That friend was local baker Colin Pitchfork.**

On 19th September 1987, Pitchfork was arrested. A DNA sample was taken and matched to the crime scene samples, and the truth soon came out.

He admitted to the rape and murder of the two girls, and went on to explain his fetish for flashing females, an impulse that had soon led to sexual assault and finally murder.

Pitchfork was sentenced to life imprisonment for a minimum of 30 years in 1988, was originally deemed suitable for release on parole in 2021 - after serving 33 years - a decision that sparked a public outcry and saw the government challenge it.

Pitchfork was released in September 2021, but was recalled to prison two months later for breaching parole conditions.

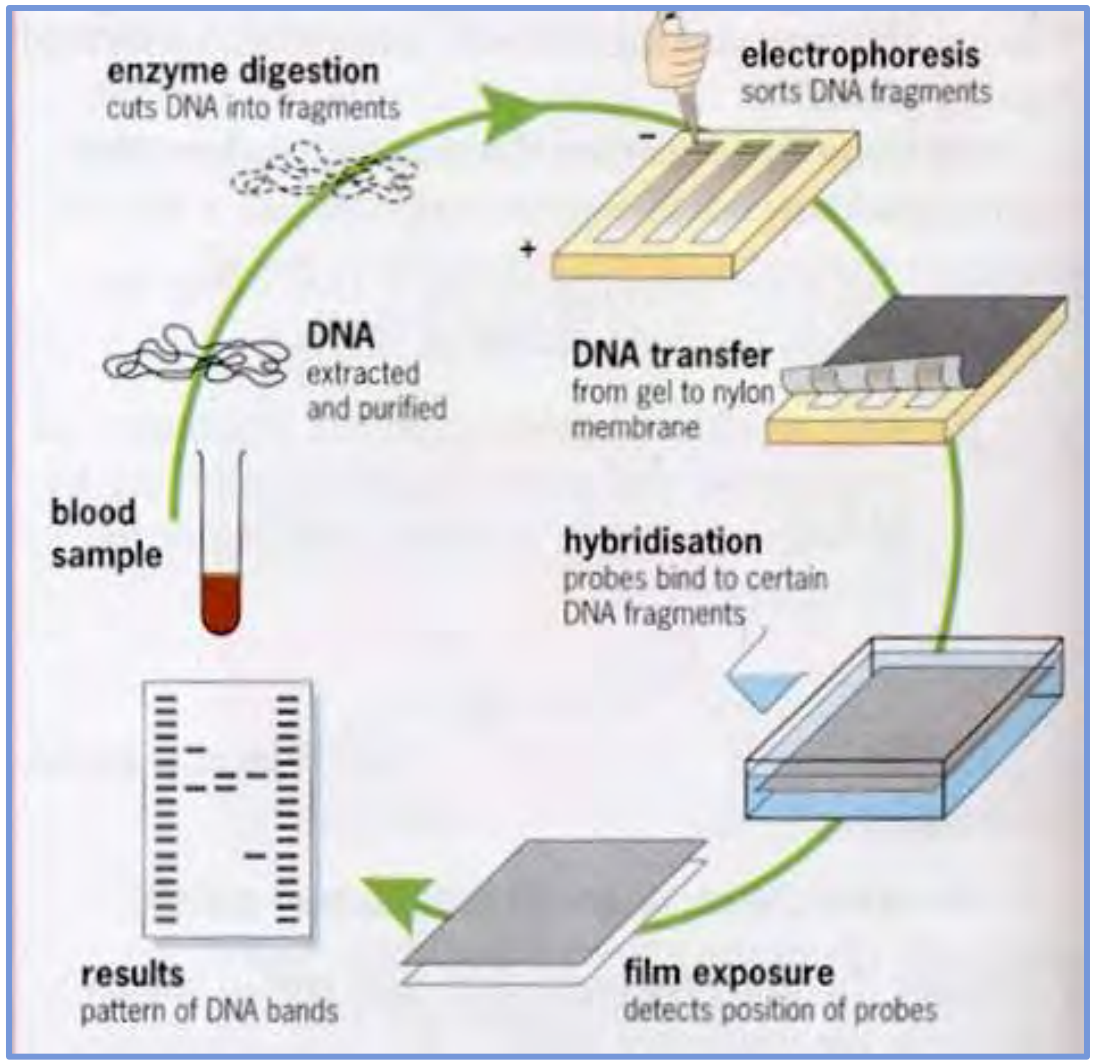
He has again been granted parole and will be released from prison soon.

DNA profiling

- A process or technique of analysis revealing unique patterns of an individual’s DNA involving non-coding regions

STAGES INVOLVED:

- Cells broken down to release DNA
- DNA strands cut into fragments
- Fragments separated
- Pattern of fragments analysed

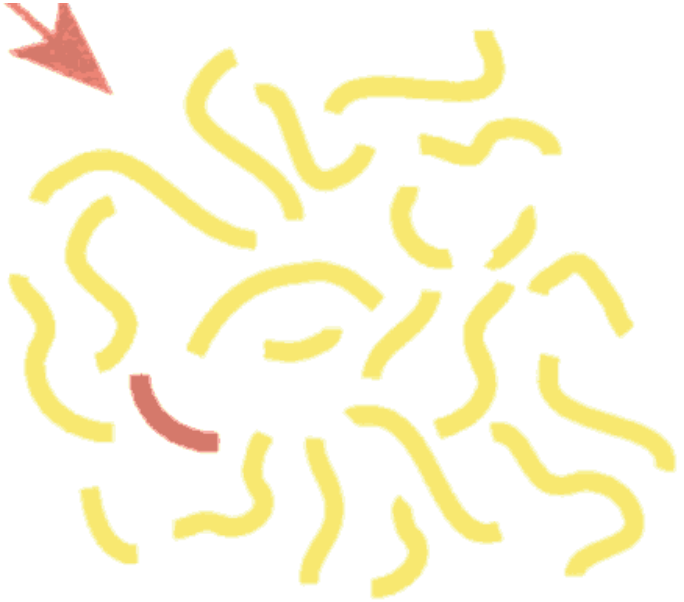


Extract DNA From Sample

A sample collected from the tissue of a living or dead organism is treated with chemicals and enzymes to extract the DNA, which is separated and purified.

1. DNA EXTRACTION

2. DNA CUTTING

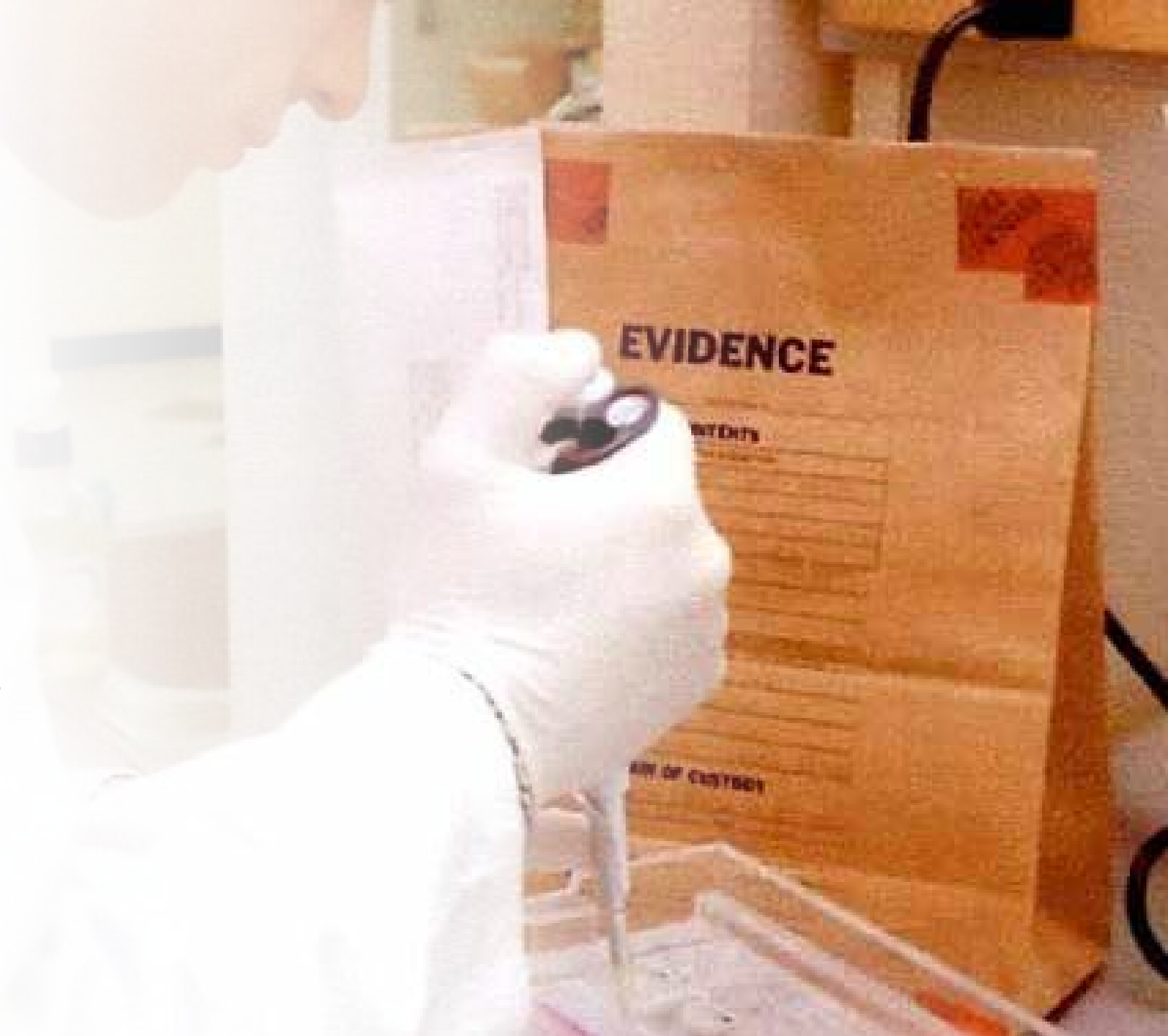


Cut Up DNA

The DNA is cut up into fragments using **restriction enzymes**, yielding thousands of fragments of all different sizes.

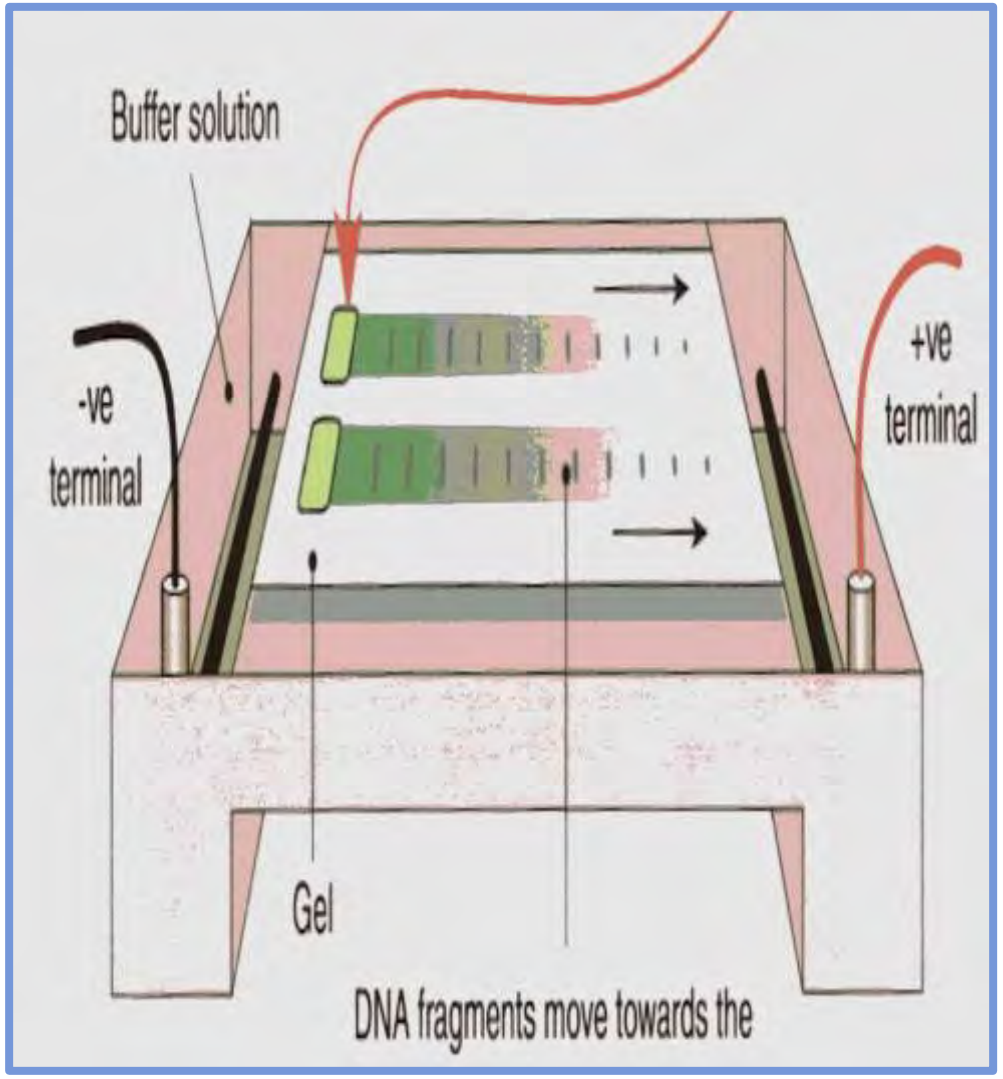
3. FRAGMENT SEPARATION

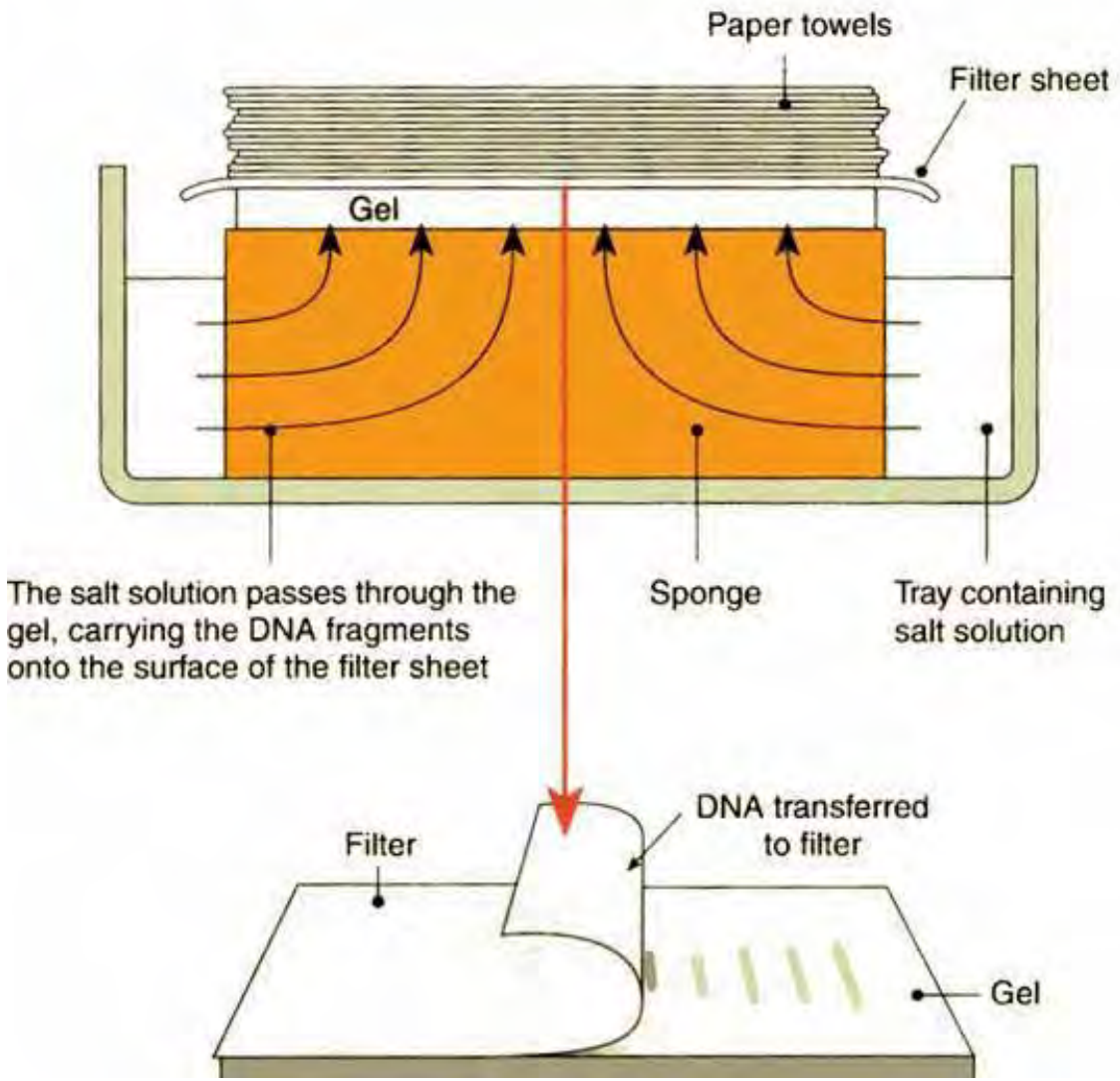
The samples containing the fragments are pipetted into individual wells in a gel



4. ELECTROPHORESIS

- Fragments separated by length
- DNA (negatively charged)
- Moves towards positive terminal
- Shorter fragments move faster

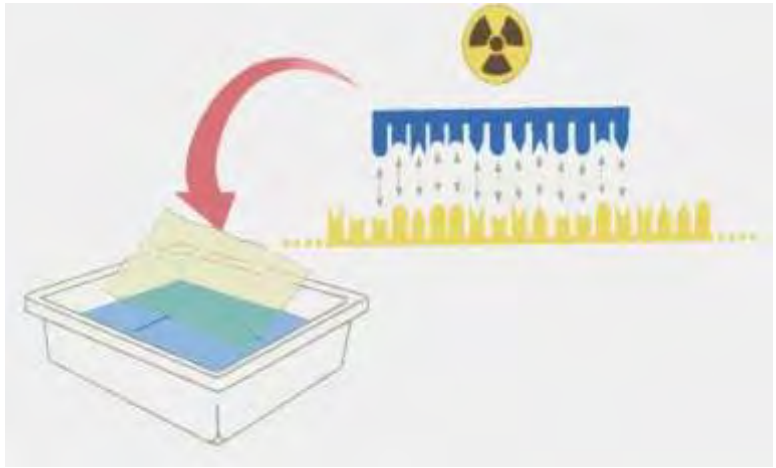




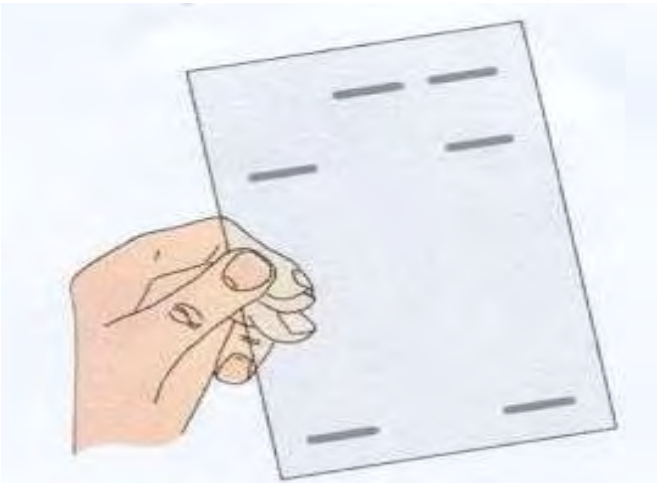
5. DNA TRANSFER

- **DNA split into single strands using alkaline solution.**
- **DNA fragments transferred from gel to filter paper or nylon membrane (This is called Southern blotting) Gel, with filter paper attached, is removed & separated.**

6. Analysis



Radioactive probe in solution binds to DNA



Revealing a pattern of bands

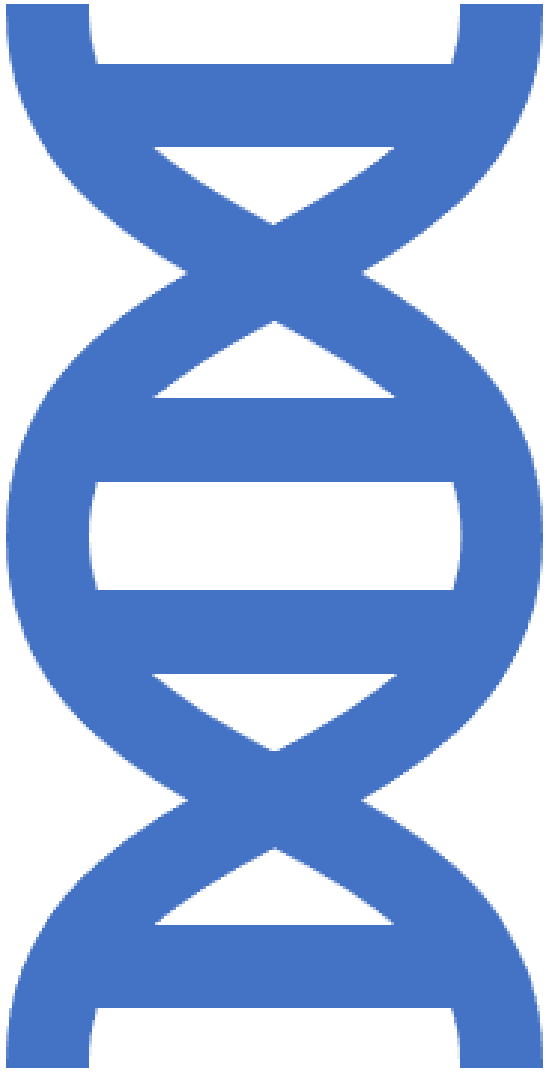
X-ray film

Principle of DNA Fingerprinting:

- Base pairing of AT (AU) & GC is the basic principle.
- Specificity of enzyme activity is the second crucial principle to understanding DNA fingerprinting. This refers to the cutting of DNA by specific restriction enzymes at unique palindrome sequences.
- The recognition that a **change** in a **single base pair** (mutation) can either MAKE a restriction enzyme-site where one did not exist previously, or it can **remove** or **eliminate** a restriction enzyme site from a gene. An analogy would be to "mutate" your phone number by one letter; callers would get a different person.

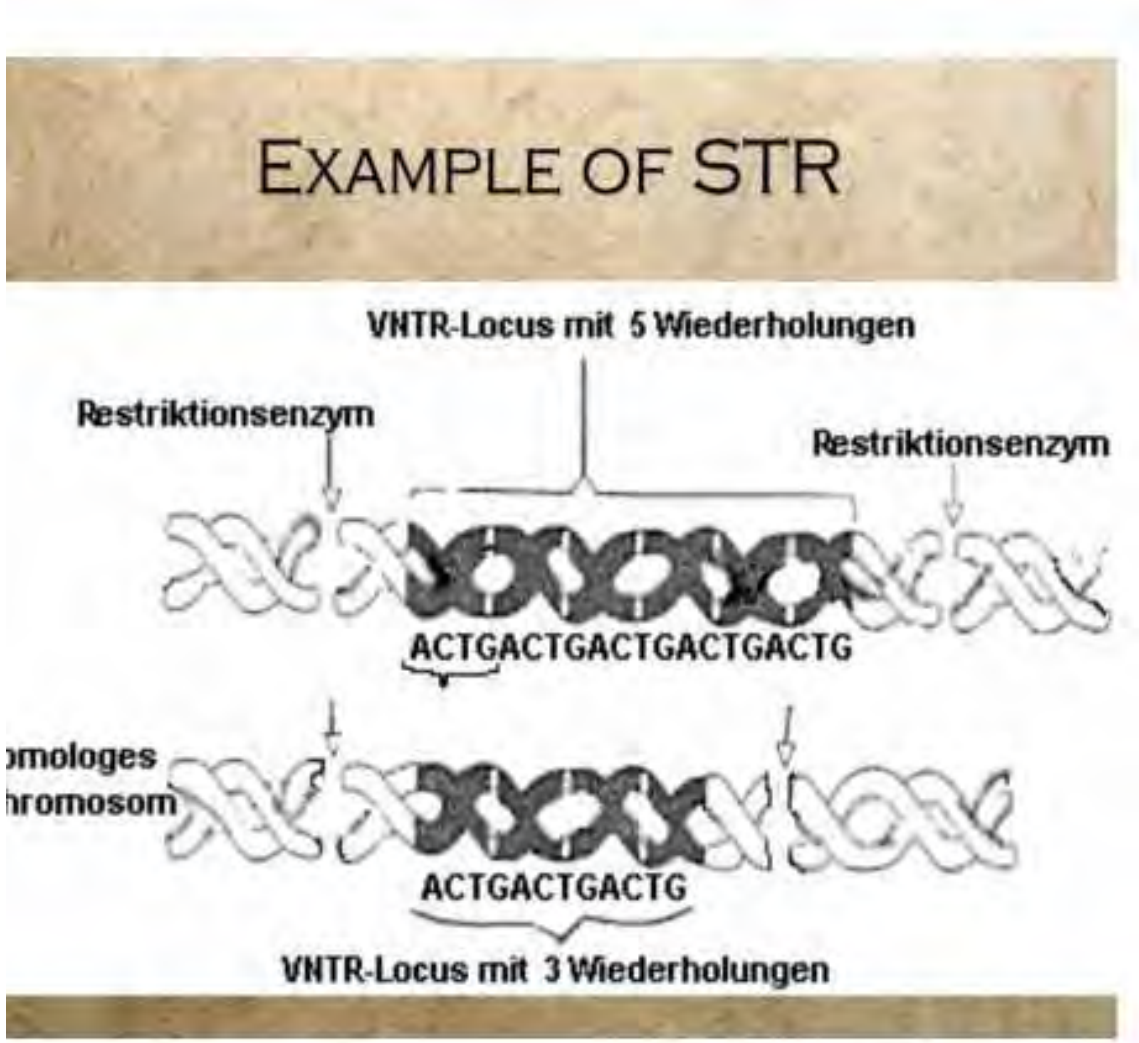
DNA Profiling Process

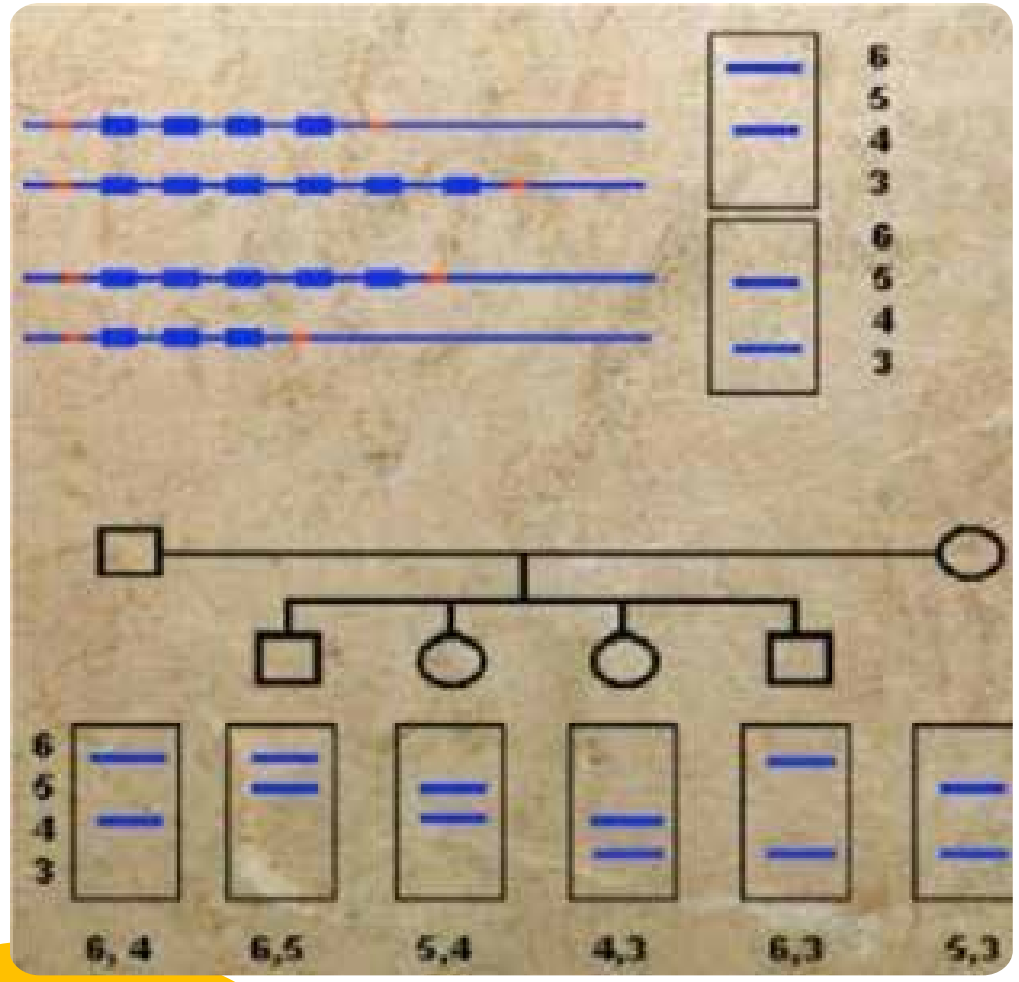
- Variable Number Of Tandem Repeats(VNTRs)
- Amplified Length Polymorphisms (AFLPs)
- Restriction Fragment Length Polymorphism (RFLP)



1.Variable Number Of Tandem Repeats(VNTRs)

- Most of the DNA in a chromosome does not code for a gene.
- These regions contain sequences that repeat from 20-100 times (ex-GTCAGTCAGTCAGTCA)
- There are several known variations of the Short Tandem Repeats (STR) in humans. Ex.-HUMTH01 (repeating AATG) has seven different variations



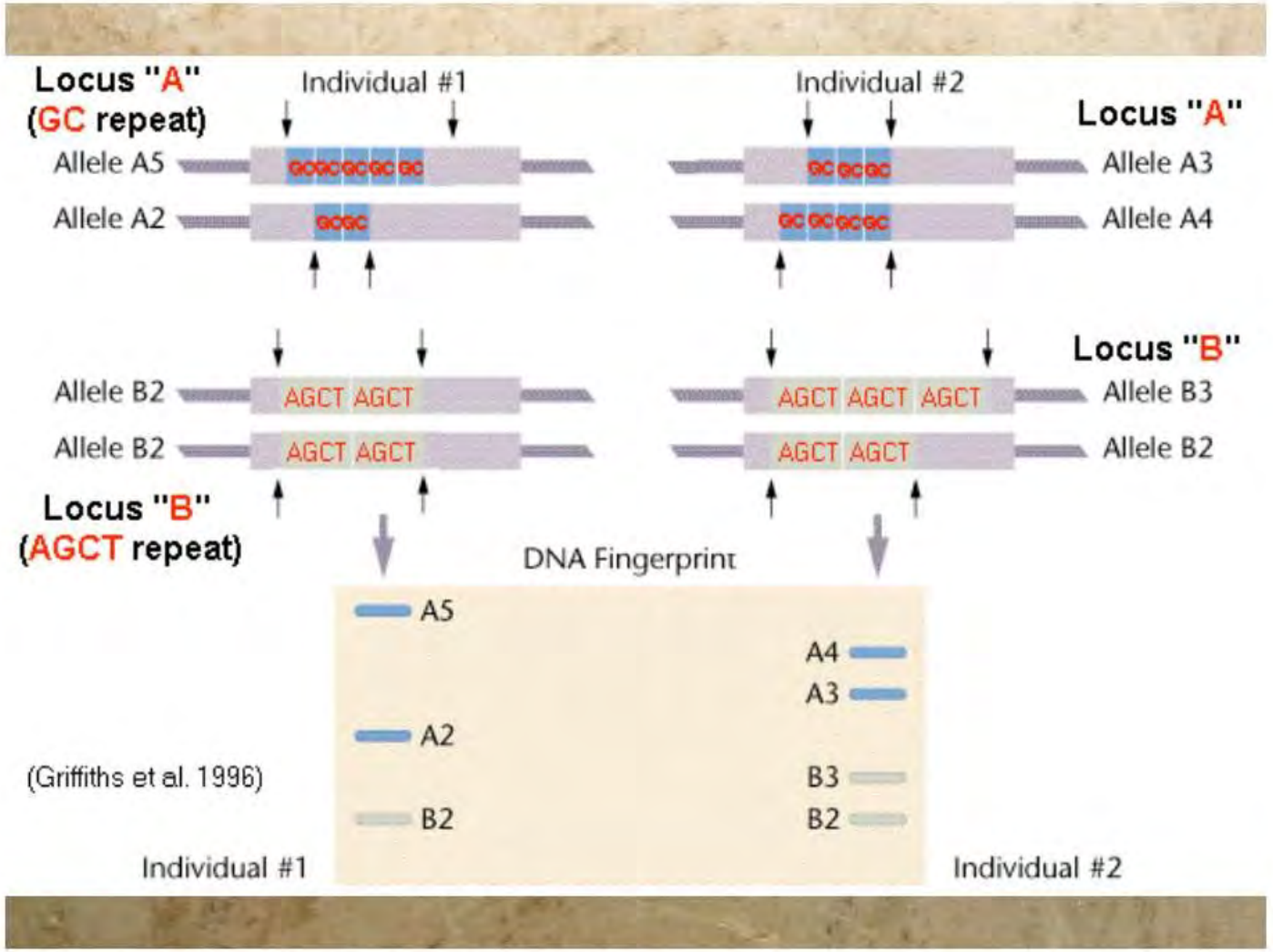


VNTR

- Scientists can look at 4-6 different STR's in the same person.
- The more STR's identified the higher the probability of a match.
- VNTR is more commonly used than RFLP.

Advantages of VNTR

- Less complex patterns in gel.
- STR's are less likely to degrade.
- Less than 400 base pairs.
- In the middle of the chromosome.
- Can be used on stains that are old or have been exposed to decomposition.


Locus "A"
(GC repeat)
Individual #1
Individual #2
Locus "A"
Allele A5
Allele A2
Allele A3
Allele A4
Locus "B"
Allele B2
Allele B2
Allele B3
Allele B2
AGCT AGCT
AGCT AGCT AGCT
Locus "B"
(AGCT repeat)
DNA Fingerprint
A5
A4
A3
A2
B3
B2
(Griffiths et al. 1996)
Individual #1
Individual #2

2. Amplified Length Polymorphisms (AFLPs)

- Any difference between corresponding DNA fragments from two organisms A and B that is detected by the amplified restriction length polymorphism technique (Kahl, 2001).
- Initially, DNA is extracted as for RFLP and then cut with two different restriction enzymes to produce well defined restriction fragments with sticky ends.
- Synthetic double stranded linkers of approximately 18 to 20 base pairs with matching sticky ends are ligated on all the restriction fragments.
- Ligated fragments are subsequently amplified in PCR with 18 to 20 nucleotide length primers recognizing linkers in each end of the fragments.

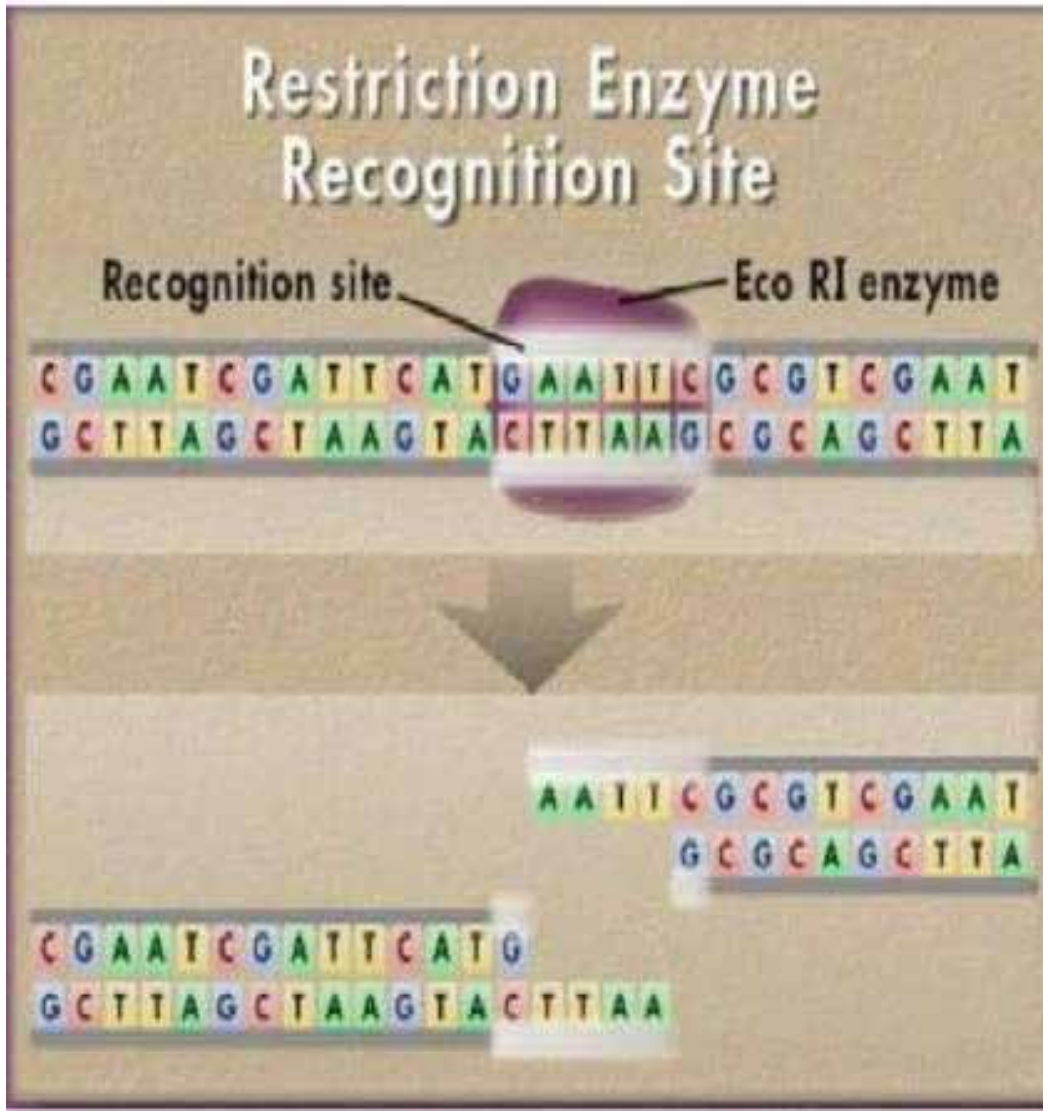
- A primer used for amplification in AFLP is normally labeled with P^{33} or some nonradioactive labeling system.
- The mixture of amplified fragments are separated according to size in a Polyacrylamide gel and visualized by means of autoradiography or other procedures for development of nonradioactive systems.
- Alternatively, automated sequencing machines can be used to read the sequence of amplification products directly from the Polyacrylamide gel if primers have been labeled with special fluorescent dyes.

- Also, silver staining of the Polyacrylamide gel after electrophoresis can be used to stain all amplified DNA fragments in the gel.
- To avoid that all restriction fragments from the genome amplify in the same PCR, which will produce a smear because of too many DNA fragments, a two step amplification procedure is used.
- Firstly, part of the total number of restriction fragments are amplified in the "preamplification" with primers containing one extra "selective" nucleotide on their 3' end.
- This selective nucleotide will allow amplification only of restriction fragments with a matching nucleotide next to the linker.

- With one selective nucleotide on both primers only 1/16th of all restriction fragments in the mixture will amplify during the preamplification.

- During the subsequent "selective" amplification, additionally, one or two selective nucleotides on each primer will further reduce the number of fragments amplified.

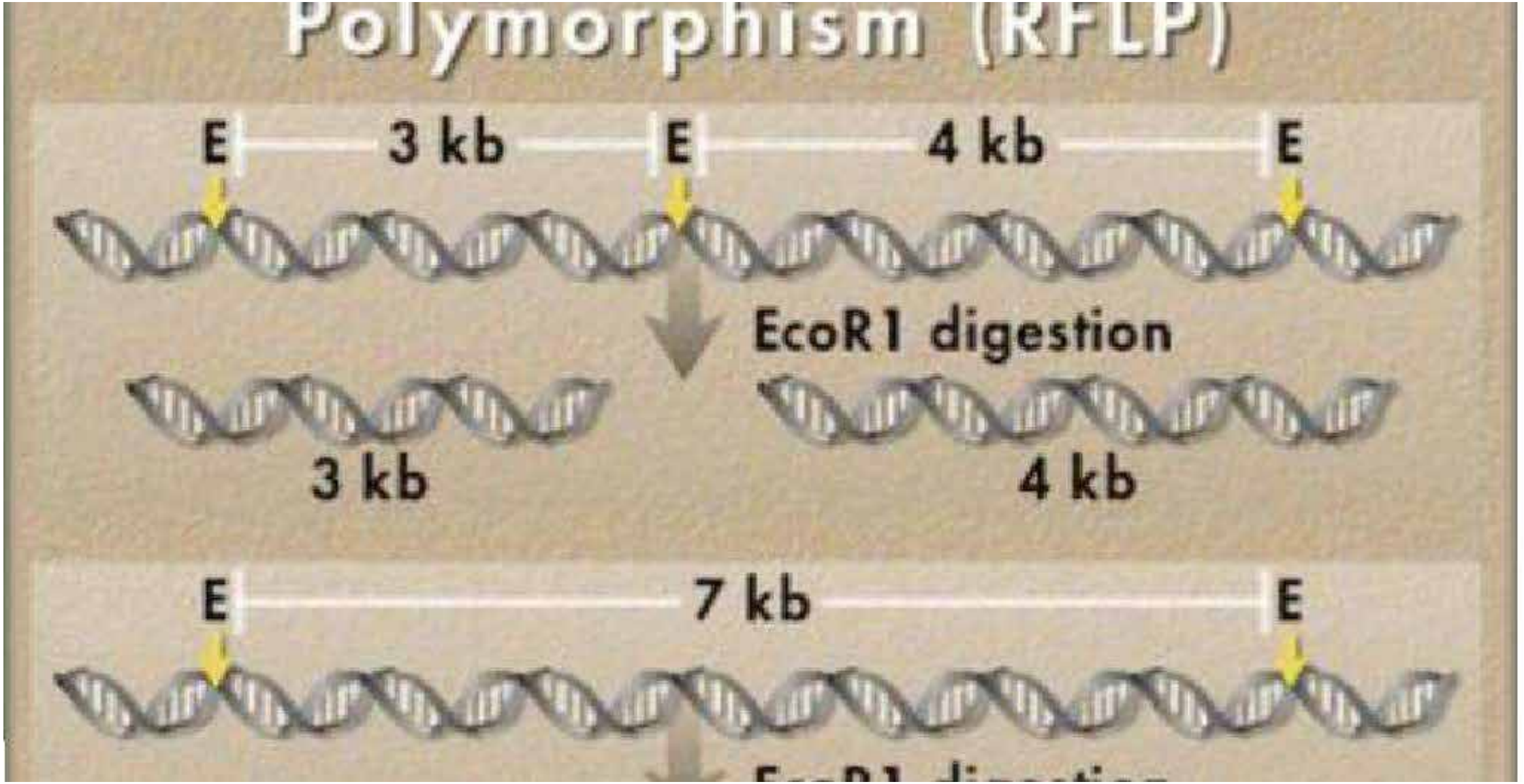
- A good AFLP amplification will show 90 to 100 different fragments in one analysis.

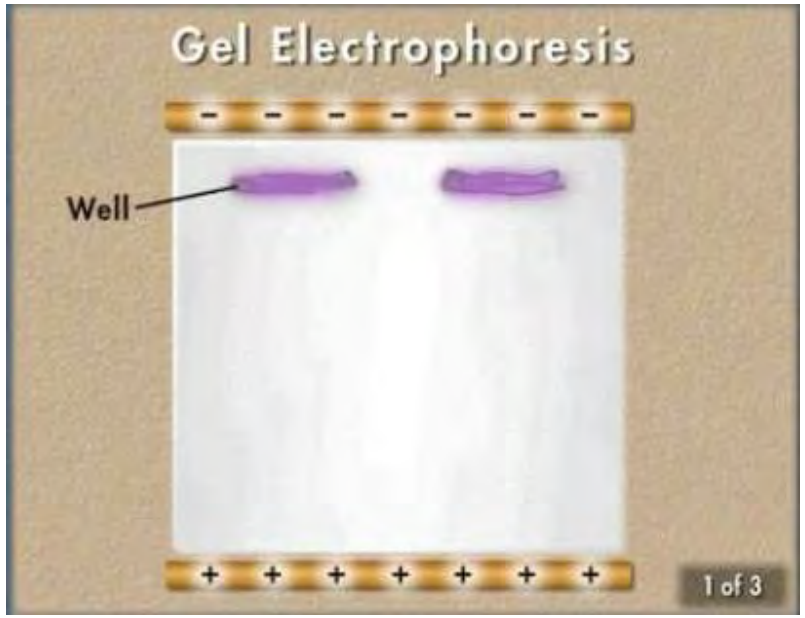


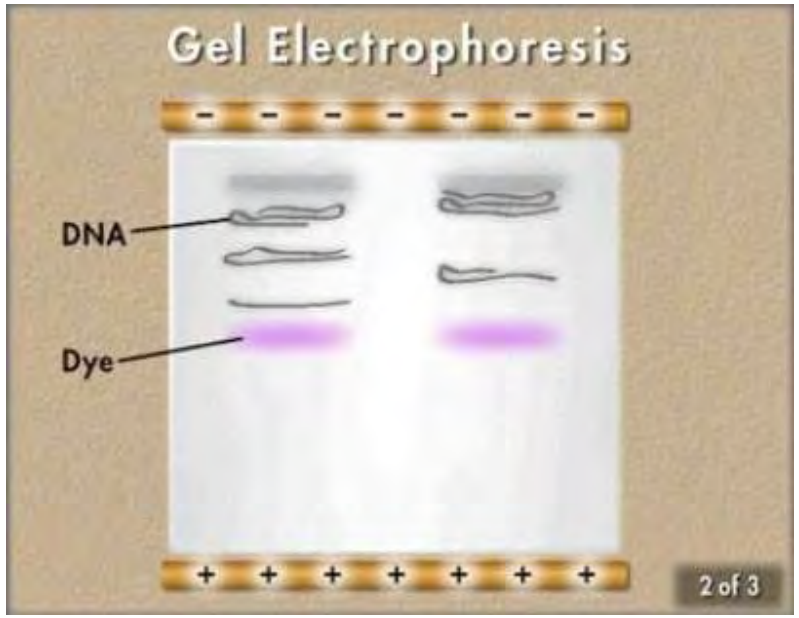
3. Restriction Fragment Length Polymorphism (RFLP)

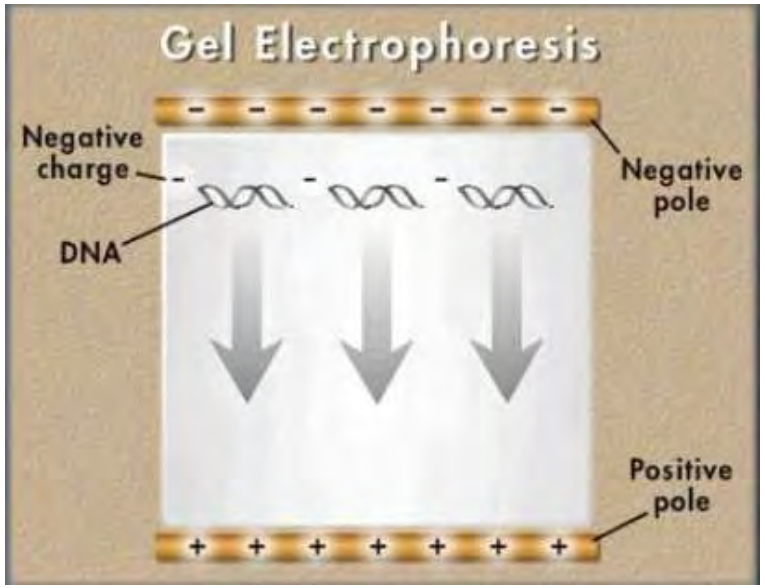
Steps of making an RFLP:

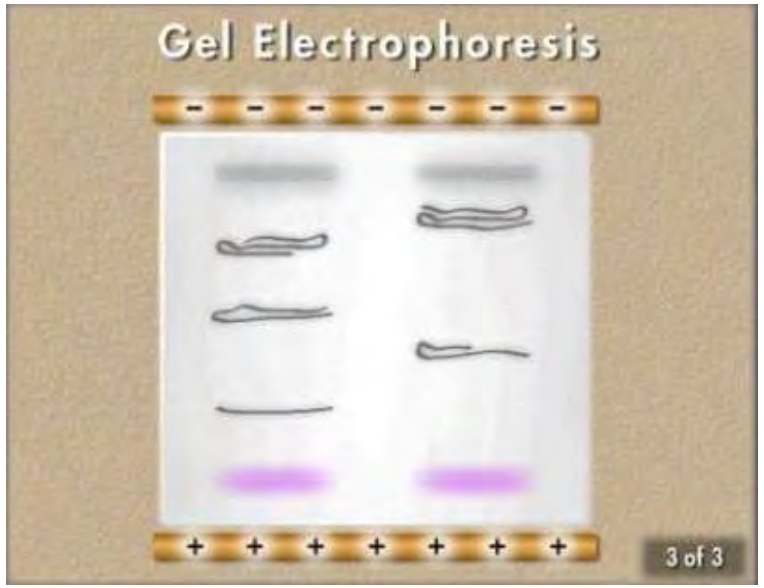
- Add a restriction enzyme to cut the DNA into fragments - Exact number and size of fragments produced varies from person to person.
- Fragments are separated by electrophoresis.
- The smaller fragments travel further than the large fragments.
- This creates a DNA Fingerprint.


Polymorphism (RFLP)
E
3 kb
E
4 kb
E
EcoR1 digestion
3 kb
4 kb
E
7 kb
E

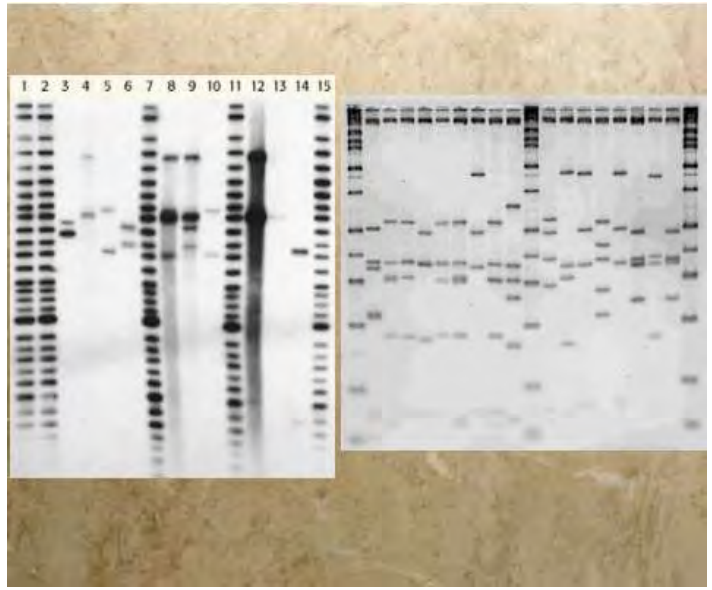

Gel Electrophoresis
Well
1 of 3

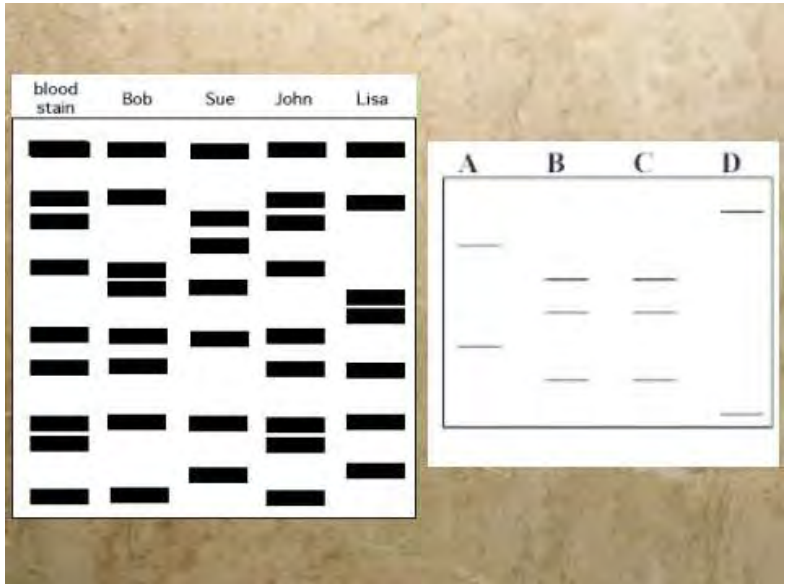

Gel Electrophoresis
DNA
Dye
2 of 3


Gel Electrophoresis
Negative charge
Negative pole
DNA
Positive pole


Gel Electrophoresis
3 of 3


Probe
AATCCTCGCATACCA*
....CTGGATTAGGAGCGTATGGTCATCC....
DNA fragment


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15


blood stain
Bob
Sue
John
Lisa
A
B
C
D

Applications of DNA Fingerprinting:

- **1.Paternity and Maternity**

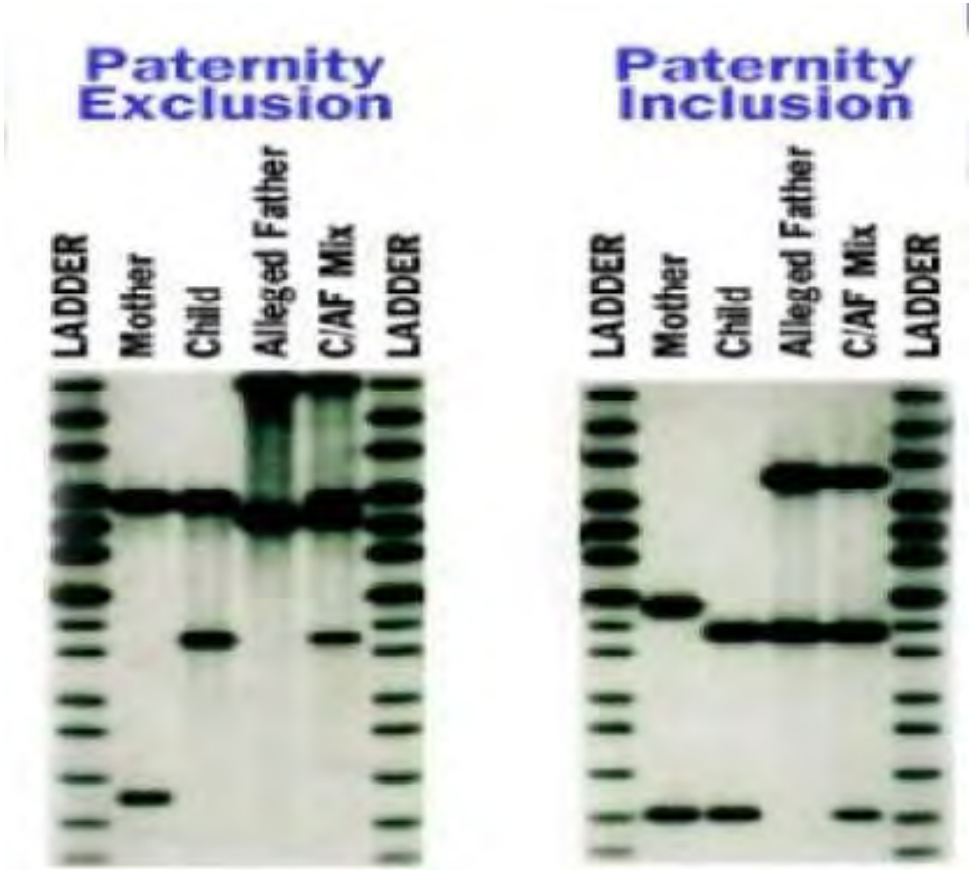
- Because a person inherits his or her VNTRs from his or her parents, VNTR patterns can be used to establish paternity and maternity.

- The patterns are so specific that a parental VNTR pattern can be reconstructed even if only the children VNTR patterns are known (the more children produced, the more reliable the reconstruction).

- Parent-child VNTR pattern analysis has been used to solve standard father-identification cases as well as more complicated cases of confirming legal nationality and, in instances of adoption, biological parenthood.

Benefits of DNA Fingerprinting:

The most important benefit of DNA fingerprinting is that there is strong similarities shown between genetic fingerprints of parents and children.
This is a benefit because a child's genetic fingerprint is made up of half the father's genetic information and half of the mother's information. This means that the bands of a child's genetic fingerprint will match the bands on both of their parents, making it possible to establish paternity and maternity tests.



The above picture shows how a paternity test is used to match a child with their biological father. It shows that the child was compared with his alleged father, and the test on the right shows the child's DNA matches the father's DNA. This means that the father on the right is his biological father, while the one on the left is not.

• 2. Criminal Identification and Forensics

- DNA isolated from blood, hair, skin cells, or other genetic evidence left at the scene of a crime can be compared, through VNTR patterns, with the DNA of a criminal suspect to determine guilt or innocence.
- VNTR patterns are also useful in establishing the identity of a homicide victim, either from DNA found as evidence or from the body itself.

• 3. Personal Identification

- The notion of using DNA fingerprints as a sort of genetic bar code to identify individuals has been discussed, but this is not likely to happen.

• 4. Identification of victims of catastrophes

- Identification of victims of catastrophes such as the recent Balasore train accident.


62


64


70

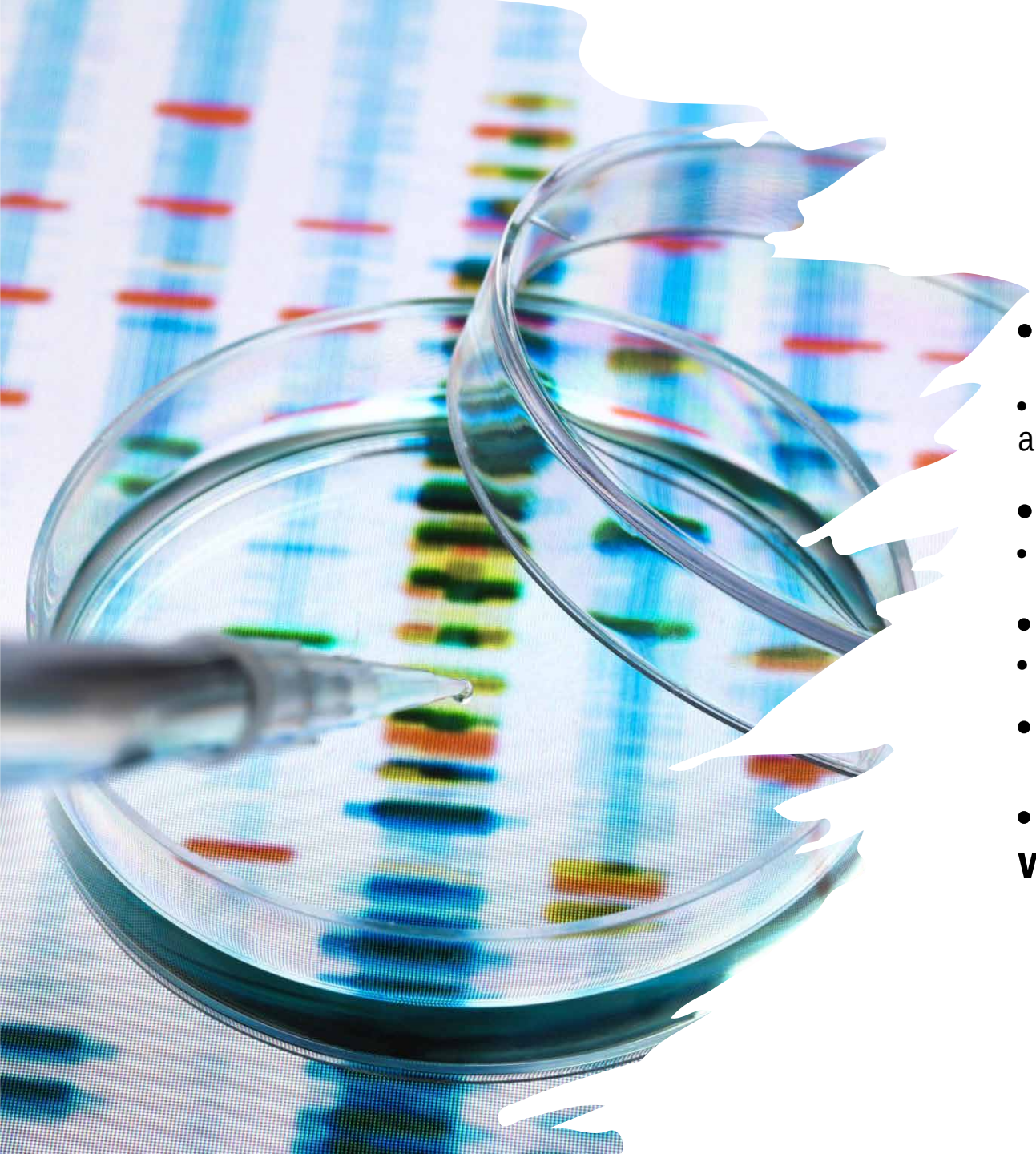

71


79


82
13


84


86



- **5. Environmental Forensics**

- Detect bacteria and other organisms that may pollute air, water, soil and food.

- **6. Wildlife Forensics**
- Identify endangered and protected species.

- **7. Immigration**
- Some visa applications may depend on proof of relatedness.

- **8. Pedigree Tracing**

- **9. Authenticate consumables such as caviar and wine.**

Advantages And Disadvantages of DNA Fingerprinting:

- **Advantages:**

- DNA profiling is an ideal method for confirming an identity with absolute certainty.

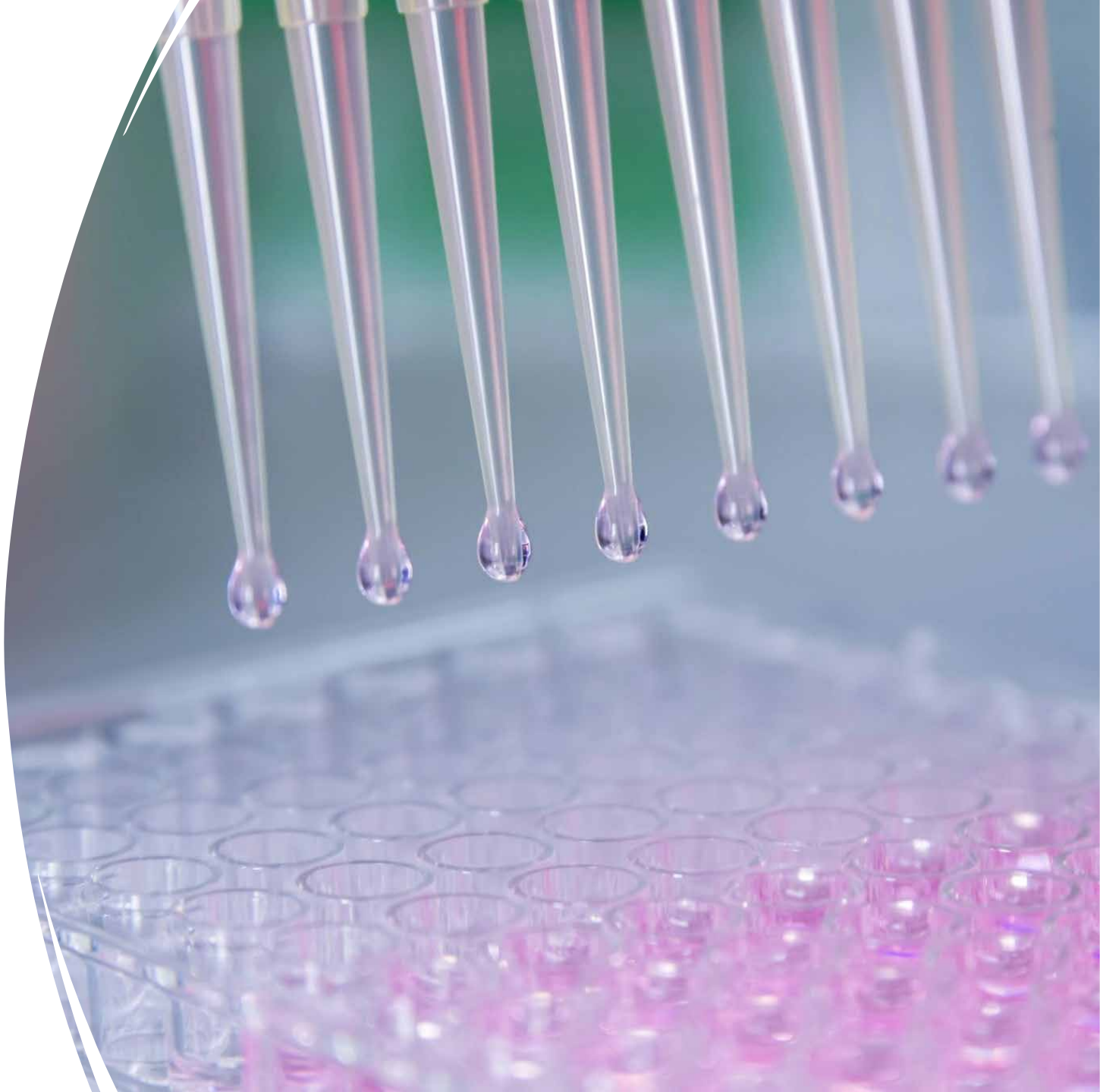
- It's easy and painless to obtain a specimen for testing.

- A thorough, scientific test can be conducted in as little as 48 hours.

- DNA testing is affordable and reliable.

Disadvantages:

- To be conclusive, a DNA test should be run on multiple samples, at least twice.
- Misuse of results can lead to privacy concerns.



Limitations:

- DNA profiling of identical twins is same.
- Expensive, Elaborate equipment.
- To be conclusive, a DNA test should be run on multiple samples, at least twice.
- Contamination of samples can give wrong results.
- Illegal sharing of information.
- DNA evidence can easily be planted at a crime scene.
- In blood and bone marrow transfusions, DNA profile of donor is generated and he/she may be indicted for a crime he/she did not commit.
- Misuse of results can lead to privacy concerns.

- It must be remembered that these tests are not always fool proof and should be used in conjunction with other evidence where possible.

- DNA fingerprinting has nevertheless affected the outcome of criminal investigations in a revolutionary way.

Case studies

Immigration case of a Ghanian boy [1985]

- Andrew, a 13-year-old boy who had been born in Britain, had been stopped at Heathrow Airport coming back into the UK after a trip back to see his father in Ghana, as immigration officials thought that his passport had been tampered with or forged.
- To make matters worse, Andrew referred to Christiana Sarbah, the woman who was supposedly his mother, as ‘Auntie’ - a common habit in his culture - even though she was genuinely his mum.
- The officials refused to believe that Andrew truly was her son, and thought he was a cousin trying to illegally sneak into the UK.
- After two years of protracted legal argument the family was distraught, and there seemed to be no way to persuade the officials to drop the case.
- As a last-ditch effort, Alec Jeffreys produced DNA fingerprints from Andrew, his mother, and three other children that were definitely hers: David, Joyce, and Diana.
- The results were completely convincing: the boy was undeniably his mother’s child.
- The Home Office immigration tribunal backed down immediately.

Tommy Lee Andrews [1988]

- Andrews, 24, was convicted of breaking into the home of a 27-year-old woman, raping and stabbing her.
- The women identified Andrews during the trial as her attacker.
- Andrews' DNA was matched with the vaginal swabs taken from the rape victim.
- He was sentenced to 22 years in prison.

Bill Clinton and Monica Lewinsky’s case [1998]

- There were allegations that U.S. President Bill Clinton had a sexual relationship with Monica Lewinsky, a young white house intern.
- President Clinton publicly denied the allegations.
- During investigation, a dark blue dress belonging to Monica Lewinsky was brought to the FBI laboratory for examination and examined with seven RFLP single locus probes.
- Semen was identified on it.
- A reference blood sample was drawn from President Clinton for comparison and a match was obtained at all seven RFLP loci examined.
- The random match probability calculated was 1 in 7.8 trillion.
- This resulted in the impeachment of President Clinton.

Thank You