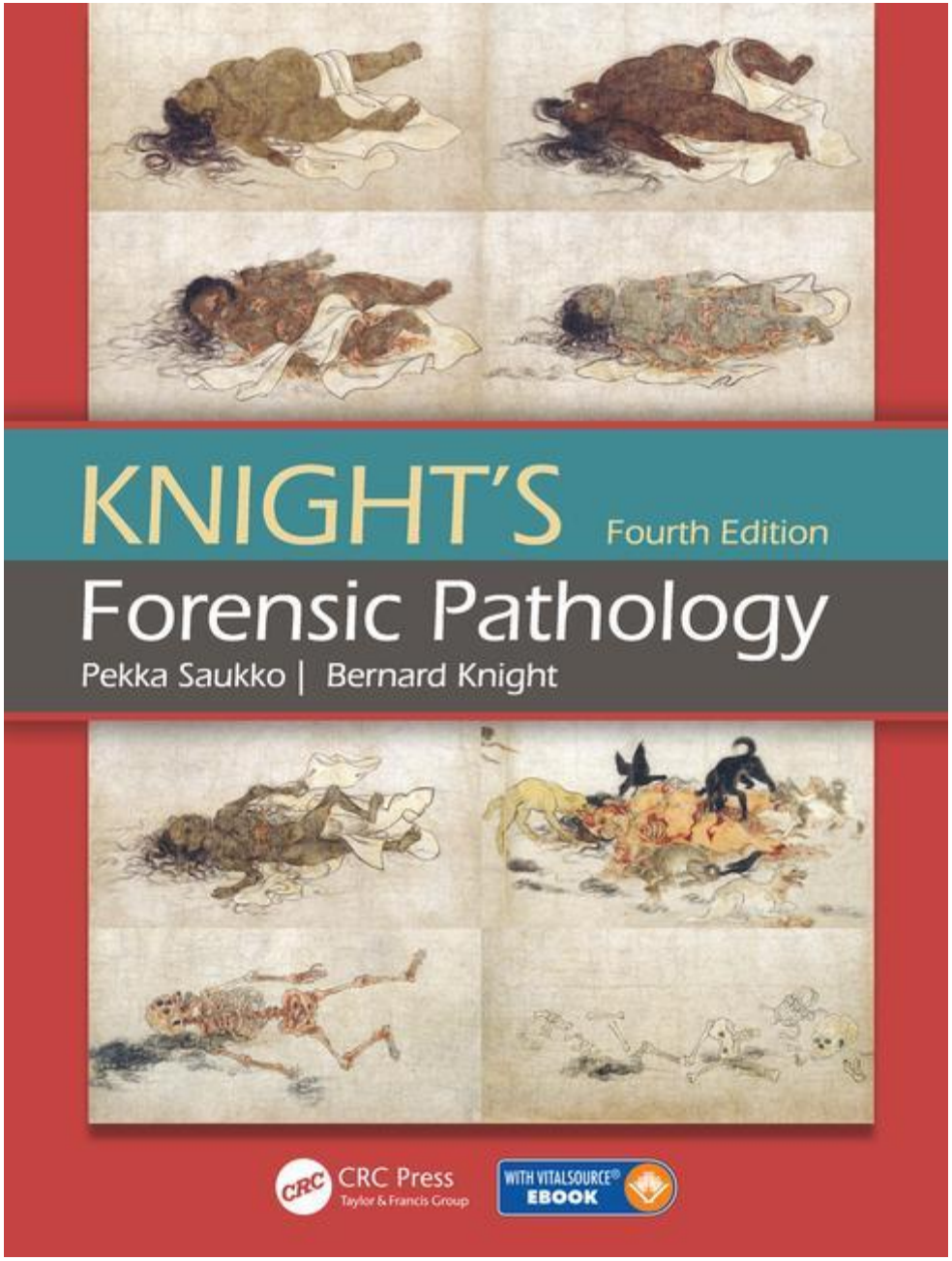
Head Injuries

Objectives

At the end of this lecture the medical student should be able to

- Understand the mechanism of causation of head injuries
- To describe head injuries in sequence from scalp to brain
- Medico-legal significance, sequelae and complications of head injuries


KNIGHT'S
Fourth Edition
Forensic Pathology
Pekka Saukko | Bernard Knight
CRC Press
Taylor & Francis Group
WITH VITALSOURCE®
EBOOK

Simpson's Forensic Medicine

13th Edition

Jason Payne-James
Richard Jones
Steven Karch
John Manlove


Only I can change my life. No one can do it for me.
Carol Burnett
BrainyQuote

Causation of head injuries

- Direct trauma – assault with club, fall from height, road traffic accidents
- Indirect trauma – due to transmitted force (blow to the chin, fall from height with feet striking the ground)
- Acceleration, Deceleration movement of the head
- Violent shaking

Head injuries

- Scalp Injuries
- Skull fractures
- Intracranial haemorrhages
- Brain damage

Scalp - Anatomy

S- Skin

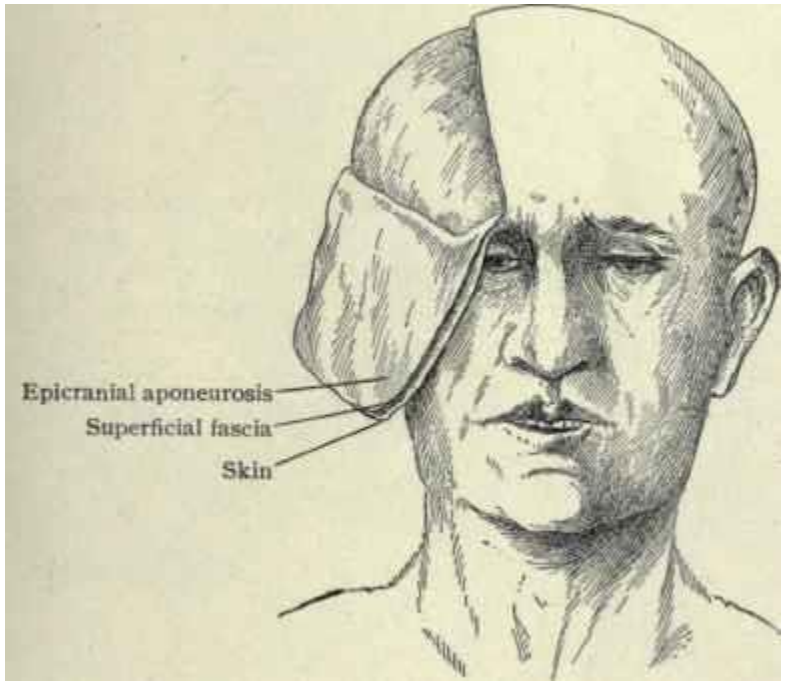
C – Connective tissue

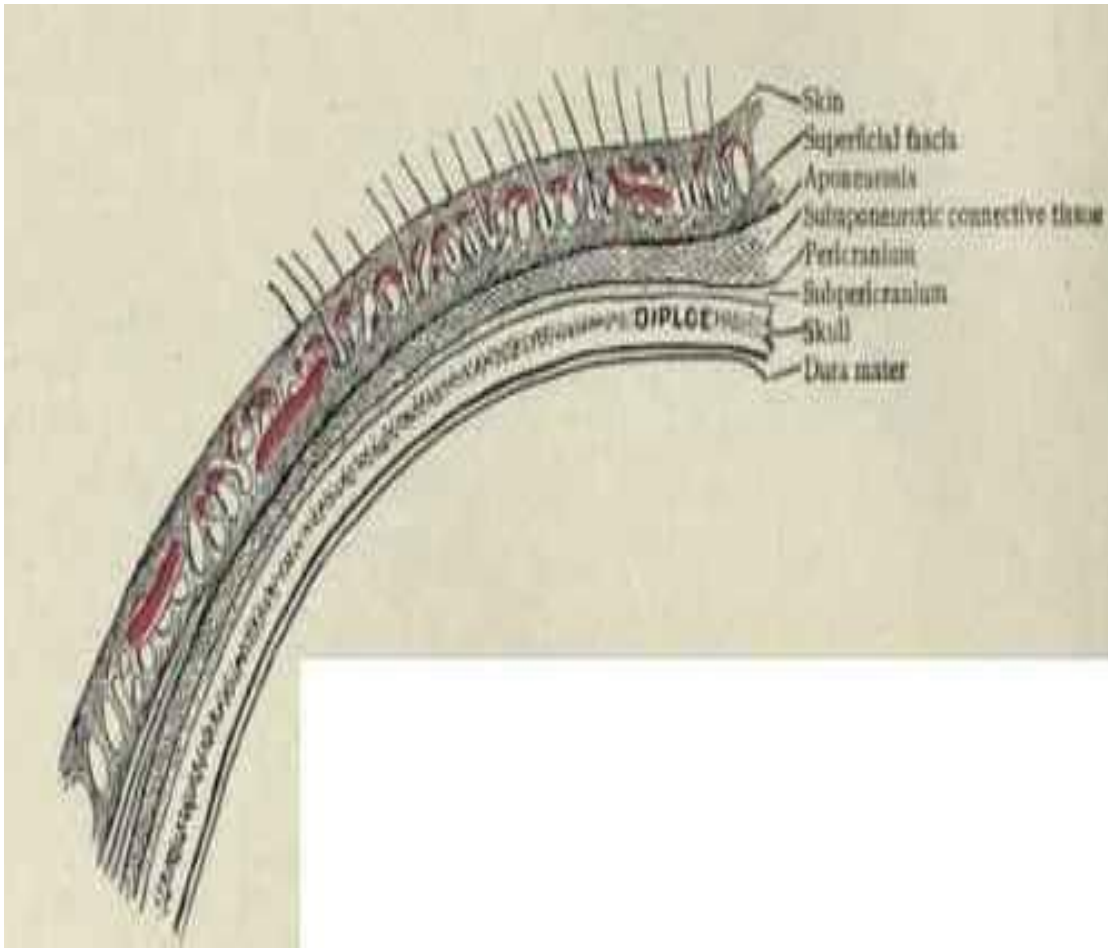
A- Aponeurosis

L – Loose areolar tissue

P - Pericranium

Scalp - Anatomy





Scalp injuries

- Injuries may involve all or some layers
- Scalp is very vascular and bleeds profusely

<u>Common injuries</u>

- Abrasions
- Contusions
- Lacerations
- Incised wounds
- Fire arm injuries

Abrasions

- Less due to the head hair
- Seen in bald persons and friction between scalp and a rough surface

Scalp Contusions

- Difficult to detect until the hair is removed
- Appear between the aponeurosis and the skin
- Marked swelling is a common feature of extensive bruising
- Bruise under the anterior scalp may slide down to appear in the orbit (Black eye)
- Shape of an inflicting weapon is poorly produced in the scalp due to the padding effect of hair

Scalp contusion

Battle's sign

Battle's Sign

- bruising of the scalp over the mastoid area behind the ear, is called 'Battle's sign'
- which develops as a consequence of a basal fracture of the skull involving the middle cranial fossa
- It is not therefore an indicator of an impact at this site

Scalp lacerations

- Lacerated by an impact due to the underlying rigid skull
- Blow from an instrument (hammer), fall against a hard object, impact against a blunt object cause a sharply defined split
- Can be mistaken for an incised wound
- Wound edges will show a narrow zone of bruising, hairs and fibrous strands crossing the depths of the wound

Scalp injuries – Blunt force trauma

Scalp lacerations – Blow with an hammer

Scalp lacerations

- Stellate – blunt rod
- Linear – rod like objects
- Y shaped- rod with a rounded end
- Curved – blunt weapon with an edge

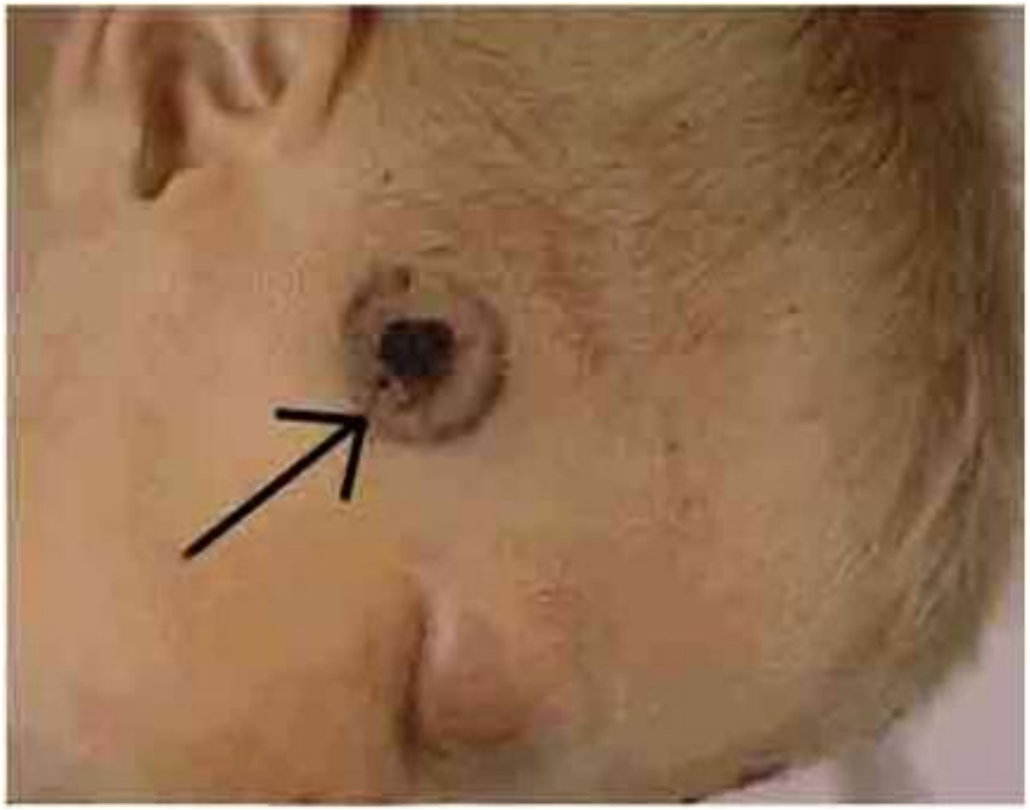
Incised wounds

Incised wounds

Incised wounds

- Slashed cut
- Cut hair
- Cut underlying tissues and bones
- Regular margins
- Cut ends showing tailing

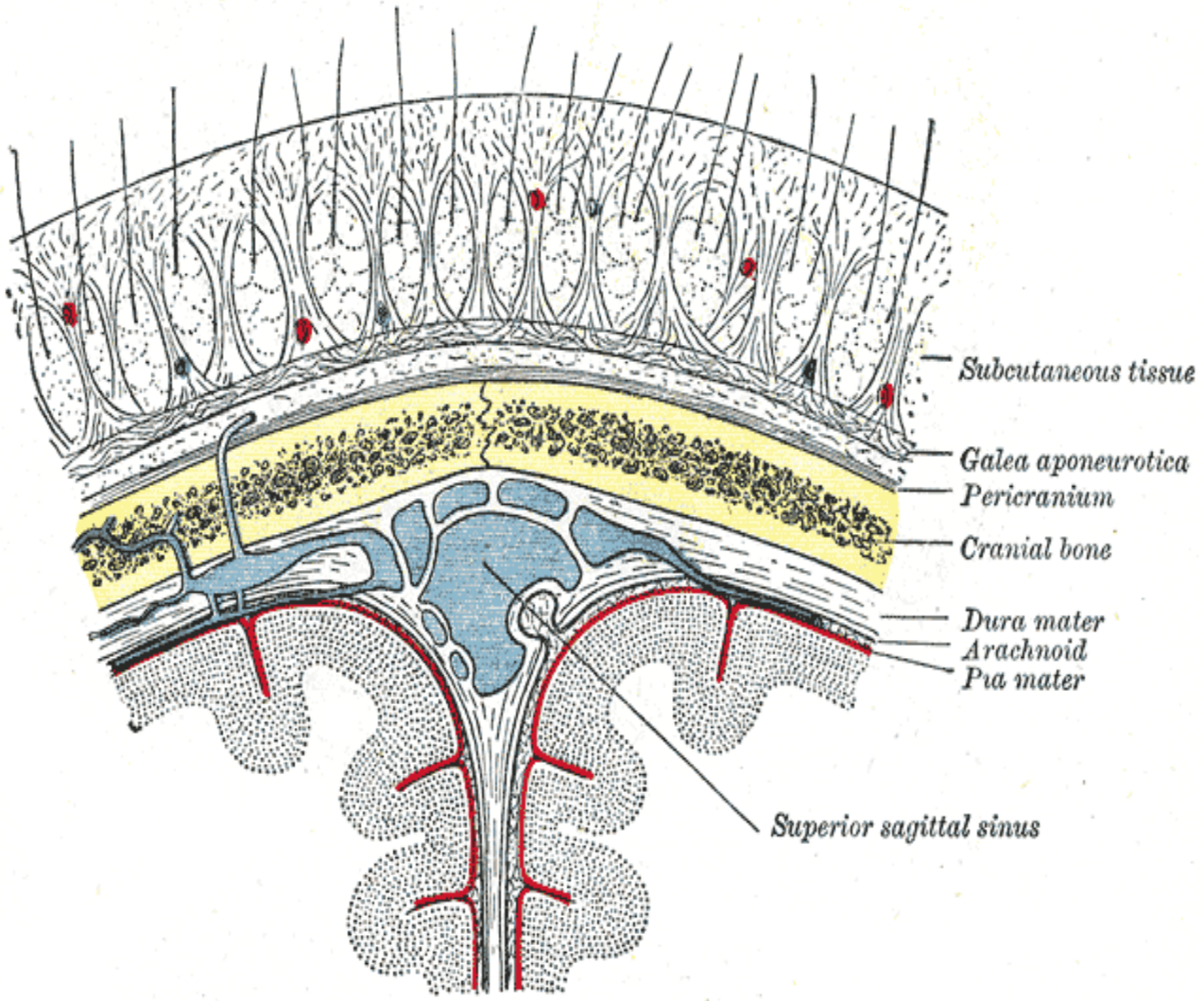
Firearm injuries



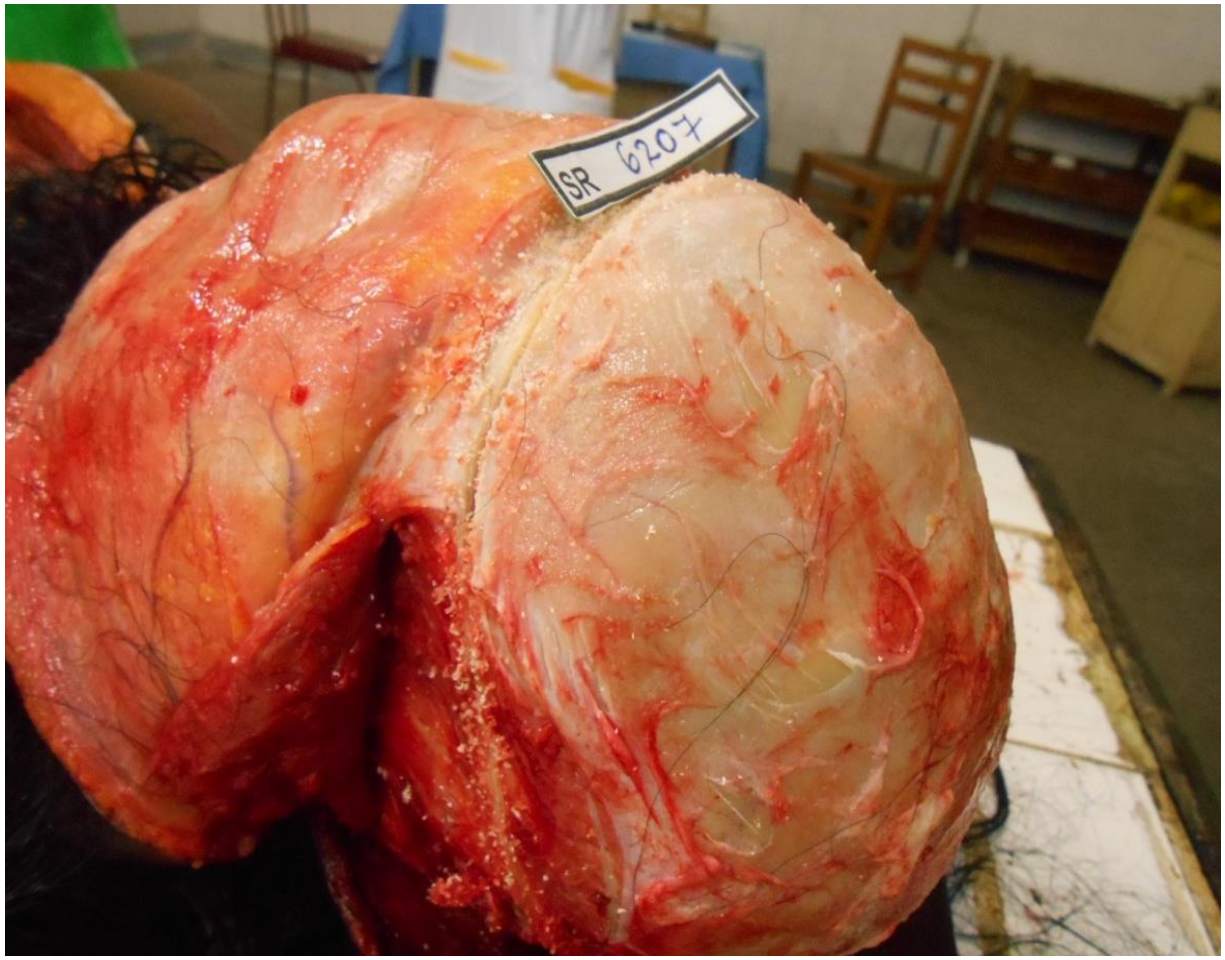
Firearm injuries

- Perforating lacerations
- Other features depending on entry, exit and range of firearm injuries

Skull Fractures – Forensic anatomy



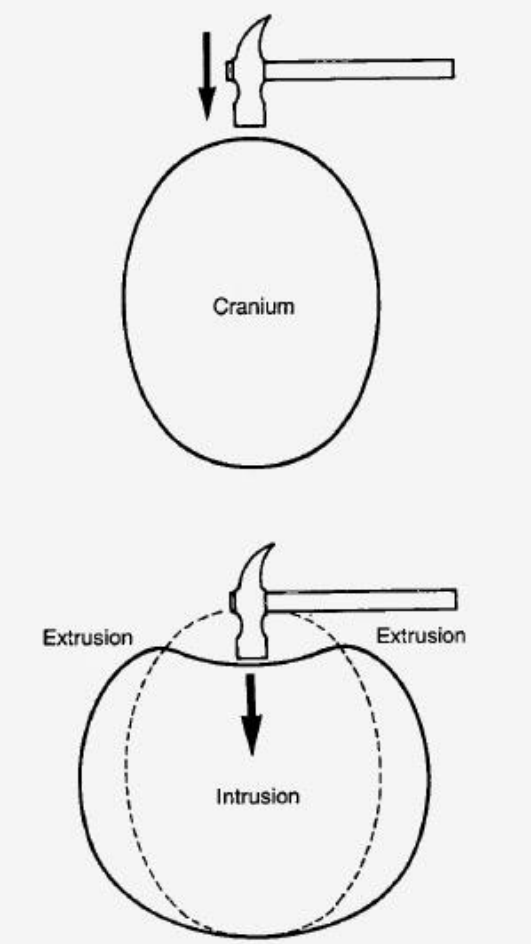
Forensic Anatomy - Skull

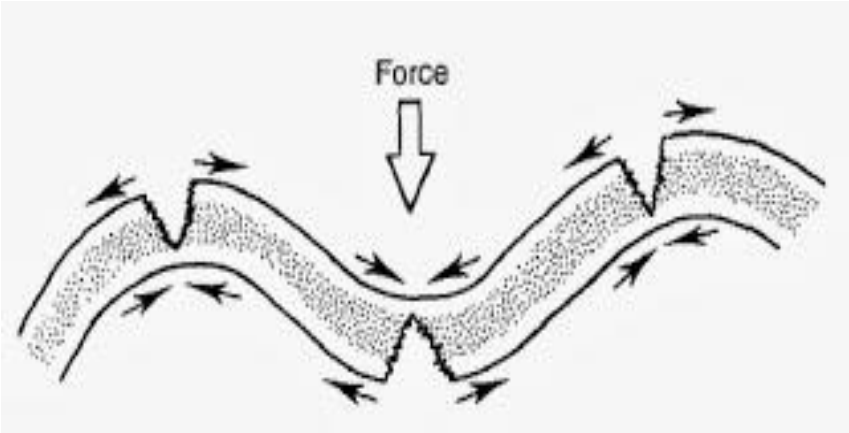


Mechanism of skull fractures

- Impact causes distortion
- Skull can withstand slight distortion but if this exceeds a certain limit fracture occurs
- Skull fractures themselves are not fatal
- Damage to the cranial contents is fatal
- Fractured skull is an indication that a severe force was applied
- Often indicate the position and nature of the head injury
- Fracture usually corresponds to the point of impact

Struck hoop illustration

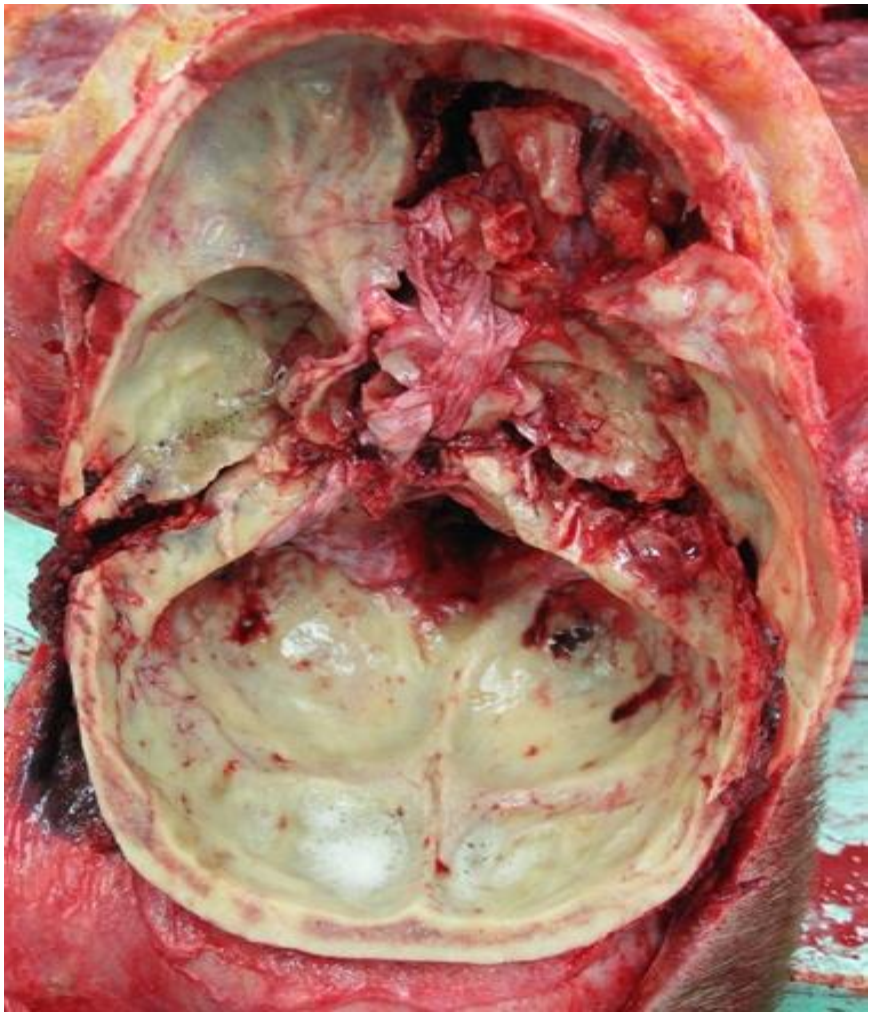




Struck hoop analogy

- Impact makes skull deformed, intrustion and extrusion
- skull is more susceptible to traction forces than compression so that convexities tend to fracture during the distortion of the ‘struck hoop’.
- Break do not start at the point of impact, but initiated at a distance due to the compensatory deformation and usually run back towards the impact site.

Hinge Fracture



Hinge Fracture

- Blow or fall on the top or side of the head causing linear fractures commonly rundown the temparo-parietal plates.
- These fractures run across the base of the skull often in the middle cranial fossae and pituitary fossae.
- These base of the skull fractures may separate the base of skull into two halves called the 'hinge fracture.' Eg: RTA

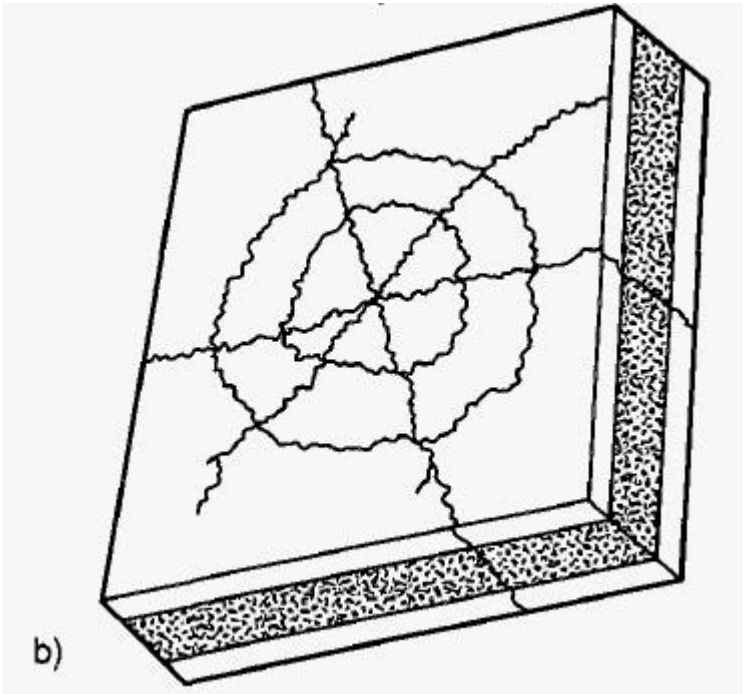
Depressed Fracture

Depressed fracture

- Due to a focal impact which drives the fragments inside
- Caused by weapons with a small striking surface eg; hammer
- May damage the meninges, vessels or brain tissue
- Later may gives rise to traumatic epilepsy

Mosaic or spider's web fracture

- Depressed or not fractures from a focal impact may show radiating lines
- Sometimes joined by concentric circles in a 'spider web' pattern

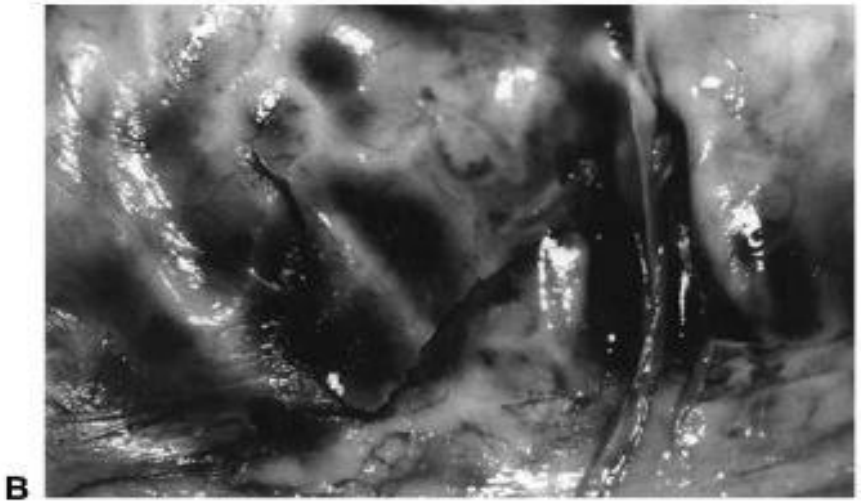


Ring Fracture

- Fall from height on to the top of the head or to the feet ‘ring fracture’ may be seen
- Encircles the foramen magnum due to the skull and cervical spine being forced together

Contre-coup fractures

- Seen in roof of orbits, and ethmoidal plates following occipital impacts



Intracranial haemorrhage

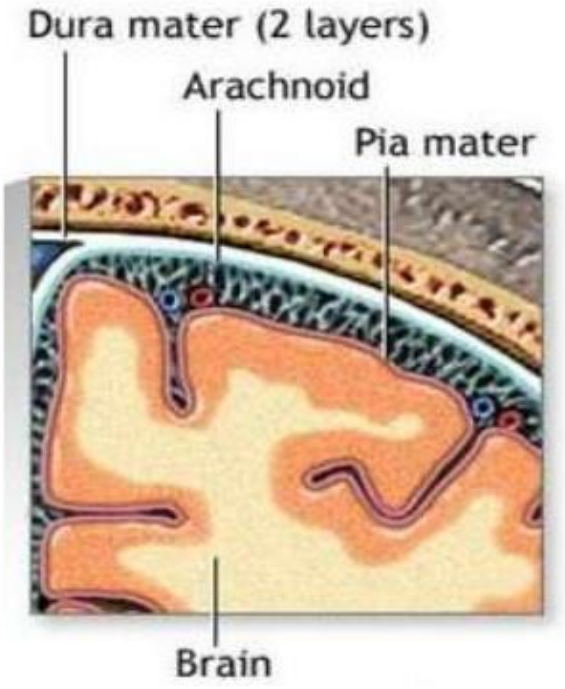
- Extra dural haemorrhage
- Sub dural haemorrhage
- Sub arachnoid haemorrhage

Anatomy of brain membranes

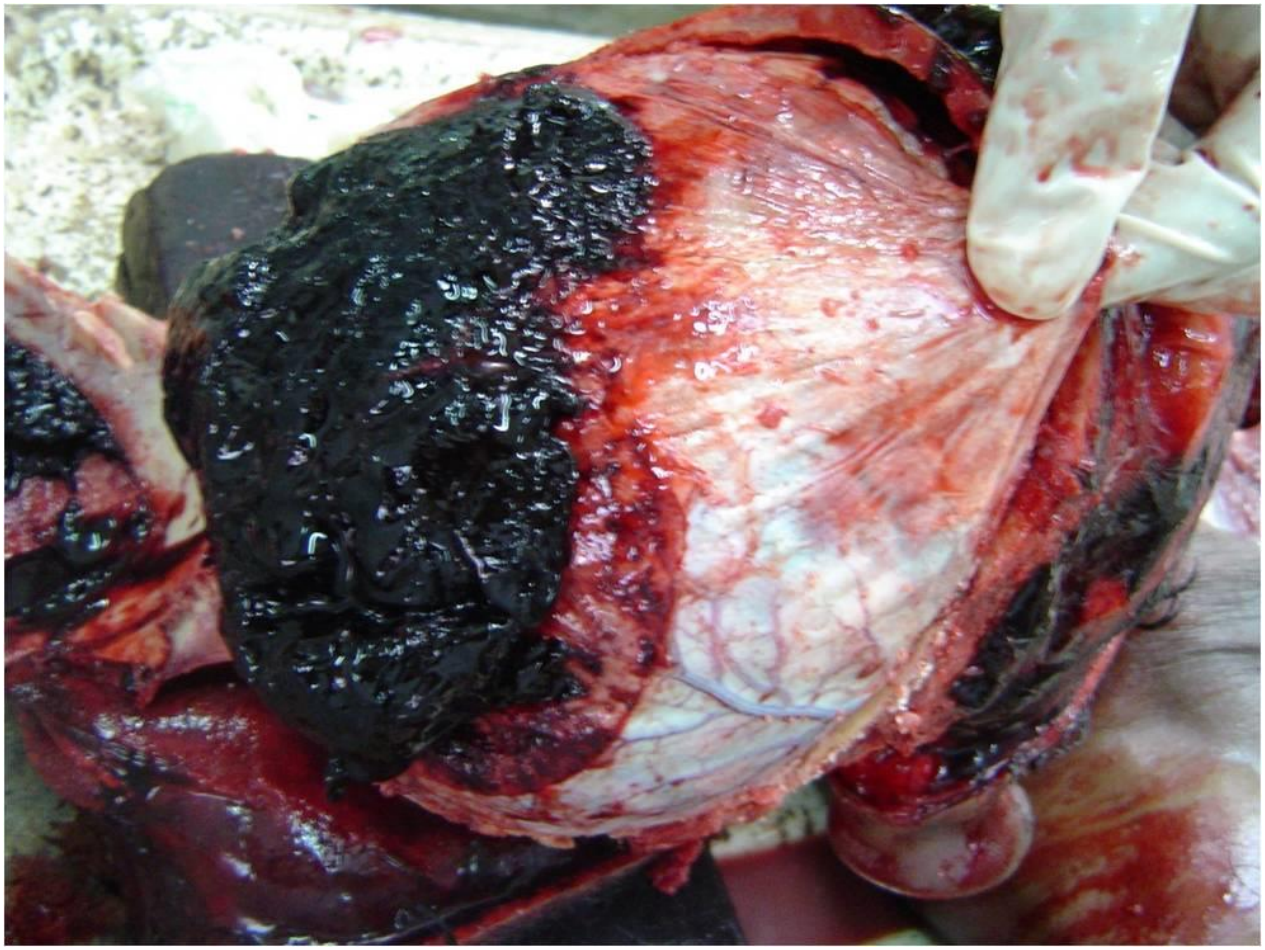
The Meninges

- The Meninges are the membrane covering the brain and spinal cord.
- The Meninges consist of three membranes:

1. The dura mater,
2. The arachnoid mater,
3. The pia mater.



Extradural haemorrhage



Heat haematoma (Post mortem artefact)

Extradural haemorrhage

- Usually associated with a fracture of the skull
- Blood escapes from a meningeal artery
- Blood forms a haematoma which strips away the dura from the skull to form a space occupying lesion (SOL)
- Flattening of the underlying parietal lobe, cerebral oedema, hippocampal herniation and coning of the cerebellar tonsils can occur due to the SOL.

Extradural haemorrhage

- Sources of bleeding are the middle meningeal vessels, diploic vessels, sagittal sinus and other sinuses in the posterior cranial fossae.
- 100-150 ml could be fatal if not removed by surgery.
- The classical lucid interval of about 4 hours followed by coma may be observed in minority of cases.

Extradural haemorrhage

- The category of hurt is FOCN in larger bleeds.
- The dead body, exposed to heat/Flame burns causes heat haematoma which can mimic EDH.
- Heat haematoma is bilateral, pink in colour, cavernous in appearance and found in the anterior cranial fossae.

Clinical picture

- Temporary concussion
- Lucid interval of consciousness
- Relapse into coma

Subdural haemorrhage

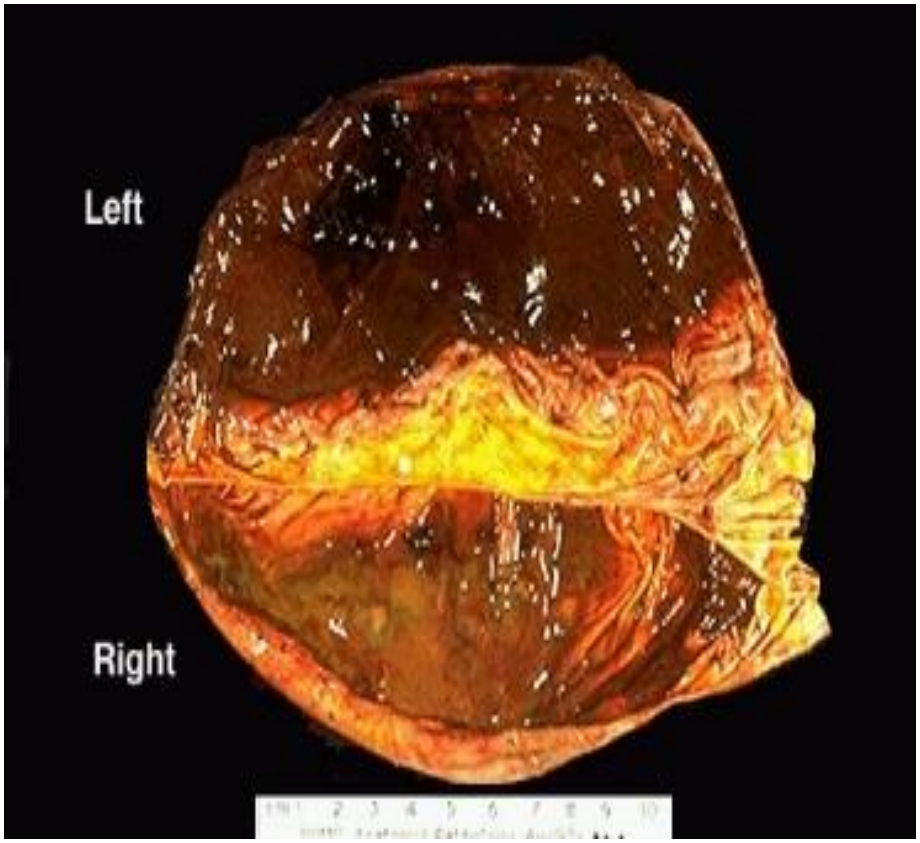
Acute

- Occurs in the absence of a fractured skull
- In infants it can occur solely from vigorous shaking
- Bleeding comes from the communicating veins which cross the subdural space
- Any rotational or shear force can tear the veins

Chronic

In old persons may be found at autopsy as an incidental finding

Acute and Chronic subdural haematoma



Sub dural haemorrhage

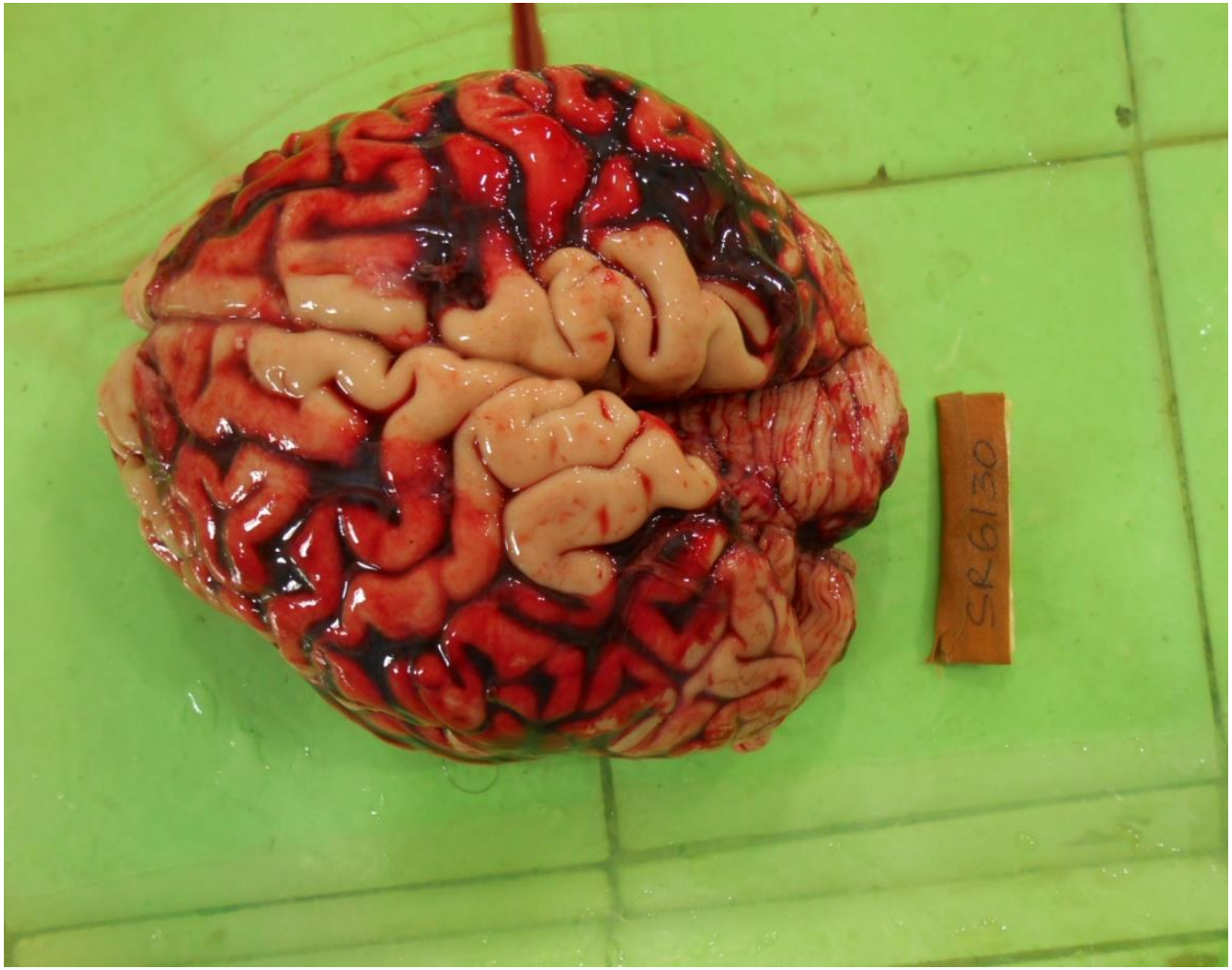
Chronic

A gelatinous membrane forms around the haematoma which may harden into a dense rubbery capsule in the chronic stages

Subarachnoid haemorrhage

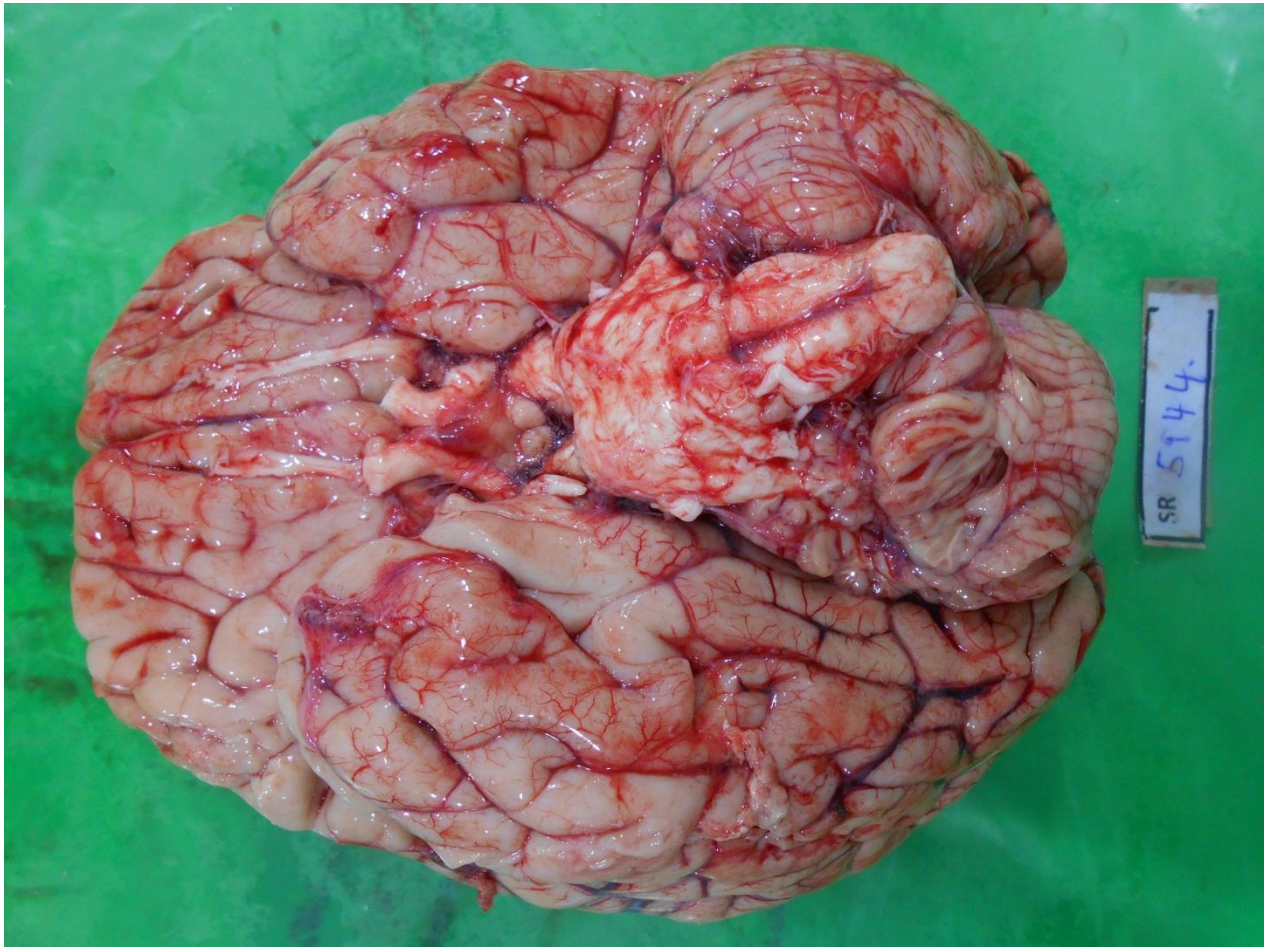
- Common wherever brain damage has been caused
- May also occur without injury to the cerebral tissue
- Mostly pure subarachnoid bleeding is due to natural causes – ruptured berry aneurysm
- Traumatic subarachnoid haemorrhage – bleeding can occur from the vertebra-basilar vessels in the **posterior cranial fossae** where a person suffers a kick or heavy blow to the side of the neck

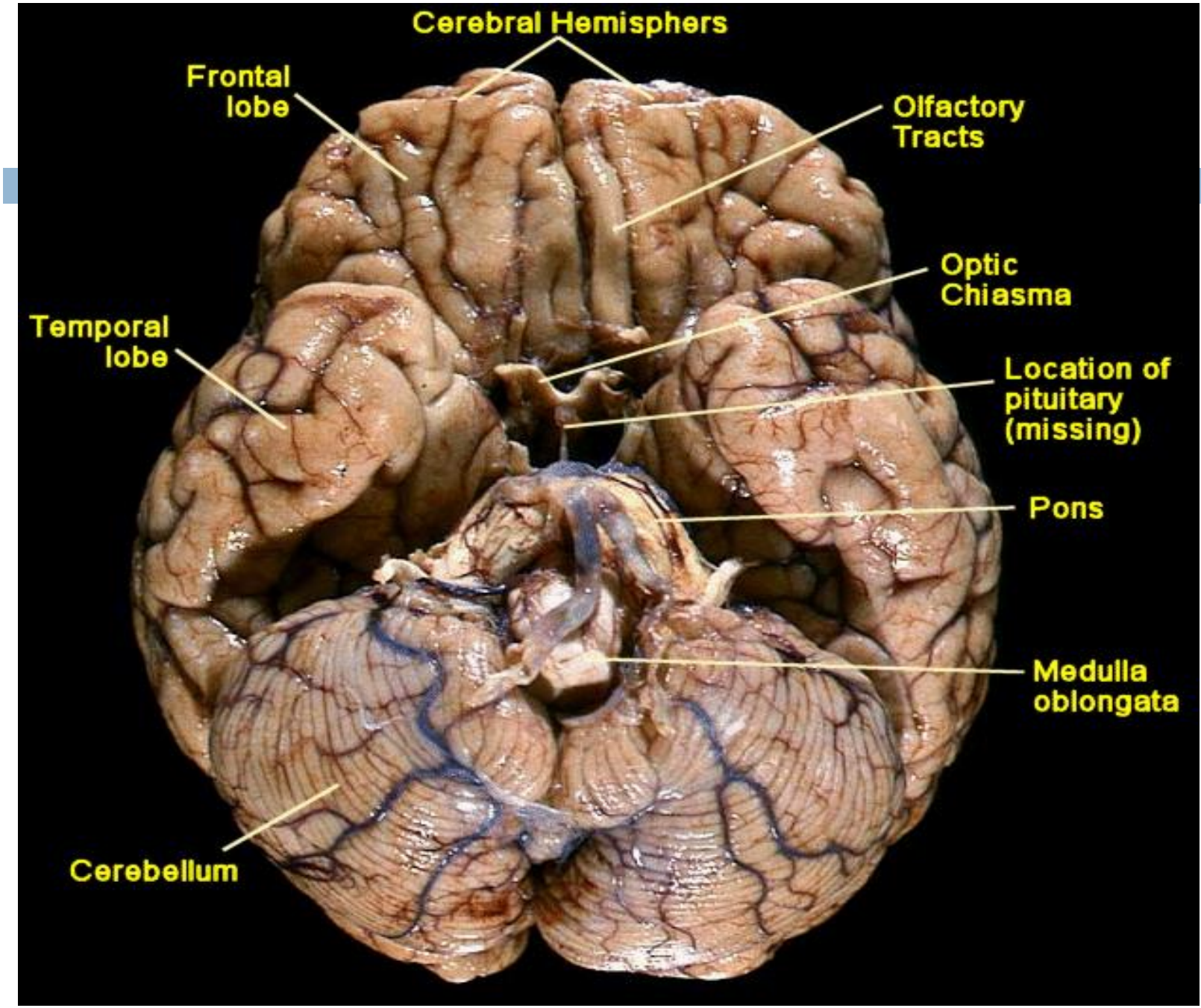
Sub arachnoid haemorrhage



Brain - Anatomy

Normal Brain - Anatomy

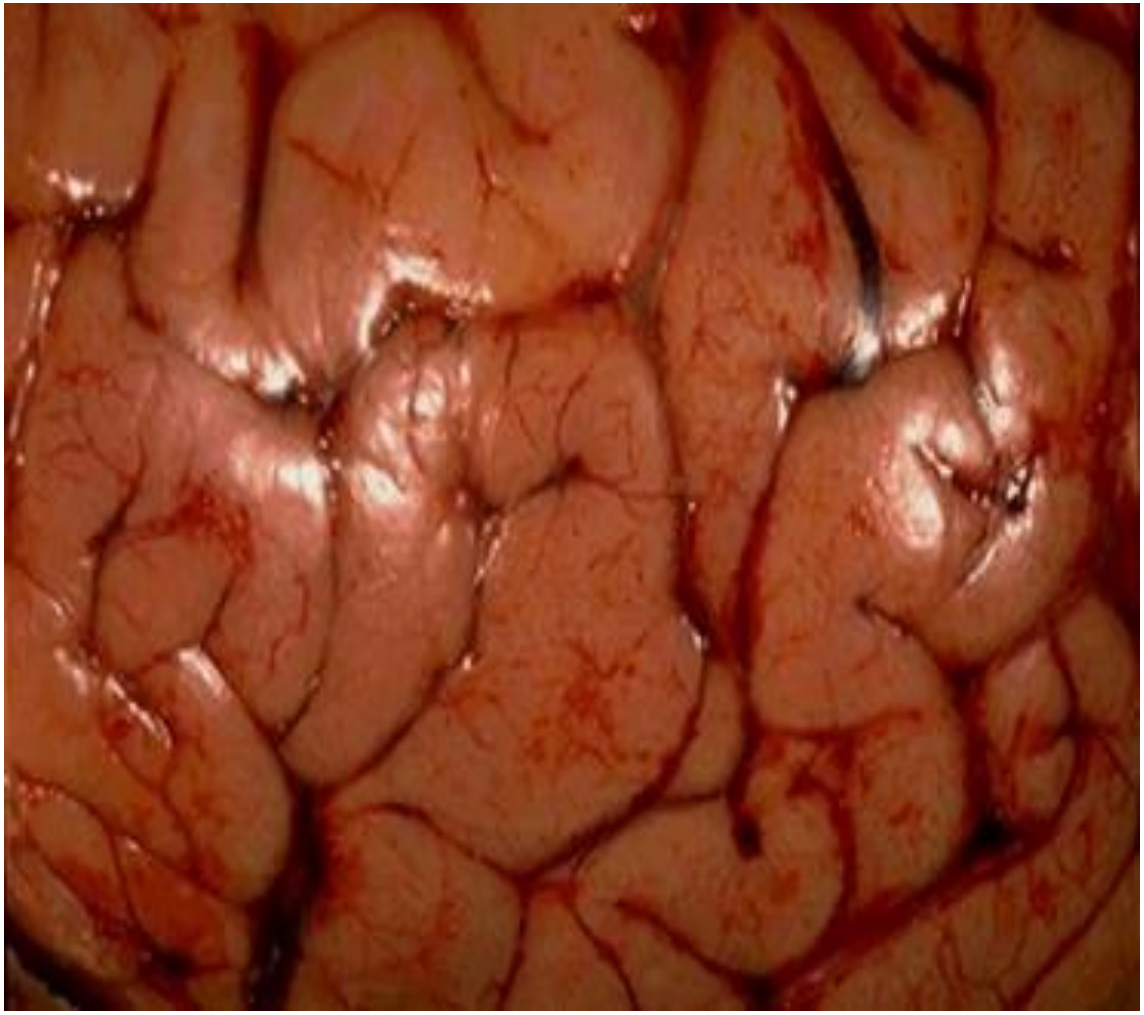



Cerebral Hemisphers
Frontal lobe
Olfactory Tracts
Optic Chiasma
Temporal lobe
Location of pituitary (missing)
Pons
Medulla oblongata
Cerebellum

Brain injuries - Cerebral oedema

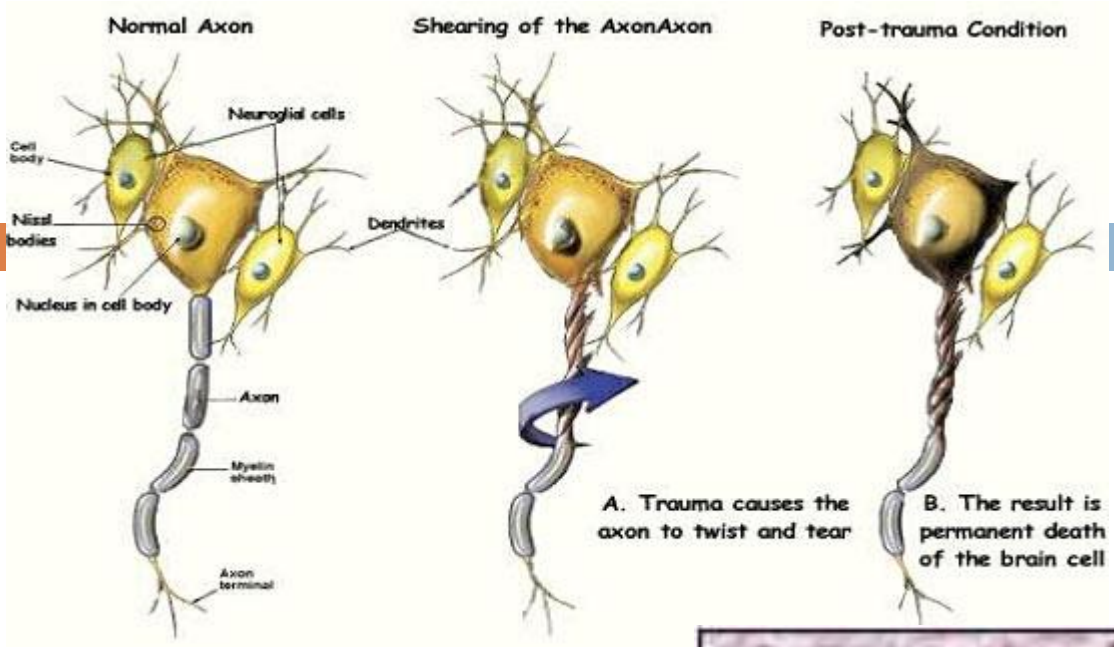
- Common and a rapid sequel to head injury
- Cause death by raised intracranial pressure with secondary effects to the brain stem
- Gyri expand, sulci fill up resulting in the flattening of the cerebrum
- Cerebellum and brainstem are forced into the foramen magnum
- Hippocampal gyrus herniates through the opening in the tentorium cerebelli

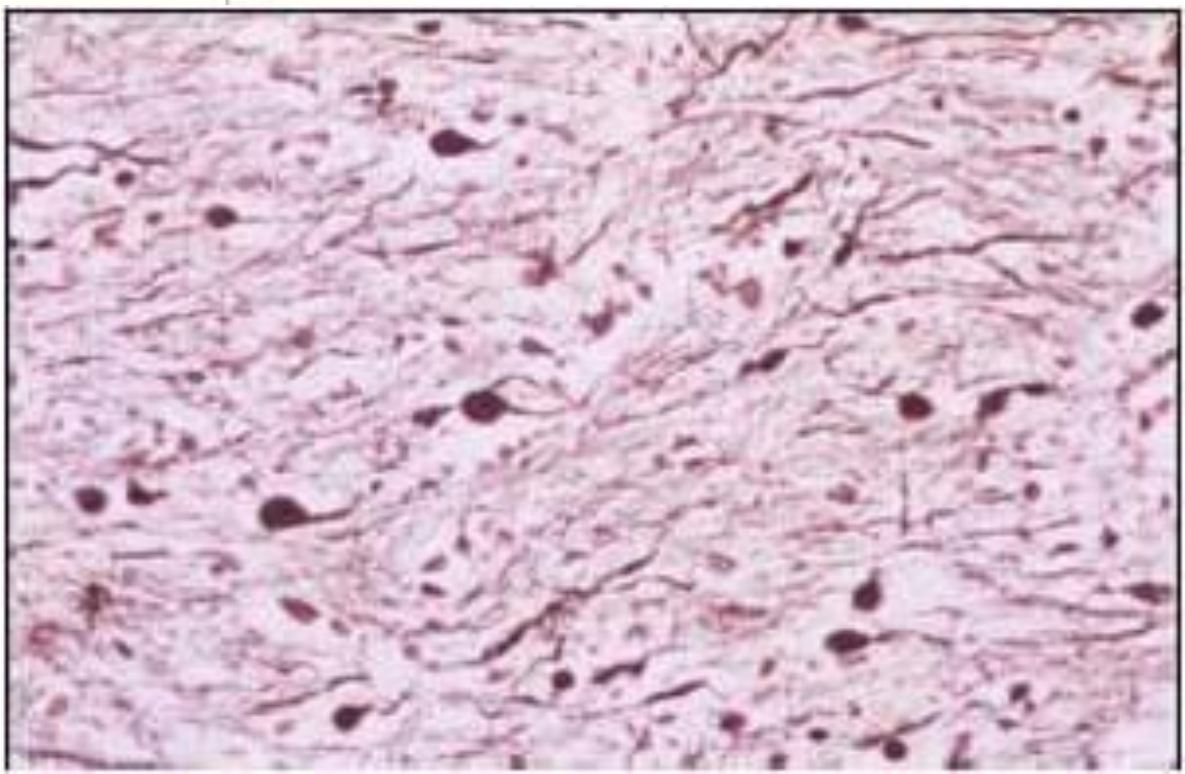
Cerebral oedema



Diffuse Axonal Injury (DAI)

- Lesions are due to shearing stresses within the soft brain substance
- Axons of neurons become broken and within hours spherical retraction balls form
- Demonstarble by special stains histologically
- Neurons may recover but many will degenerate
- Certain parts of the brain more prone to DAI
- Eg: Corpus callosum, parts of the cortex and brain stem

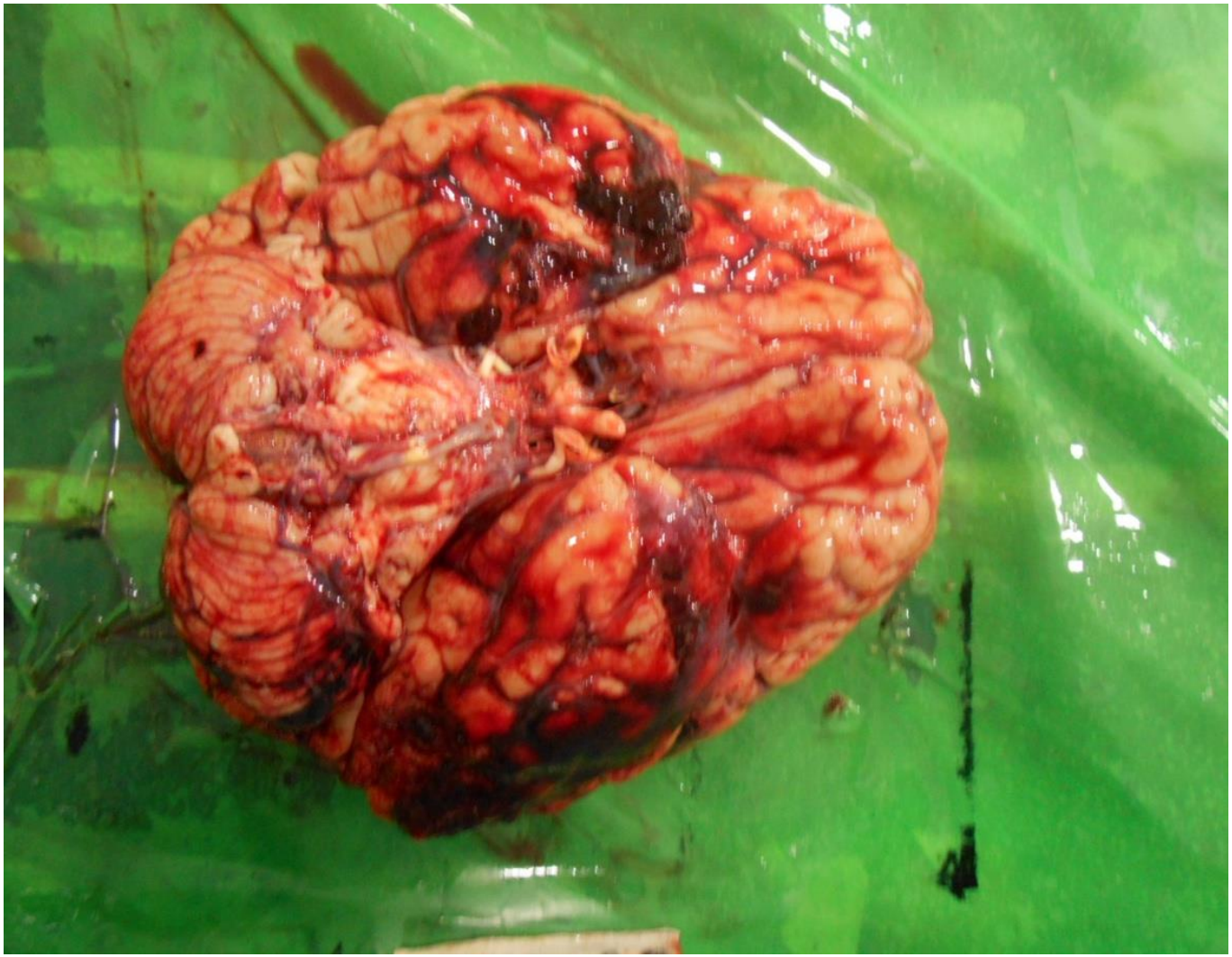

Normal Axon
Shearing of the AxonAxon
Post-trauma Condition
Neuroglial cells
Cell body
Nissl bodies
Dendrites
Nucleus in cell body
Axon
Myelin sheath
Axon terminal
A. Trauma causes the axon to twist and tear
B. The result is permanent death of the brain cell



Cerebral Contusion and laceration

- Mechanical damage to the brain substance and may occur anywhere in the cerebral hemisphere
- Depressed skull fractures or penetrating head injuries may directly injure the cortex
- Rotation, acceleration, deceleration are necessary for brain damage to occur

Brain injuries



Coup and contre-coup injuries

- Coup injuries- they are found directly under the external injury
- Contre-coup injury – Injuries found opposite to the external point of impact.
- Greater severity than coup injuries and occurs when the head is free to move. Eg: Falling backwards
- Common in the frontal and temporal areas (apical and inferior surface)
- Often associated with a SAH and SDH

Concussion

- Immediate and transient loss of consciousness due to blunt head trauma with complete paralysis of cerebral function with no demonstrable brain injury.

After recovery there can be

- Post concussion syndrome
- Post traumatic automatism

Brain Stem Haemorrhages

- Usually seen in the midbrain and pons area
- Primary brain stem haemorrhages

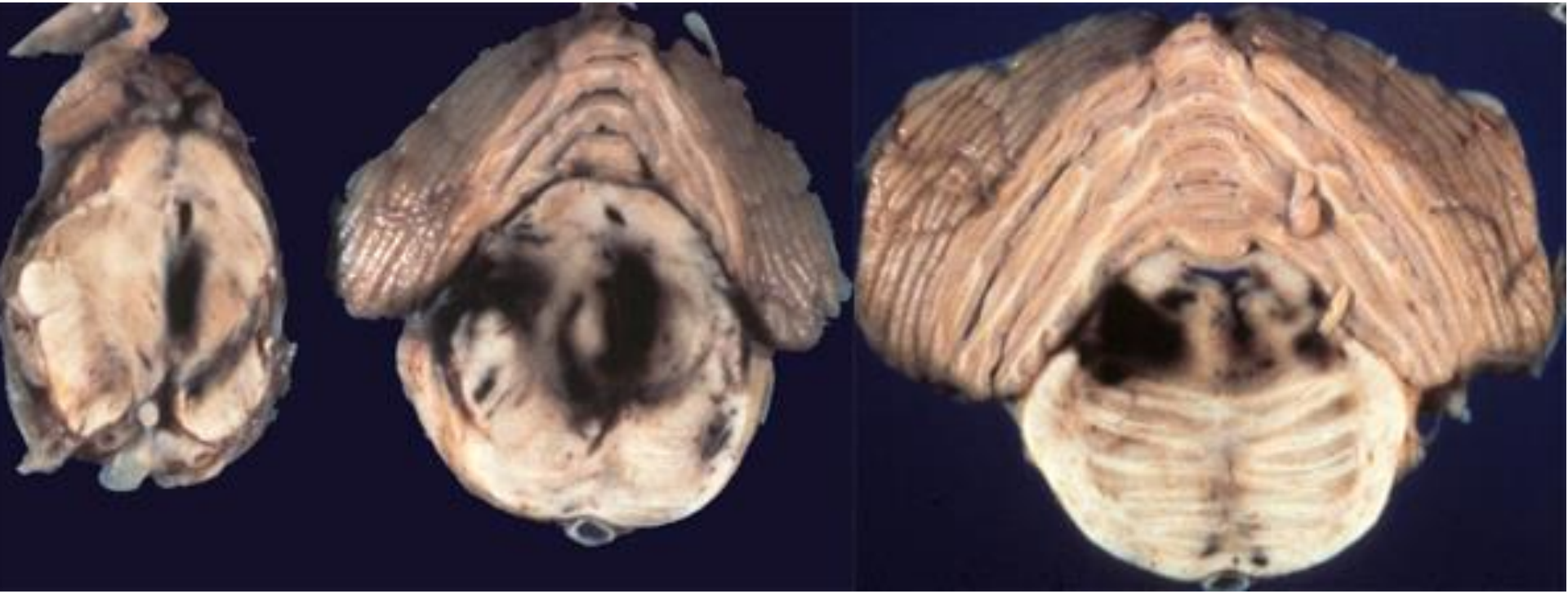
Occurs at the moment of trauma with occipital impacts

Small, well circumscribed, solitary or few found between the aqueduct and outer end of substantia nigra.

- Secondary brain stem haemorrhages- due to the effects of raised intracranial pressure causing herniation and compression of brain stem.

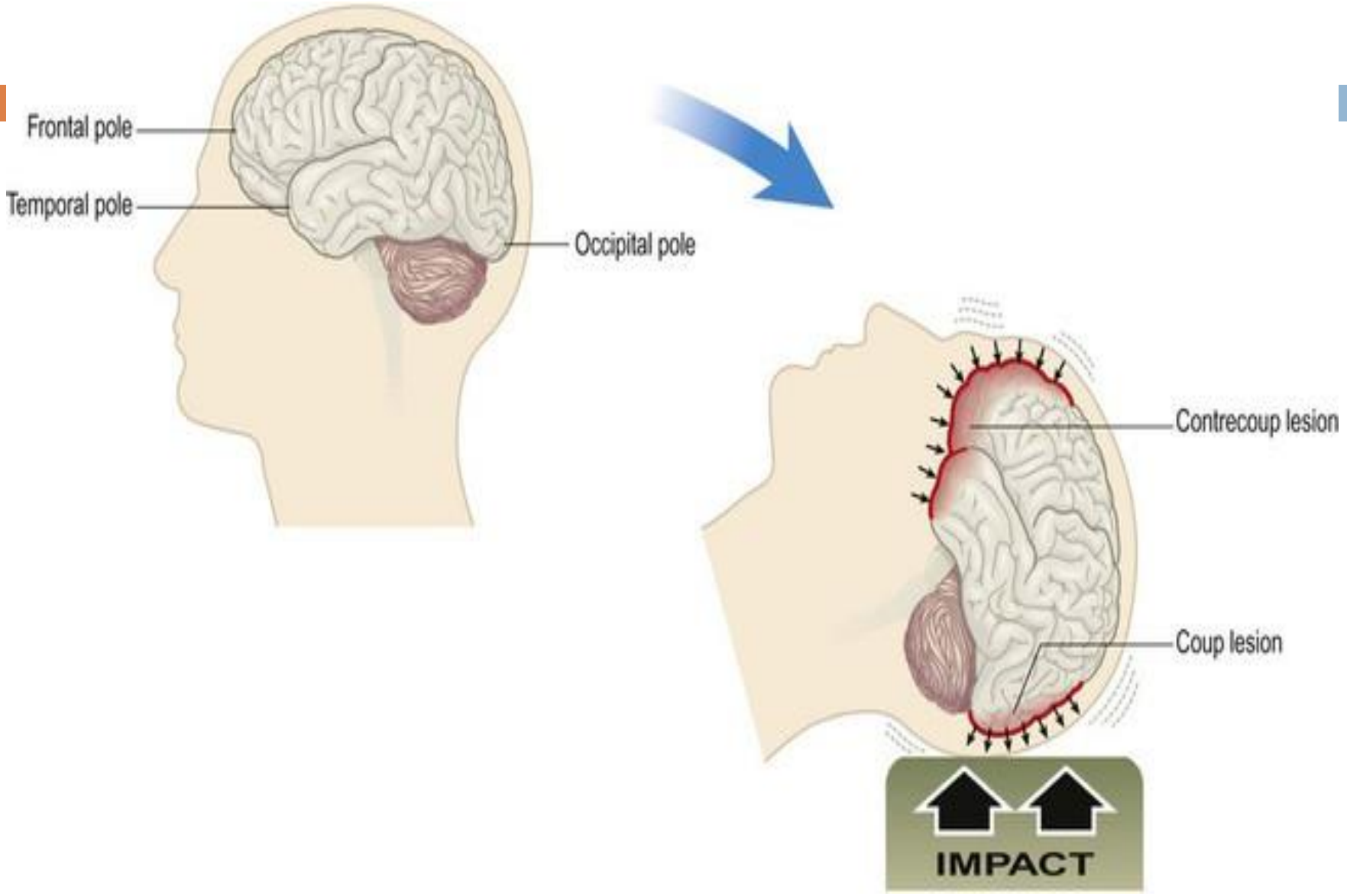
Brain Stem Haemorrhages

- Multiple, streaky and found centrally.
- Referred as ‘Duret haemorrages’
- Other features such as oedema, herniation and infarction also observed



Complications of head injuries

- Complete uneventful recovery.
- Post concussional syndrome.
- Post traumatic automatism.
- Post traumatic epilepsy
- Disfiguration of head or face.
- Cranial nerve palsies.
- Meningitis, cerebral abscess formation
- Hydrocephalus
- Sinus thrombosis


Frontal pole
Temporal pole
Occipital pole
Contrecoup lesion
Coup lesion
IMPACT

Reference

- Knight's Forensic Pathology 4th edition
- Lecture Notes in Forensic Medicine Volume I
  By Dr. L.B.L.De Alwis
- Simpson's Forensic Medicine – 13th Edition
- The pathology of trauma by JK. Mason

THANK YOU