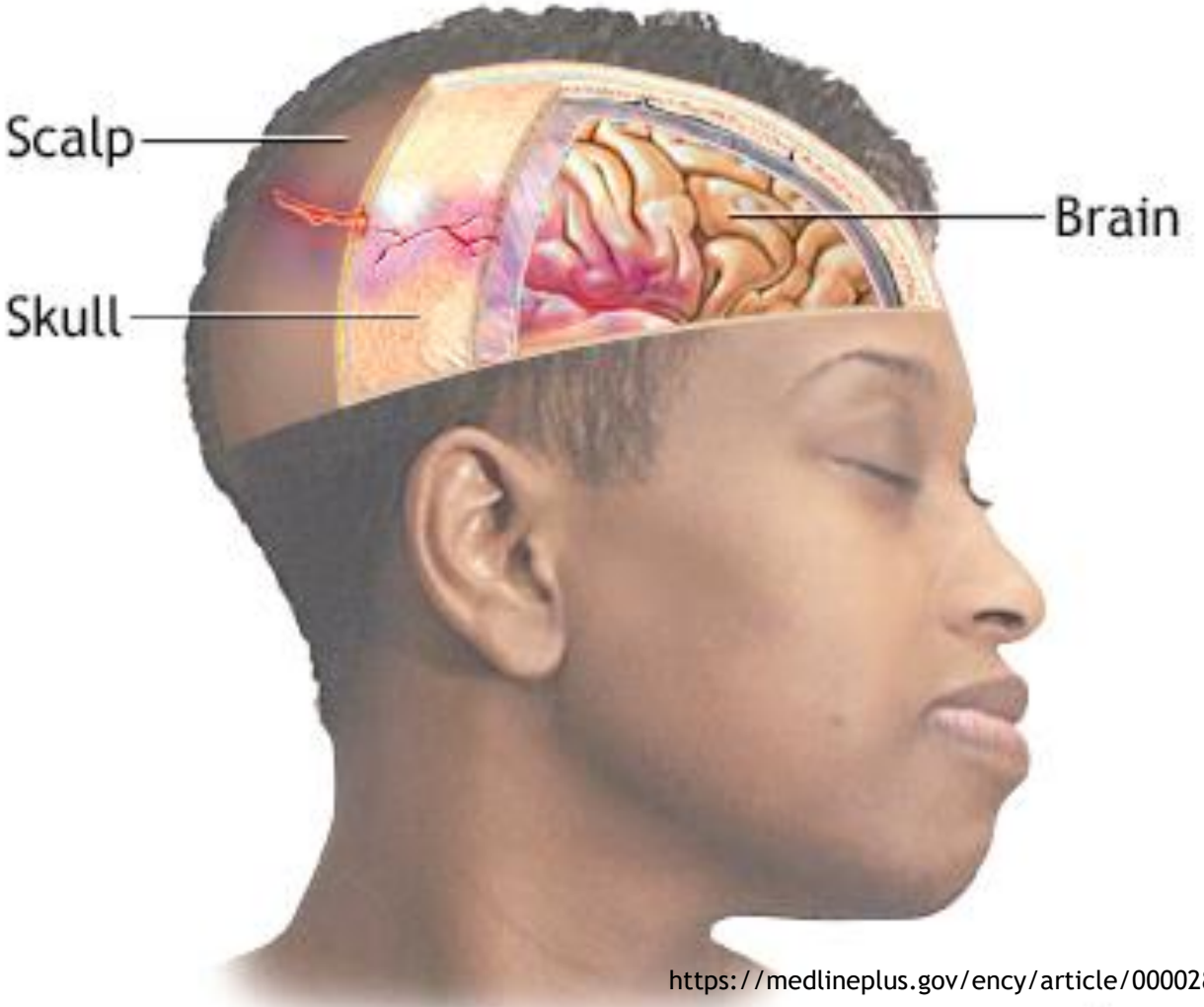
آسیب های تروماتیک سر وستون فقرات

دکتر مرتضی طاهری
جراح مغز و اعصاب- فلوشیپ نورووااسکولارانترونشن
استادیار دانشگاه علوم پزشکی ایران

آسیب تروماتیک جمجمه

Head Trauma refers to any damage to the Scalp, Skull or Brain



https://medlineplus.gov/ency/article/000028.htm

Causes

- Falls (from a ladder or down the stairs)
  - the major cause of TBI
  - maximum rates in children with age 0–4 and adults with age 75 and older.
- Vehicle-related collisions (cars, bicycles)
  - second most common
  - with the excessive rates in adults of age 20–24 years
- Violence (shootings, domestic violence)
- Sports injuries (football, boxing, etc.)
- Combat injuries (military)

- elevated rates of hospitalization and death:
  - Adults of 75 years of age and above
  - Males than females

Signs and Symptoms

- Symptoms of Increased intracranial pressure (ICP)
  - Decreased level of consciousness (LOC)
    - Restlessness
    - Changes in behavior
    - Irritability
    - Confusion
  - Headache
  - Nausea and projectile vomiting
  - Pupillary changes
  - Changes in vital signs: (Cushing's triad)
    - Severe hypotension
    - Widened pulse pressure
    - Bradycardia
- Seizures
- Ataxia
- Abnormal posturing
  - Decerebrate (extension)
  - Decorticate (flexion)
- Cerebrospinal fluid leakage from the nose or ears

EYE OPENING			VERBAL RESPONSE			MOTOR RESPONSE		
								
Spontaneous	>	4	Orientated	>	5	Obey commands	>	6
To sound	>	3	Confused	>	4	Localising	>	5
To pressure	>	2	Words	>	3	Normal flexion	>	4
None	>	1	Sounds	>	2	Abnormal flexion	>	3
			None	>	1	Extension	>	2
						None	>	1

GLASGOW COMA SCALE SCORE

Mild	Moderate	Severe
13-15	9-12	3-8

تشخیص آسیب های مغزی

Conventional Radiography

- **not indicated** in acute closed head injury.
- **skull film radiographs are not recommended in the evaluation of mild TBI.**

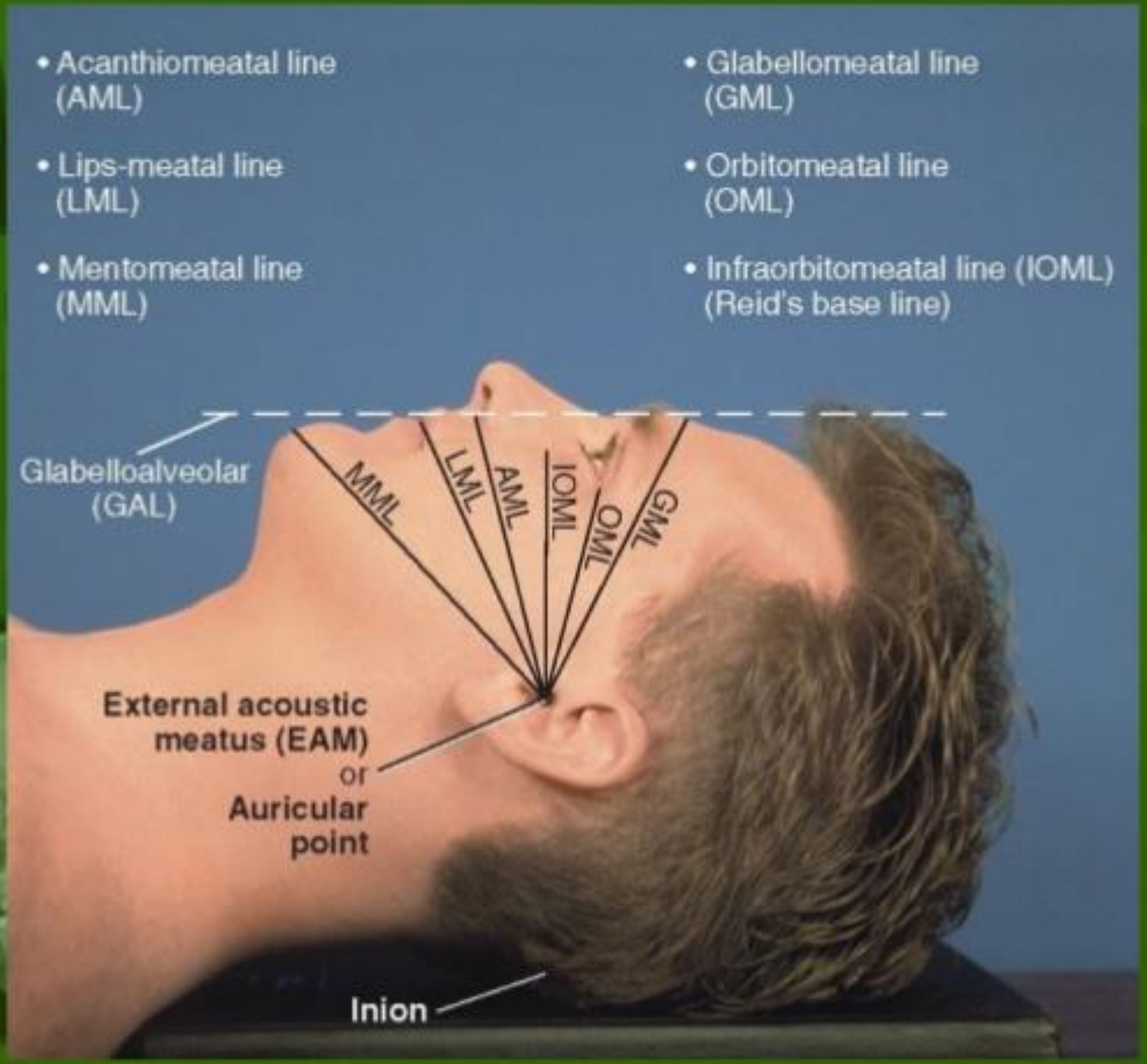
- skull fracture increases the likelihood of an intracranial lesion, its **sensitivity is not sufficient** to be a useful screening test.
- negative findings on skull films may **mislead the** clinician

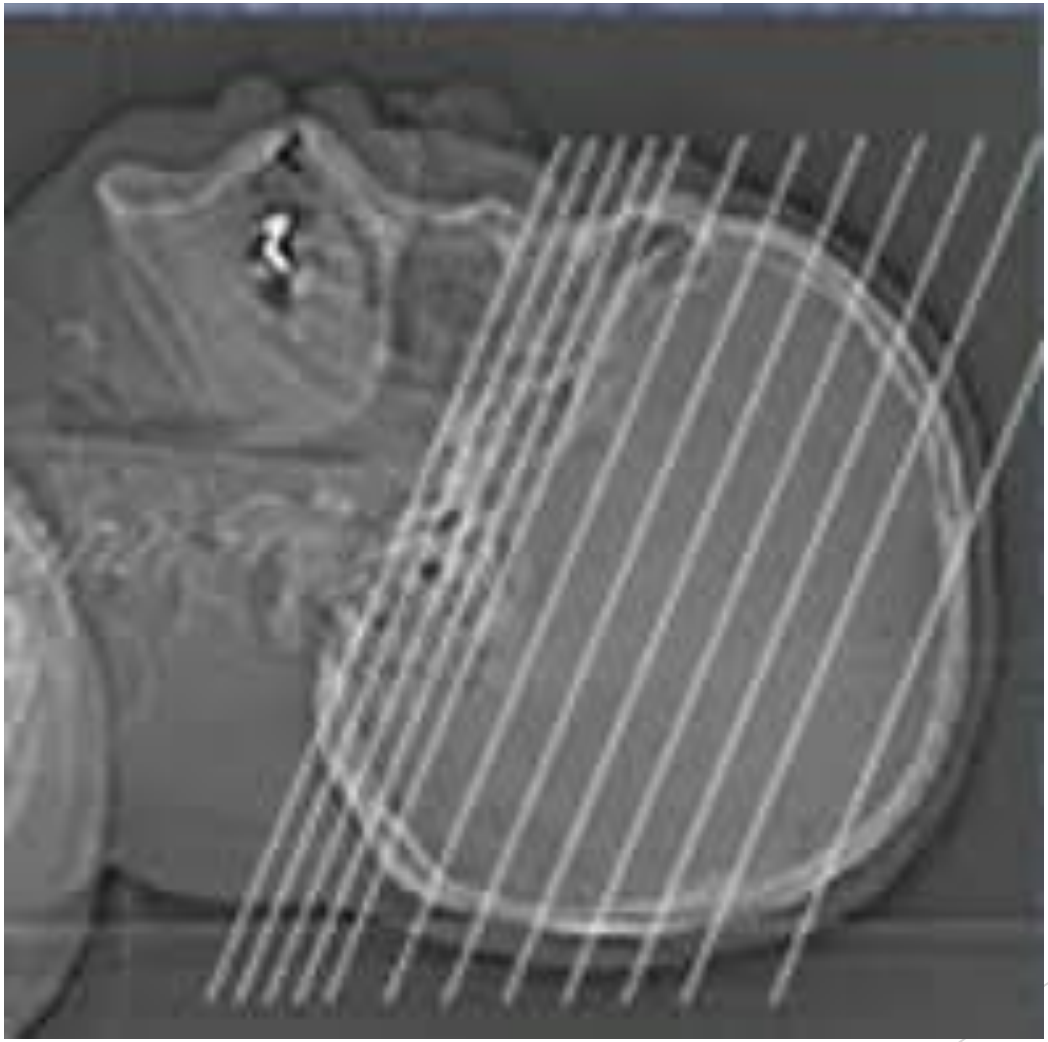
- review the frontal and lateral “scout” views obtained at the beginning of the head CT examination using the CT scanner hardware.

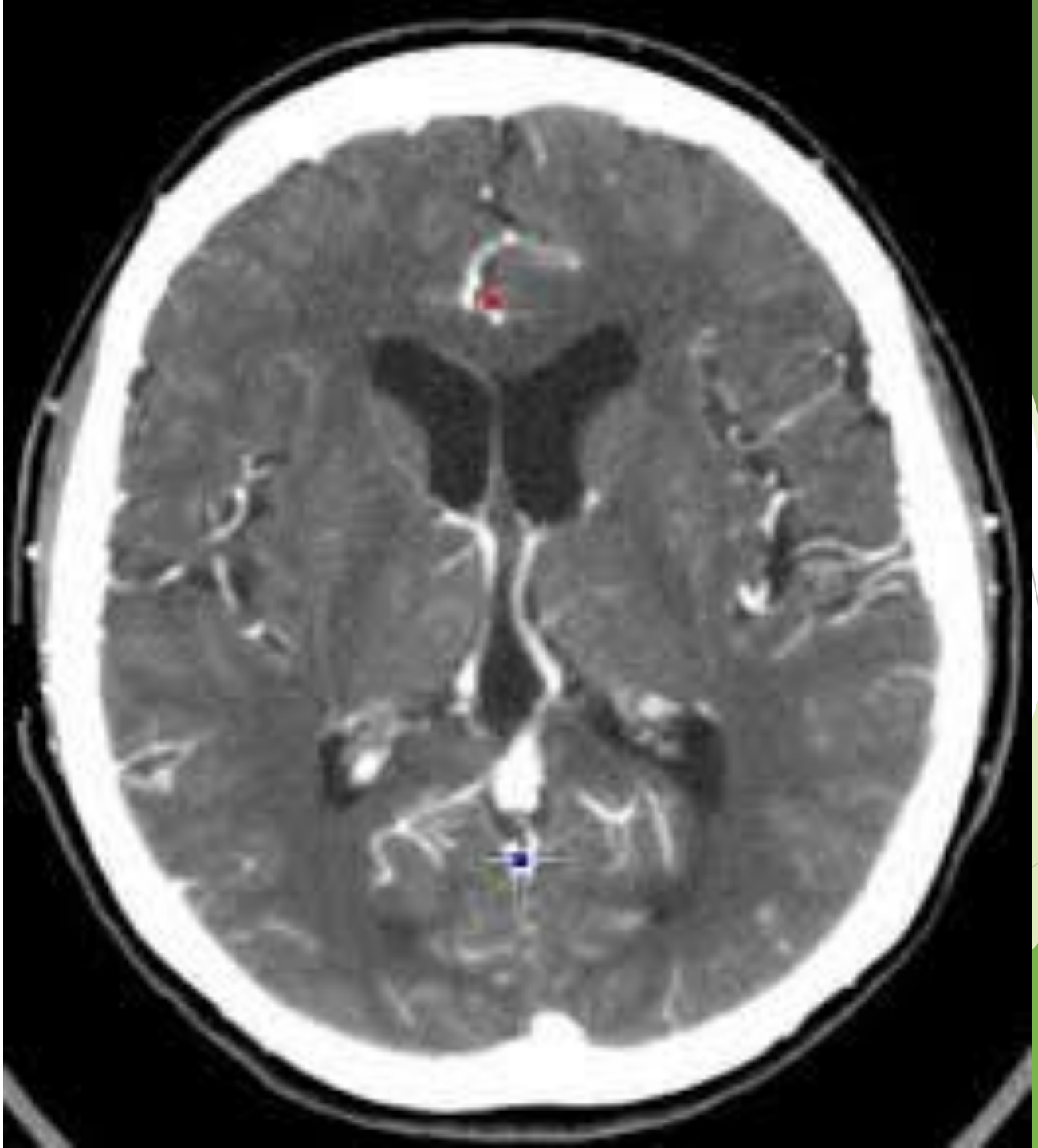
Computed Tomography

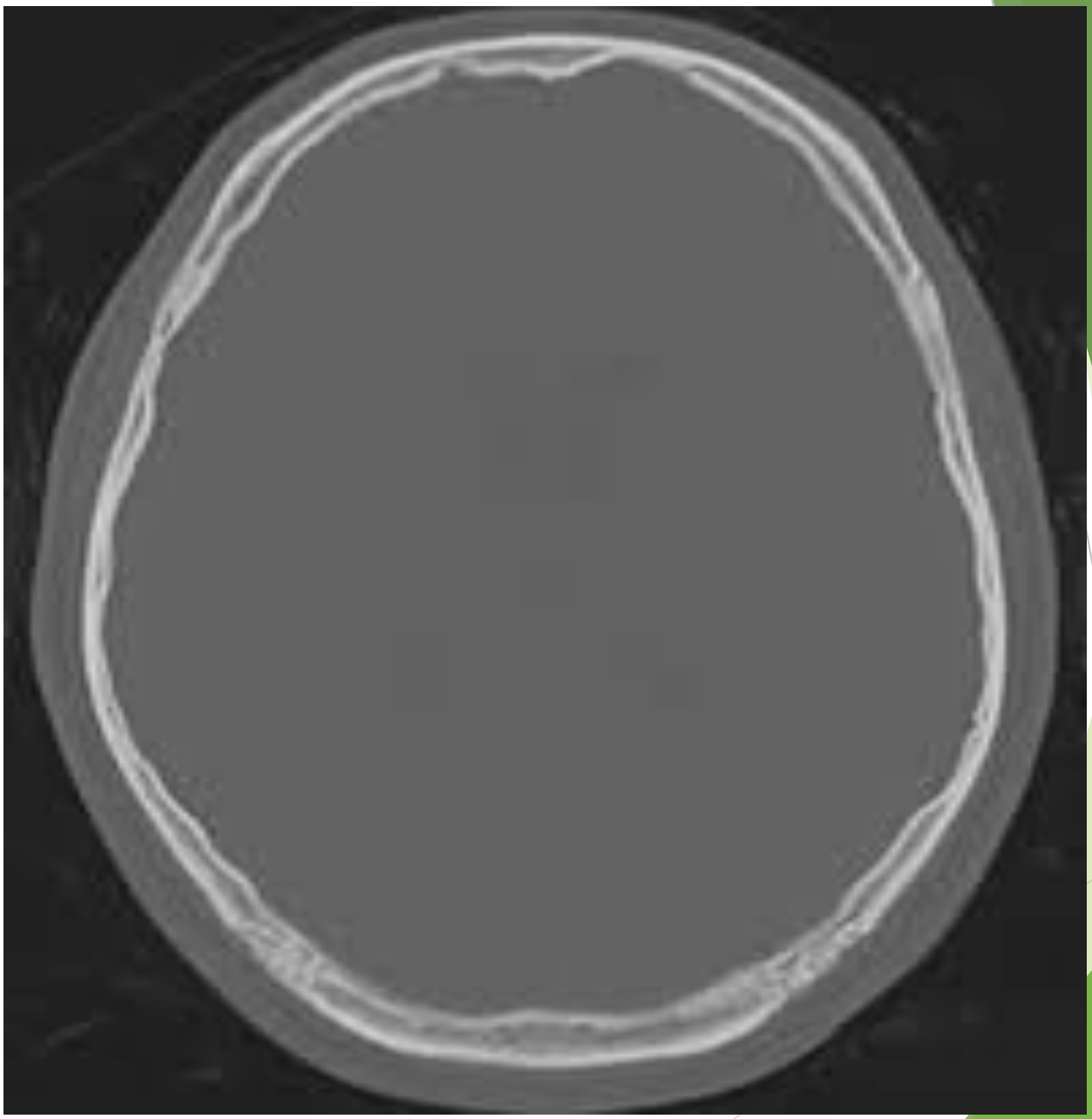
- NCCT plays a **critical role** in immediate decisions,
- **initial imaging modality of choice** in acute TBI for
  - high sensitivity for acute intracranial hemorrhage
  - superb delineation of bony detail
  - moderately sensitive for very small brain contusions and extra-axial collections
  - available overnight and on weekends
  - Fast (in approximately 1 second using modern multidetector-row CT scanners), a major advantage for
    - Agitated patients
    - Young children
    - Unstable polytrauma patients
  - Noncontrast CT has no absolute contraindications
- Even in children, known to have a greater vulnerability to radiation-induced malignancy, American Academy of Pediatrics continues to recommend CT over MRI for acute TBI, including mild TBI.

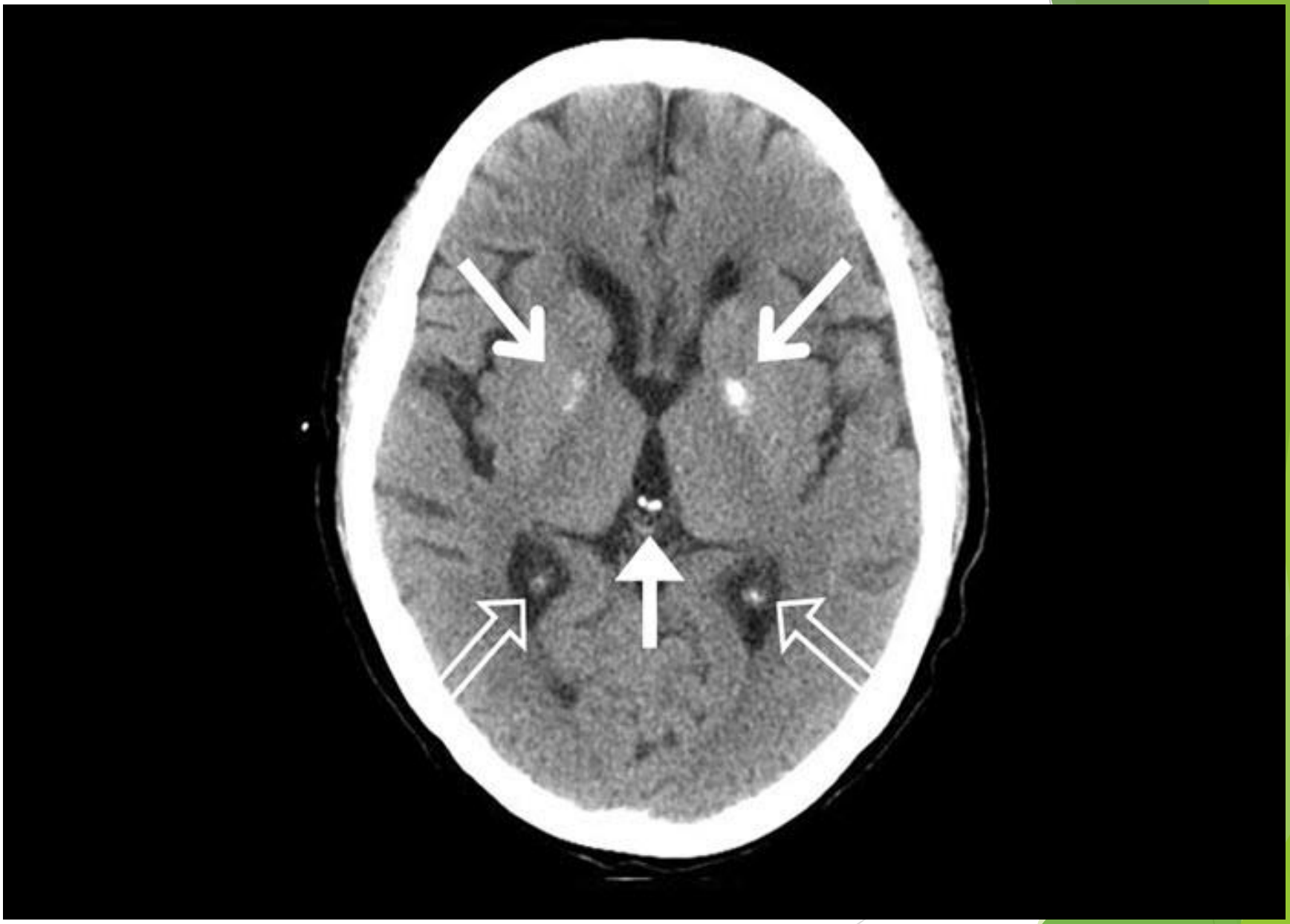
- Acanthiomeatal line (AML)
- Lips-meatal line (LML)
- Mentomeatal line (MML)
- Glabellomeatal line (GML)
- Orbitomeatal line (OML)
- Infraorbitomeatal line (IOML) (Reid's base line)









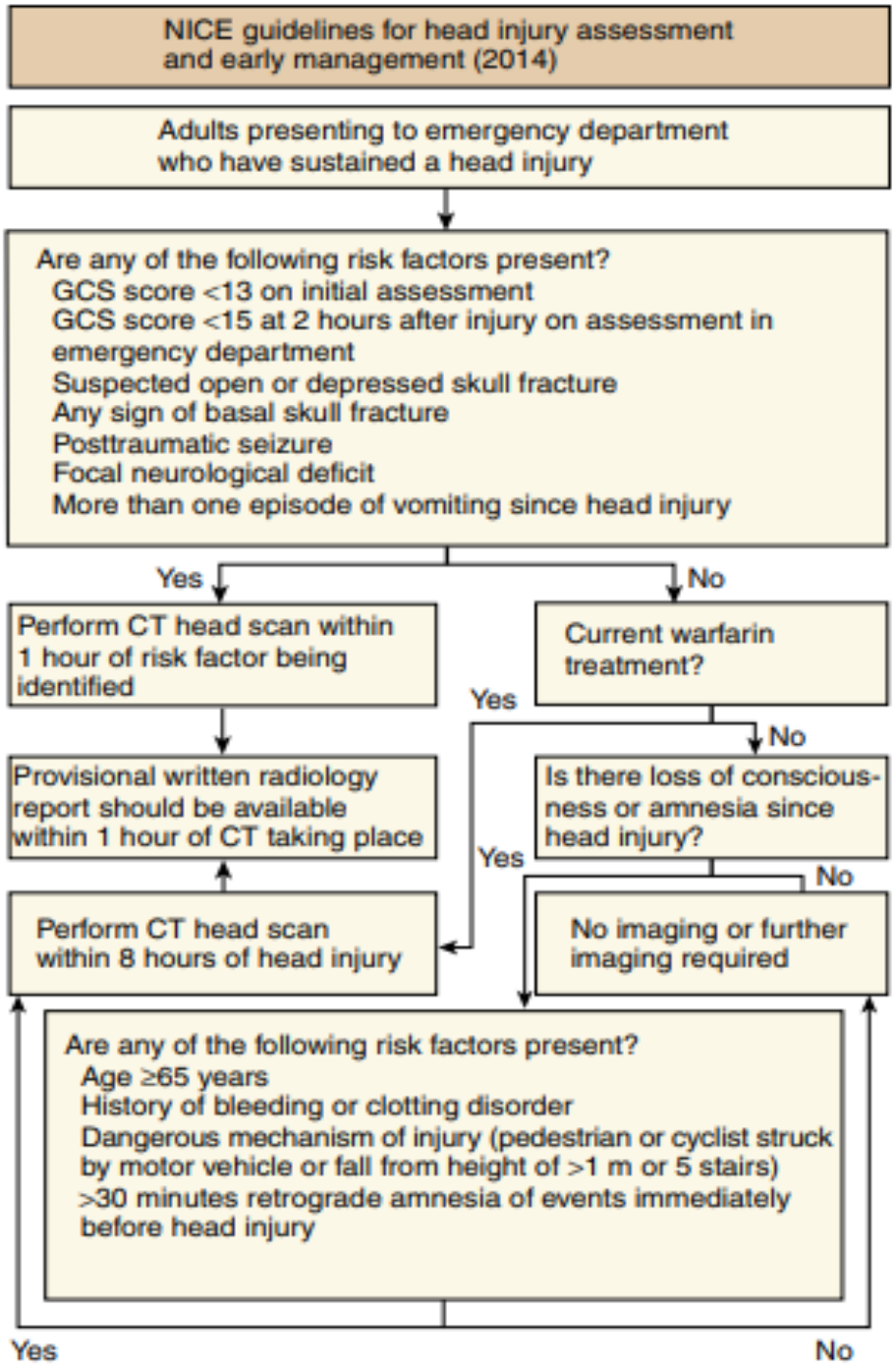


اندیکاسیون سی تی اسکن در mild HT

Indications for noncontrast head CT in nonpenetrating head trauma for patients ≥16 years of age presenting to emergency department within 24 hours of injury, with admission GCS score of 14 or 15 and no multisystem trauma (ACEP/CDC joint practice guidelines[2])

Loss of consciousness or posttraumatic amnesia?

Yes	No
Noncontrast head CT indicated for: • Headache • Vomiting • >60 years of age • Drug or alcohol intoxication • Deficits in short-term memory • Physical evidence of trauma above clavicle • Posttraumatic seizure • GCS score <15 • Focal neurological deficit • Coagulopathy	Noncontrast head CT should be considered for: • Focal neurological deficit • Vomiting • Severe headache • >65 years of age • Physical signs of basilar skull fracture • GCS score <15 • Coagulopathy • Dangerous mechanism of injury (ejection from motor vehicle, pedestrian struck by motor vehicle, fall from >3 feet or >5 stairs)



CHIP prediction model (2007) for intracranial traumatic CT findings in patients with minor head injury

A CT scan is indicated in the presence of 1 major criterion

- Pedestrian or cyclist versus vehicle
- Ejected from vehicle
- Vomiting
- Posttraumatic amnesia ≥4 hours
- Clinical signs of skull fracture
- GCS score <15
- GCS deterioration ≥2 points (1 hour after presentation)
- Use of anticoagulant therapy
- Posttraumatic seizure
- Age ≥60 years

A CT scan is indicated in the presence of at least 2 minor criteria

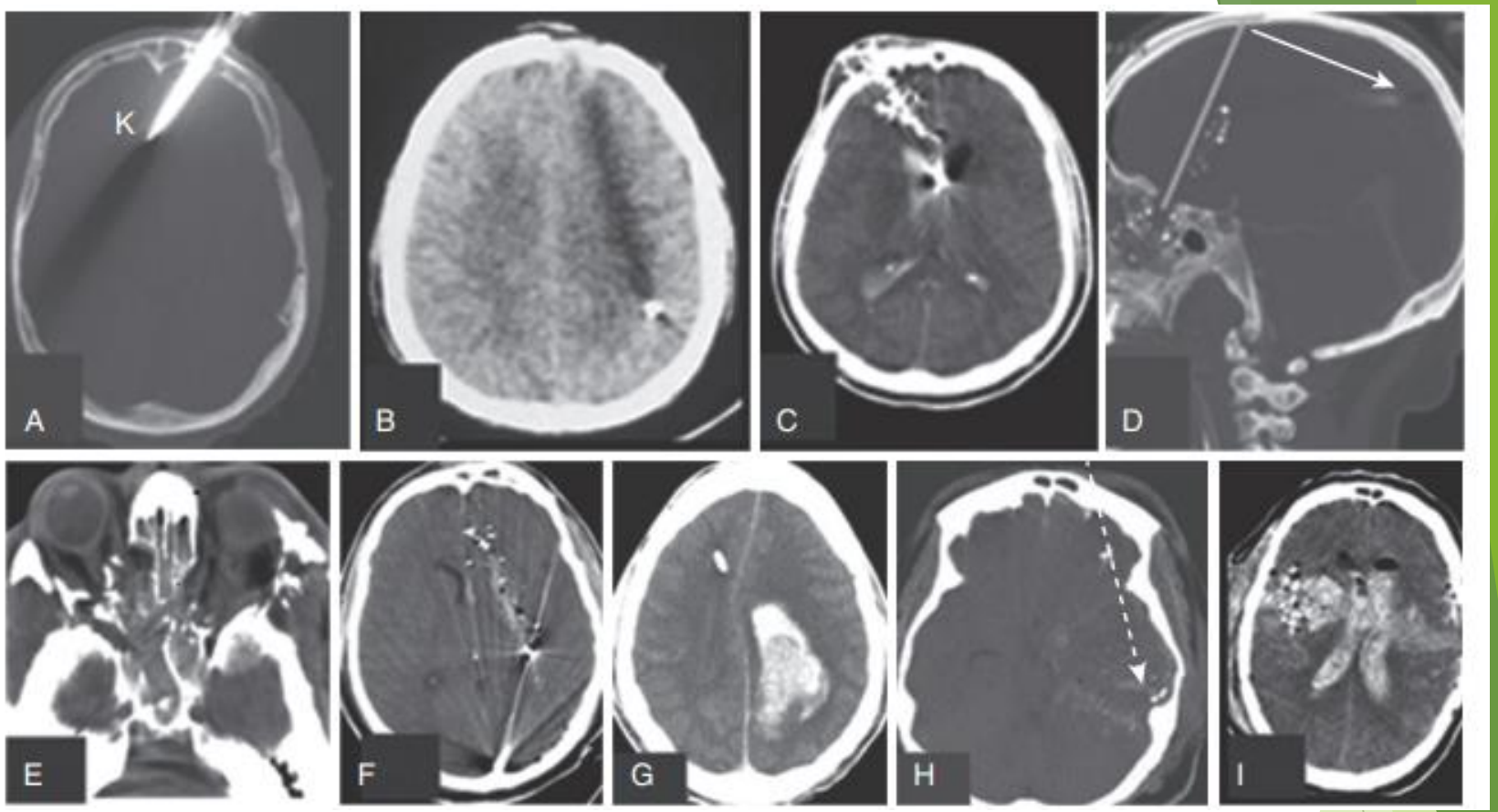
- Fall from any elevation
- Persistent anterograde amnesia
- Posttraumatic amnesia of 2 to <4 hours
- Contusion of the skull
- Neurological deficit
- Loss of consciousness
- GCS deterioration of 1 point (1 hour after presentation)
- Age 40–60 years

انواع آسیب های مغز

Penetrating brain injury

From: http://
rain-injury-

- High mortality and morbidity
- predispose the patient to deep CNS infections
- Injuries violating the basal cisterns, posterior fossa, and ventricular systems are notoriously prone to **cerebrospinal fluid fistulas and nosocomial infection**.
- Paranasal sinus and mastoid air cell injuries at the frontal base and posterior fossa need to be taken very seriously, and **clean watertight grafting of dura at the base** following débridement is a sine qua non step toward preventing meningitides.
- **screening for traumatic intracranial aneurysm (TICA**) by early CTA
- Patients who are prone to TICA:
  - intracerebral hematoma
  - penetration near the orbits, face, and pterion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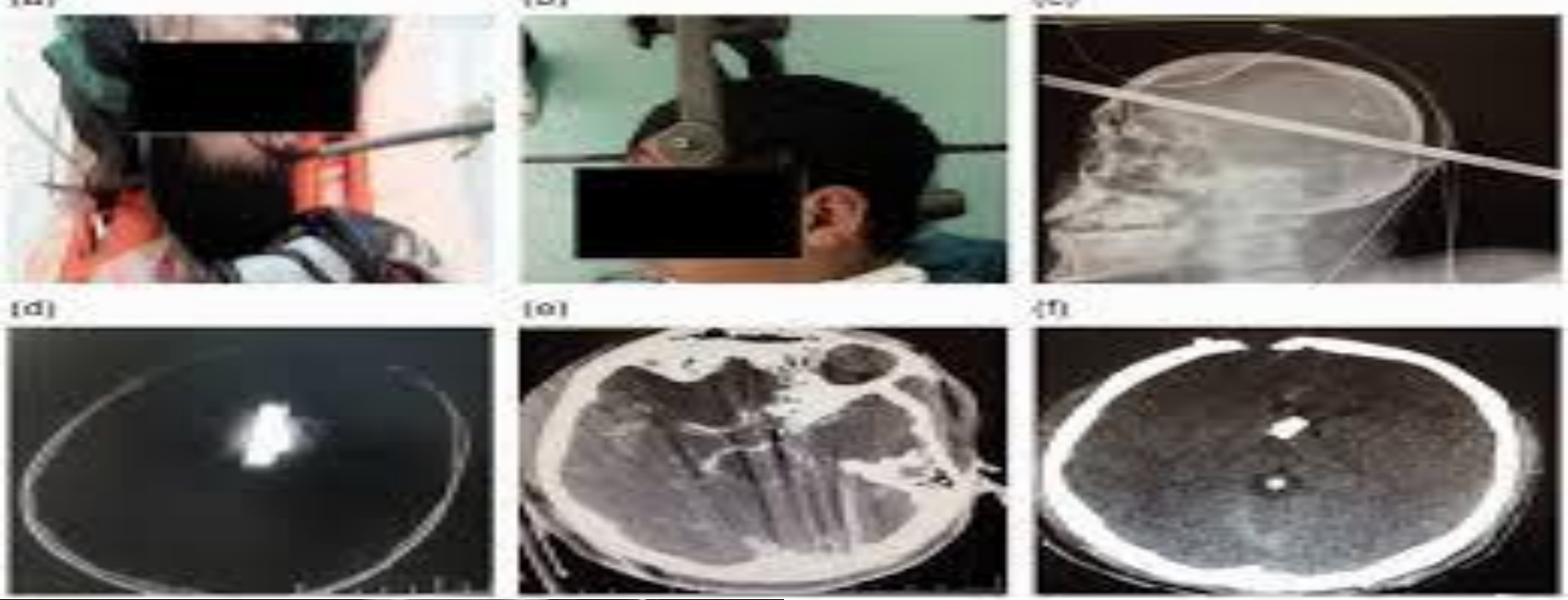
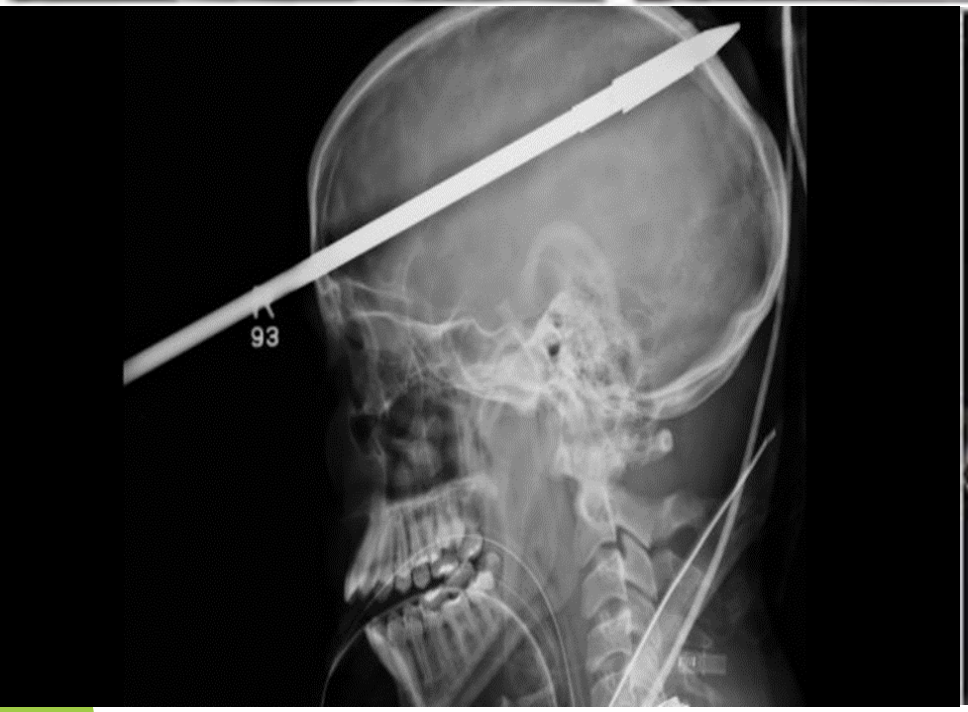
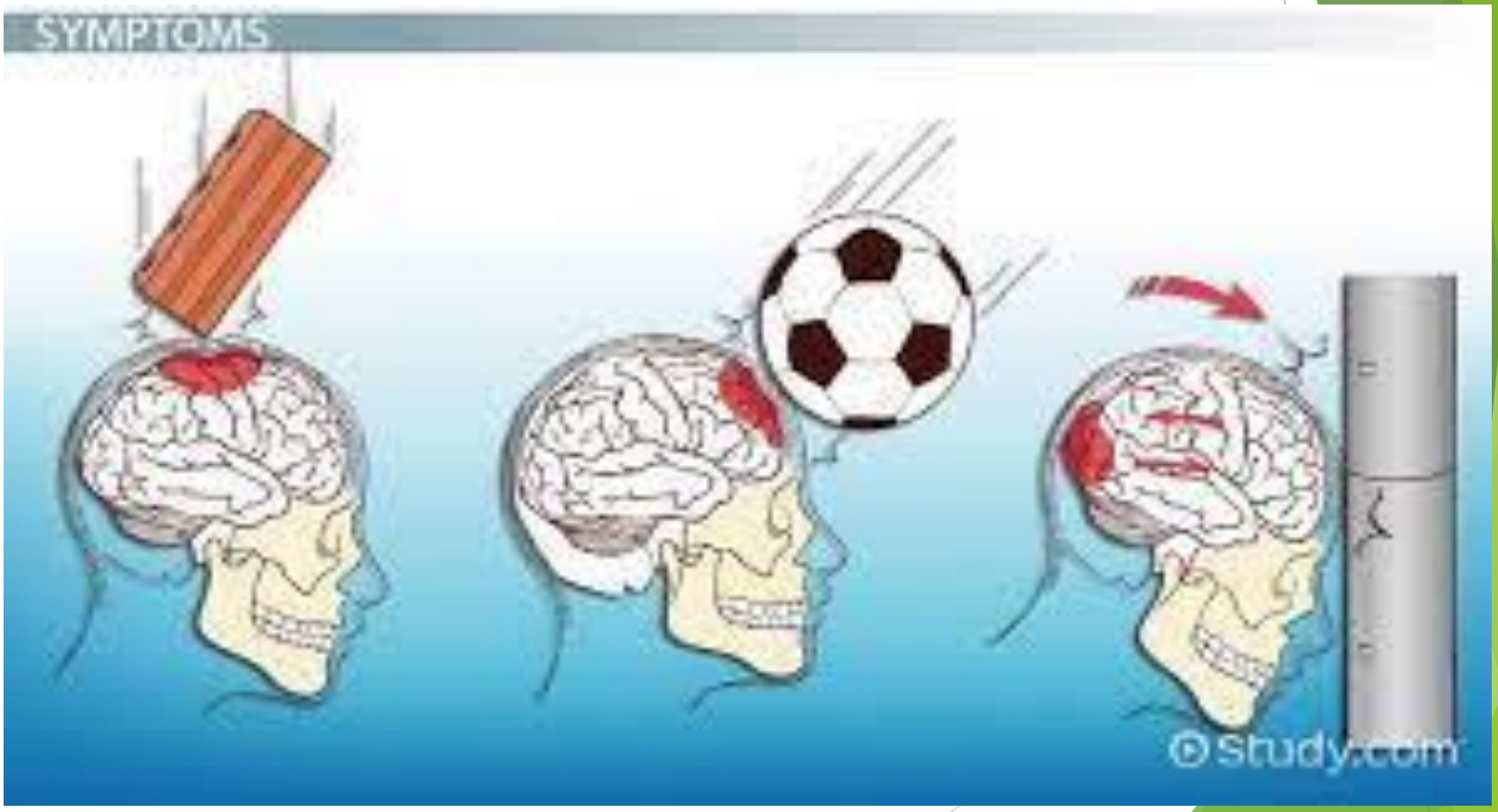





A


B

Blunt (non-penetrating) head injury



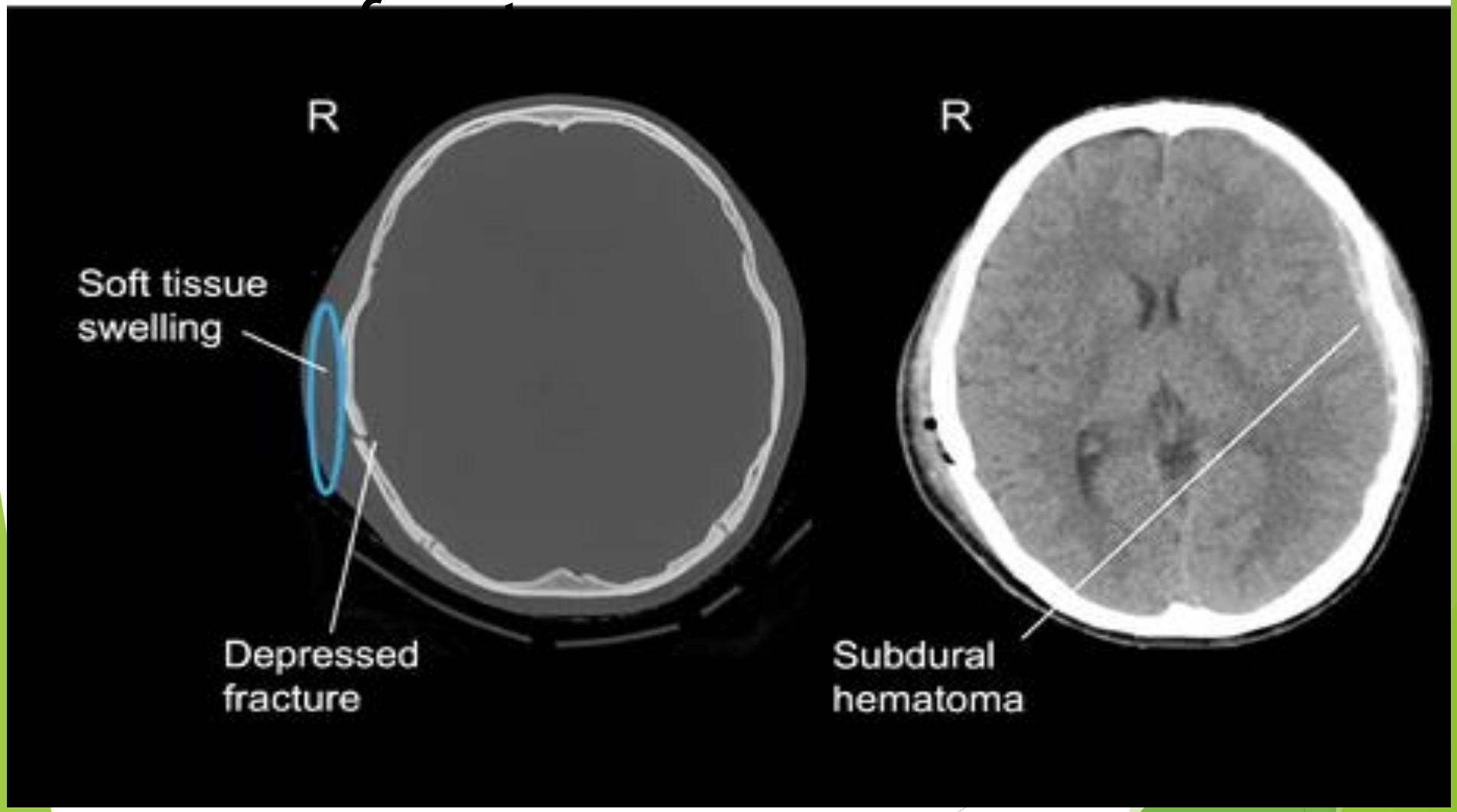
Skull fractures can be classified as

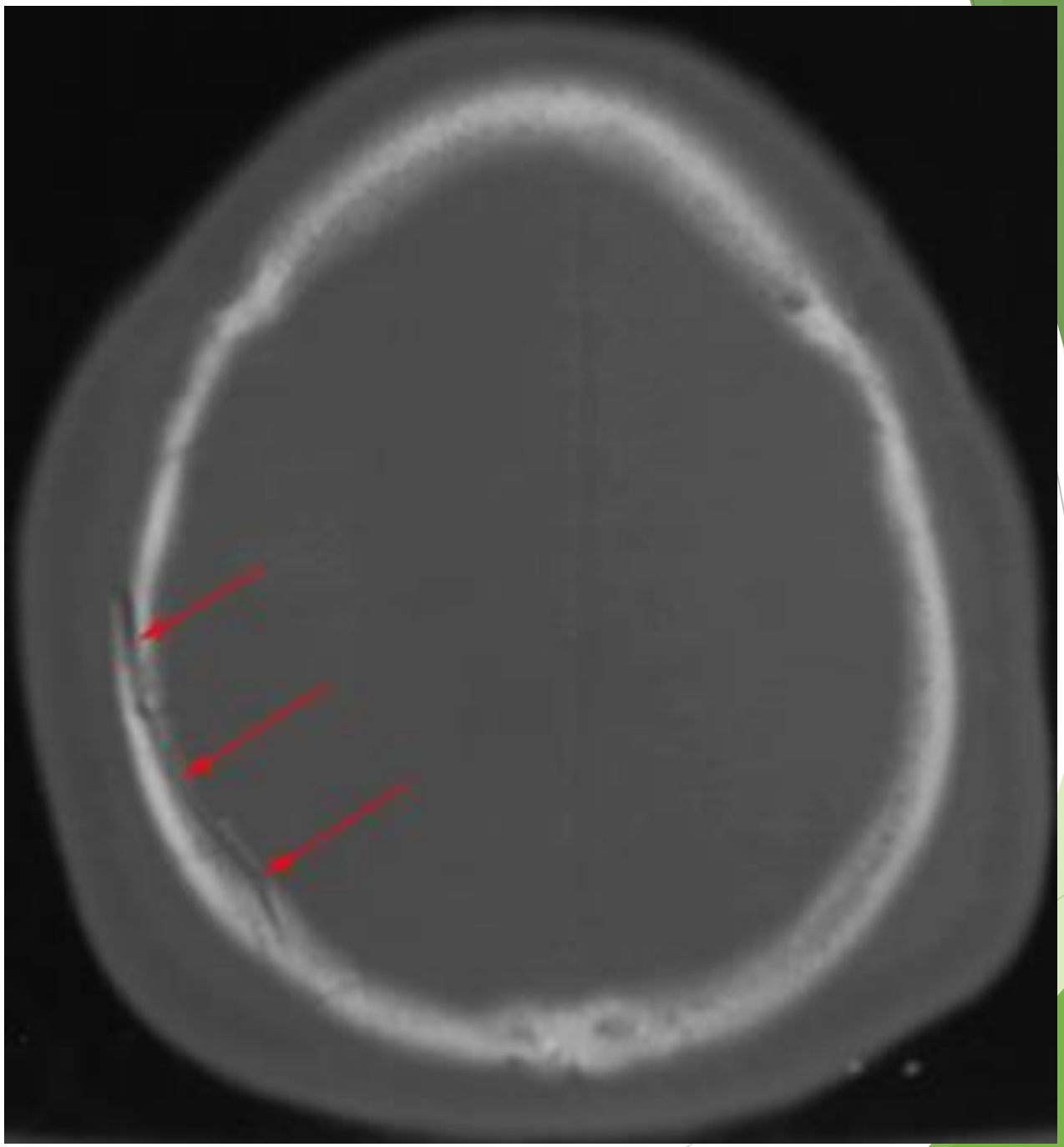
- *linear*
- *depressed*
- *comminuted*
- *compound (open)*
- *Diastatic*
- *Skull base FX*

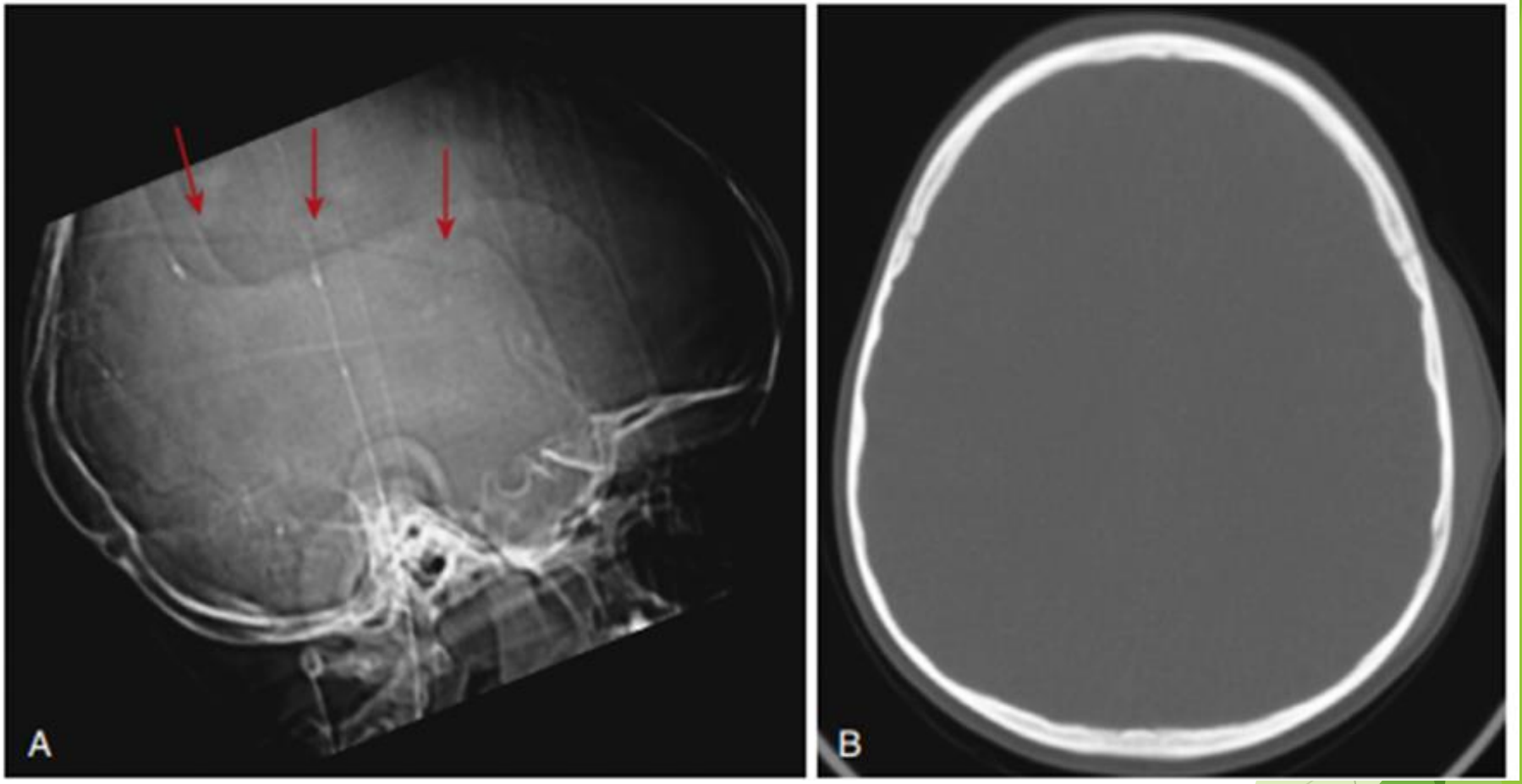
- **Linear fx: the most common type** of skull fracture.
- nondisplaced *linear* skull fractures may be difficult to detect, even on CT, if the fracture plane is parallel to the plane of section.
- Fortunately, isolated linear fractures without associated intracranial pathology are usually clinically **insignificant.**
- Depressed and comminuted (i.e., multiple bone fragments) skull fractures are easily detectable on CT.
- Depressed fractures are often (but not invariably) associated with an underlying cortical contusion.

- A skull fracture and an open wound in the overlying scalp: **compound fracture.**
  - the underlying dura is exposed
  - may be disrupted under the fracture site
  - there is an increased risk for infectious complications
  - neurosurgical emergency
  - warranting removal of the contaminated bone fragments and dural repair to prevent infection
- Diastatic fractures occur from separation of the cranial sutures and are **more frequent in children** than in adults.

Linear skull



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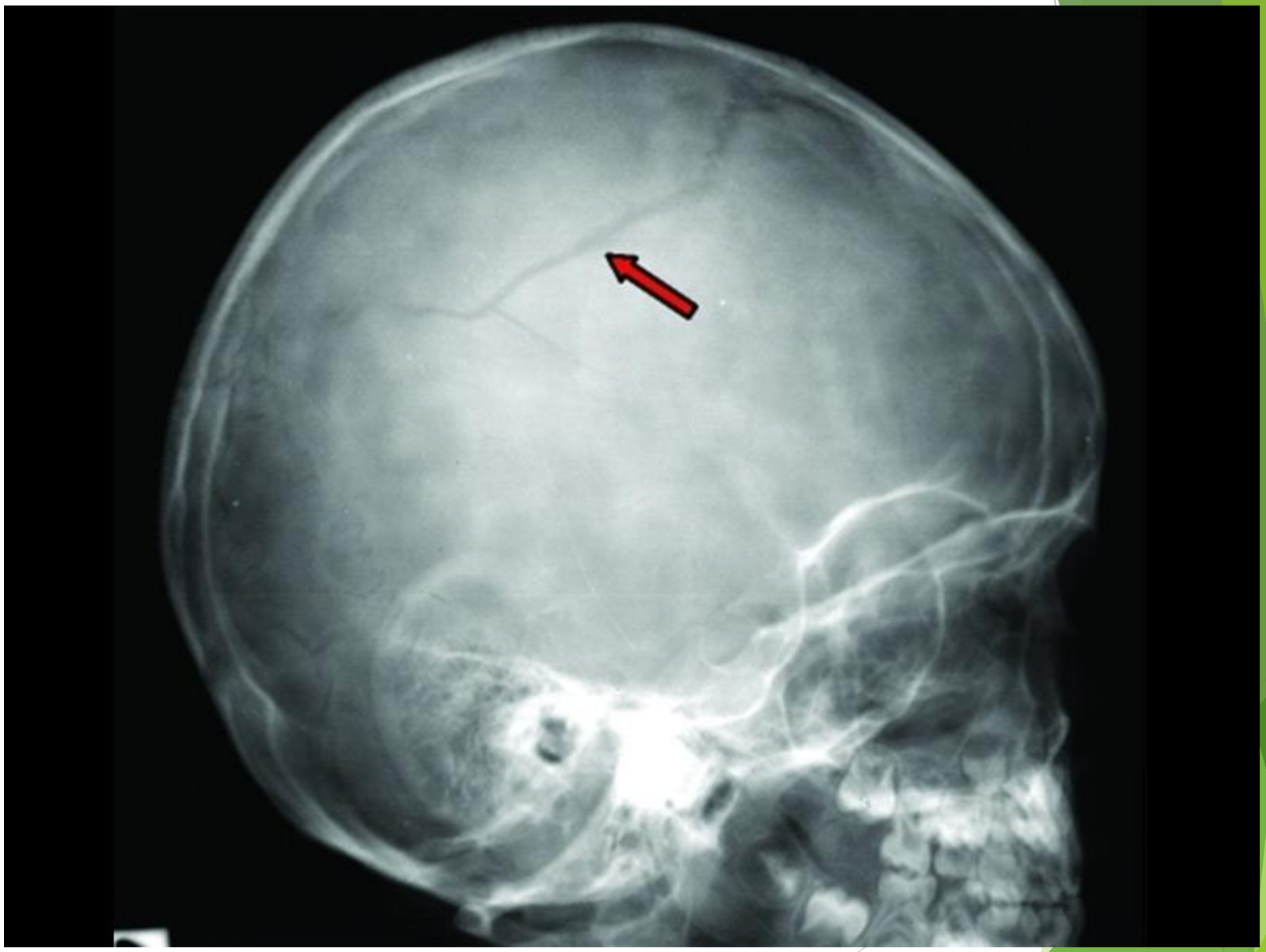
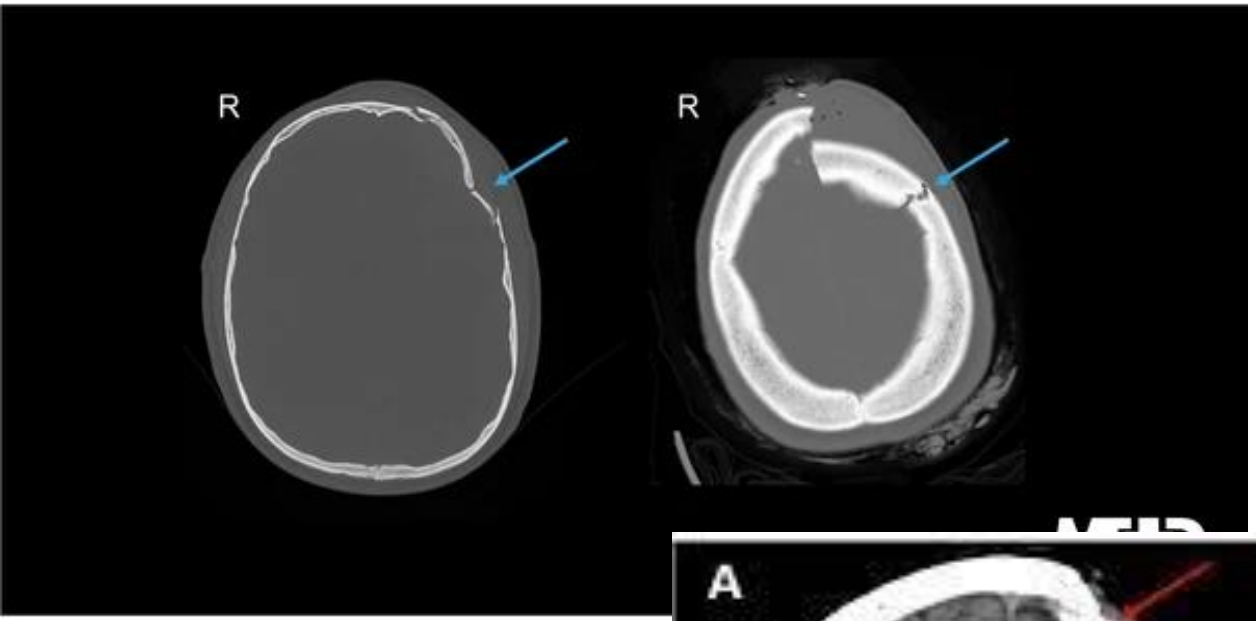
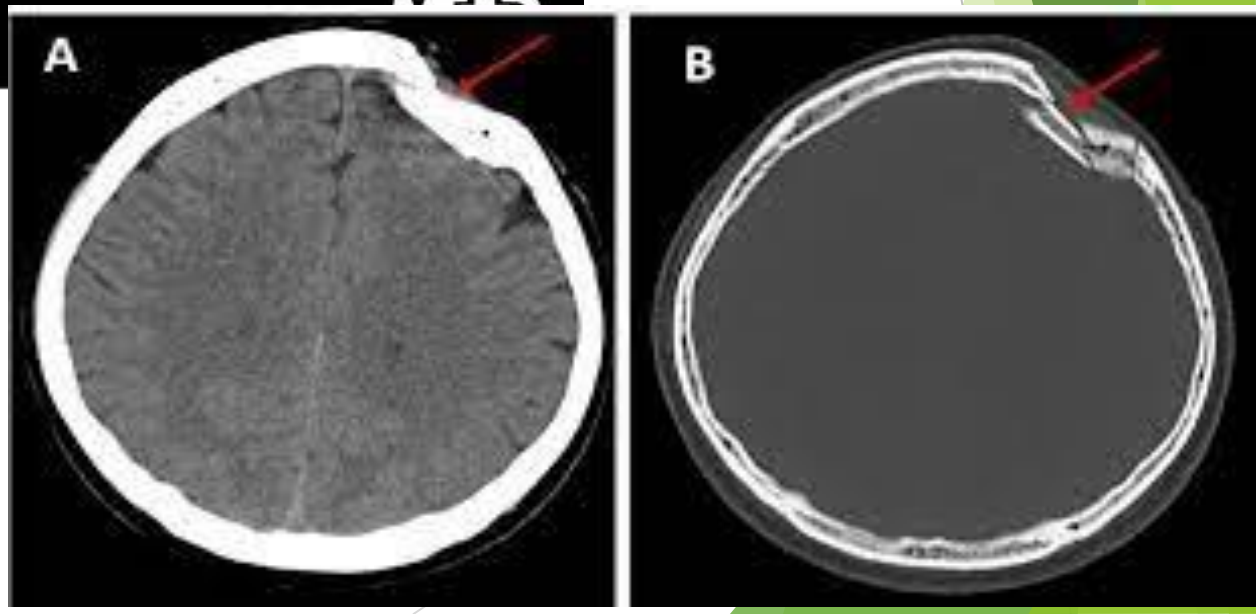


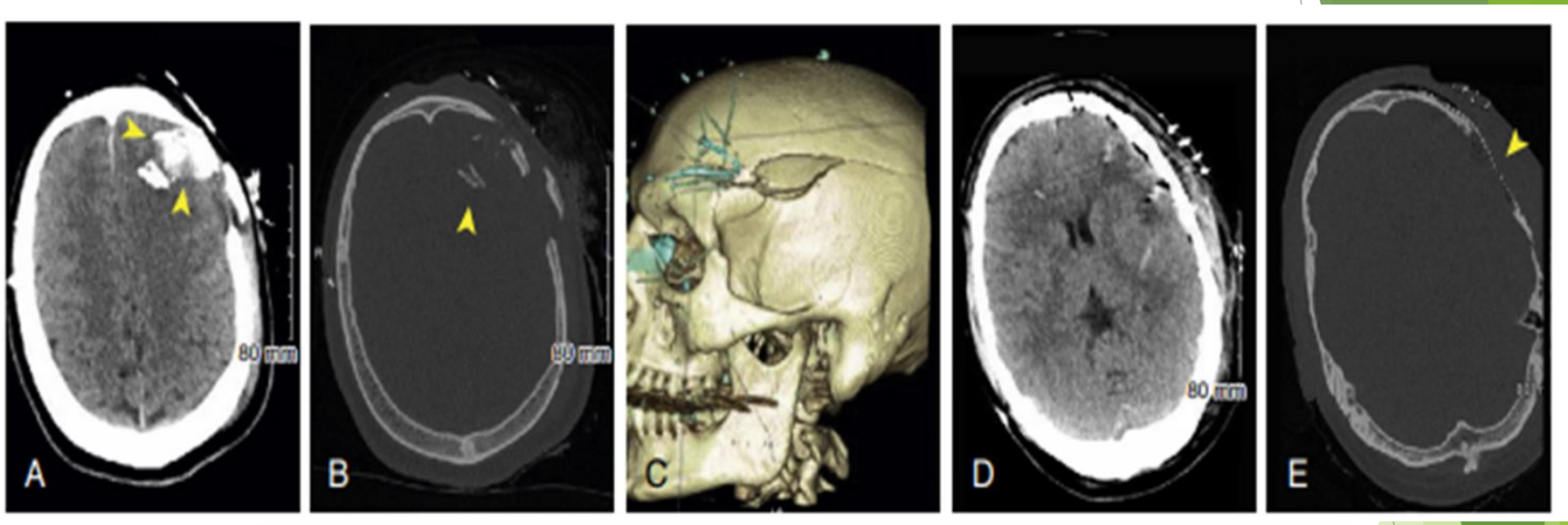
Depressed fracture

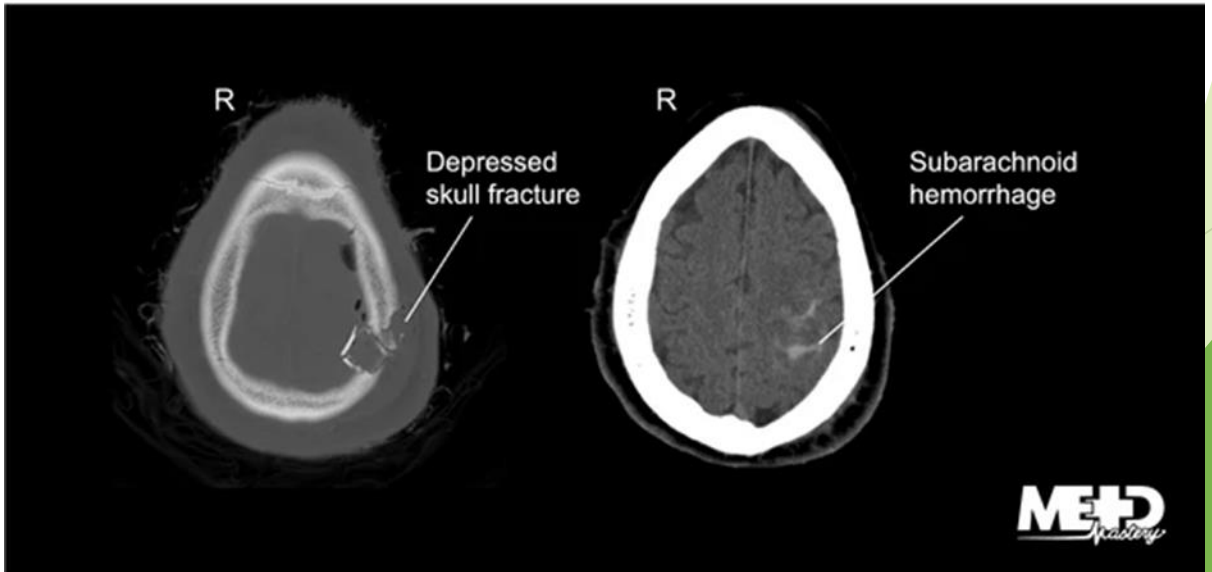




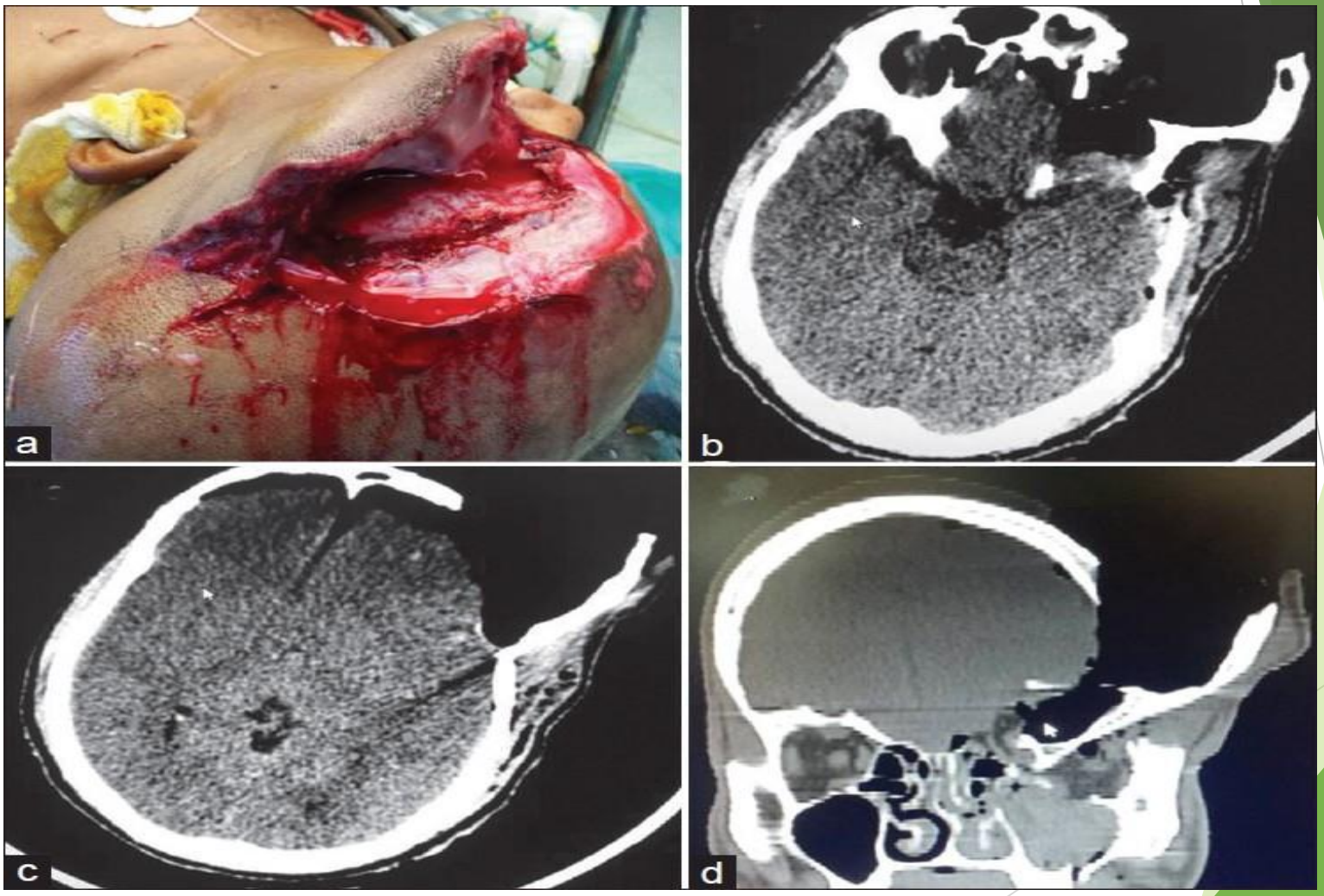
Comminuted skull fracture

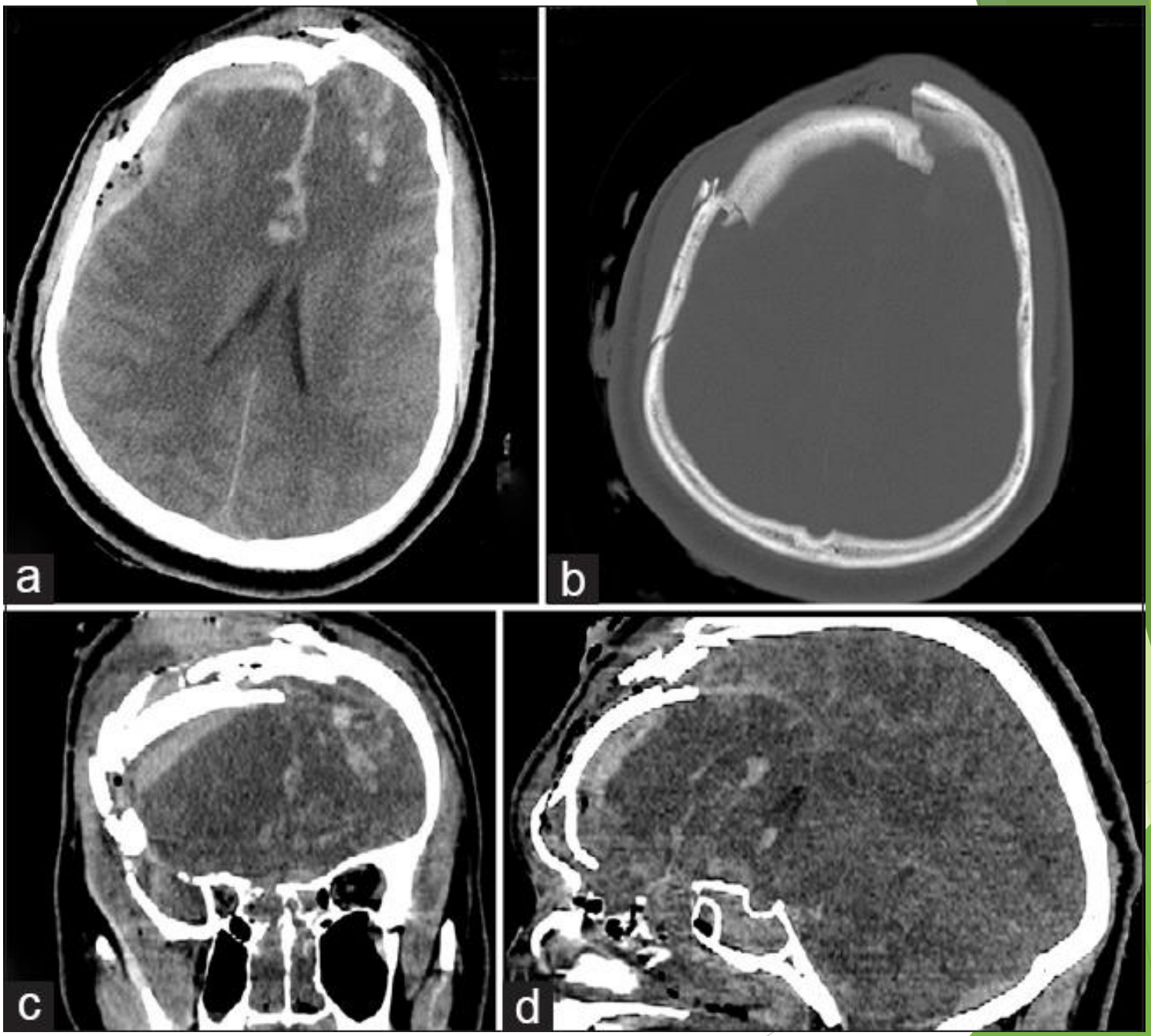
Depressed and comminuted skull fracture





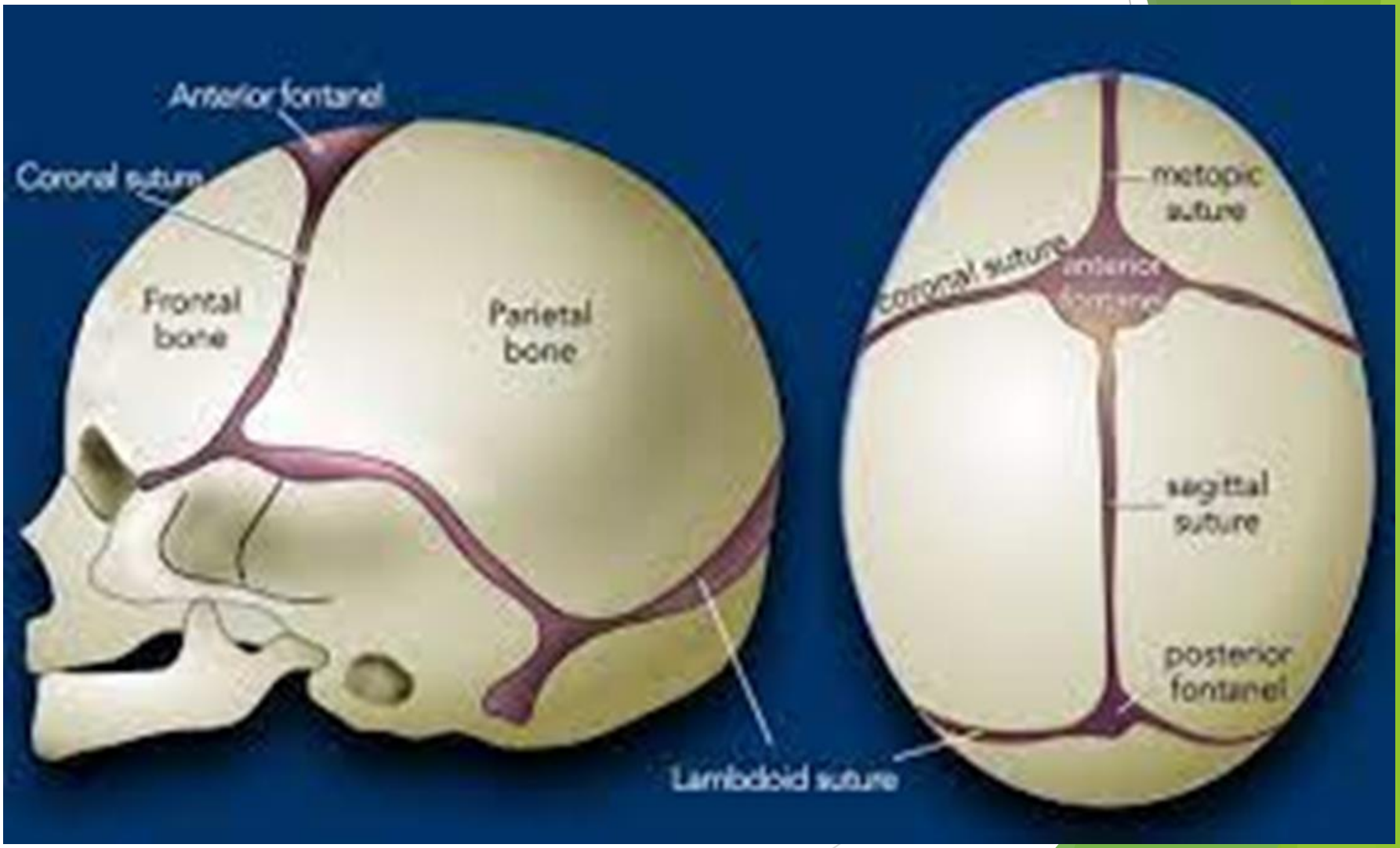
Compound skull fracture





Agrawal, A., Kumar, S. S., Hegde, K. V., Reddy, V. U., & Sundeep, N. V. K. (2014). Massive bifrontal infarction following massive depressed fracture overlying the superior sagittal sinus. *African Journal of Trauma*, *3*(2), 94.

Diastatic fractures



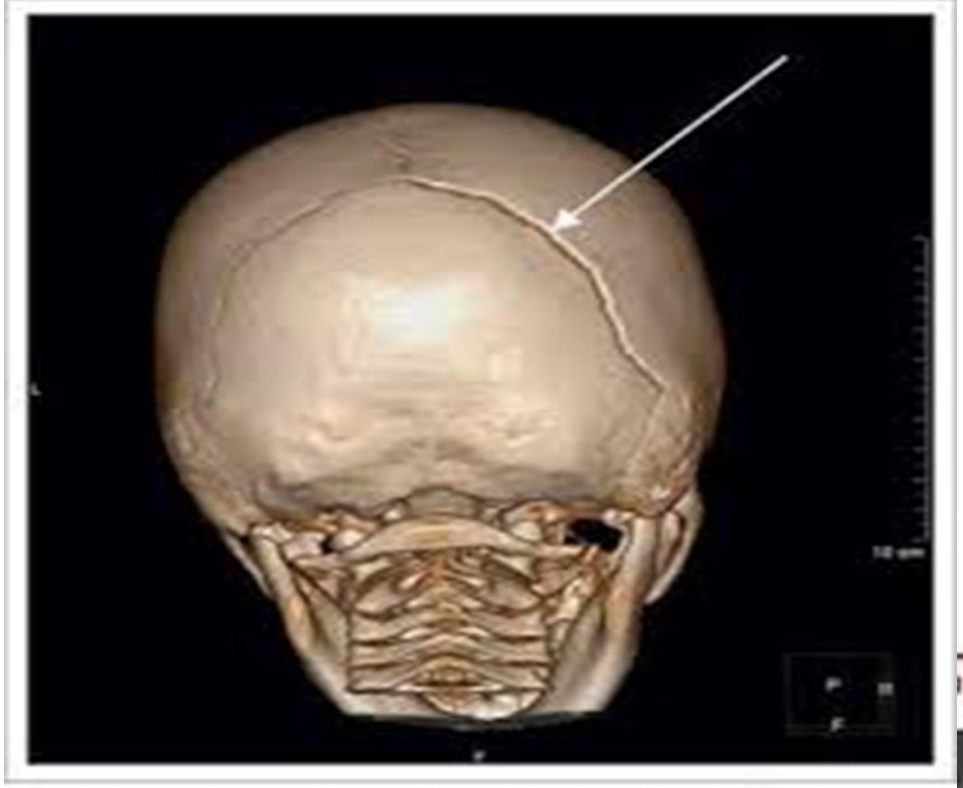
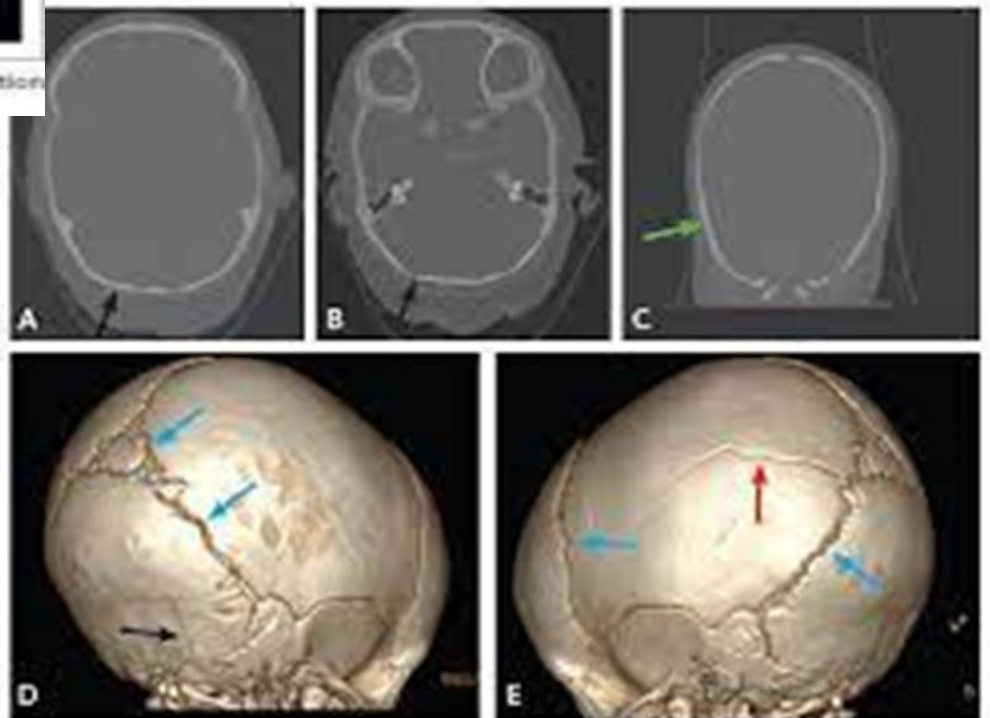
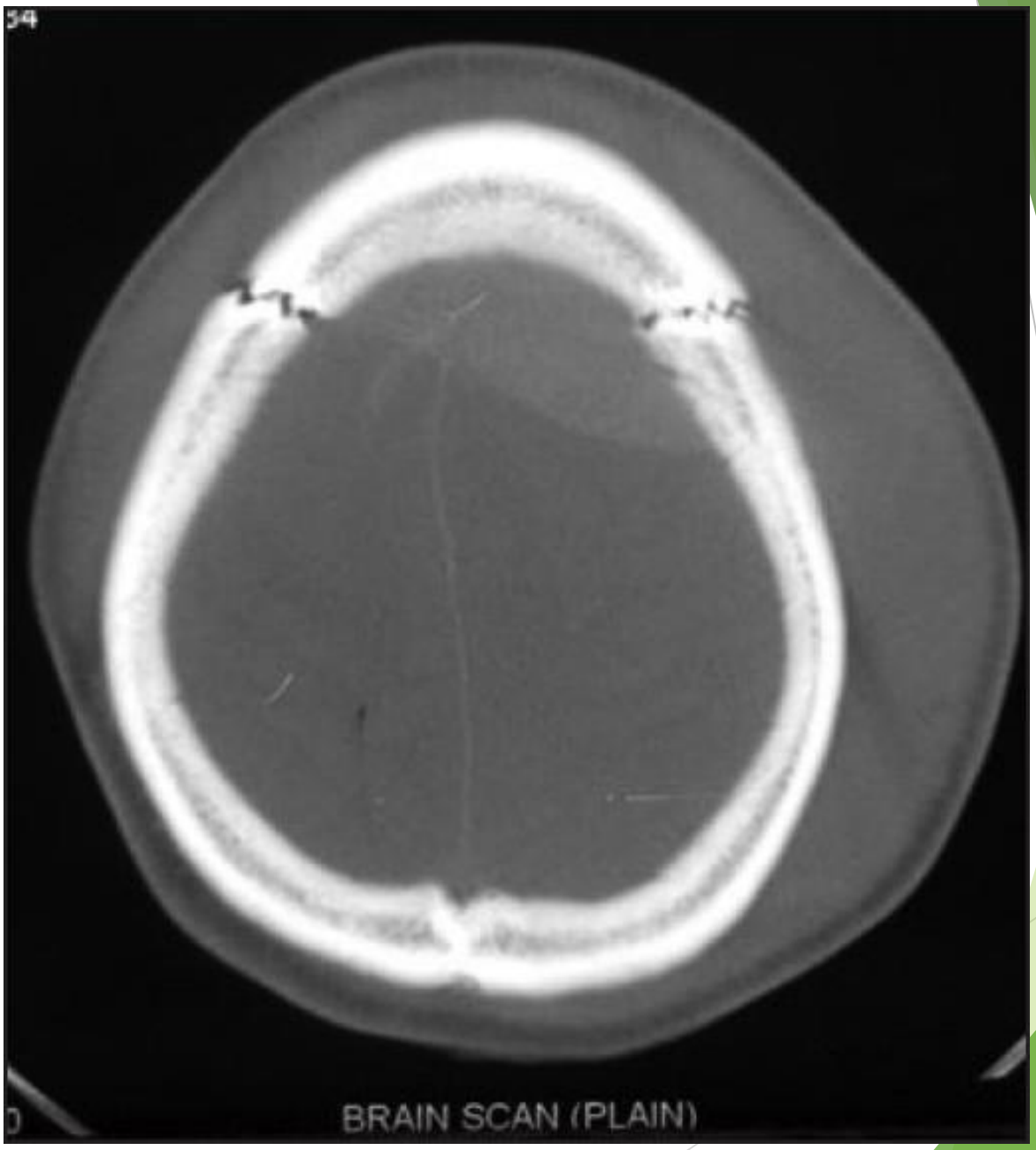


FIGURE 3: A 7 year old pedestrian was hit by a vehicle. 3D reconstruction demonstrated right lambdoid suture diastasis.

ure 9. Skull Fracture on Head CT and 3 Dimensional Reconstruction

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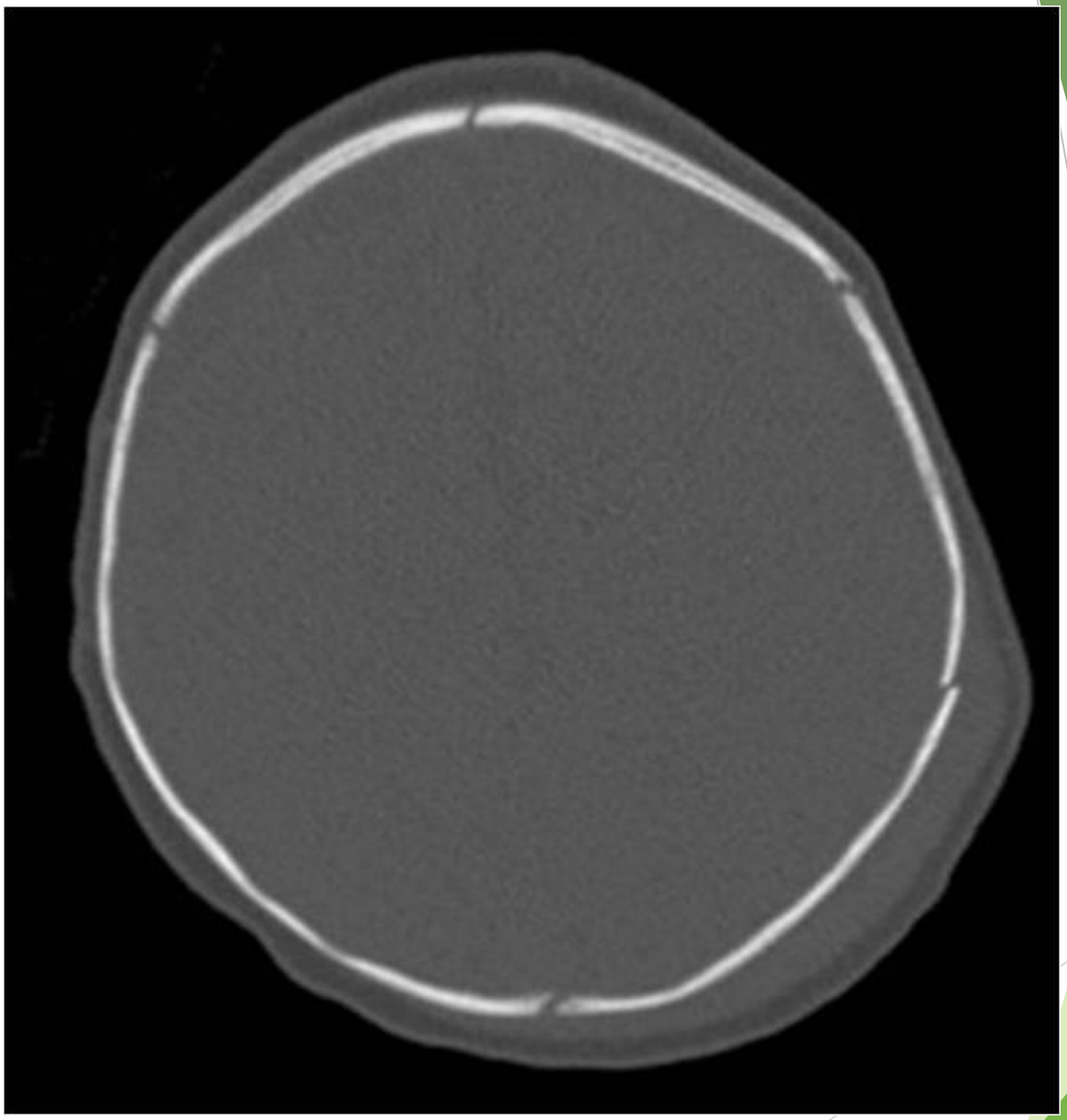
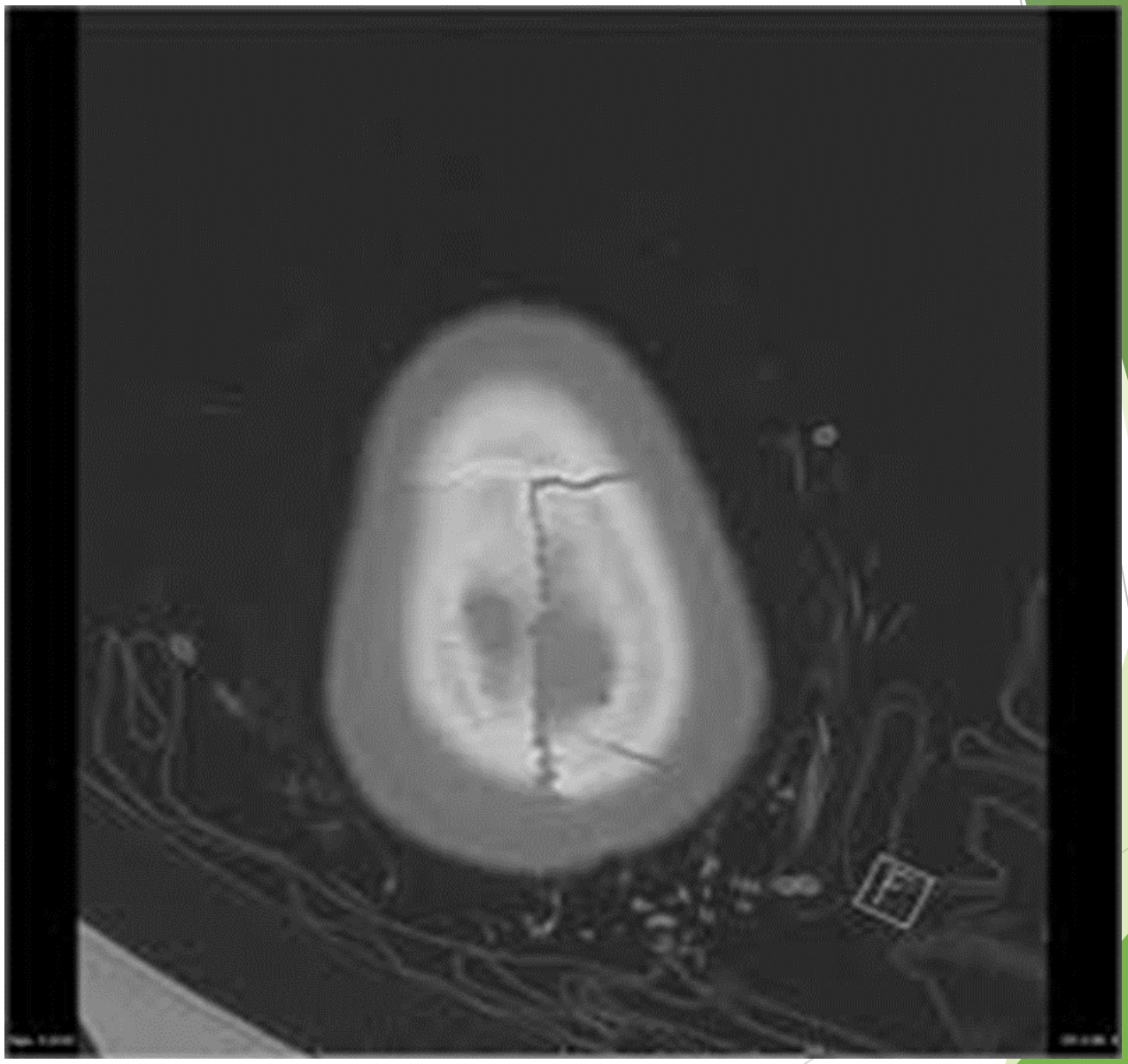
BRAIN SCAN (PLAIN)





Cranial suture closure

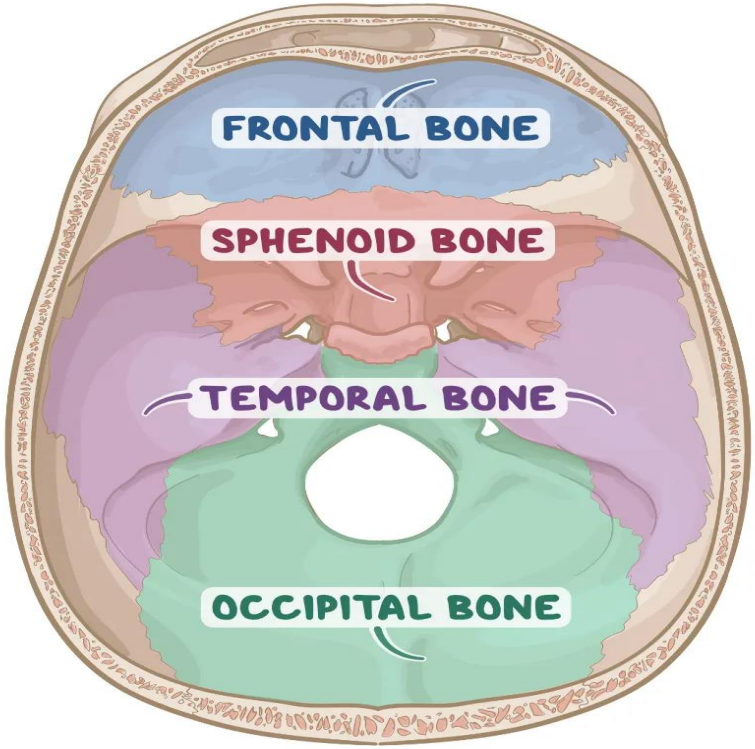
SUTURE	AGE OF CLOSURE
Posterior fontanelle	At birth- 6 months
Anterior fontanelle	1 ½ - 2 years
Two halves of mandible	1-2 years
Metopic suture	1 year (May remain unfused)
Basiocciput and basisphenoid	18- 20 years (Females) 20-22 years (Males)
Lambdoid	45-50 years
Sagittal	50-60 years
Coronal	50-60 years
Parieto-mastoid	55-70 years
Parieto-temporal	60-70 years

- In humans, the sequence of fontanelle closure is as follows:
- 1) posterior fontanelle generally closes 2-3 months after birth,
- 2) sphenoidal fontanelle is the next to close around 6 months after birth,
- 3) mastoid fontanelle closes next from 6-18 months after birth, and
- 4) the anterior fontanelle is generally the last to close between 1-3 years of age

BACKGROUND

* TRAUMATIC HEAD INJURY INVOLVING a BREAK in at LEAST ONE of the BONES at **BASE** of **SKULL**
* SERIOUS & LIFE-THREATENING COMPLICATIONS

LOCATION (FOSSA)	SIGNS & SYMPTOMS
ANTERIOR	~ "RACCOON EYES" ~ "HALO" SIGN ~ PARTIAL/TOTAL LOSS of VISION/SMELL ~ EYE MOVEMENT DEFECTS
MIDDLE	~ DAMAGE to CAROTID A. ~ HEARING LOSS ~ LOSS of BALANCE ~ BATTLE SIGN
POSTERIOR	~ CERVICAL SPINE INJURY ~ VERTEBRAL A. INJURY ~ DAMAGE to LOWER CRANIAL N.

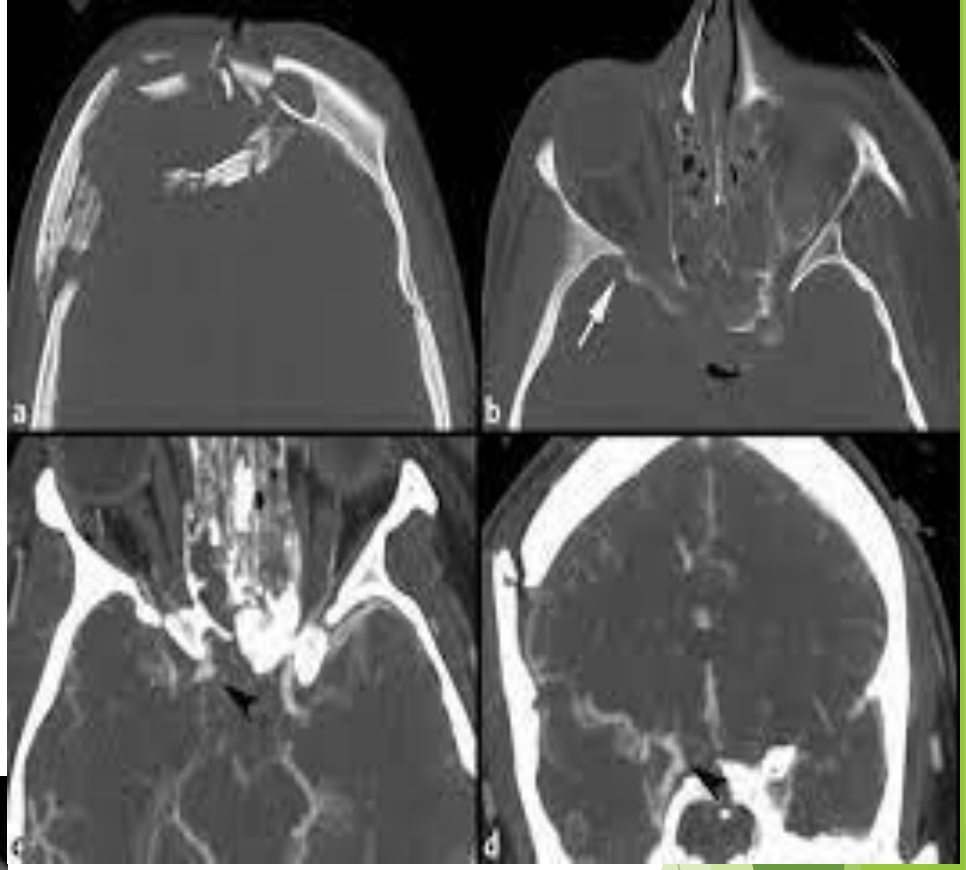


CAUSES

* SEVERE HEAD TRAUMA
* PENETRATING INJURIES
* FALLS
* ASSAULTS

DIAGNOSIS

* PHYSICAL EXAM
* GLASGOW COMA SCALE (GCS)
* NEUROLOGICAL EVALUATION
* CT SCAN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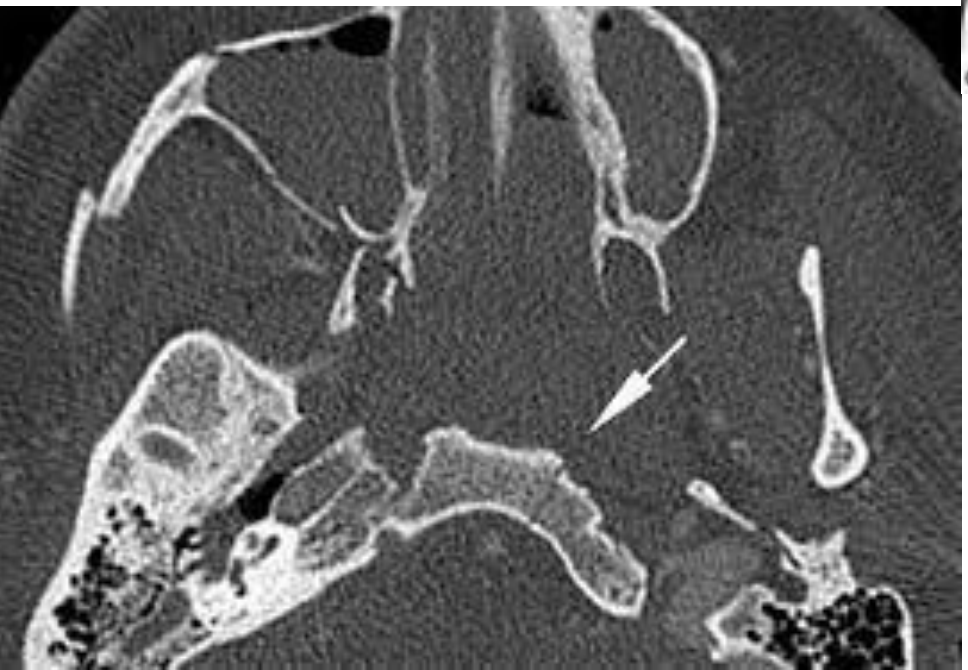

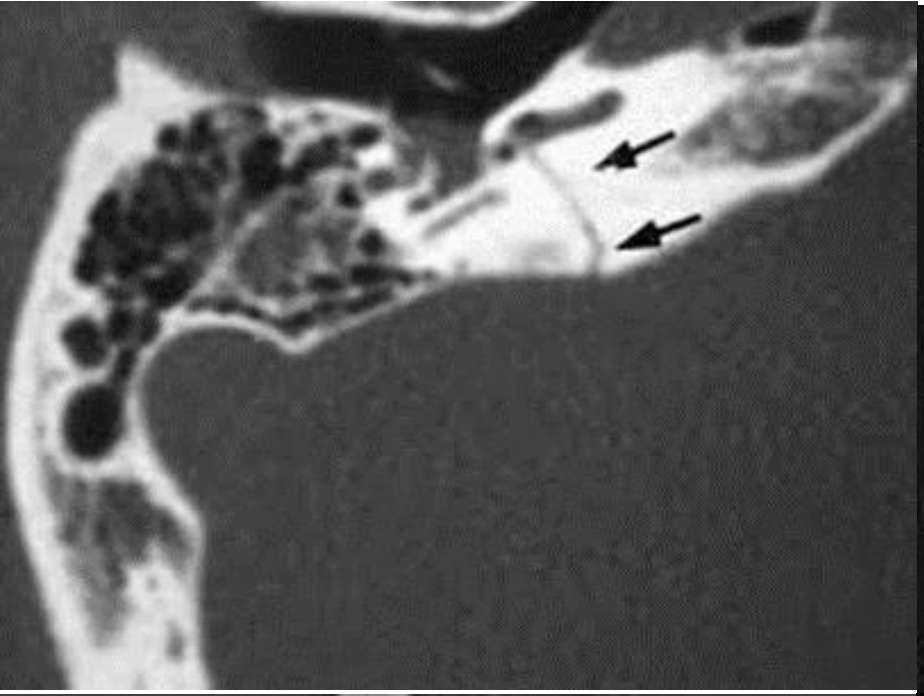


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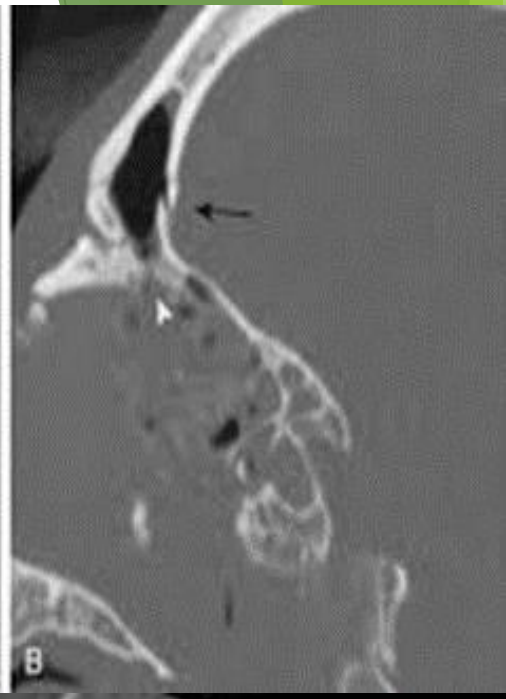
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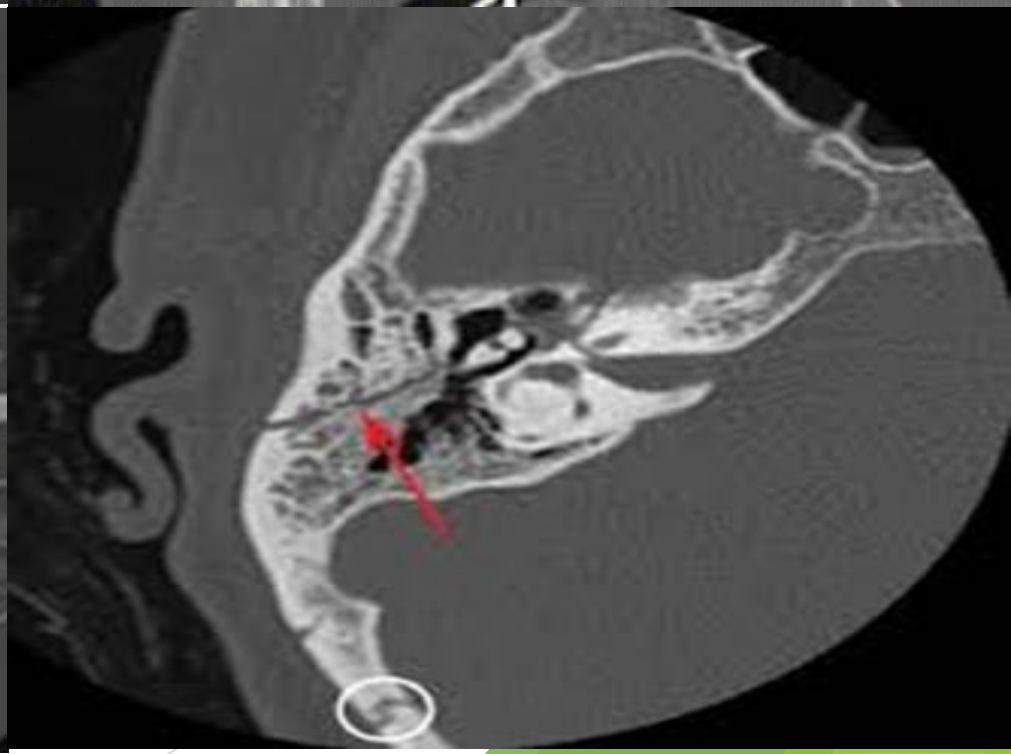

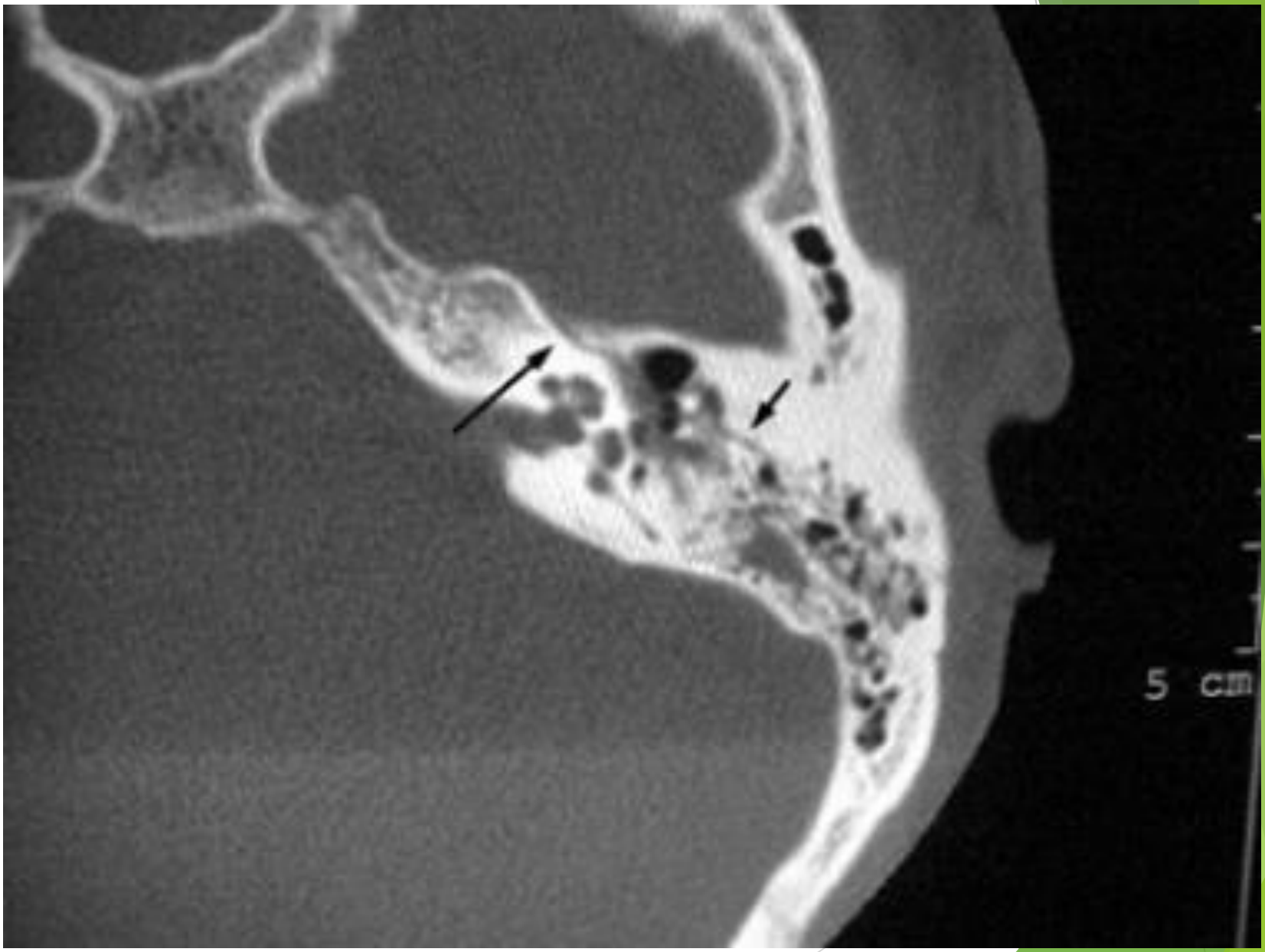
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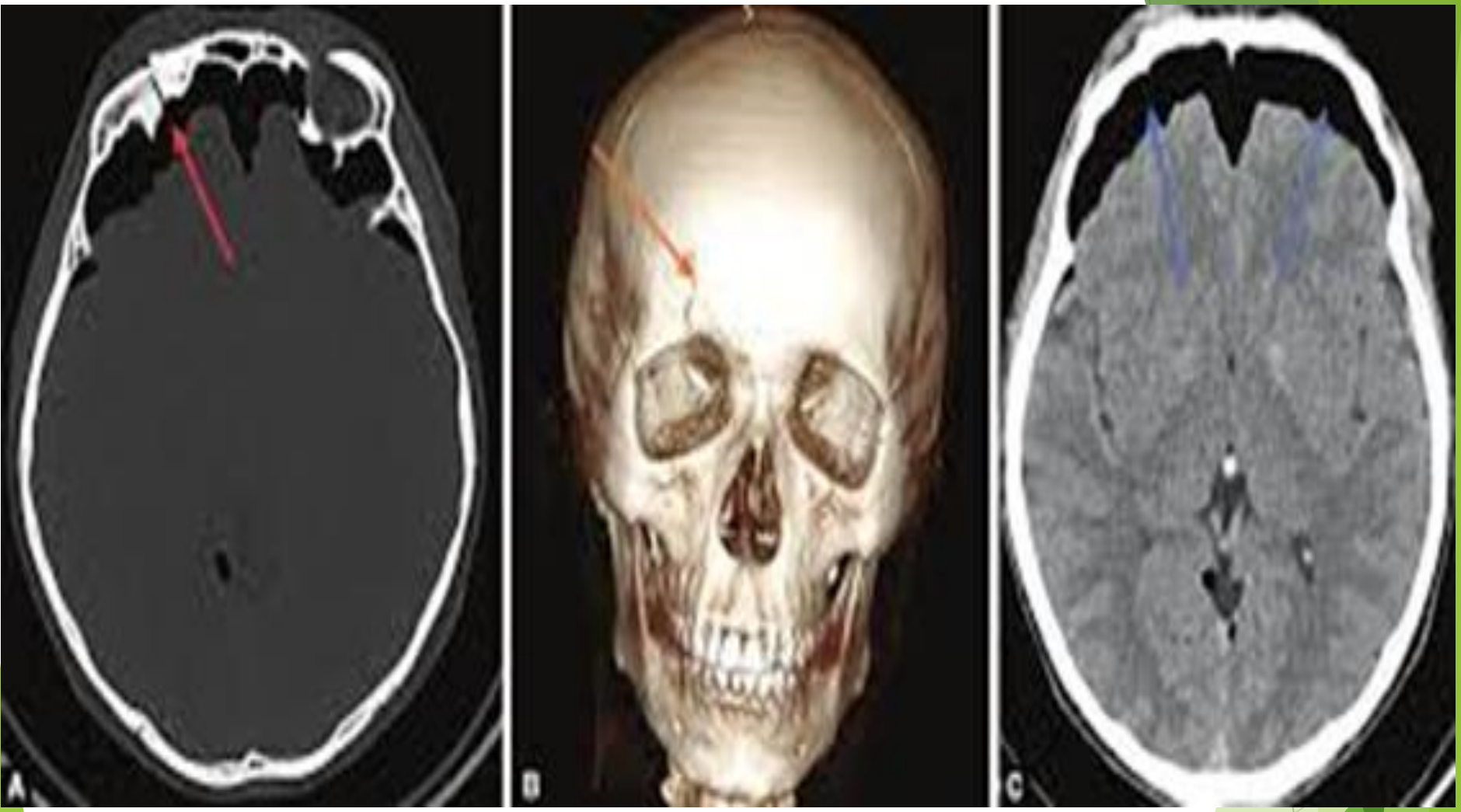
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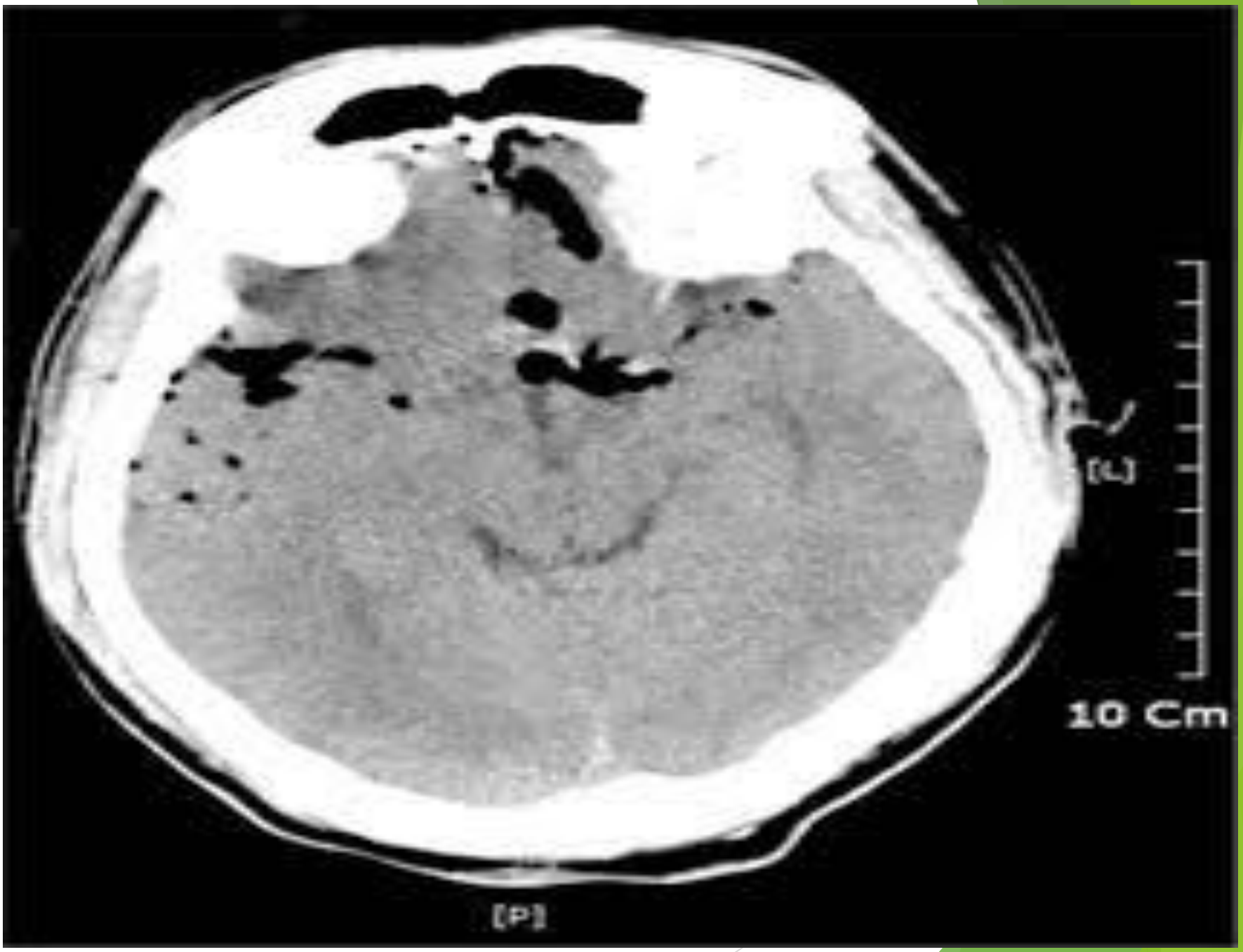
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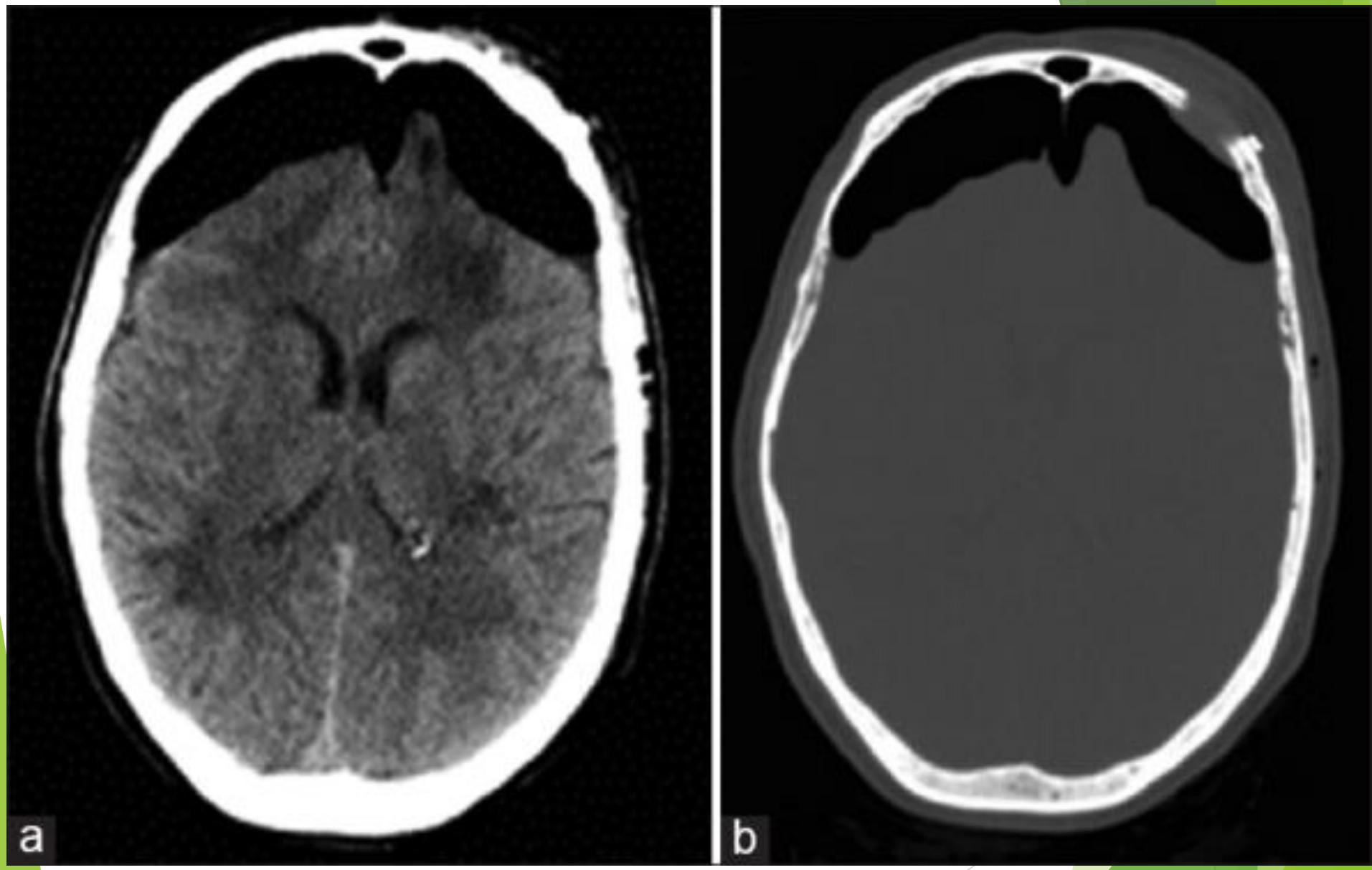
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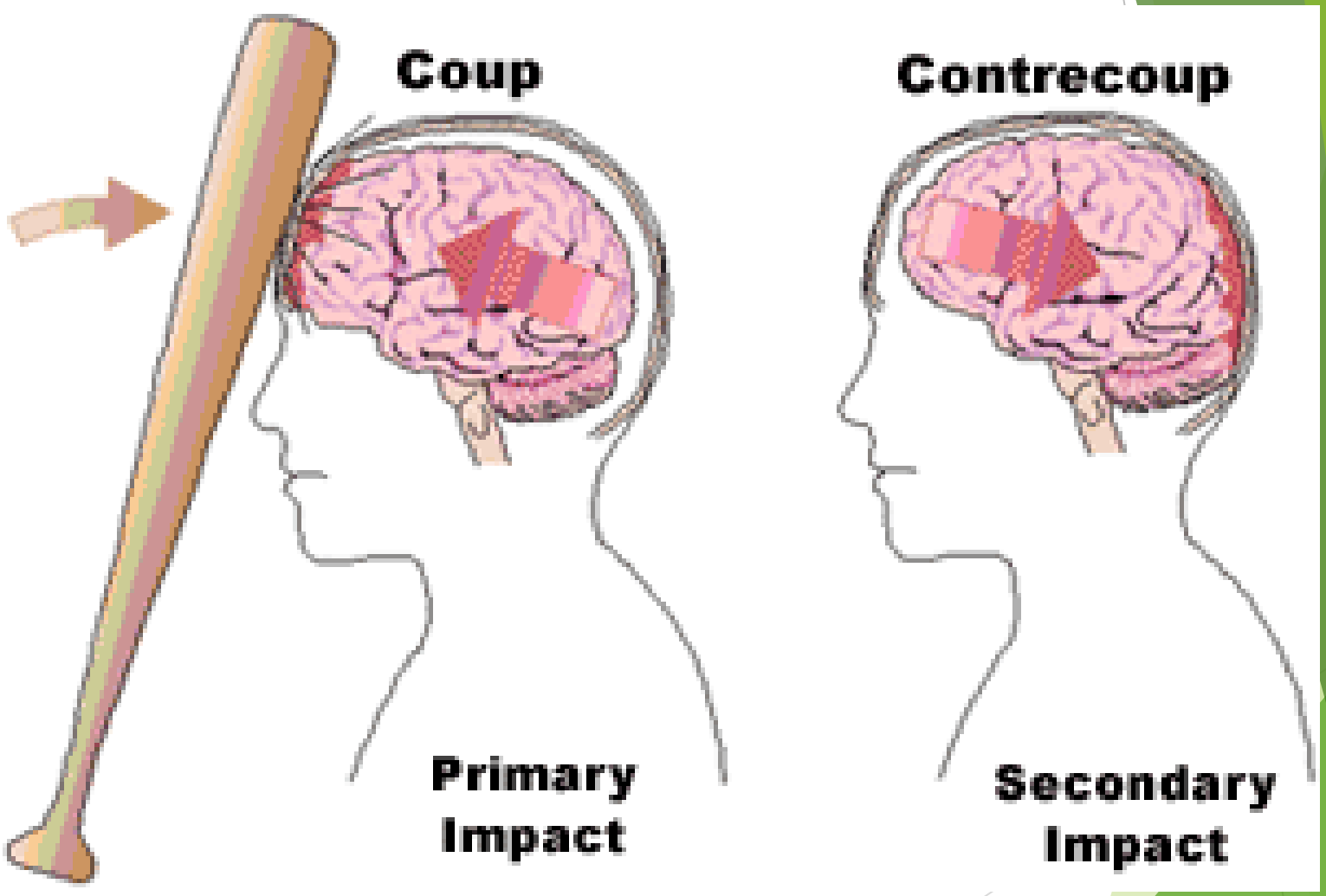
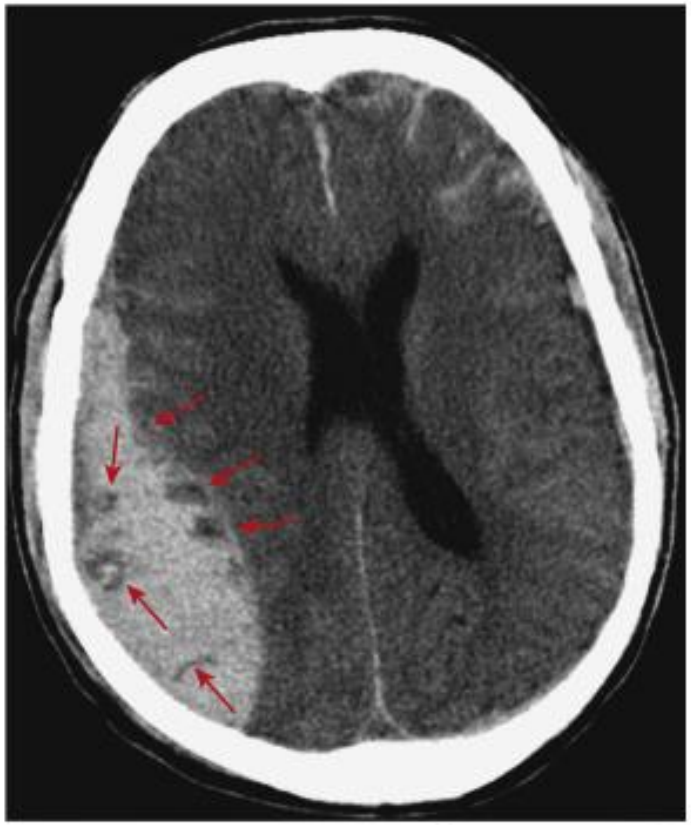
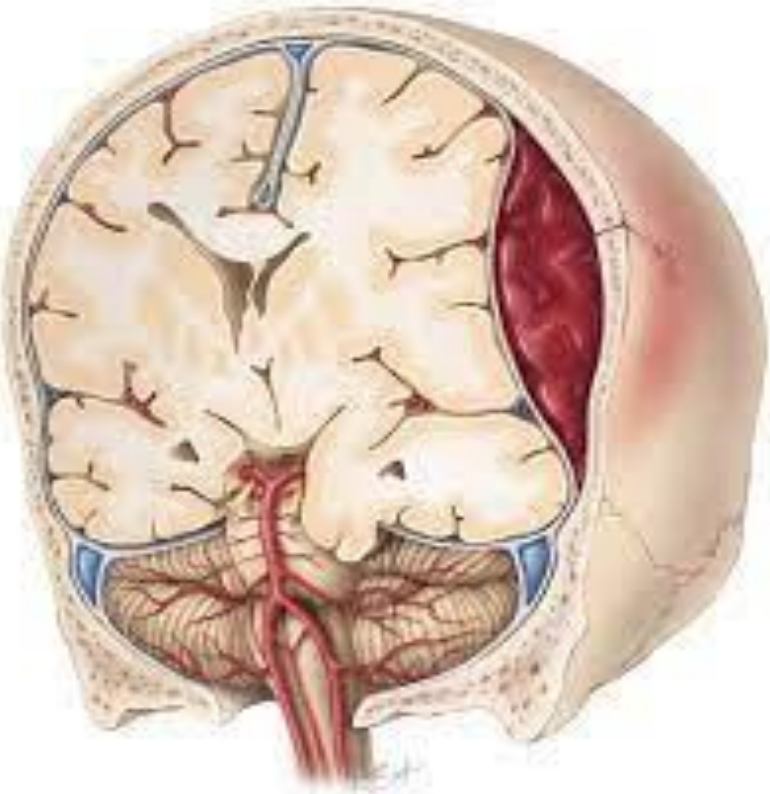
Epidural Hematoma

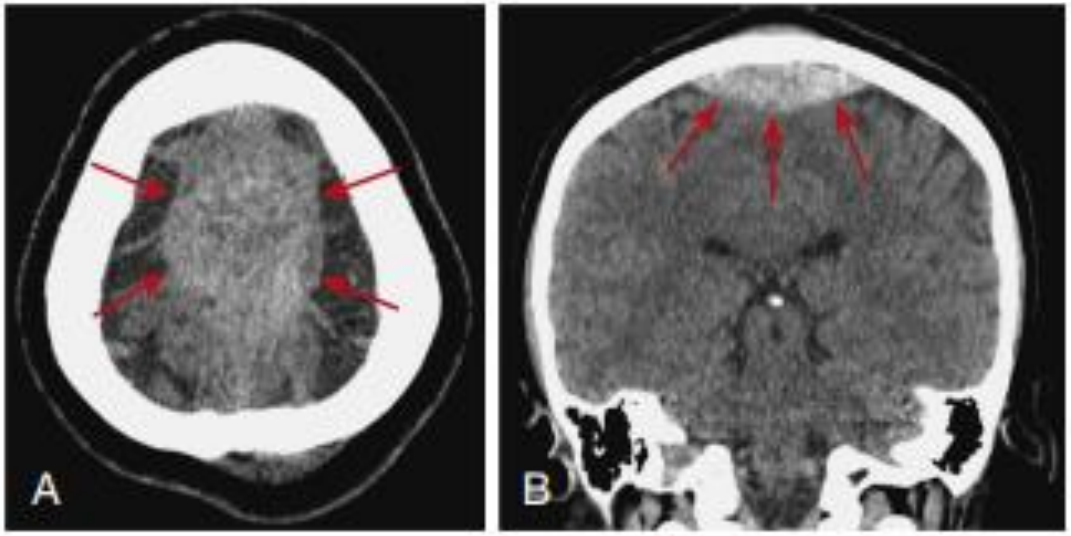
- between the outer layer of the dura mater and the inner table of the skull.
- arterial bleeding from a branch of the middle meningeal artery.
- well-defined biconvex hyperdense collection.
- hyperacute/active bleeding into the hematoma
  - low-density areas within an EDH
  - evidence of contrast extravasation into the hematoma on postcontrast head CT
  - may portend rapid expansion of the hematoma
  - can be associated with poorer prognosis.
- approximately 75% occur in the temporal region
- skull fracture in approximately 90% of cases in adults.
- is less common in children because the skull is more compliant and the middle meningeal artery is not yet or only shallowly indented into the inner table and therefore less susceptible to tearing



http://www.braininjury.com/injured.shtml






A
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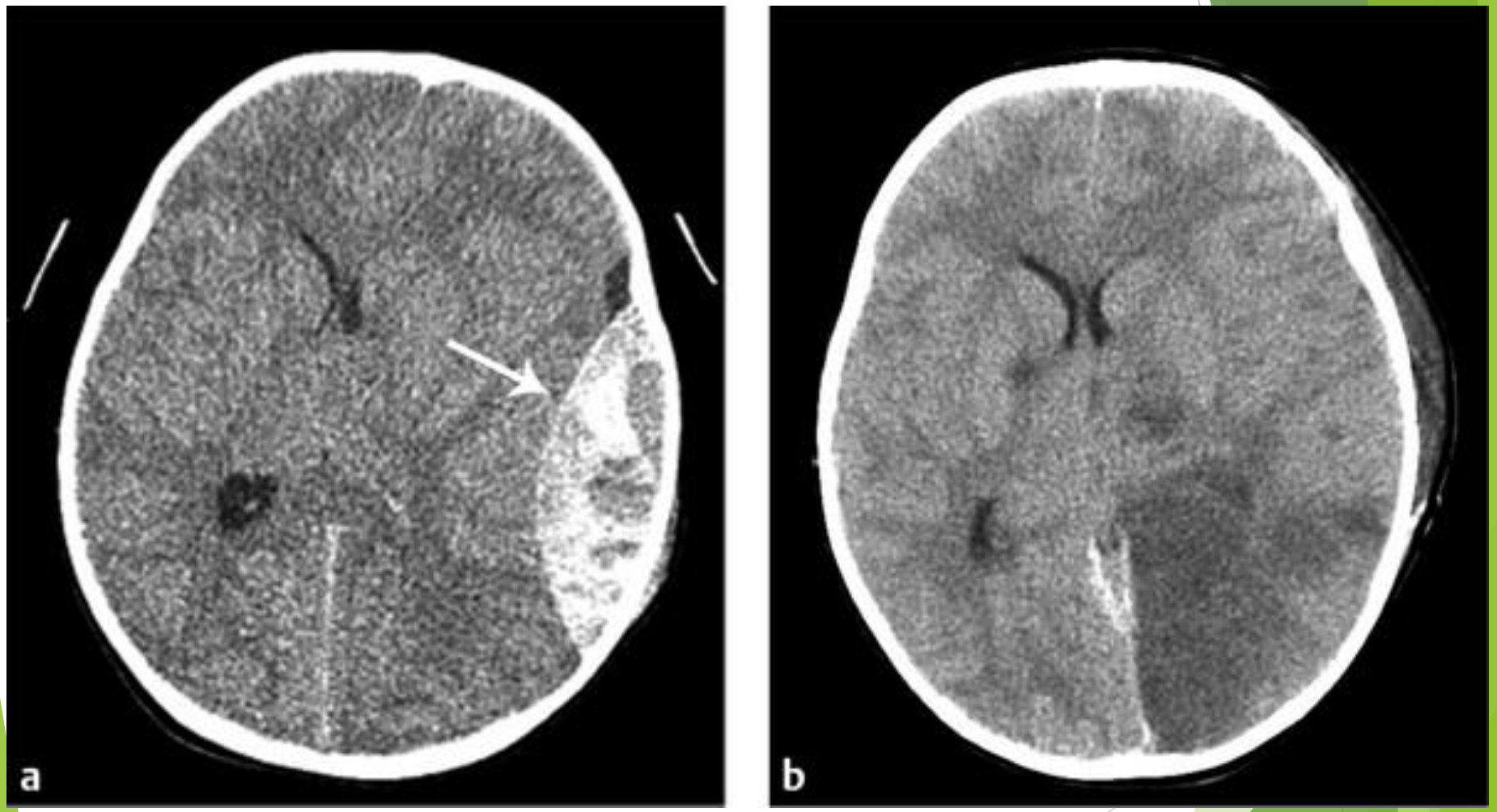
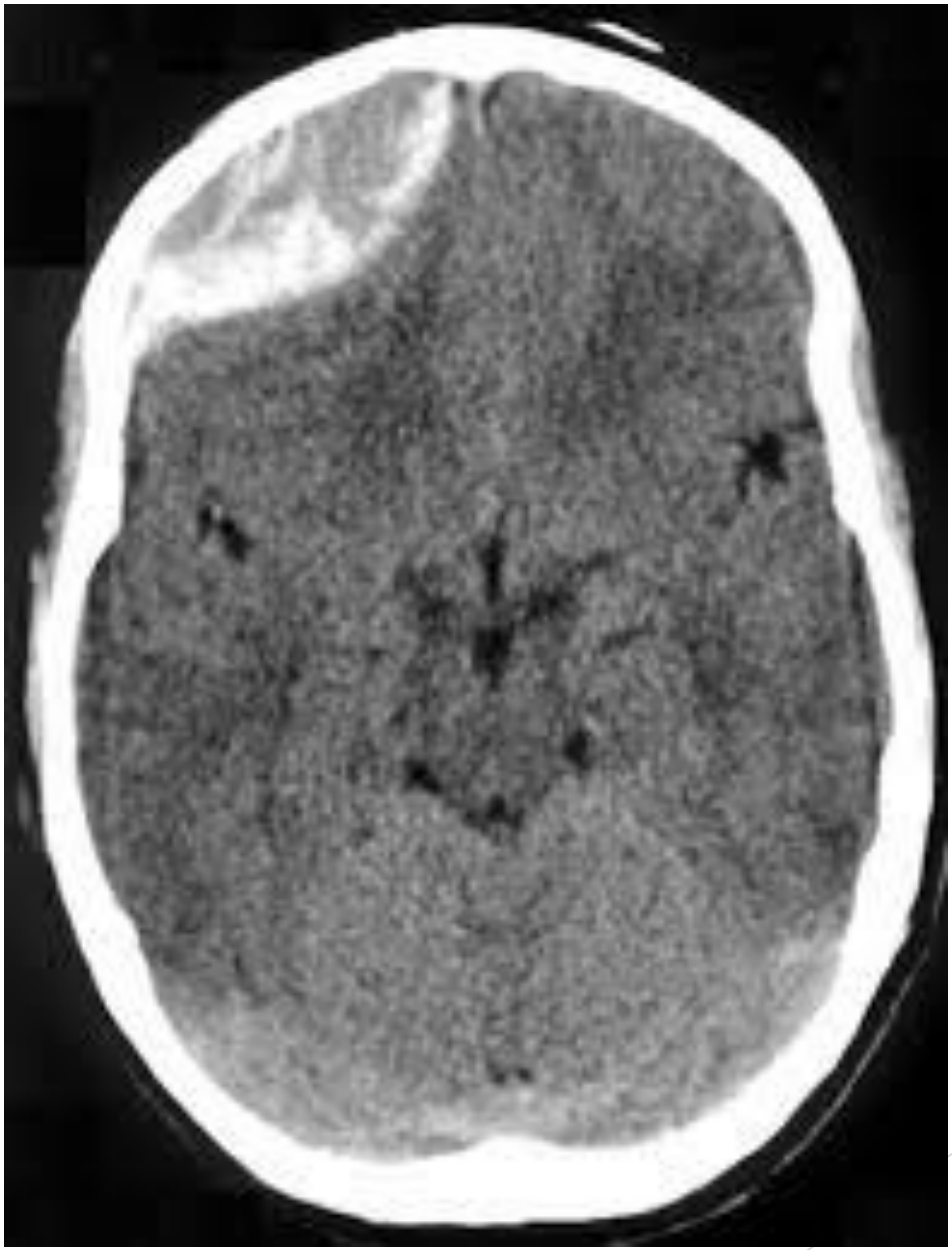

a
b

http://emedicine.medscape.com/article/343764-overview




D
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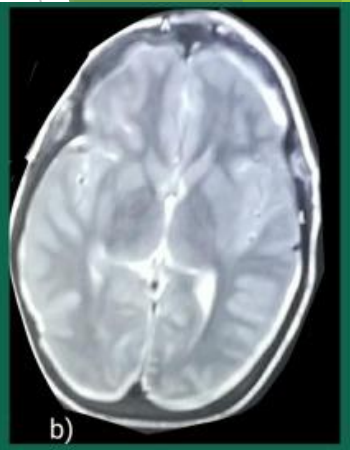
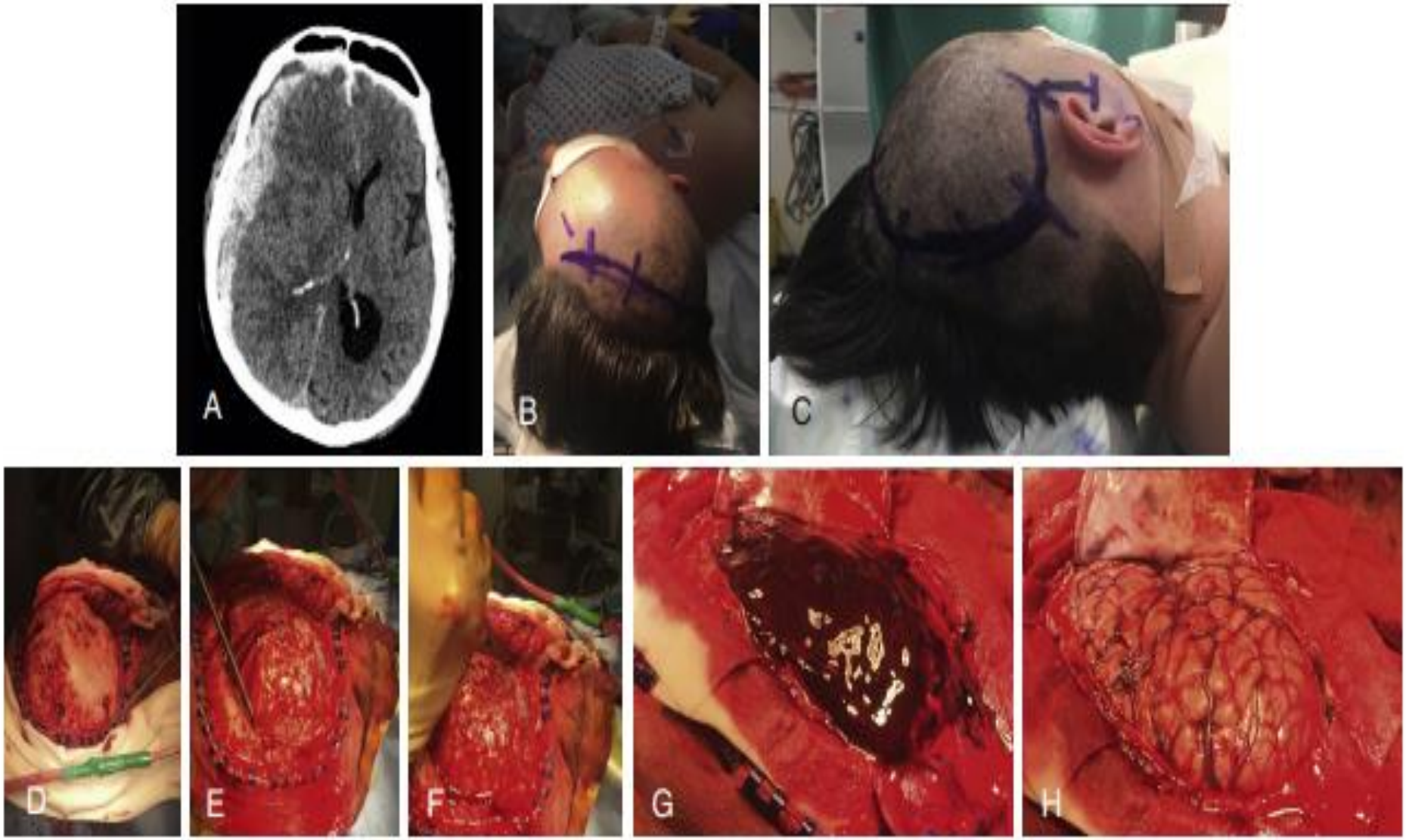
a)


b)


c)


d)


A
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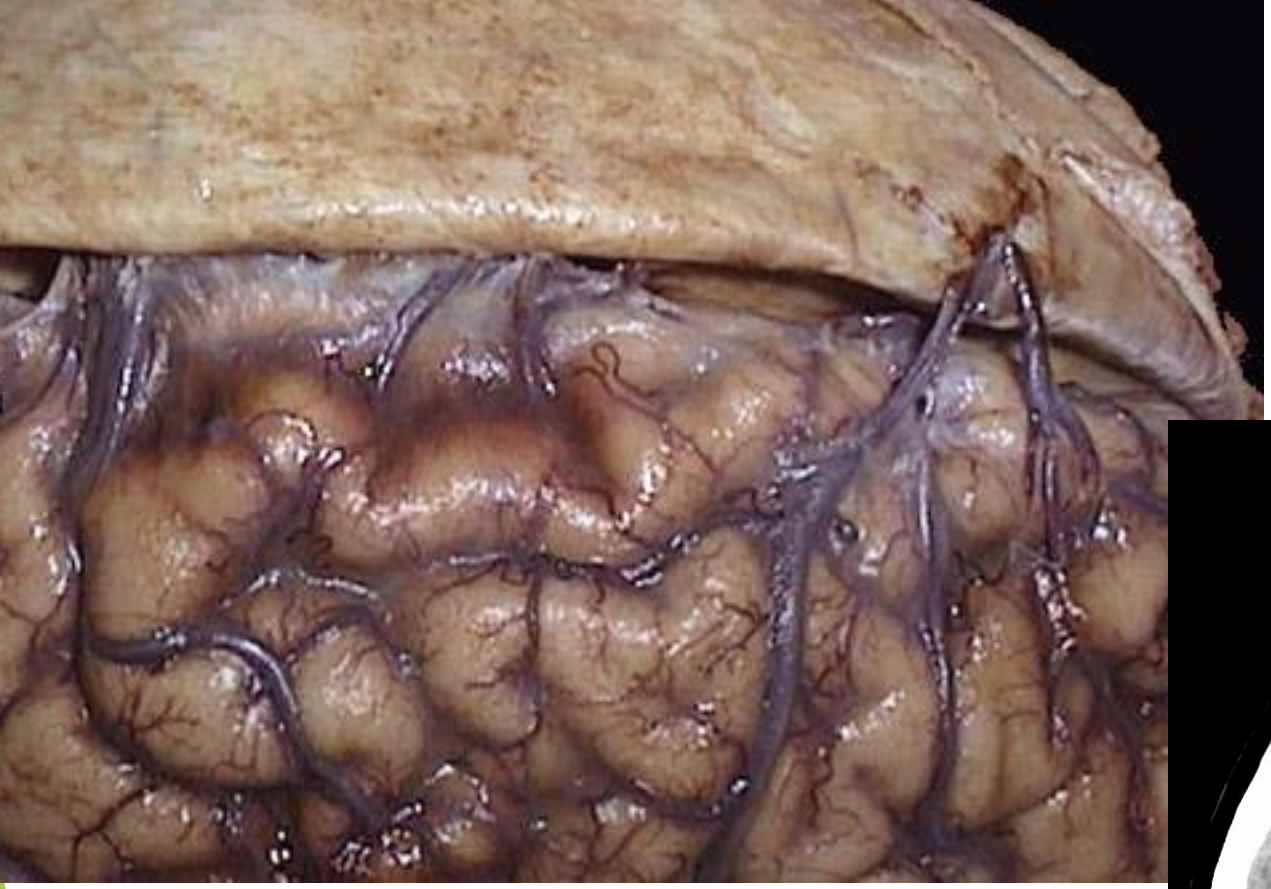
H

Subdural Hematoma

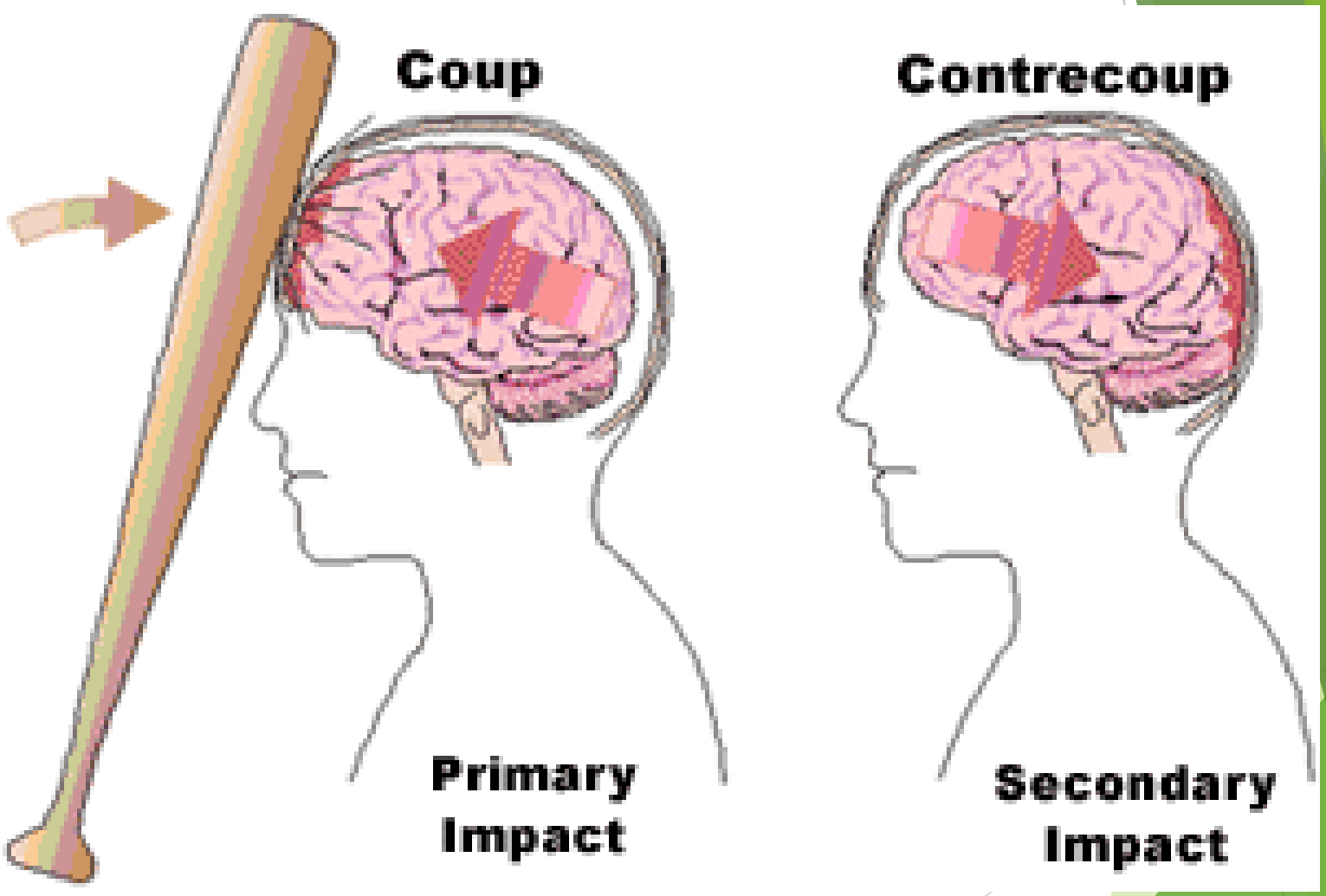
- between the arachnoid mater and the inner layer of the dura.
- from tearing of cortical bridging veins,
- crescent-shaped extra-axial collection overlying a cerebral convexity
- along the anterior and/or posterior falx: shaggy falx
- The tentorial SDH

- hyperacute SDH or an SDH in patients with coagulopathies :low density on CT
- most acute SDHs become uniformly hyperdense on CT within 1 or 2 hours
- initial several days to 1 week after formation, the SDH progressively decreases in CT density by an estimated
- Of “subacute” SDH
  - between 1 and 3 weeks of age,
  - approximately 50% are isodense to brain, and 50% are hypodense.
- At 3 weeks of age,
  - 10% are isodense and 90% are hypodense
- Rebleeding into a chronic SDH:
  - a laminated appearance
  - alternating hyperdense and hypodense layers
  - internal septations
  - a heterogeneous collection with a fluid-fluid level with high-density fluid layering below and lowdensity fluid layering above
- Calcifications occur **after months to years** in some chronic SDHs



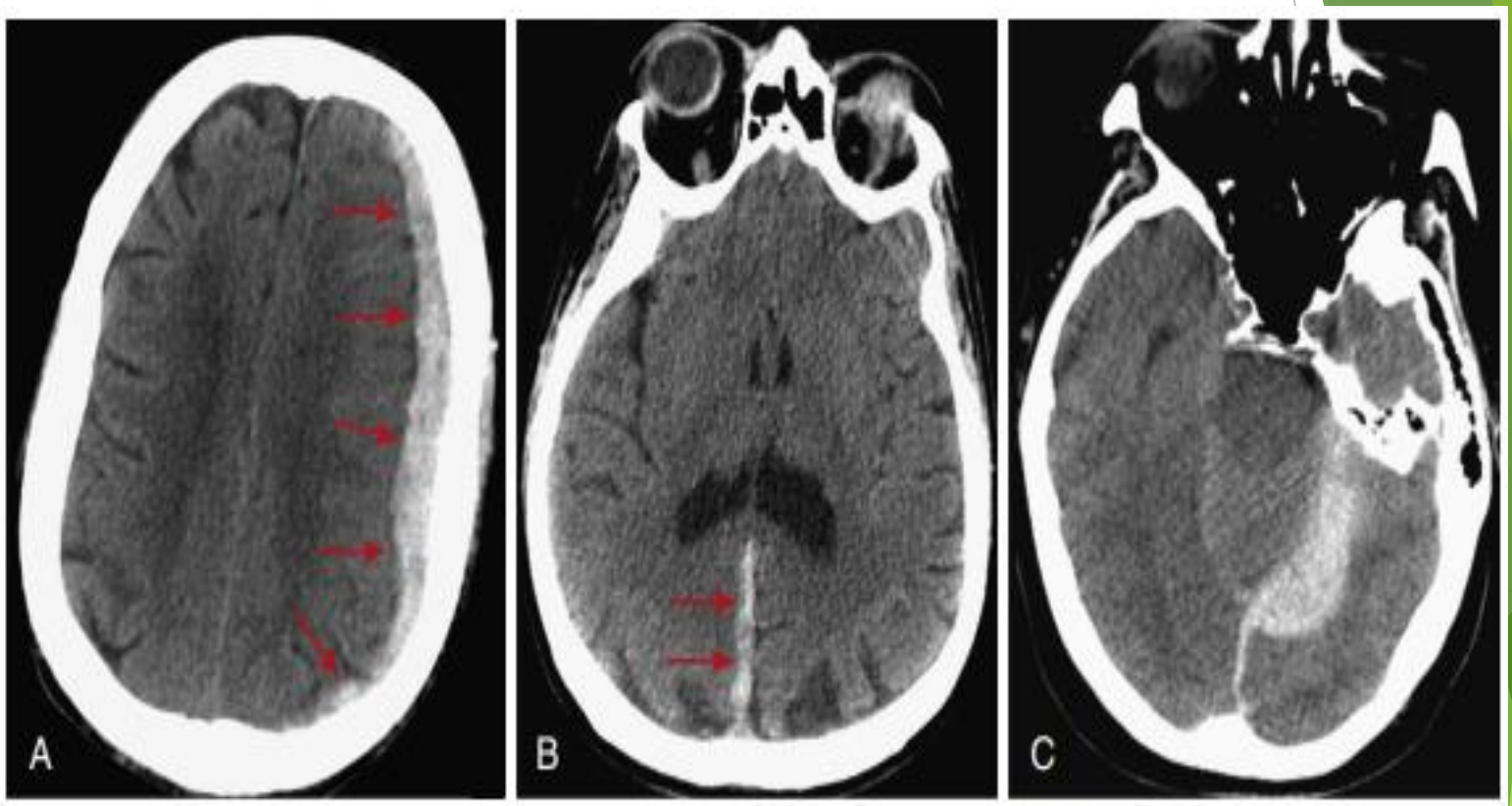
https://library.med.utah.edu/WebPath/jpeg5/CNS315.jpg

https://en.wikipedia.org/wiki/Subdural_hematoma

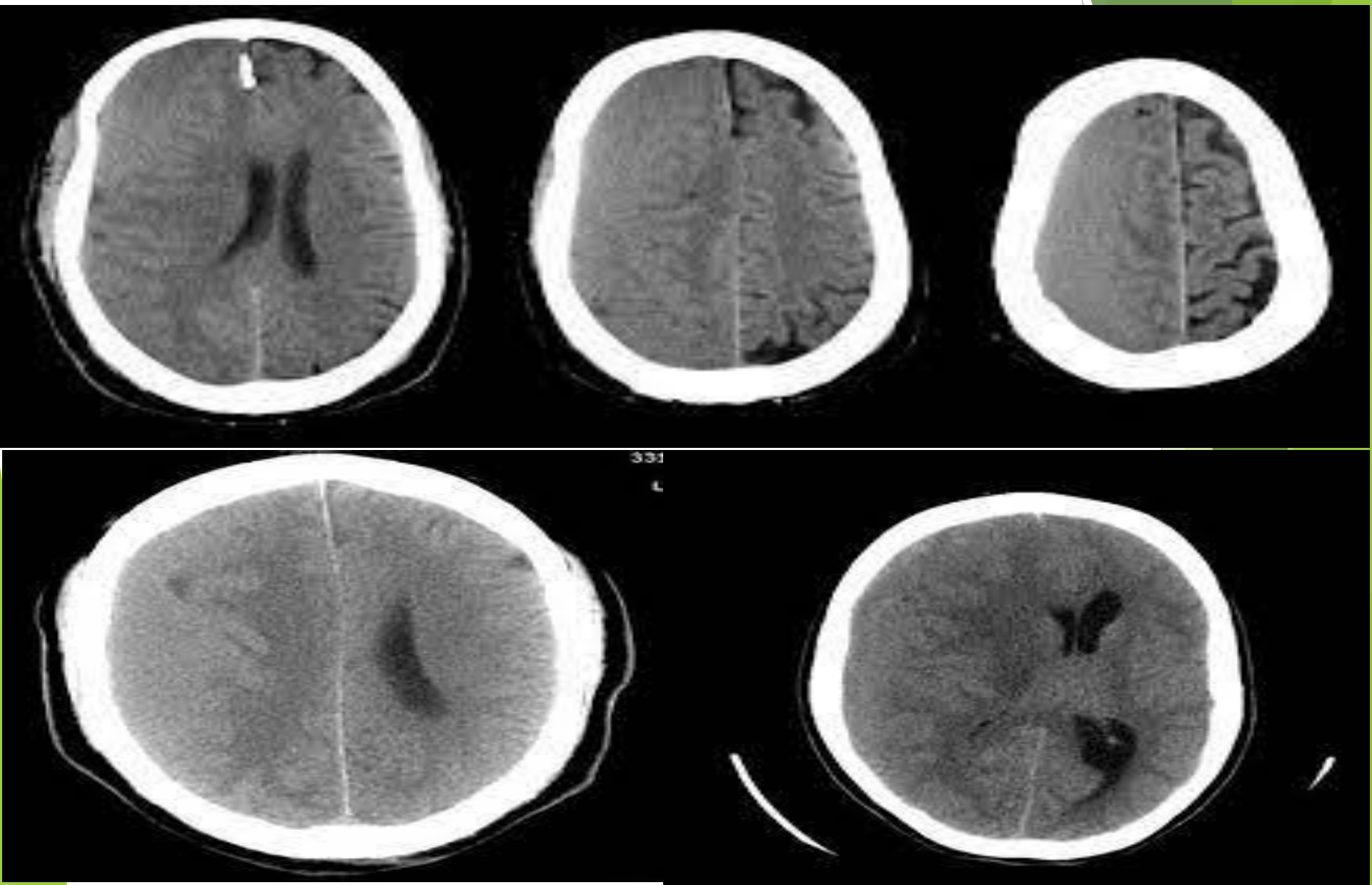


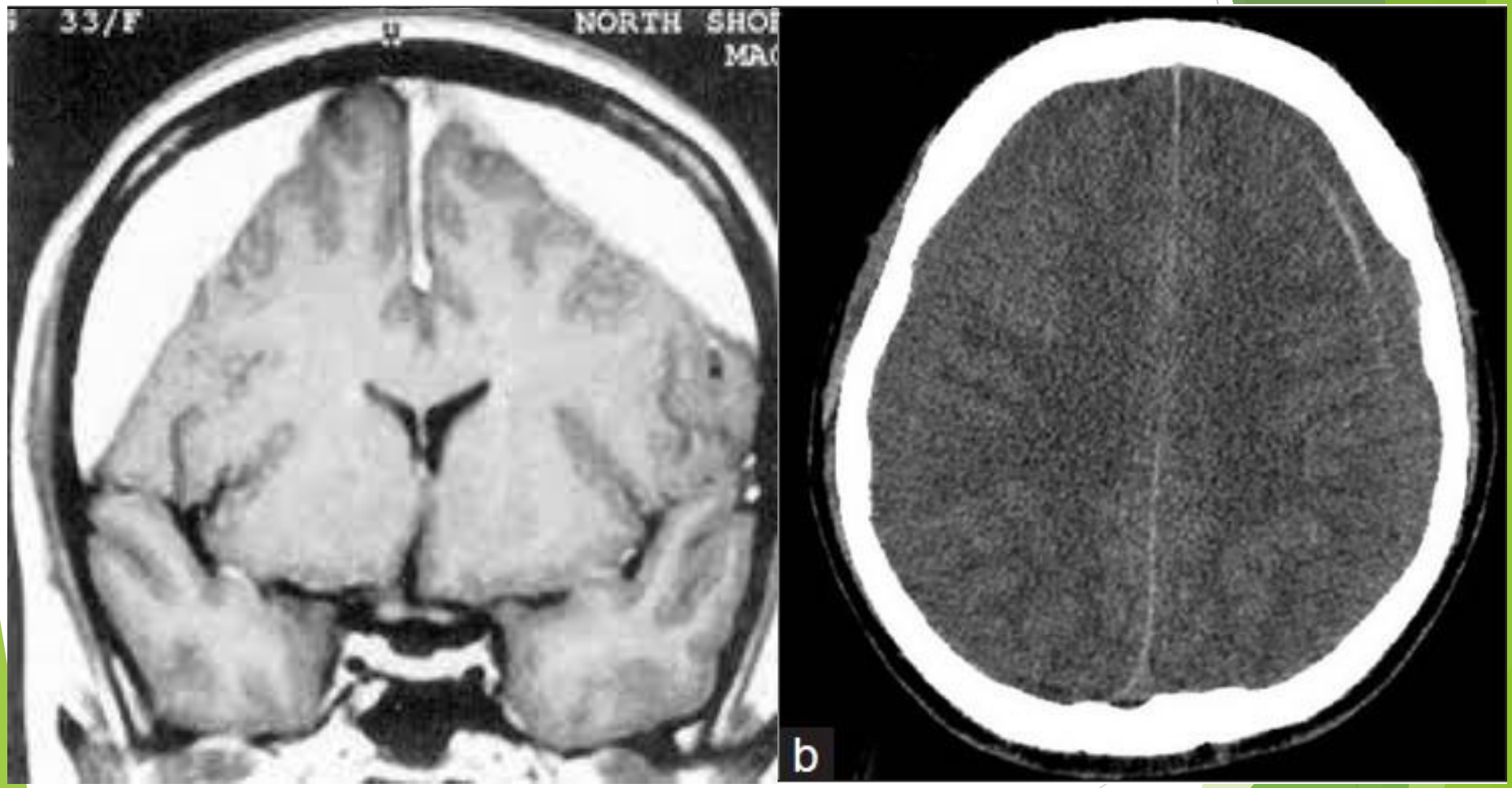
http://www.braininjury.com/injured.shtml

Acute SDH



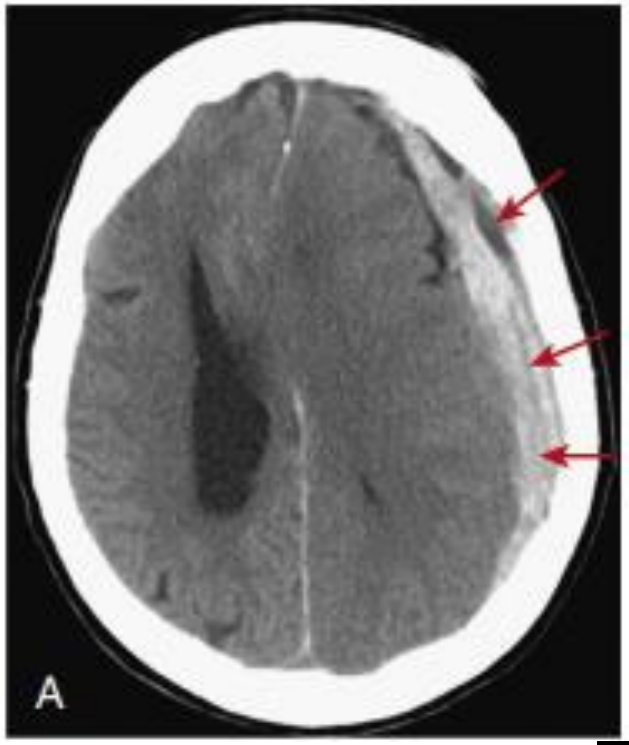
Subacute SDH

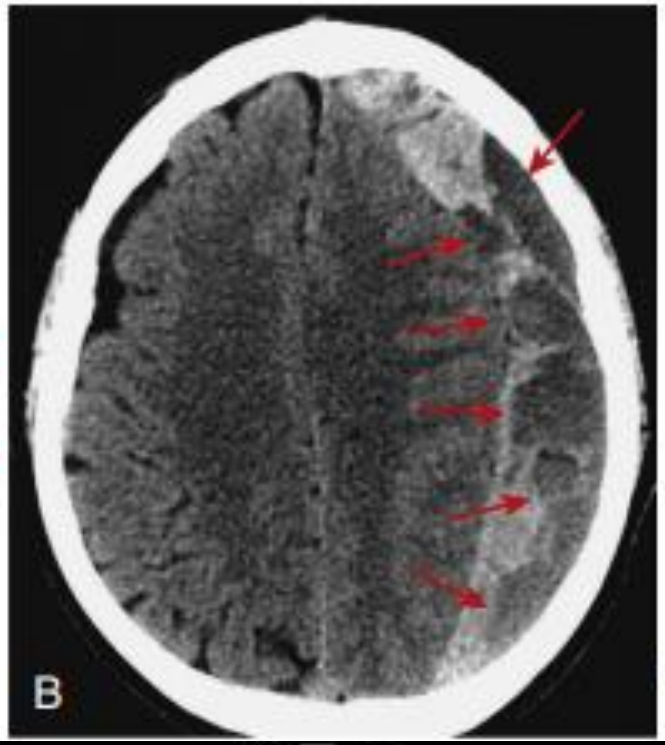


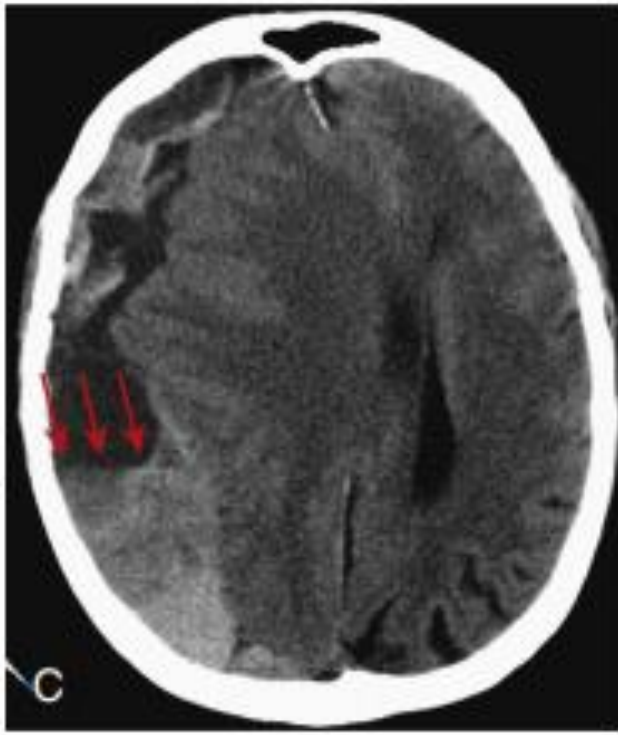

33/F
NORTH
b

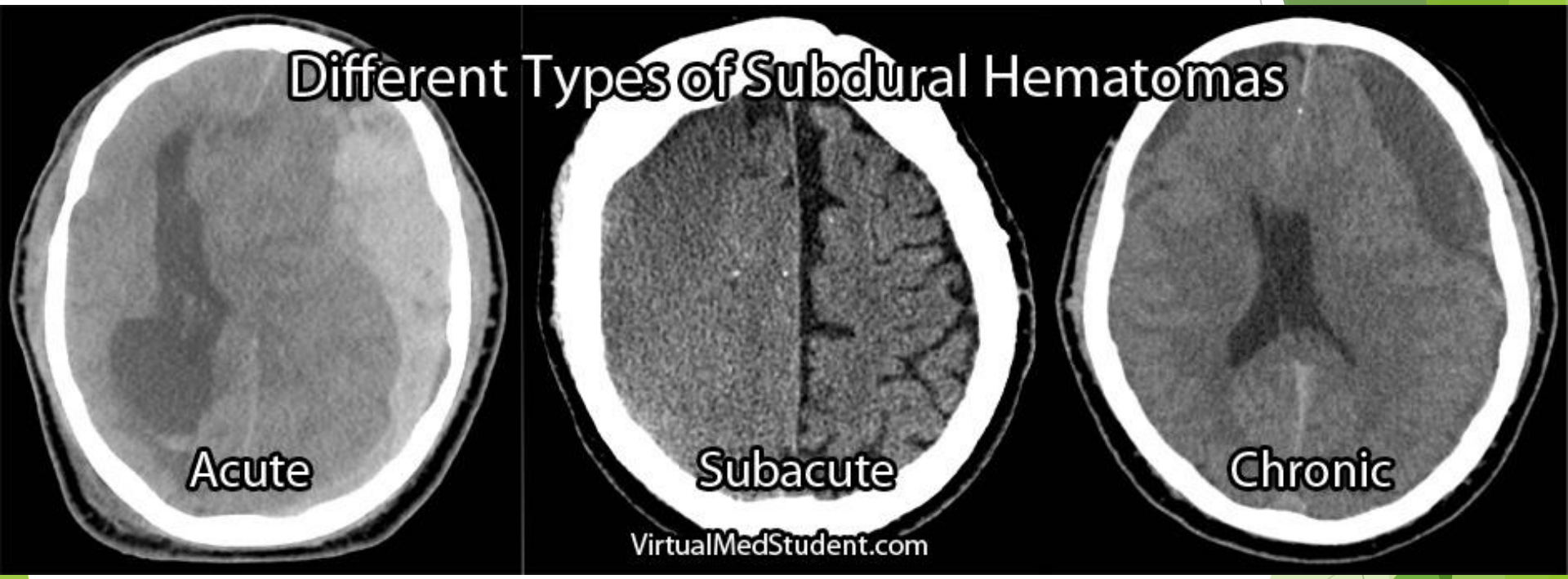
Chronic SDH

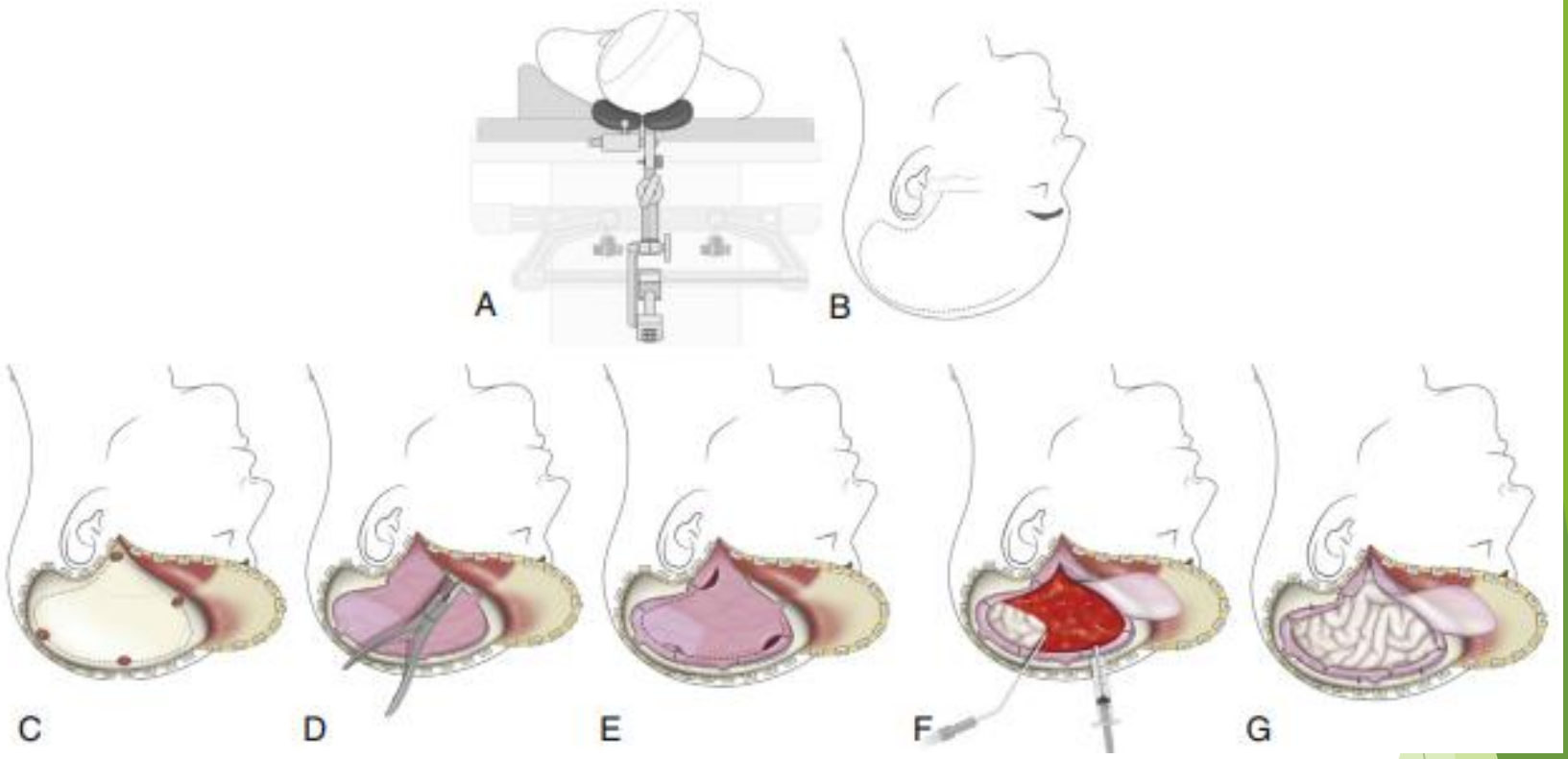
Acute on Chronic SDH








Different Types of Subdural Hematomas
Acute
Subacute
Chronic
VirtualMedStudent.com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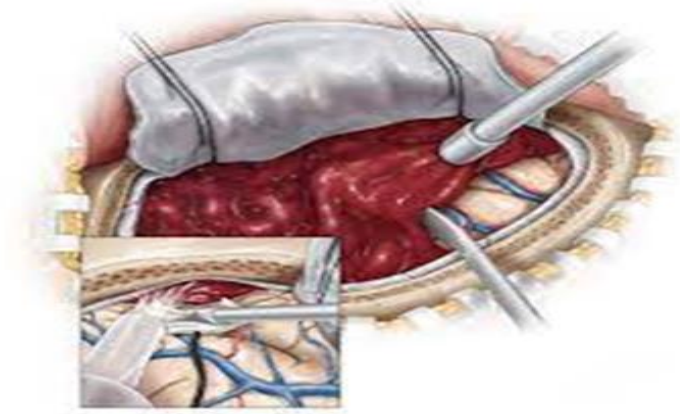


Subarachnoid Hemorrhage (SAH)

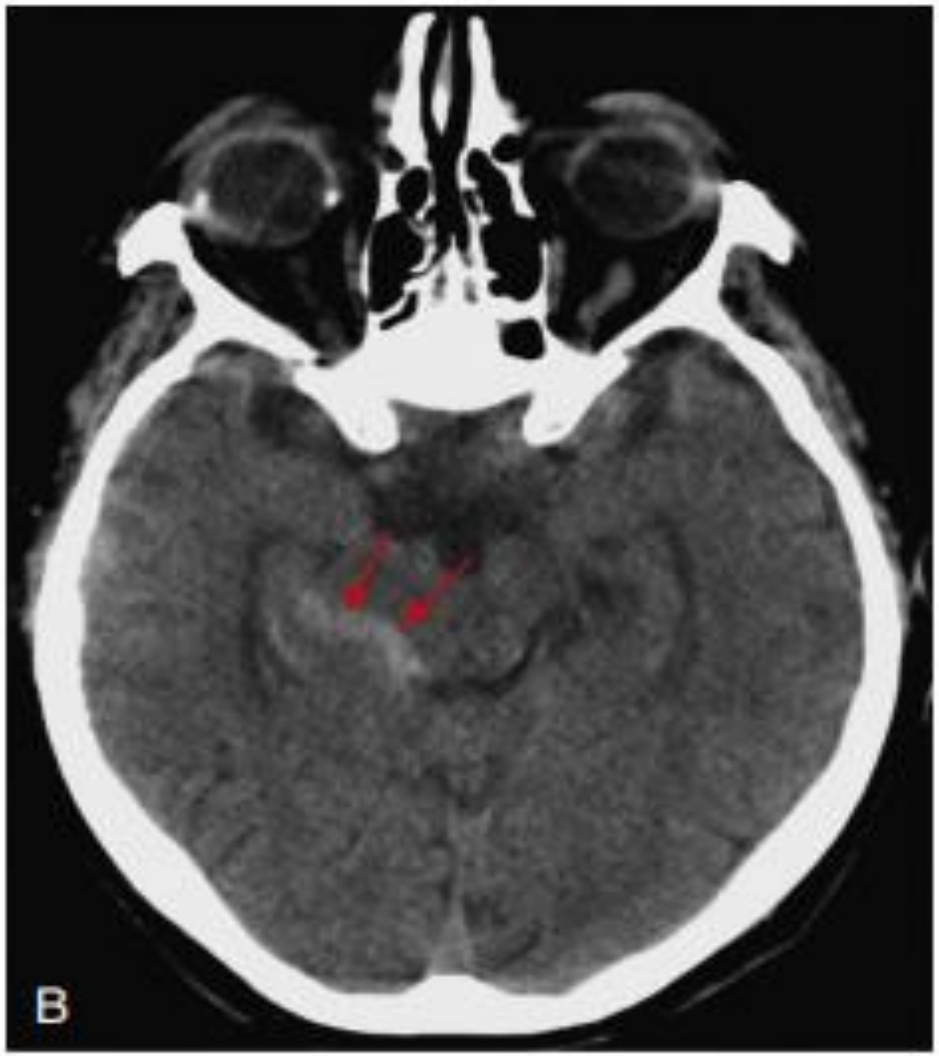
- between the arachnoid and the pia mater
- disruption of small pial vessels along the brain surface.
- on CT as high-attenuation fluid.
- conform to the local geometry of the subarachnoid space
- a linear or curvilinear morphology
- become quickly undetectable by CT, often within hours to 2 days
- Among conventional MRI sequences, T2 FLAIR MRI is the most sensitive for both acute and subacute SAH.

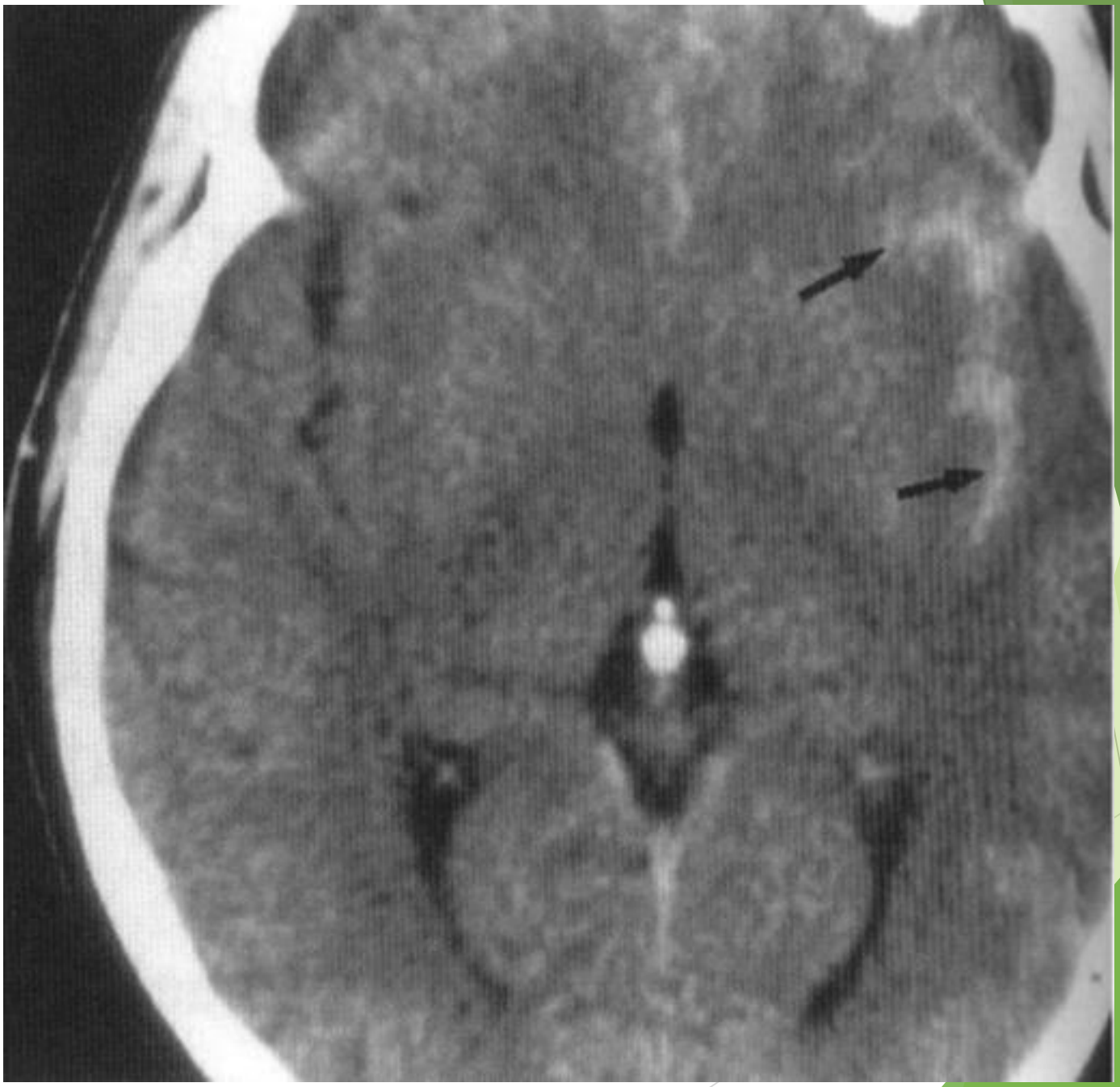
- traumatic SAH is often seen
  - peripheral cerebral sulci
  - sylvian fissures
  - anterior interhemispheric fissure
  - Small quantities within the basal cisterns.
- SAHs resulting from aneurysm rupture:
- circle of Willis
- middle cerebral artery bifurcation
- have their largest component within the basal cisterns

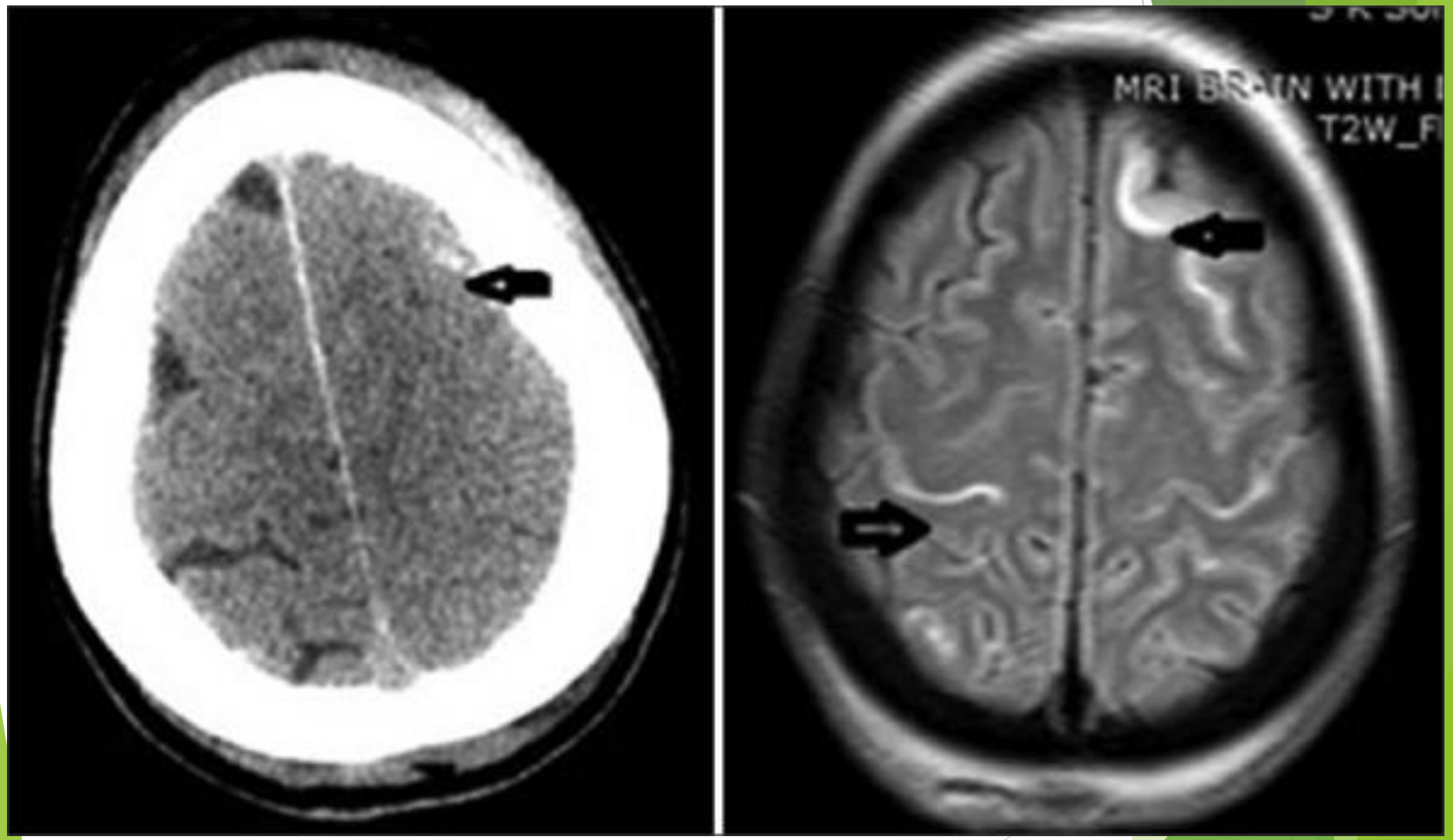
Intraventricular hemorrhage (IVH)

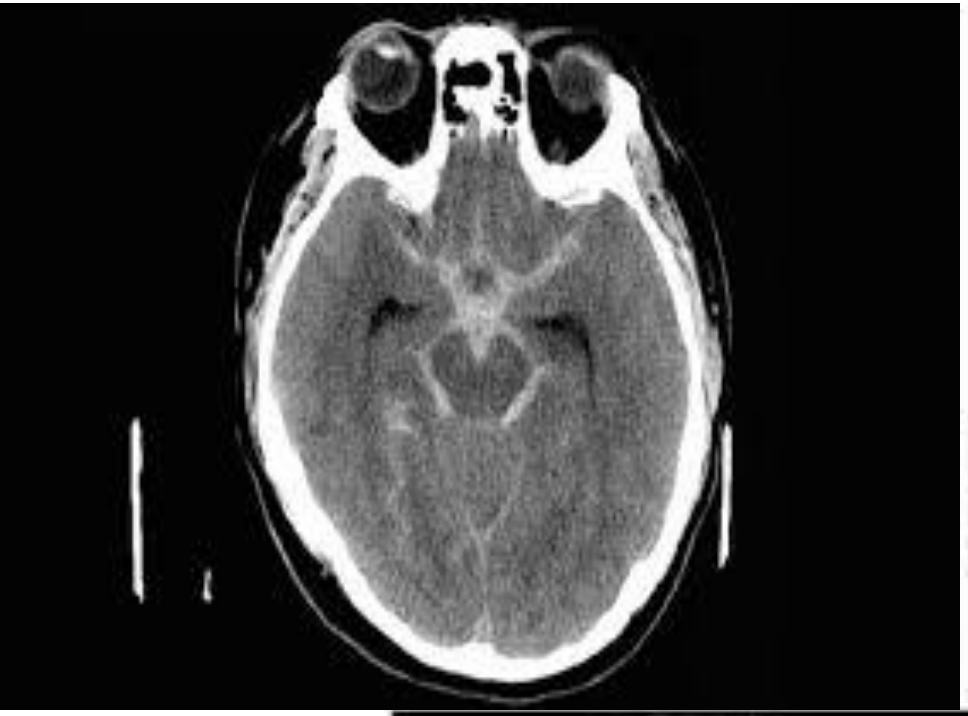
- is a form of SAH that can result from
  - tearing of tiny subependymal vessels
  - Intraventricular extension of hemorrhage from an intraparenchymal hematoma
  - retrograde reflux of SAH via the foramina of Luschka and Magendie
- high-density fluid layering within the occipital horns


A


B




MRI BRAIN WITH
T2W_F




A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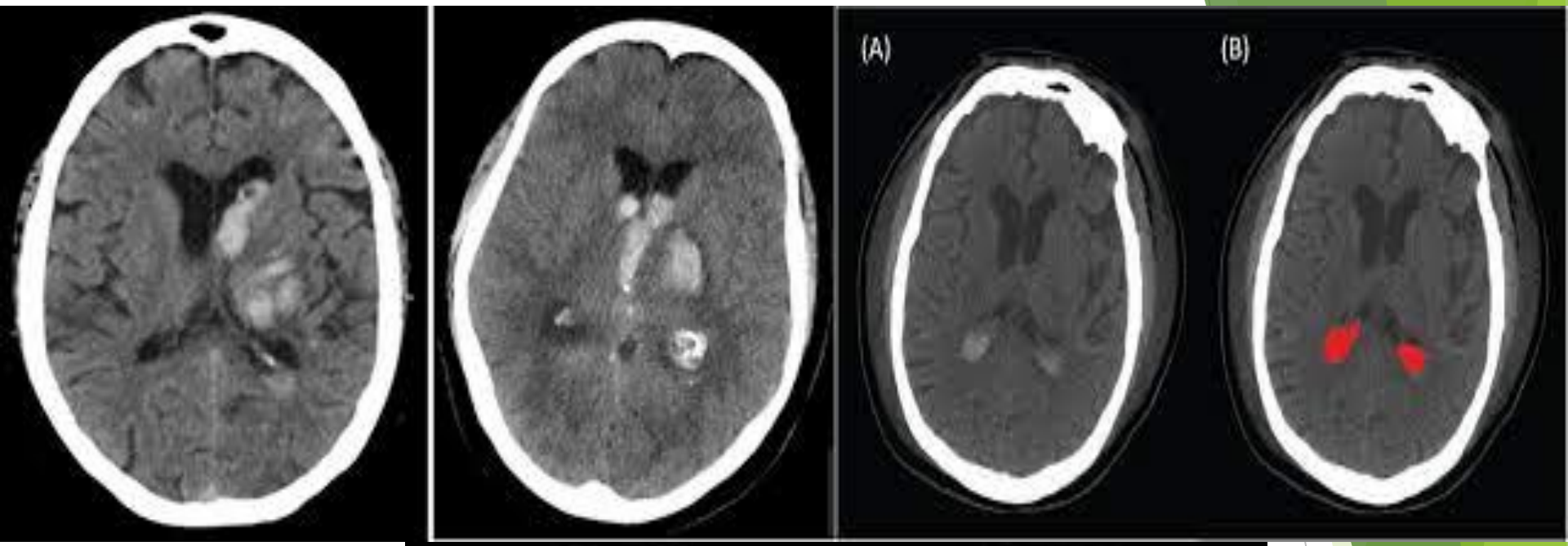
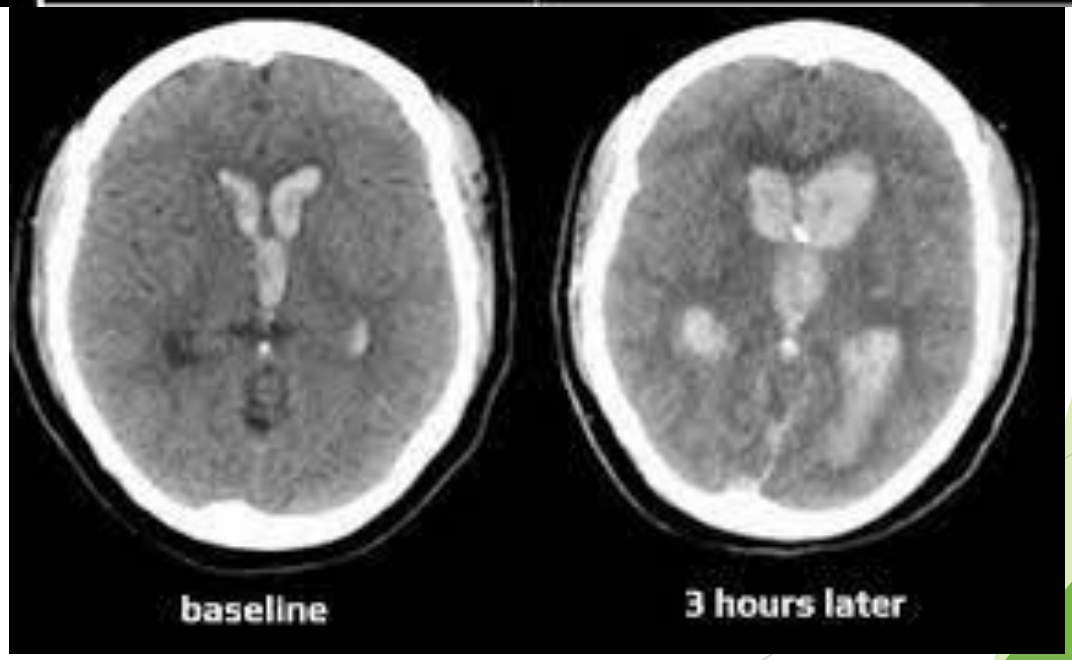
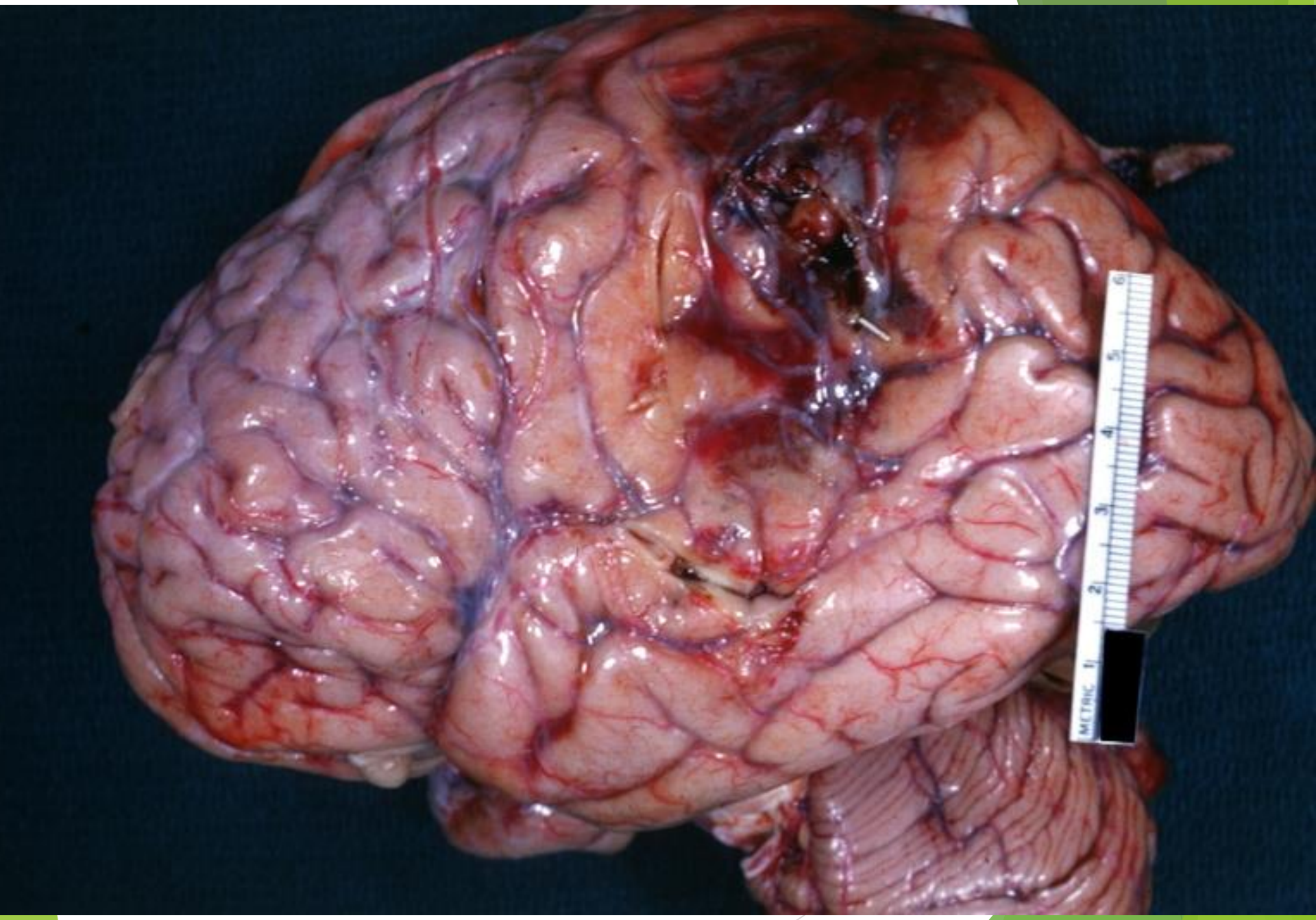

(A)
(B)

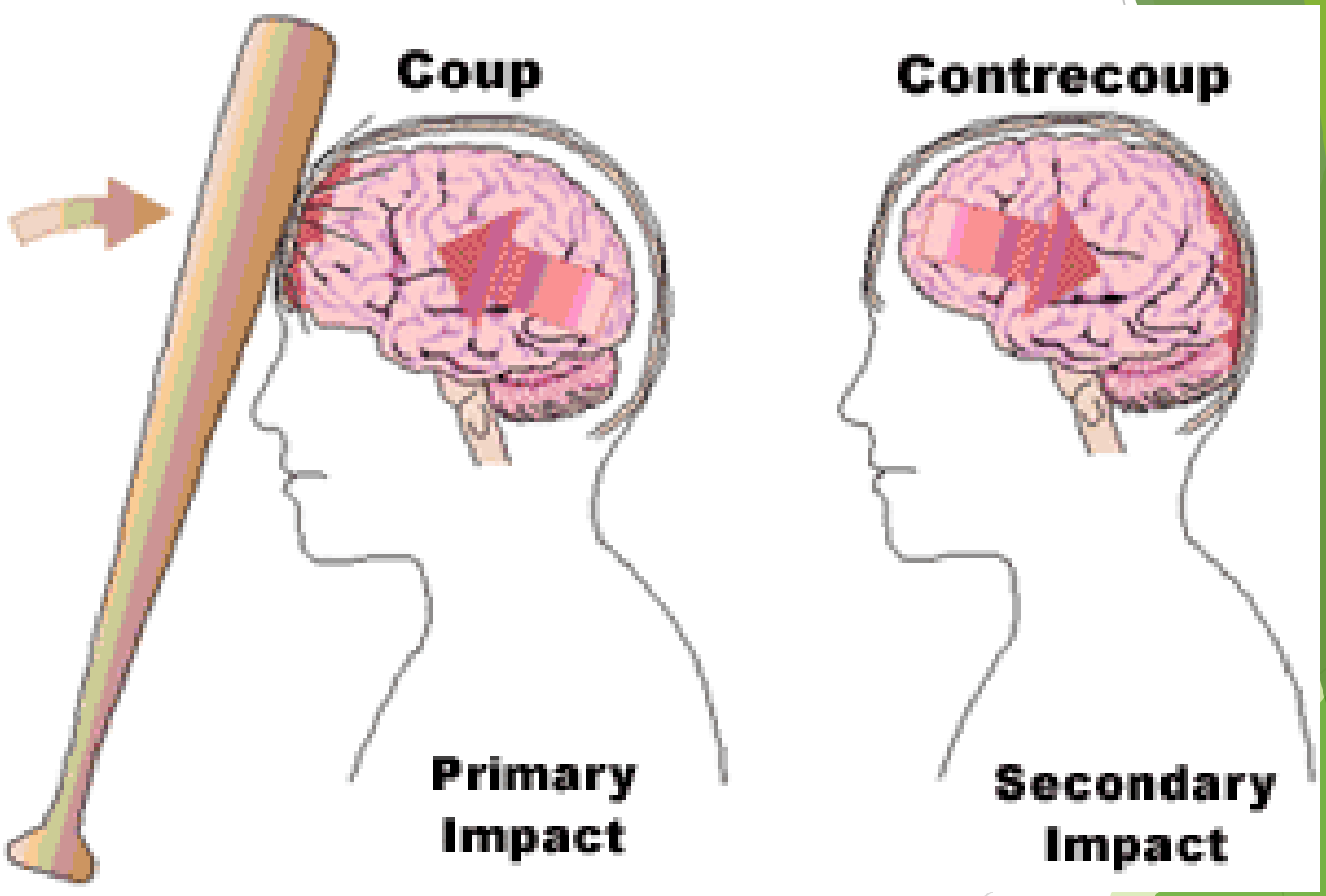

baseline
3 hours later

Brain Contusion

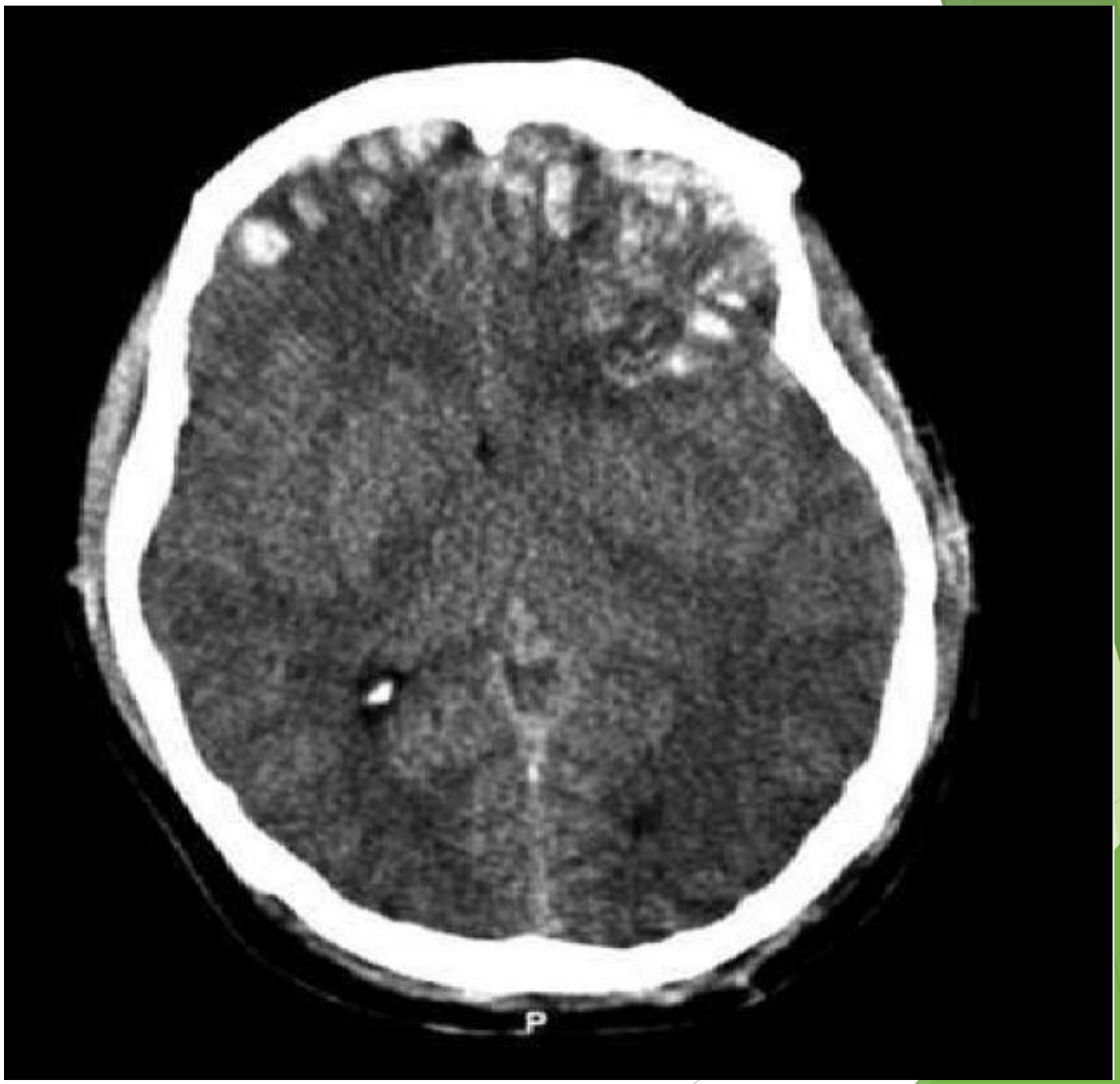
- a “bruise” of the brain caused by direct traumatic
- impact of the brain surface with the inner surface of the
- Skull
- Brain contusions can occur at either the coup or the contrecoup
- Are generally associated with hemorrhages within the contused tissue
- On both CT and MRI: focal area of patchy hemorrhage and edema
- *cortical contusions:* very tiny and limited solely to the cortex
- they can be more extensive and involve both the cortex and subjacent cortical white matter



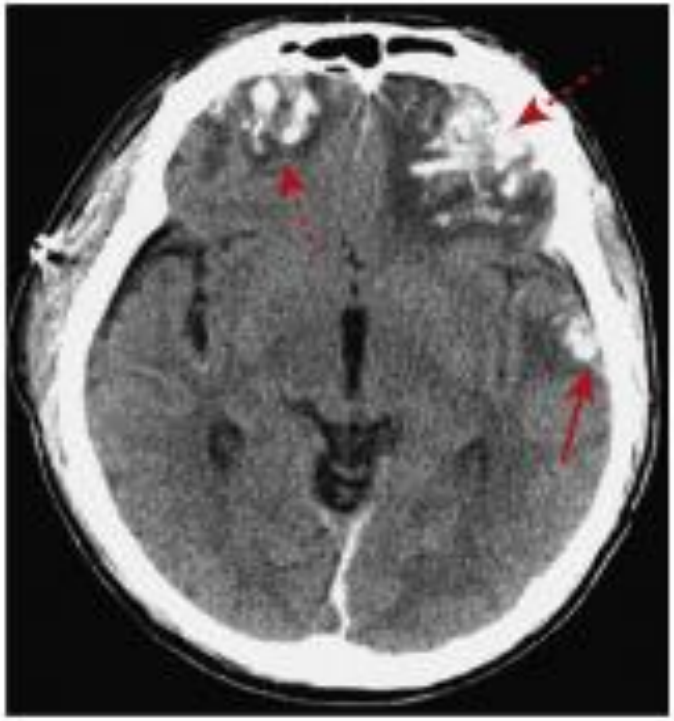
http://peir.path.uab.edu/library/picture.php?/4052

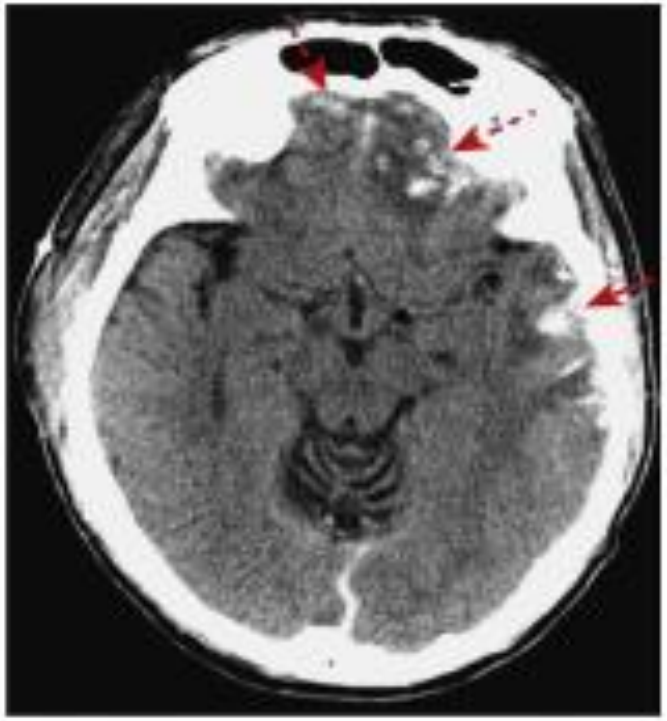


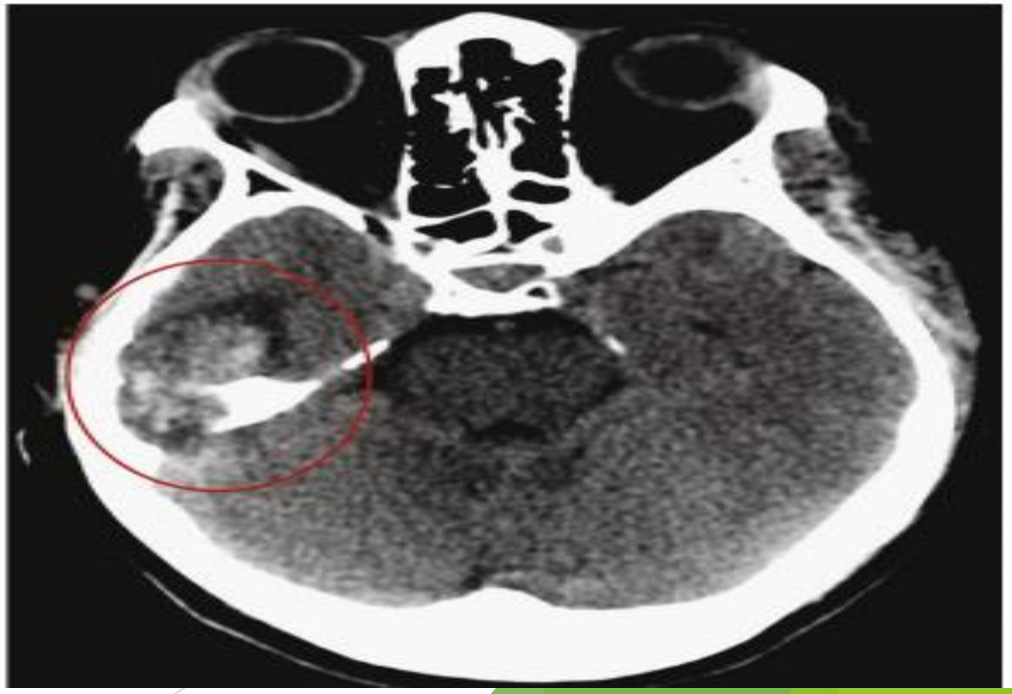
http://www.braininjury.com/injured.shtml



https://en.wikipedia.org/wiki/Traumatic_brain_injury

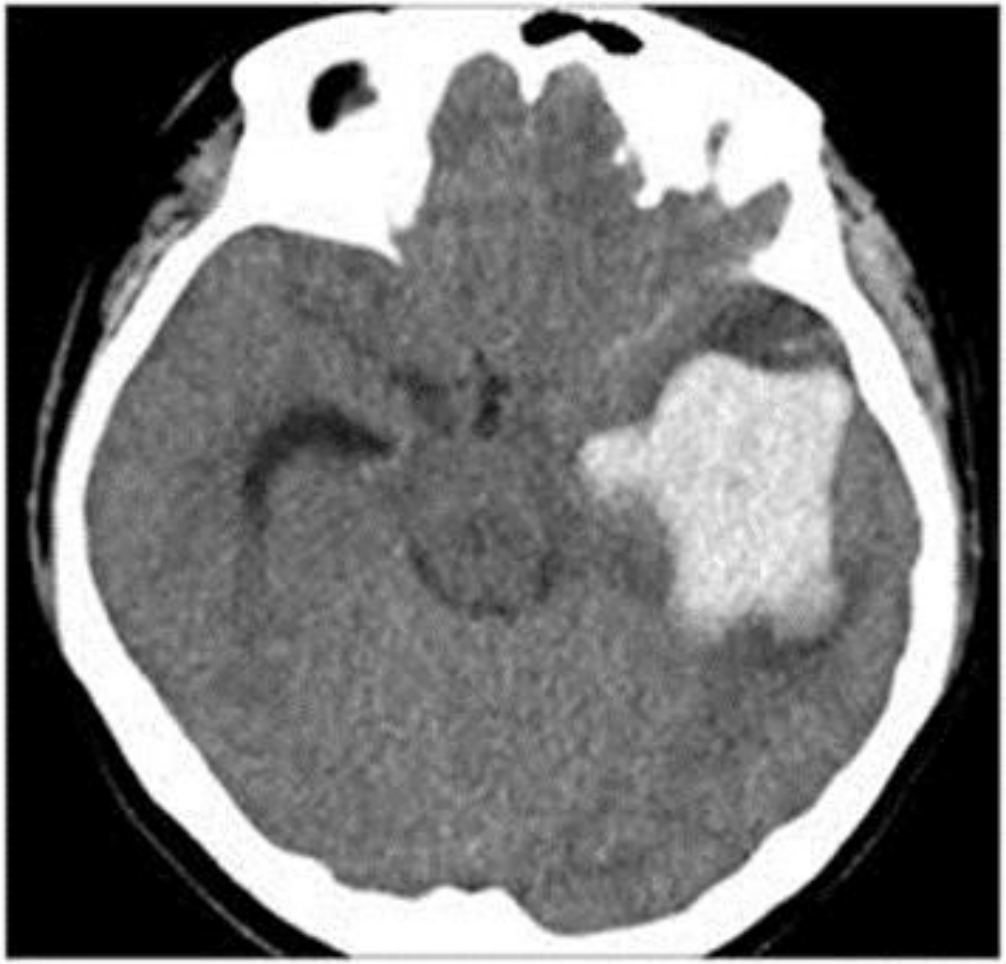






Intracerebral Hemorrhage

- exceeding 5 mm in size
- less surrounding edema than with contusions
- located deeper in the brain than contusions
- Frequently in the frontotemporal white matter
- Although traumatic intracerebral hemorrhages may occur in the basal ganglia, hemorrhage in the basal ganglia is very commonly caused by hypertensive vasculopathy
- delayed hematomas tend to occur in multiple lobar locations and are associated with a poor prognosis



Traumatic axonal injury (TAI)/diffuse axonal injury (DAI)/shear injury

- injuries to axons due to shear-strain forces
- white matter injuries
- result from rotational acceleration
- caused by shear-strain deformation of the brain at interfaces between tissues of different density (e.g., gray/white matter).
- local metabolic disturbances
  - dysregulation of calcium and other ions

- TAI is extremely common
- no limited to only moderate and severe TBI.
- very frequently in mild TBI.
- commonly in the lobar white matter
  - **frontal and temporal lobes** (approximately 50%)
  - corpus callosum (approximately 22% of lesions, with most lesions in the splenium)
  - corona radiata (19%),
  - internal capsule (8%, mostly within the posterior limb of the internal capsule)
  - dorsolateral midbrain/rostral pons (of signal void

- DWI is sensitive for TAI/DAI
- foci of shear injury may be visible on FLAIR and T2-weighted images

Impulsive type of Dynamic Loading

- Acceleration- Deceleration

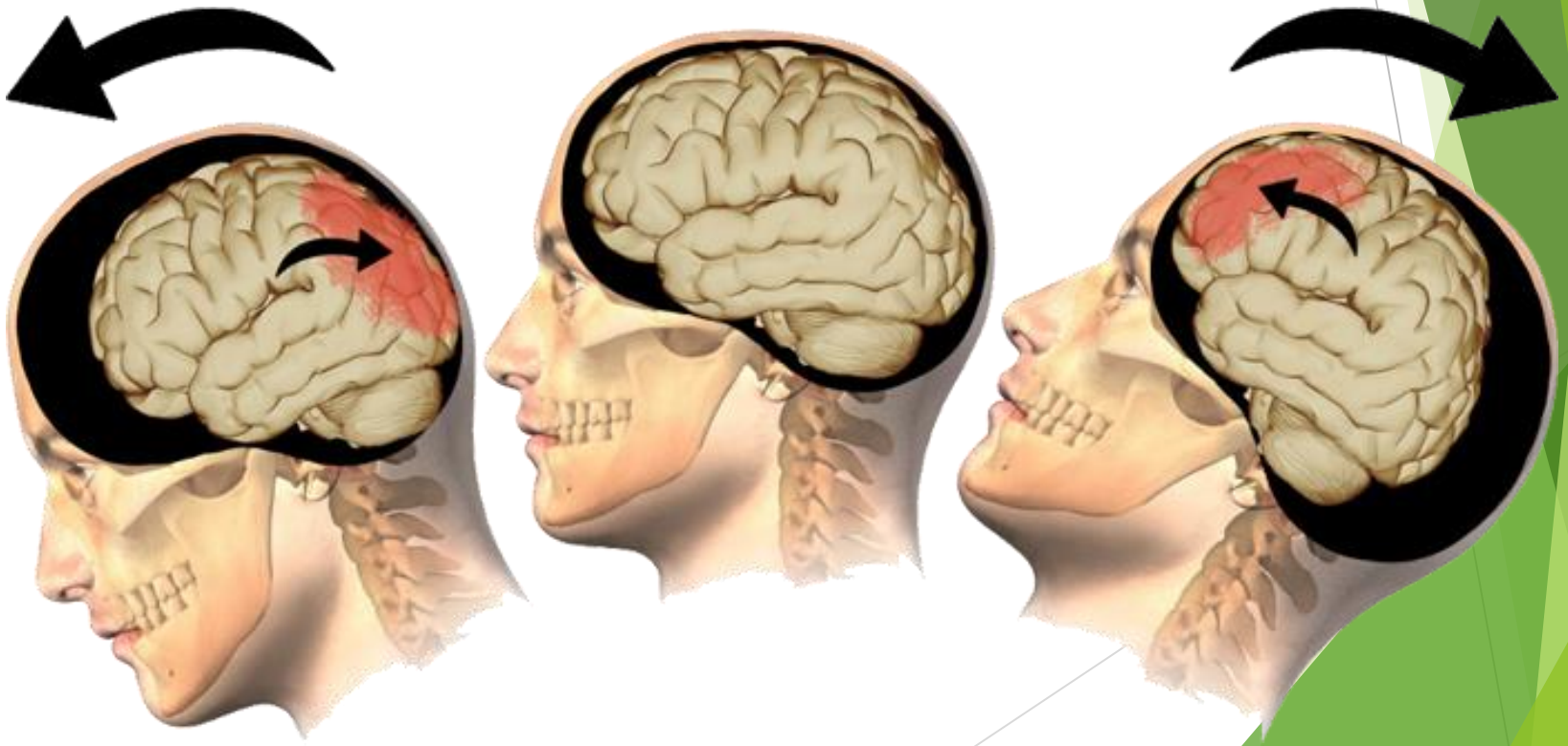
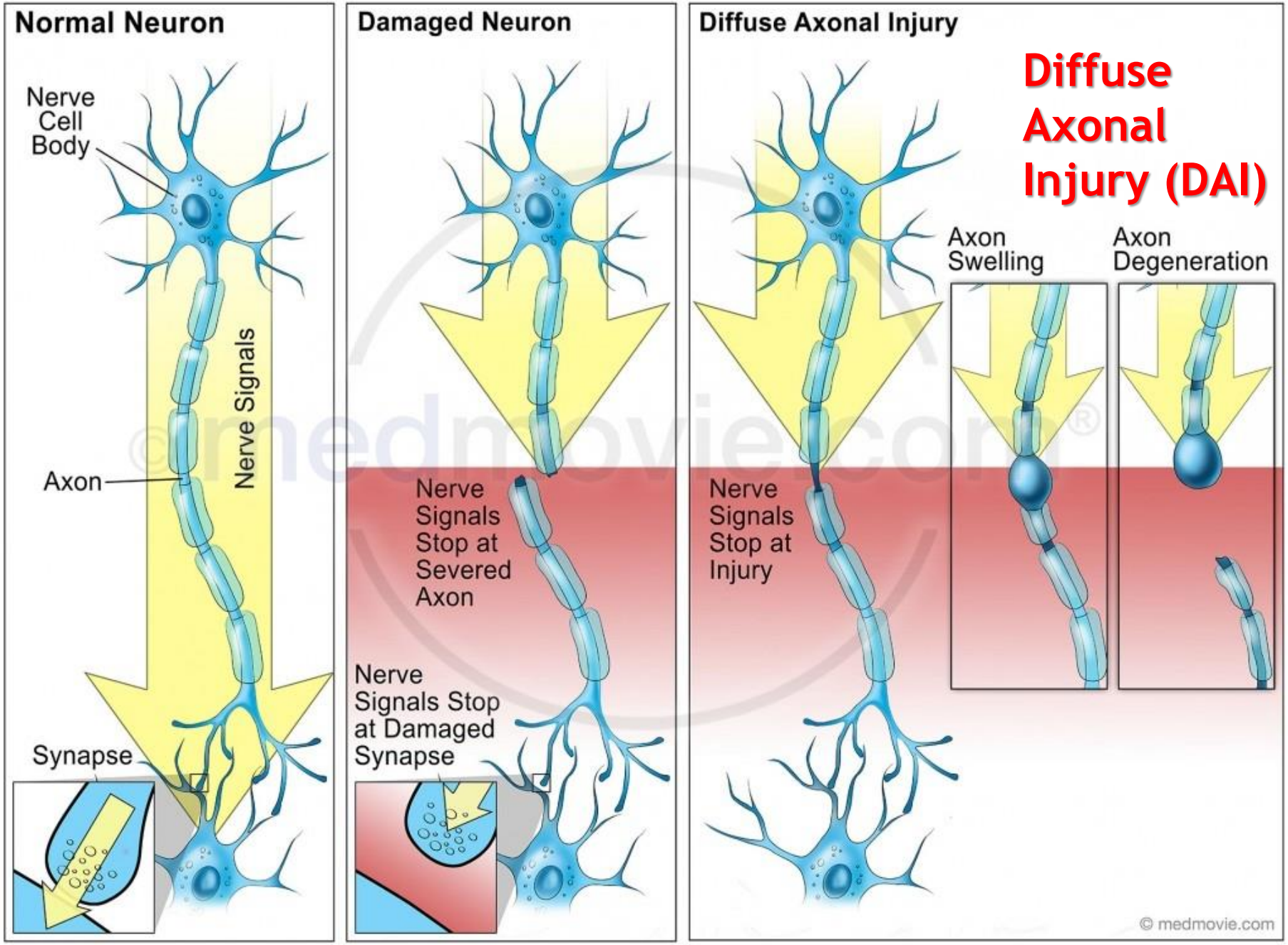
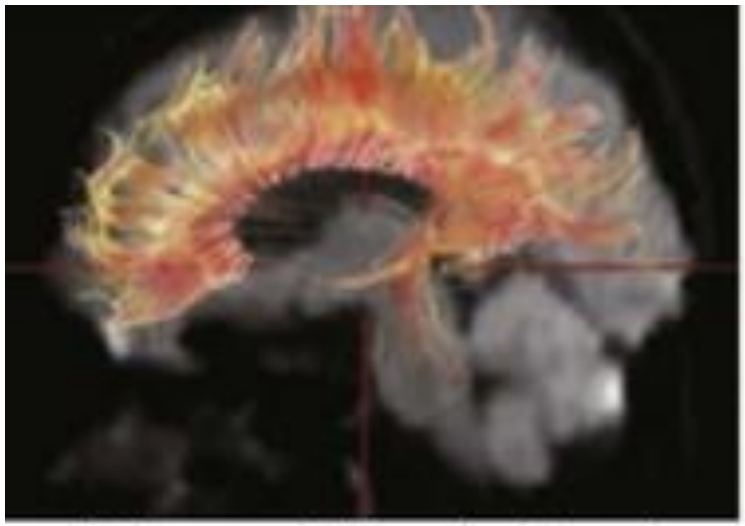


Image from: http://brain-injury-resource.com/types-of-brain-injury.html

Diffuse Axonal Injury (DAI)

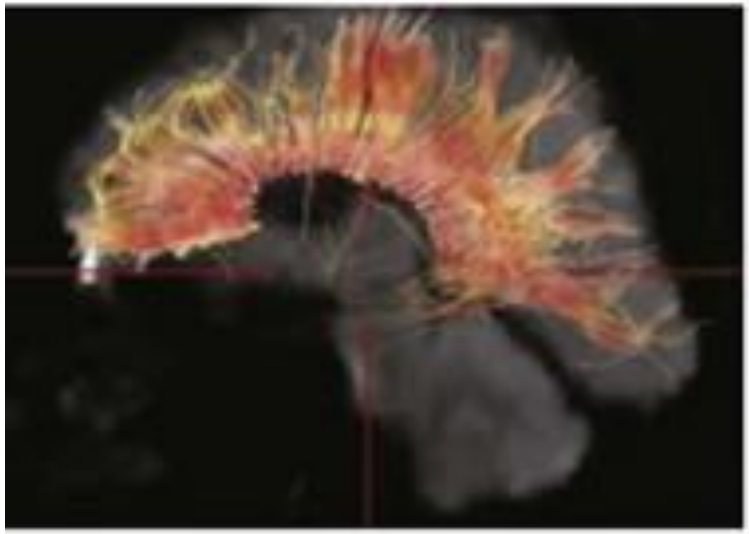


https://medmovie.com/topic/nml_0007/damaged-neurons-and-diffuse-axonal-injury/

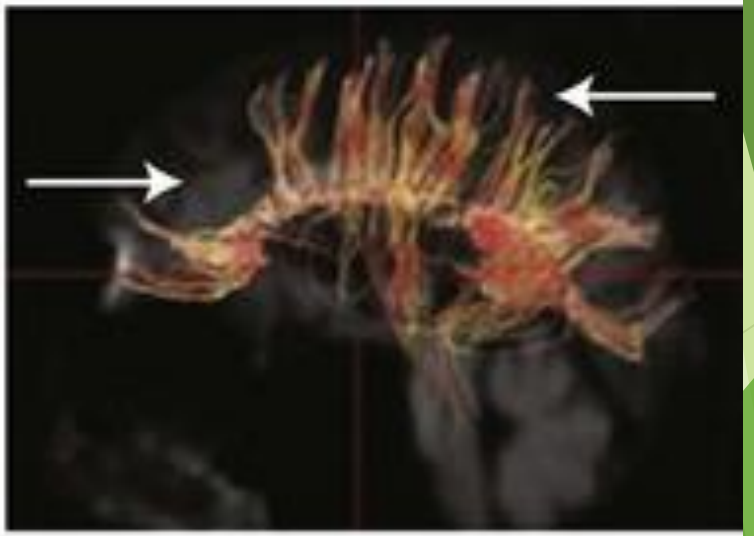


A 27-year old healthy female volunteer

A 26-year old male with DAI

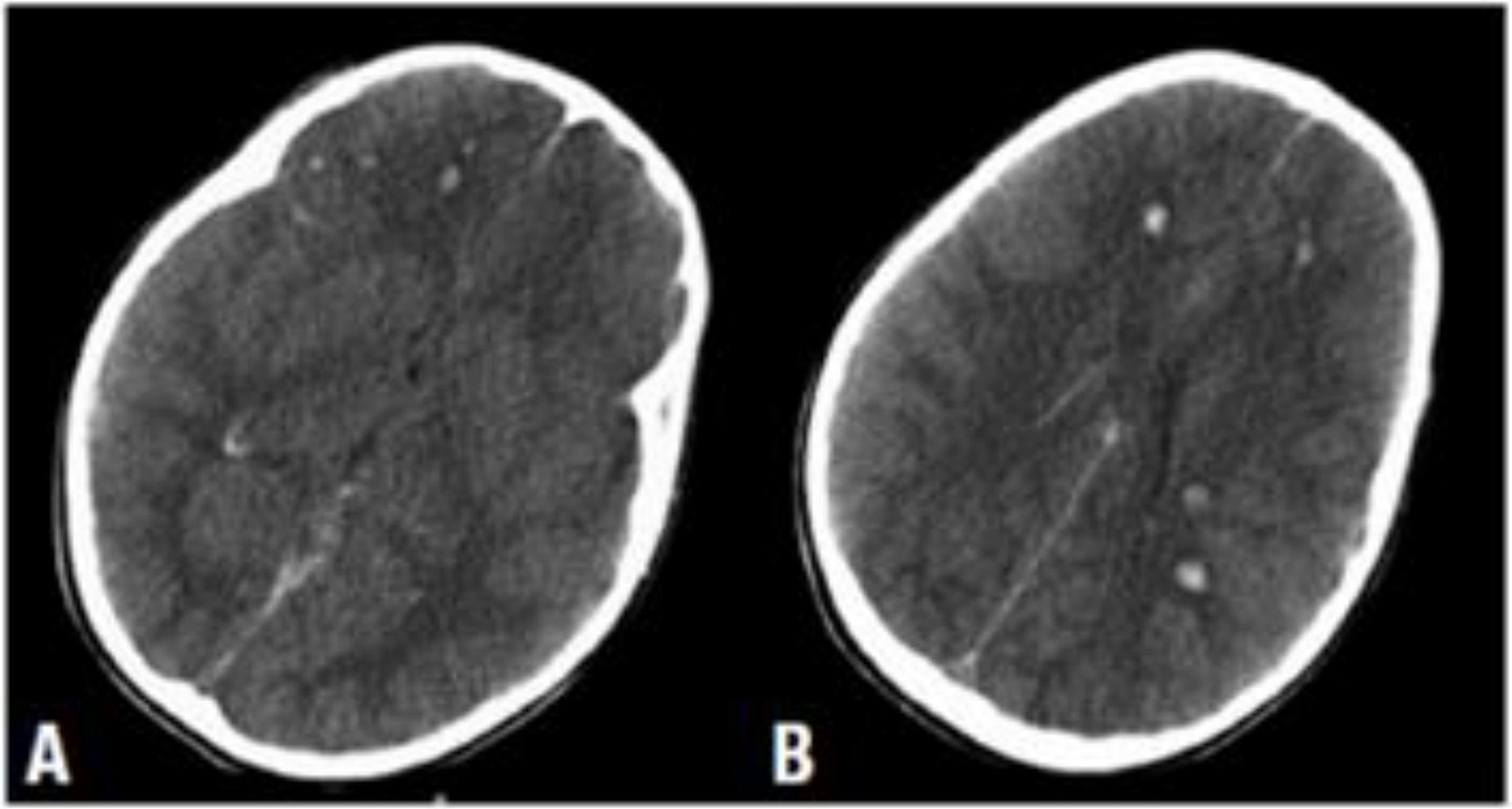


A 36-year old healthy male volunteer



A 34-year old male with DAI

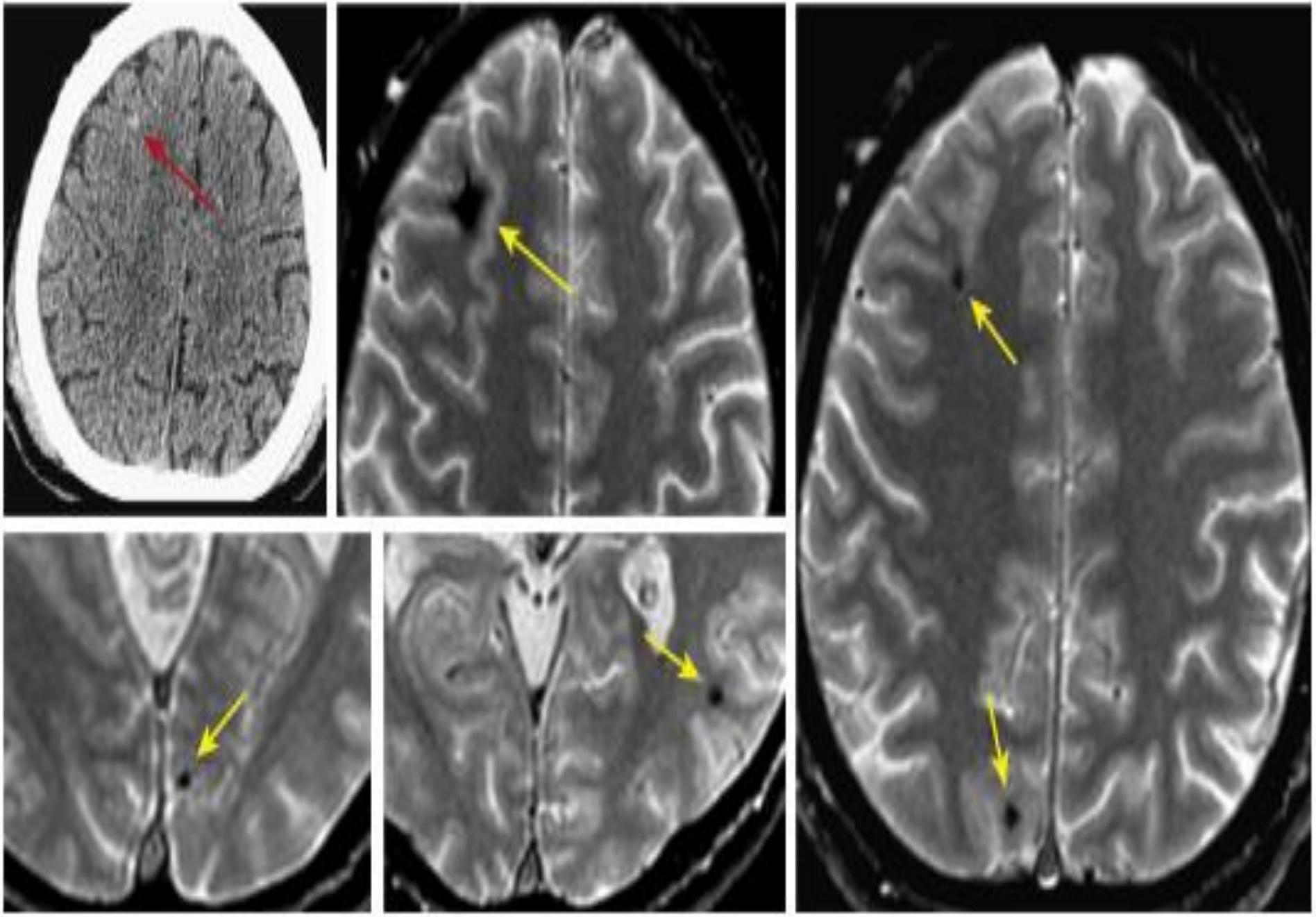
https://clinicalgate.com/trauma-of-the-nervous-system-craniocerebral-trauma/

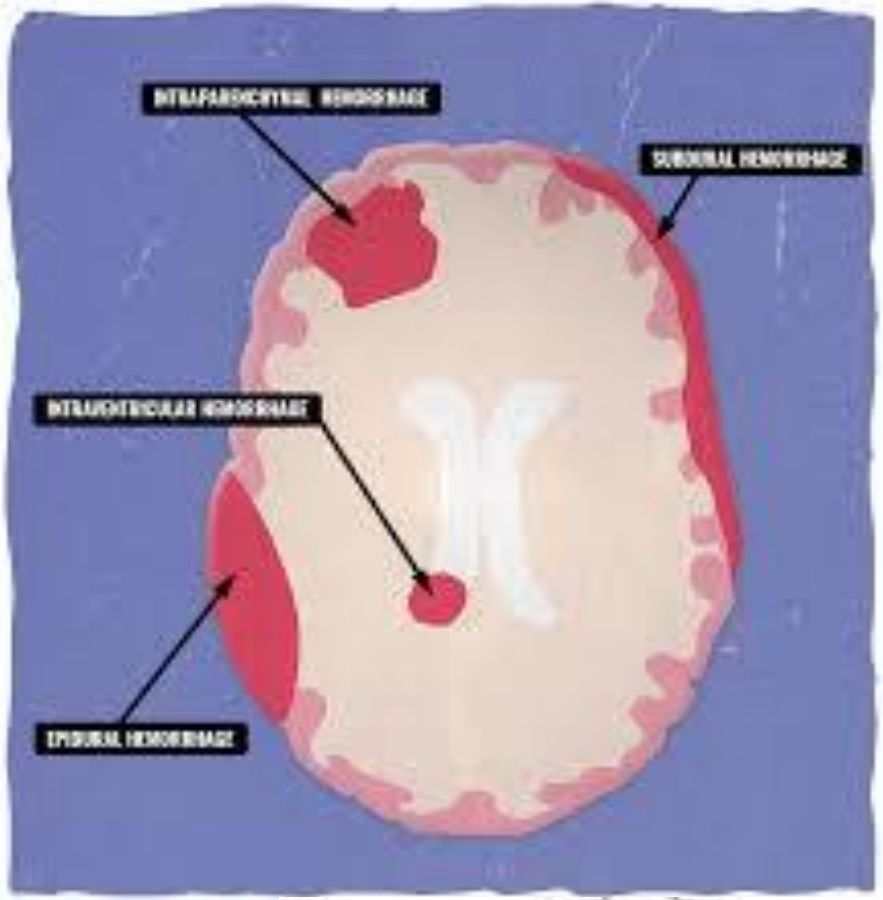


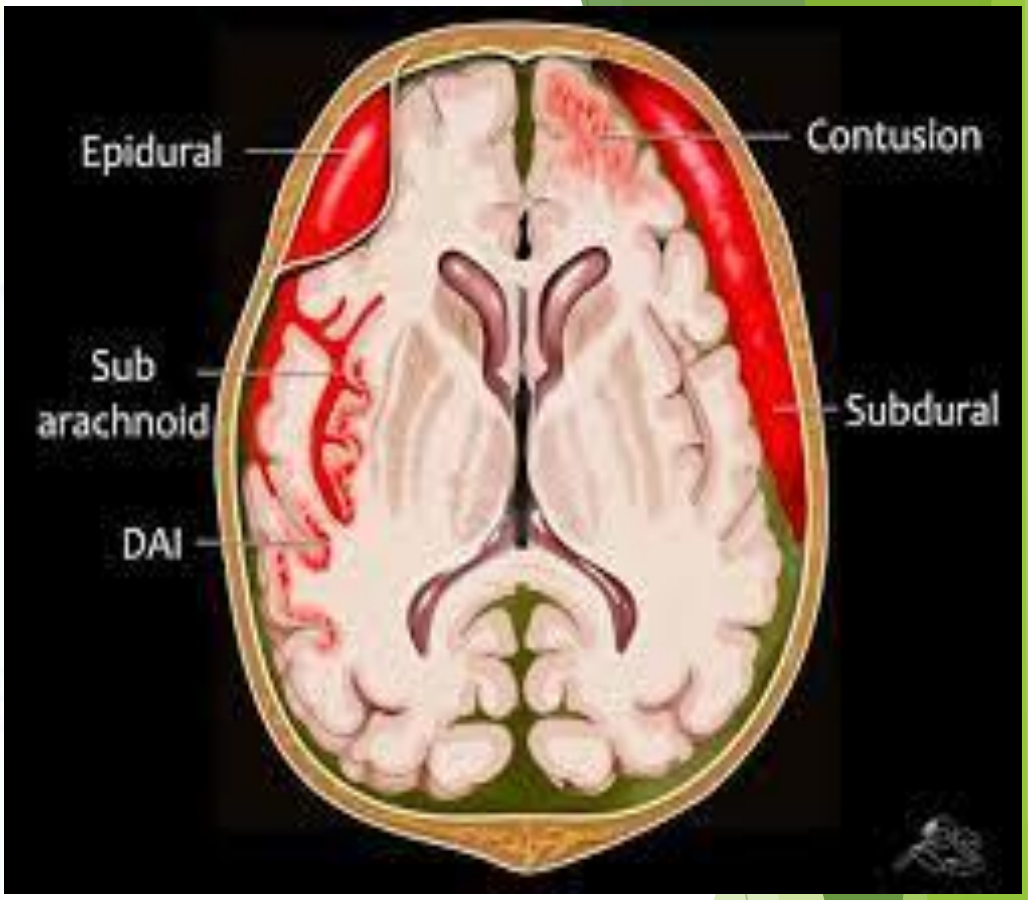
http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1980-57642015000400356

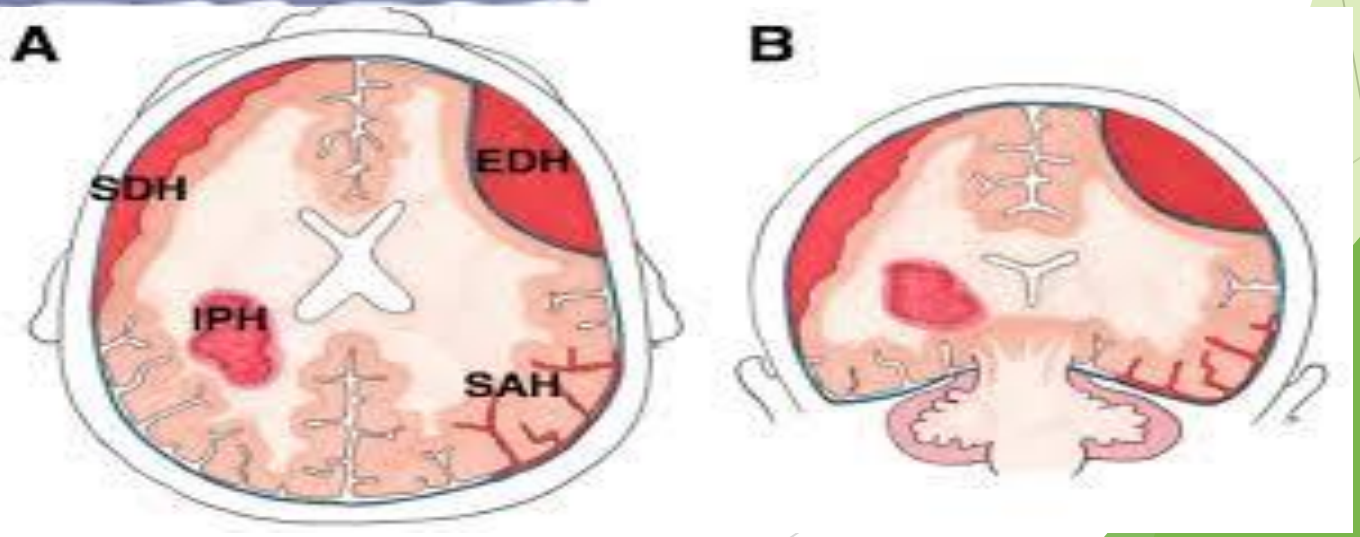

A


B




SUBDURAL HEMORRHAGE
EPIDURAL HEMORRHAGE


Epidural
Contusion
Sub
arachnoid
Subdural
DAI

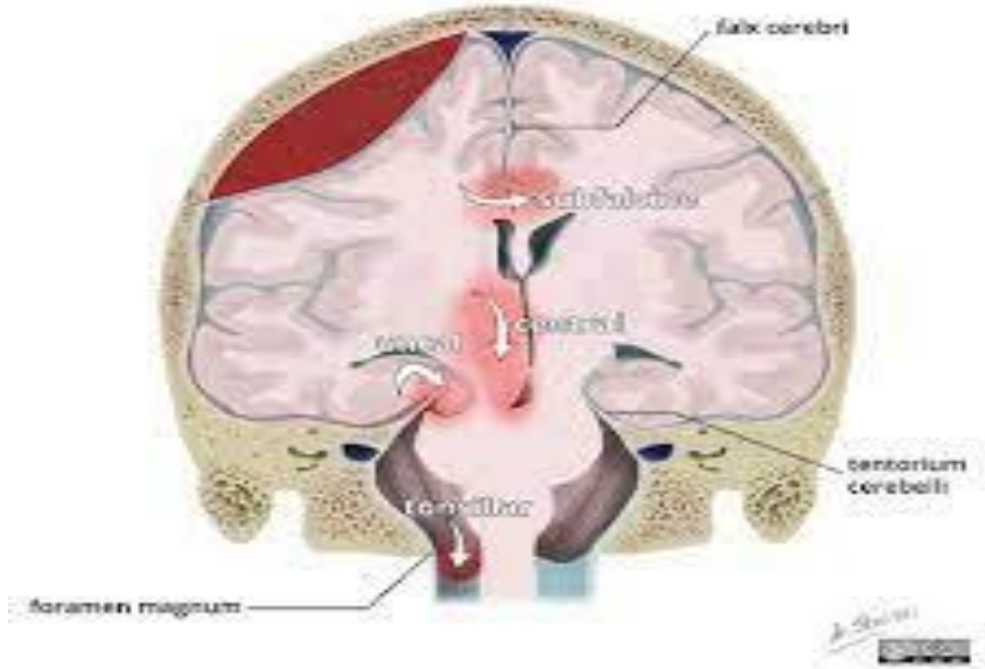

A
SDH
EDH
IPH
SAH
B

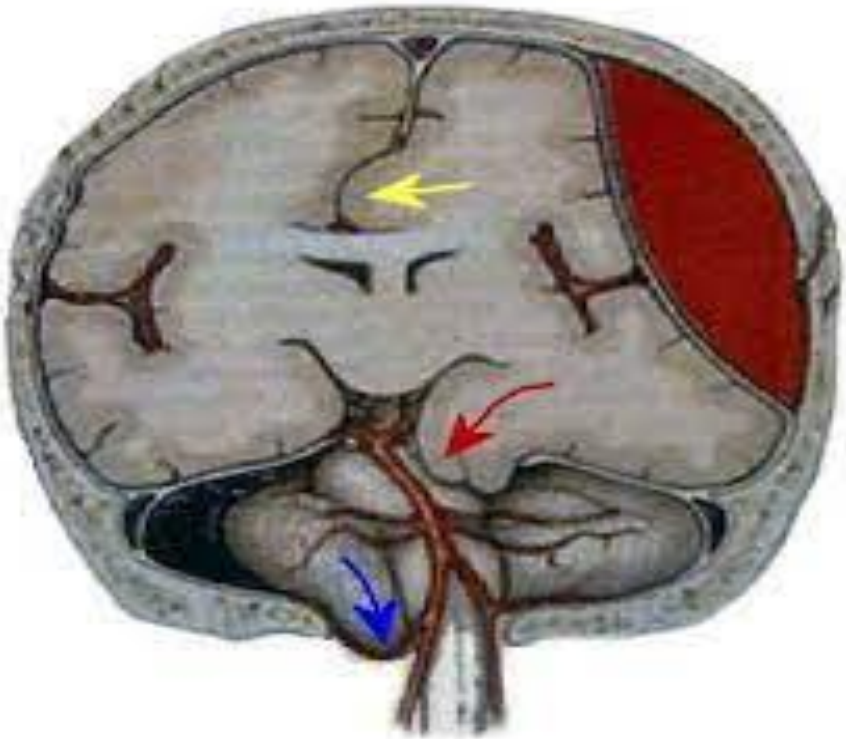
Cerebral Swelling and Brain Herniation

- increase in cerebral blood volume (hyperemia)
  - cerebral dysautoregulation
- or an increase in tissue fluid (cerebral edema).

- Cerebral edema:
  - Vasogenic
    - BBB disruption
  - Cytotoxic
    - secondary to ion channel leakage, mitochondrial failure, and tissue hypoxia
  - Hydrostatic
    - sudden increase in intravascular pressure and can be seen with sudden decompression of a focal mass
  - hypo-osmotic
    - decrease in serum osmolality and a subsequent efflux of fluid from the intravascular to the extravascular space
  - Interstitial
    - movement of fluid into the periventricular space secondary to obstructive hydrocephalus.
- **cytotoxic edema is the most common in TBI, particularly in pediatric patients.**

- Brain herniation:
  - displacement of a portion of the brain from its normal anatomic location.
  - from both primary and secondary injuries
- Types of cerebral herniation:
  - subfalcine herniation
    - commonly referred to as midline shift
    - displacement of the cingulate gyrus across the midline under the falx cerebri.
  - uncal herniation
    - isolated displacement of the medial anterior portion of a temporal lobe into the suprasellar cistern
  - downward transtentorial herniation
    - bilateral (symmetric or asymmetric) or unilateral effacement of the perimesencephalic and/or suprasellar cisterns.
  - external herniation
    - severe open skull
    - a desired effect of decompressive hemicraniectomy





Brain Herniation Types

4. Transcalvarial
- Brain displacement outside the cranial cavity via a cranial defect (either surgical craniectomy or skull fracture)

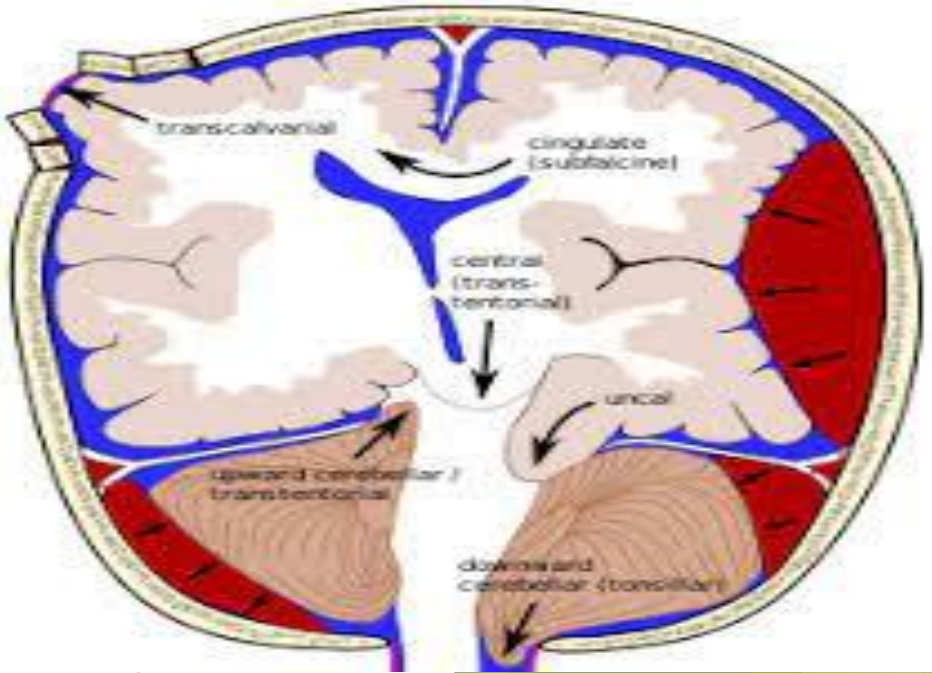
3. Subfalcine
- Compression of cingulate gyrus under falx cerebri
- ACA infarction, contralateral leg weakness, behavioral changes

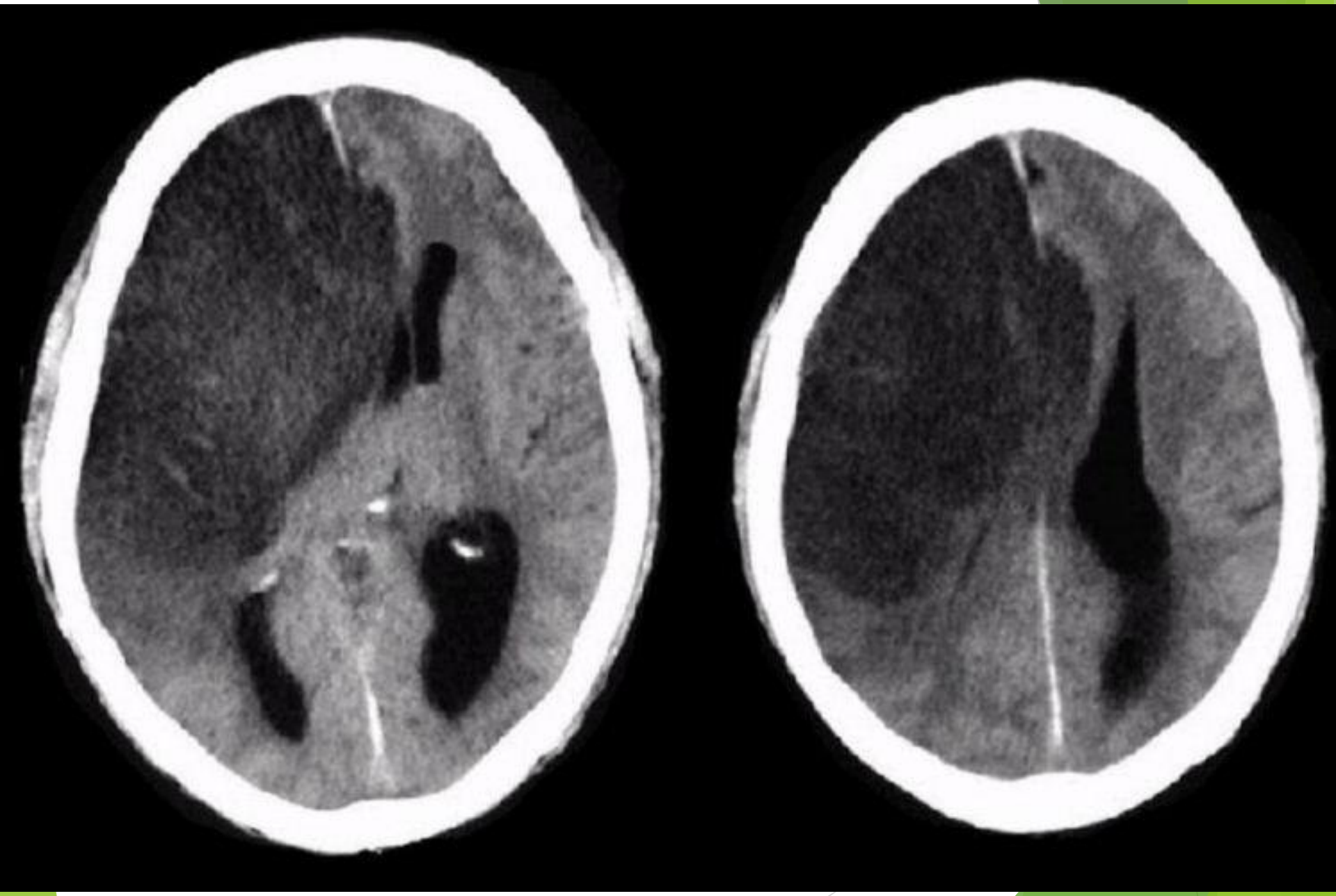
5. Ascending transtentorial
- Upward displacement of cerebellum through tentorial foramen, compression of the midbrain
- Coma, mysis, absence or asymmetry of oculocephalic reflex, decerebrate posturing

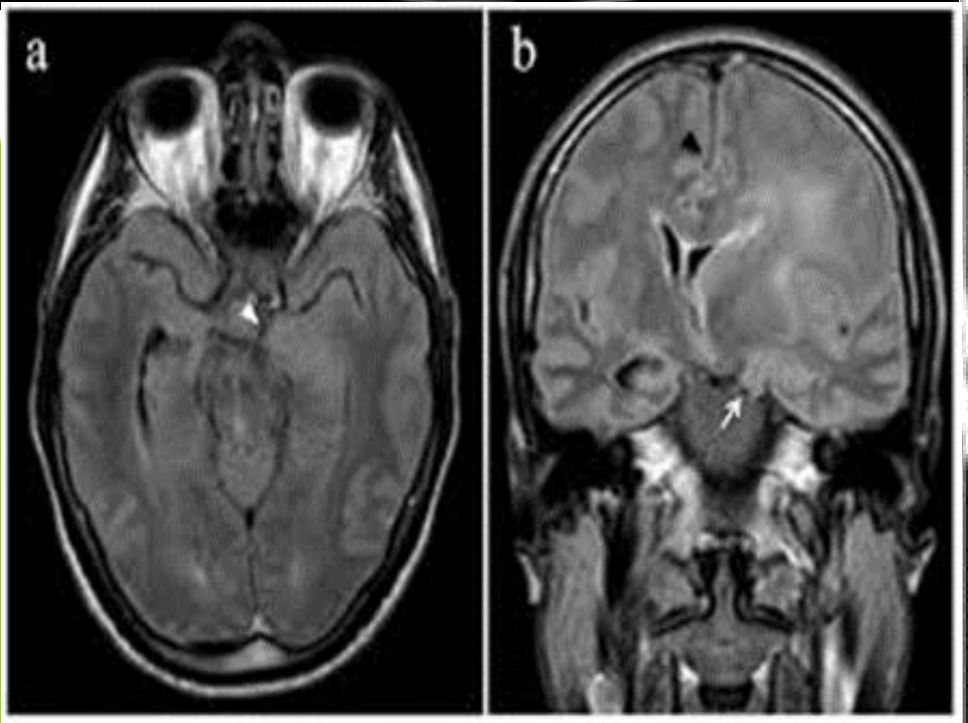
2. Central transtentorial
- Progressive downward displacement of diencephalon and brainstem
- Coma, diabetes insipidus, Parinaud syndrome

1. Uncal transtentorial
- Inferior displacement of medial temporal lobe (uncus) past free edge of tentorium cerebelli
- Ipsilateral oculomotor nerve palsy, PCA infarction, Kernohan's notch phenomenon

6. Tonsilar
- Downward displacement of cerebellar tonsils through foramen magnum
- Cardiorespiratory dysfunction (apnea, hypertension) and coma



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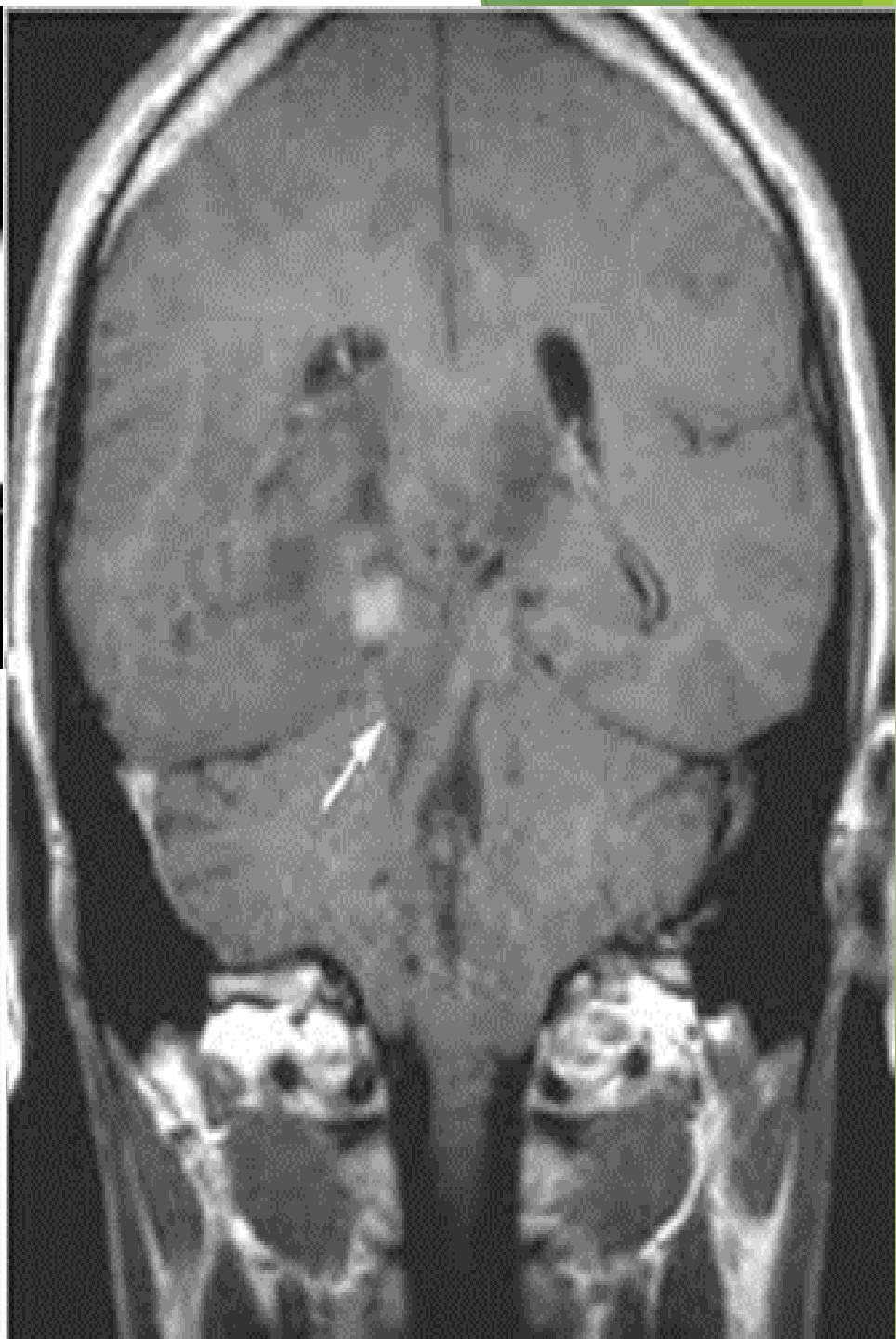

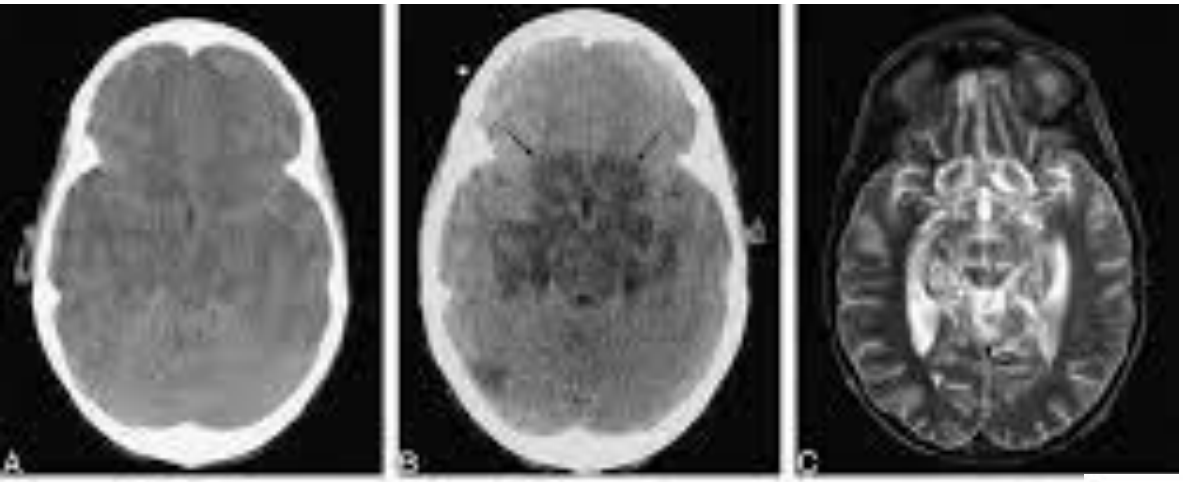
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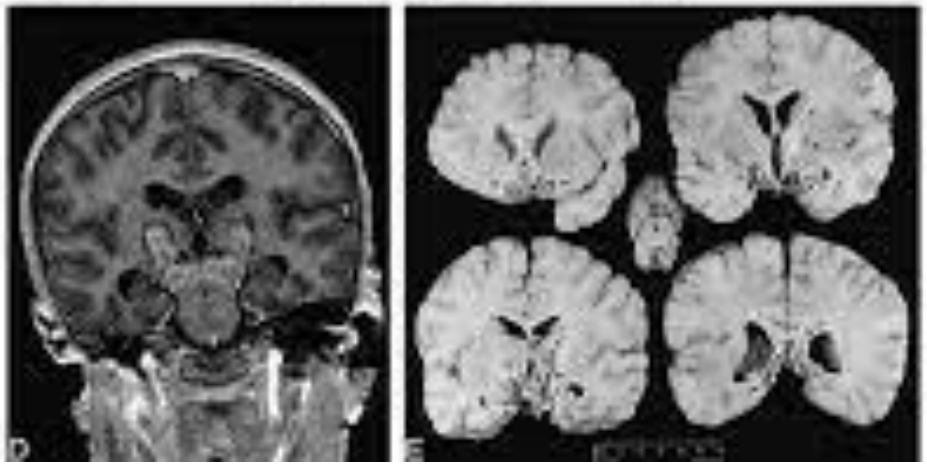
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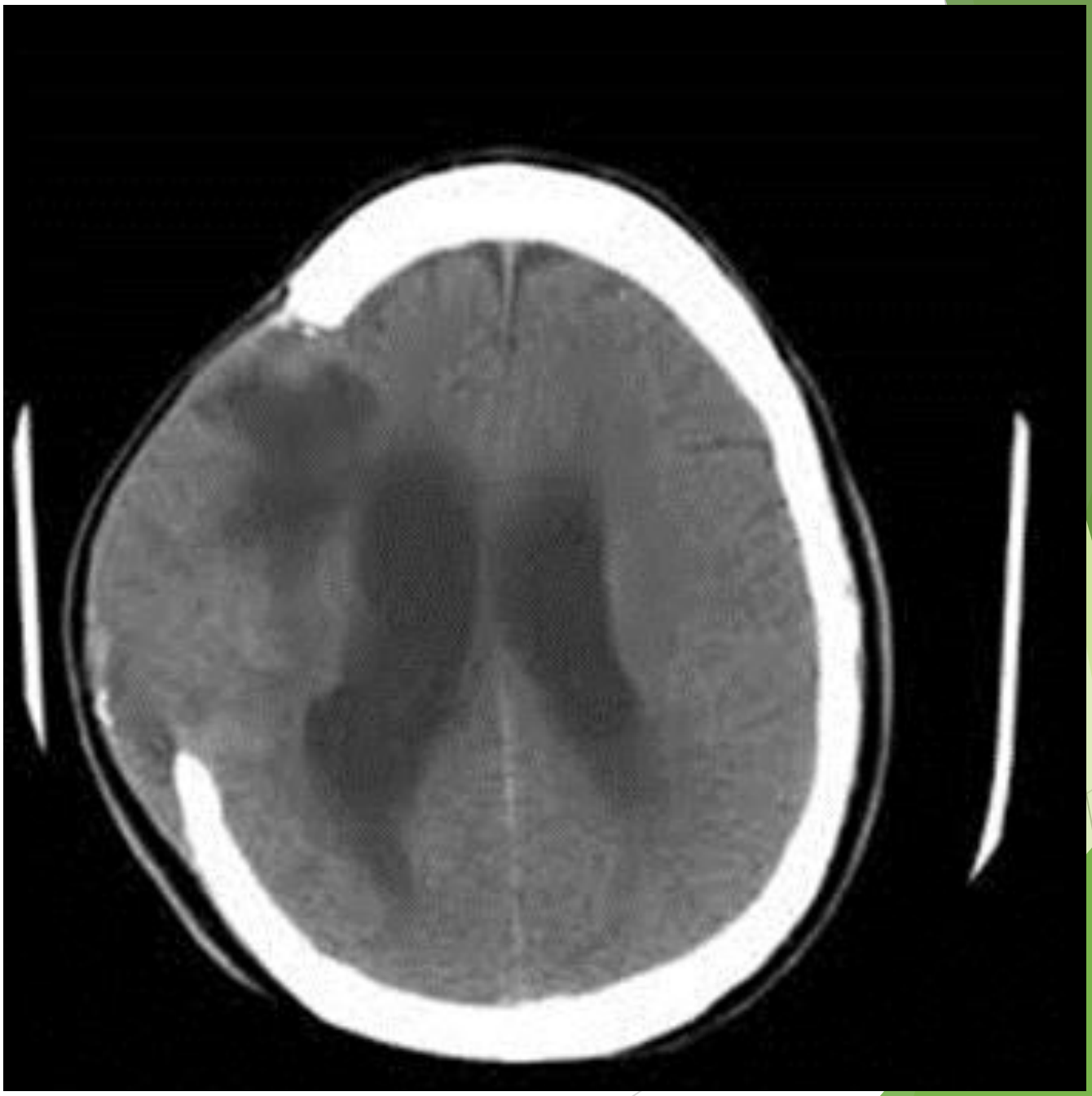


Diagnosis

- Arterial blood gas (determine oxygen-carrying capacity)
- CBC (to identify hemodynamic stability and infection)
- CT scan (identify scope of injury)
- MRI (more specific picture about brain)
- Electroencephalogram (EEG) (to detect seizure activity)

Nursing Care Plans for Head Injury

- **Decreased Intracranial Adaptive Capacity/ increased intracranial pressure**
- **Expected Outcome**: The patient will have an optimal cerebral tissue perfusion as evidenced by stable ICP and LOC

- **Monitor the patient's neurological status meaning:**
  - **LOC**
  - **Pupils**
  - **Glasgow coma scale scores continuously.**

- *Subtle changes such as*
  - *Irritability*
  - *increased confusion*
  - *restlessness can indicate a deterioration in status.*
- *A change in LOC may be a sign of an increased ICP (intracranial pressure).*

- **Monitor vital signs continuously or at least every hour.**
  - *Changes in vital signs: a sign of increased ICP*
- *An increased ICP causes bradycardia, a widening pulse pressure, and irregular respirations (Cushing's triad).*

- **Assess for fluid leakage from the ears and nose.**
  - *Rhinorrhea and otorrhea might be cerebrospinal fluid (CSF) after head trauma caused by fractures.*
- *Because there is no accumulation of fluid in the brain, there might be no signs of ICP.*

- **Keep**
  - **Po2 between 80 and 100 mmHg**
  - **Pco2 between 35 and 38 mmHg.**

- *The goal is to prevent*
  - *prolonged states of hypoxemia (decreased blood level of oxygen) and hypercarbia (increased amount of carbon dioxide in arterial blood).*
  - *Hypercarbia can cause cerebral vasodilation, which could cause an increased intracranial pressure.*

- **Avoid any activities and symptoms that increase ICP.**

  Position changes (keep head straight)
  Endotracheal suctioning
  Coughing, vomiting
  Bending at the waist
  Valsalva maneuvers
  Pain
  Fever
  Shivering

- *These factors can increase cerebrospinal fluid and, therefore, intracranial pressure.*
- *Elevation of the head of the bed and maintaining a neutral alignment help reduce venous pressure and thus decrease ICP.*
- *Limiting suctioning and hyperoxygenation before suctioning helps keep ICP at bay.*
- *Treating pain, fever and shivering helps lower ICP as well.*

- **Use an intracranial monitoring system.**

  This equipment allows for real-time, continuous monitoring.

- *An ICP that is greater than 15 mmHg should be reported right away.*

- **Administer medication as ordered to decrease ICP.**
  - Hyperosmotic agents (Mannitol)
  - Steroids
  - Barbiturate
  - Antipyretics
  - Muscle relaxants
  - Anticonvulsants

- *Medications such as Mannitol are used to draw fluid from interstitial spaces into the intravascular space reducing cerebral edema.*
- *Steroids help reduce brain swelling.*
- *Barbiturates are used to reduce brain metabolism and blood pressure.*
- *Antipyretics lower body temperature, which lowers metabolism, which lowers cerebral blood flow – decreasing ICP.*
- *Muscle relaxants prevent shivering.*
- *Anticonvulsants are administered to avoid seizure activity.*
  - *Seizures might increase metabolic demands and cerebral blood flow, increasing ICP.*

Risk for Seizures

- **Expected Outcome**: The patient will remain free from seizure activity and injury thereof.
- **Risk factors:**
  - Intracranial Bleeding
  - Contusion
  - Hyponatremia
  - Open and closed brain injuries
  - Hypoxia

- **Protect the patient's airway during seizure activity.**

  The patient might not be able to control muscle movement during a seizure.

- *The tongue might pose an airway obstruction by falling back into the upper airway.*

- **Note characteristics during the seizure:**
  - Onset
  - Duration
  - Type of seizure
  - Behavior at the onset, during, and after the seizure.

- *Documenting these characteristics can help to identify the type of seizure and allows for more specific treatment options.*

- **Maintain seizure precautions.**
  - Reduce environmental stimuli
  - Pad side rails
  - Place the bed in the lowest position
  - Have suction set up and ready if needed
  - Provide head protection

- *These implementations reduce the risk of injury during a seizure.*

- **Assist the patient during the seizure.**
  - Turn the patient's head to the side
  - Suction if necessary
  - Administer oxygen

- *These measures protect the patient's airway during and after the seizure.*

- **Administer anticonvulsants as ordered and check therapeutic levels regularly.**
  - *Phenytoin (Dilantin) can only be mixed with NS.*
  - *Its therapeutic level is 10 to 20 mcg/mL.*
  - *Close monitoring for medication toxicity is essential.*
  - *Signs include but are not limited to:*
    - *Nausea*
    - *Vomiting*
    - *Restlessness*
    - *Drowsiness*
    - *visual changes.*

Acute Confusion/increased intracranial pressure

- **Expected Outcome:** The patient will demonstrate a stable cognitive status as evidenced by intact LOC.

- **Assess the patient's level of consciousness frequently as ordered**.
  - *A change in mental status might indicate an increase in cerebral pressures.*
- **Reorient the patient to person, time, place, and situation frequently.**
  - *Memory might be affected that requires frequent repetition of the same information.*
  - *Informing the patient about their situation might reduce anxiety levels and bring their cognitive status back to baseline.*

- **Treat the underlying cause of the confusion.**
  - *For increased intracranial pressure, implement measures to reduce this pressure.*

- **Introduce yourself before any interaction and procedures.**
- **Explain care in short and simple sentences before and throughout the process.**
  - *These measures are part of reorientation.*
  - *Too much information at once might increase confusion and make the patient more irritable.*

- **Promote continuity of care.**
  - *Frequent changes in staff and environment might further worsen the patient's confused state.*
  - *Keep the staff and environment consistent as much as possible.*
- **If possible, have the family communicate with the patient via facetime.**
  - *Seeing familiar faces and recognizing familiar voices might stimulate memory and helps with reorientation.*

Deficient Knowledge r/t lack of experience with head injury

- Expected Outcome: The patient will demonstrate knowledge about the disease process, treatment, and prognosis as evidenced by verbalizing correct information and posing appropriate and relevant questions.

- **Assess the patient's cognitive ability and receptiveness to learning information.**
  - *Brain injury might affect short-term memory and cause behavior and mood changes.*
  - *Ability to focus and learn new information might be difficult and take more time.*

- **Assess the patient's knowledge about the injury and treatment plan.**
  - *Most patients and families have no prior experience with head trauma injuries.*
  - *In most cases, these types of injuries arise from very sudden and unexpected events.*

- **Update patients and family members regularly about changes in health status.**
  - *Family members and caregivers are a vital part of the healthcare team.*
  - *They can provide unique information about the patient's baseline before the head injury.*

- **Prepare the patient and family for possible need for physical, occupational, speech therapy, and ongoing home support.**
  - *Rehabilitation can be a long process that goes beyond the hospital stay.*
  - *Patients and families need to be aware of all members of the healthcare team.*
  - *The roles of significant others might turn into primary caregiver roles after the patient is discharged.*
  - *Families need help to adjust to their new roles and situation.*

Nursing Management of Adults with Severe Traumatic Brain Injury

Prehospital management

- The main goals: prevent hypoxia and hypotension
- Hypoxia and hypotension are strongly associated with poor outcome.
- intubation by poorly trained paramedics has been associated with worse outcome.

- Arterial hypotension:adequate fluid resuscitation with normotonic crystalloids and colloids.

- No benefits for hypertonic solutions, or for albumin
  - associated with worse outcome.

Emergency room management

- recognizing TBI
- involves assessment of the level of consciousness of the patient
- securing the airway
- endotracheal tube for patients with Glasgow Coma Scale (GCS) score of ≤8
- adequate oxygenation
  - (PaO2>60 mmHg)
  - BP (systolic BP >90 mmHg)
- inserting peripheral intravenous (I.V) canulas, cardiac monitoring, pulse oximetry, and continuous waveform capnography if needed.

- A neurologic examination should be done **as soon as possible**
- a GCS score ≤8 is considered an STBI
- Lab data:
  - CBC
  - Electrolytes and glucose
  - coagulation parameters
  - blood alcohol level
  - urine toxicology should be checked.
- noncontrast head computed tomography (CT)

Intracranial pressure (ICP) monitoring is advised for:

- all patients with STBI
- patients at risk of ICH
- GCS score <9
- an abnormal CT scan.

- The target:
  - maintain ICP <20 mmHg
  - and cerebral perfusion pressure (CPP) range is 60–70 mmHg
- Draining cerebrospinal fluid (CSF) decreases ICP.
- Hyperventilation therapy can reduce ICP
  - but there is no strong evidence which indicates whether this improves outcomes.
- Correction of hypotension and hypoxia helps in improving patient outcomes.

- The management of patients with head trauma should always consider **C-spine motion restriction.**
- Hold the neck immobile in line with the body
- apply a rigid or semirigid cervical collar
- (unless the patient is very restless) secure the head to the trolley with sandbags and tape.
- Cervical spine injury can be difficult to diagnose in the unconscious patient
- should be assumed to be present until it can confidently be excluded.

- The priority in TBI: a clear airway.
- Remove secretions and foreign bodies by manual extraction or suction
- giving oxygen by mask (10–12 L/min).
- The adequacy of ventilation by ABG
- indwelling arterial cannula allows serial blood gas measurement and continuous recording of BP
- Pulse oximetry is valuable for indirect measurement

- Hypotension is a late sign of hypovolemic shock.
- Pulse rate, respiratory rate, and capillary refill time are the more useful ways of assessing the circulation after injury.

- Peripheral I.V infusions should be considered for decreased blood volumes.
- Early direct monitoring of arterial pressure and central venous pressure is helpful for assessing the adequacy of resuscitation.

- When managing the immediate and long-term consequences of TBI, many pharmacological options, including psychostimulants, antidepressants, antiparkinsonian agents, and anticonvulsants can be used.
- These can play a role in managing the neuropsychiatric, neurocognitive, and neurobehavioral sequelae of injury to the brain.

Conservative and operative management

- Positioning
  - The patient should be positioned properly
  - neck in neutral position
  - head end of the bed elevated to 30°.
    - facilitates cerebral venous drainage.
  - Head end of the bed should be elevated for patients with CSF rhinorrhea, and otorrhea.
  - Rigid cervical collars should be loosened or removed to decrease ICP.

- Brain tissue oxygen-directed management
  - to maintain brain tissue oxygen tension ≥20 mmHg
  - to keep ICP <20 mmHg and CPP > 60 mmHg
  - have a better outcome and decreased mortality.
- Management:

  (1) earlier recognition and removal of hematomas

  (2) intubation and ventilation with FiO_2 and minute ventilation adjusted to set SaO_2>93% and to evade PaO_2<60 mmHg

  (3) $PaCO_2$ set at 35–45 mmHg unless ICP is increased when $PaCO_2$ is maintained between 30 and 40 mmHg

  (4) normothermia (~35°C–37°C)

  (5) sedation by administering propofol during the initial 24 h, succeeded by sedation and analgesia with lorazepam, morphine, or fentanyl

  (6) head end elevated to 15°–30° and knee elevated

  (7) if seizures are present, administer anticonvulsants (phenytoin)

  (8) euvolemia by administering a crystalloid infusion (0.9% normal saline)

- The use of both an ICP and a brain tissue PO2 monitor:reduces the mortality rate
- Temperature management:
- Hypothermia reduces ICP (40%) and cerebral blood flow (CBF, 60%)
  - has positive effects on cerebral metabolism, and improves outcome for 3 months after injury
  - Thus, it limits secondary brain injury
- Normothermia should be maintained with the use of:
- antipyretic medications
- surface cooling devices
- even endovascular temperature management catheters

- Stress ulcer prophylaxis
  - Stress ulcers (Cushing's ulcer) are a very common risk factor of patients in the Intensive Care Unit (ICU).
  - recommended for the prophylaxis of stress ulcers:
    - Early enteral feeding
    - H2-blockers
    - proton-pump inhibitors
    - sucralfate

Nutrition

- Patients immediately after injury may experience a systemic and cerebral hypermetabolic state.
- Early enteral feeding should be initiated within 72 h of injury.
- By day 7 of postinjury, these patients should be given full caloric replacement.
- After TBI, early initiation of nutrition is recommended.
- Parenteral nutrition is superior to enteral nutrition in improving outcomes.
- Evidence-based guidelines include the provision of early (within 24 h of injury) nutrition (>50% of total energy expenditure and 1–1.5 g/kg protein) for the first 2 weeks after the injury.[30]
- Feeding patients to attain basal caloric replacement at least by the 5th day and at most by the 7th day postinjury is recommended to decrease mortality.
- Transgastric jejunal feeding is recommended to reduce the incidence of ventilator-associated pneumonia.[31]

Fluid therapy

- Fluid therapy helps in restoring vascular capacity, tissue perfusion, and cardiac flow rate.
- Hypertonic saline can be used for patients with complications of STBI and systemic shock
- Euvolemia can be maintained using isotonic fluids such as normal saline

- Hyperventilation
  - Hyperventilation reduces $PaCO_2$, CBF, and ICP by the cerebral autoregulation.
  - It can be used only if ICP >30 mmHg and CPP <70 mmHg; CPP >70 mmHg but higher ICP >40 mmHg
- Transport of patients
  - These patients should be transported with caution and care with suitable protection.
  - It should be done by trained and suitably equipped personnel with careful supervision, support to the vital organs, continuous monitoring, prevention of damage to the spine, and complete documentation

Hemostatic therapy

- Patients with STBI develop coagulopathies
- Prothrombin complex concentrate, fresh frozen plasma, and/or Vitamin K should be given for patients with warfarin-associated intracerebral hemorrhage (ICH).
- Platelet count should be maintained >75,000 with platelet transfusions if necessary for patients with thrombocytopenia.

Glucose management

- Extremes of very high or low blood glucose levels should be managed accordingly
- A target range of up to 140 mg/dL or possibly even 180 mg/dL may be appropriate
- Patients with hyperglycemia should be managed insulin protocol in cases with value >200 mg/dl for improving the outcome
- Tracheostomy might be favorable if it is performed in the 2nd or 3rd week after admission.

Medical management

- An increase in ICP can be prevented by administering sedation.
- The foremost therapies after pain and agitation are mannitol or hypertonic sodium chloride solution.
- Propofol, I.V dexmedetomidine, and fentanyl are commonly used in mechanically ventilated patients.[2]
- Steroids are not recommended in TBI.
- Barbiturates are commonly used to treat ICP.
- There is no affirmation that barbiturates reduce mortality; it also causes low BP
- Mannitol can be used to reduce ICP, and it also helps in improving CBF.
- Phenytoin is recommended to reduce posttraumatic seizures
- Levetiracetam can be used as an alternative

Medical management

- Sympathetic storming
  - includes posturing, dystonia, hypertension, tachycardia, dilatation of the pupils, sweating, hyperthermia, and tachypnea can occur within the first 24 h after injury till several weeks.
- Can be caused after the cessation of sedatives and narcotics in the ICUs
- should be treated based on their signs and symptoms by initiating planned medications to reduce the activities of the sympathetic nervous system
- erythropoietin show lower mortality and better neurological outcome and limit neuronal damage induced by TBI
- Naloxone effectively reduce mortality and control ICP in TBI.

Surgical management

- patients having GCS score ≤8 with a huge lesion on noncontrast head CT scan.
- Depressed skull fractures those are open or complicated need surgical repair.
- Decompressive craniectomy helps in positive patient outcome.
- An epidural hematoma larger than 30 mL in volume despite a patient's GCS score should be evacuated immediately.
- Acute subdural hematomas greater than 10 mm in thickness or associated with midline shift greater than 5 mm on CT also should be should be surgically evacuated.
- If there is an evident mass effect, then a surgical evacuation is recommended in traumatic ICH.
- Superficial debridement and dural closure are indicated in a penetrating injury to prevent CSF leak.
- For depressed skull fractures, elevation and debridement are recommended.

Monitoring

- The primary aim of neuromonitoring in patients with TBI
  - early detection of secondary brain insults
  - timely interventions can be instituted
  - to prevent or treat secondary brain injury.
- Cerebral oxygenation and near-infrared spectroscopy are also established as an important parameter for monitoring.
- Cerebral microdialysis is an invasive laboratory device for analyzing brain tissue biochemistry.
  - It is used to measure biochemical changes in the area of brain which are at higher risk to secondary insults and its use is very limited
- Vestibulo-ocular monitoring is an indicator of brainstem function.
  - It helps identify brainstem lesions by imaging techniques

On-going management and prevention of complications

- The prevention of ventilator-associated pneumonia
- persistent systemic inflammatory response syndrome
  - increases the risk of nosocomial sepsis,
  - low-dose hydrocortisone might exert beneficial immunomodulatory effects rather than inducing an immunosuppressive state.
    - The use of stress-dose steroids to prevent ICU-acquired infections is still an emerging concept

On-going management and prevention of complications

- Patients with STBI are prone to develop pressure ulcer.
- The factors influencing pressure ulcer:
  - poorer GCS
  - delayed enteral feeding
  - >10% fall in hemoglobin
  - >10% fall in albumin
- A risk identification scale can be used each shift to identify which patients are at risk
- ventilator tubing should not causing tension on tracheostomy tube and faceplate and pressure-relief devices including specialty mattress surfaces, padded cervical collars, heel lift devices, and pillows, skin barrier creams, topical or indwelling fecal containment devices can be used to prevent the pressure ulcer.

- Around 80% of the urinary tract infections are attributable to an indwelling urethral catheter.
  - Limiting catheter use and
  - minimizing the duration the catheter remains in situ
  - Urinary catheters must be inserted only when necessary for patient care and leave them in place only if indications persist.
  - hand hygiene must be practiced immediately before insertion of the catheter and before and after any manipulation of the catheter site or apparatus.
  - use of aseptic technique and sterile equipment

- Contractures are a common complication of TBI a
- may occur in up to 84% of cases.
- The most commonly affected joints are hip, shoulder, ankle, elbow, and knee,
- with a significant percentage of patients developing contractures in five or more joints.
- Stretch is one of the most widely used techniques for the treatment and prevention of contractures.
- Splints, positioning programs, or casts changed at regular intervals (serial casting) can also be used.
- All methods involve mechanical elongation of soft tissues during varying lengths of time

Postoperative care

- change in ICP, circulation of the CSF, CBF should be monitored continuously.
- Mechanical ventilation should be provided to maintain $PaCO_2$ between 35 and 45 mmHg, maintain normal temperature, correct cerebral perfusion pressure, and prevent secondary brain injury.
- Patients with STBI are at an alarming risk for DVT.
- This can be minimized with
  - range-of-motion exercises,
  - pneumatic compression devices
  - drugs such as low-molecular-weight heparin if needed
- The detection of DVT is difficult; therefore, it is good to concentrate on preventing their development using mechanical or pharmacological methods
- Ventriculostomies and other ICP monitors should be placed under sterile conditions to prevent CSF infections

Initiation of early in-hospital rehabilitation

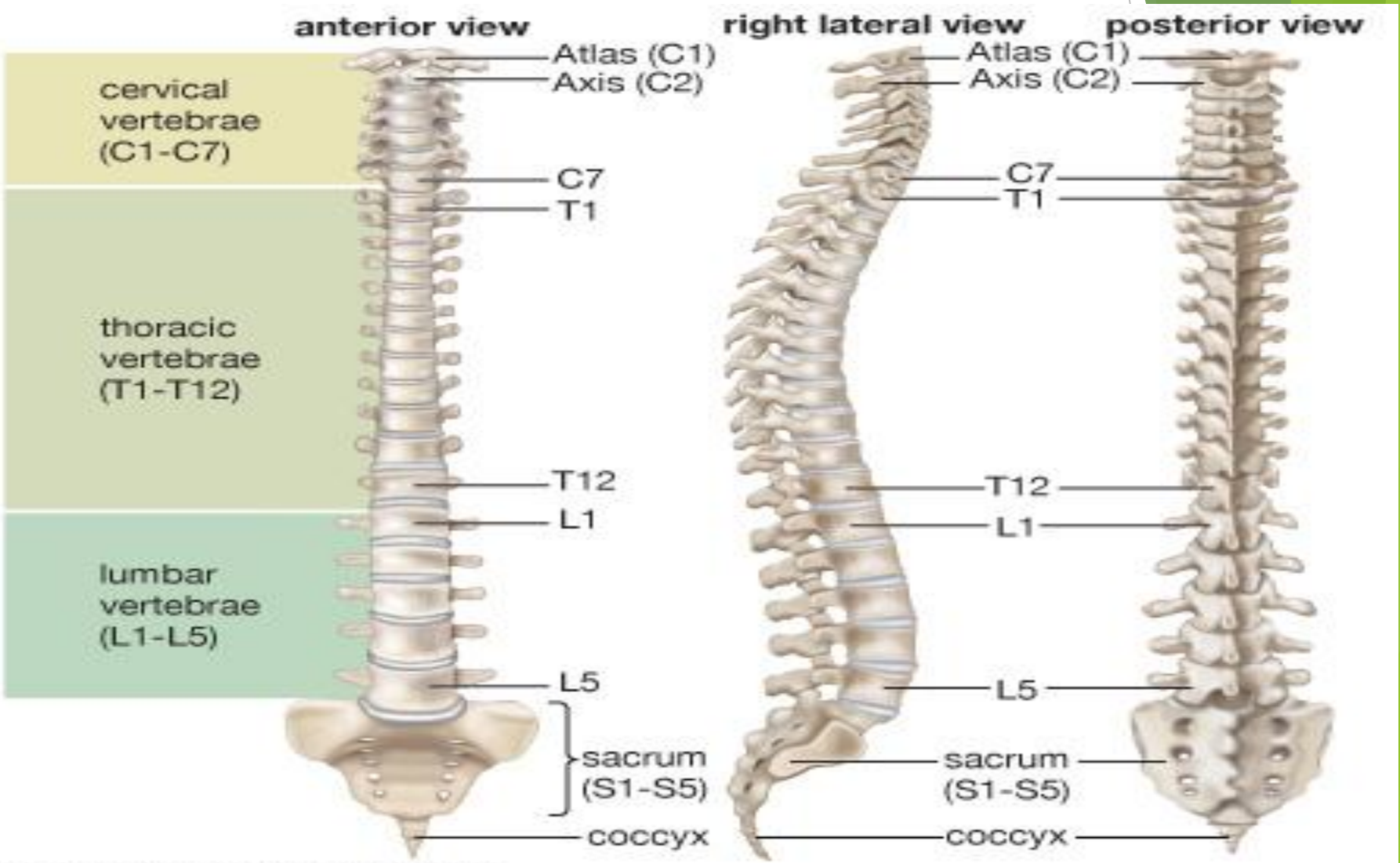
- STBI is the most debilitating of all injuries and has very poor outcome.
- The survivors of STBI suffer from multiple problems such as physical deformity, memory disturbances, functional disability, cognitive dysfunction, and difficulty in performing various activities.
- The strategy of early rehabilitation results in better short- and long-term outcomes.
- patients should receive rehabilitative treatment as soon as possible
- Potential benefits for patients participating in early rehabilitation in the ICU include
  - improved muscle strength,
  - improved physical function,
  - improved quality of life
  - reduced hospital and ICU length of stay, duration of mechanical ventilation, and hospital costs.

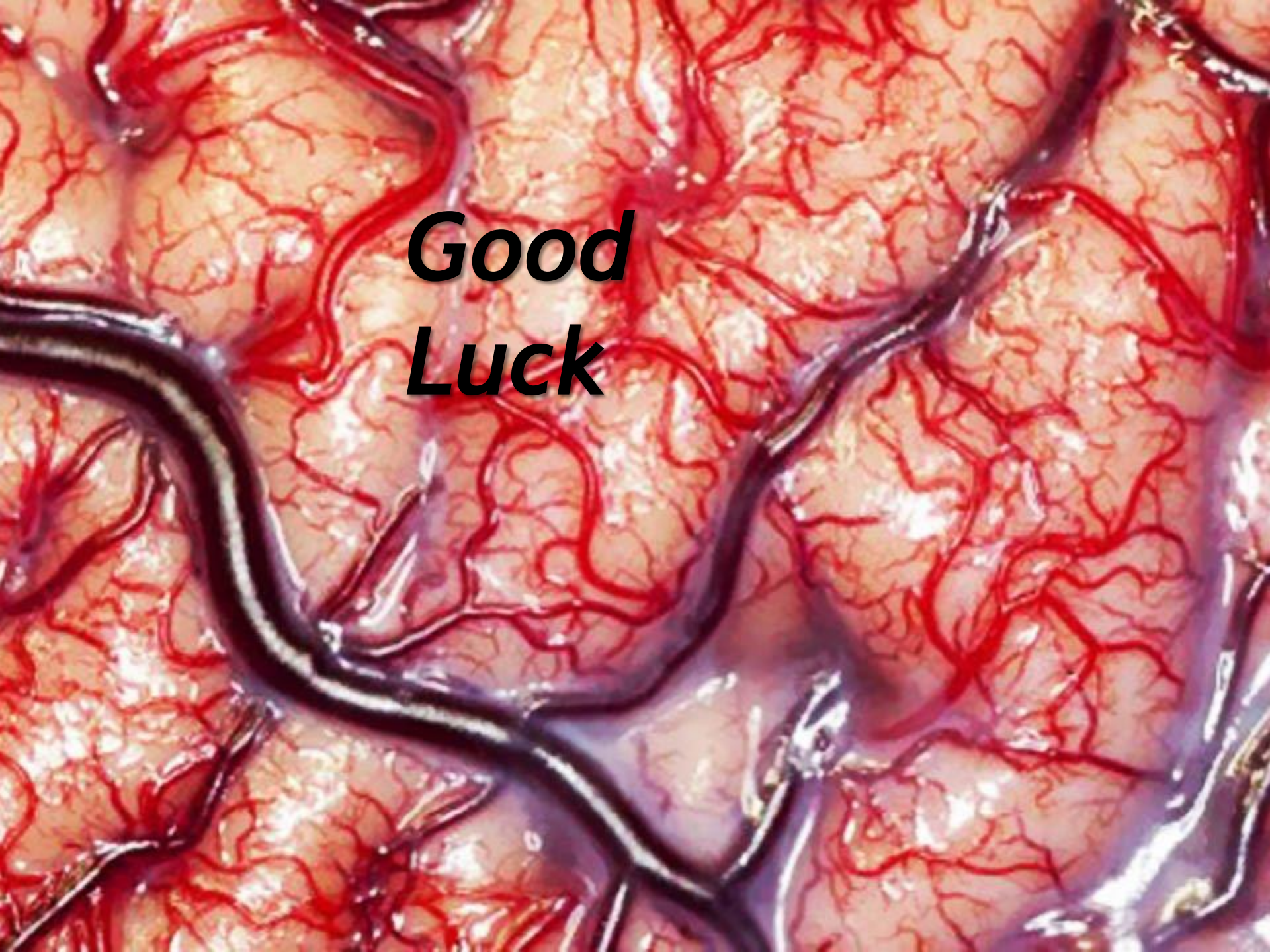
- As a part of long-term management, cranioplasty can be done after **2-6 months of the initial injury to** replace the patient's bone flap or restore the area with mesh or plastic.
- Patients with decompressive craniectomy need neuropsychological, physical, speech, and occupational therapy.
- Patients require weeks to months of TBI rehabilitation
- Measuring the S-100β protein could be convenient in determining the long-term prognosis in patients with severe traumatic injury.
- The cognition in STBI is always related with the patient outcome.
- Cognition improves over time and will be stable from 3 months to 1 year; thus, early screening of cognitive function is recommended for rehabilitation planning in a clinical setting
- Amantadine is proved to be effective in accelerating the pace of recovery during acute rehabilitation
- Sleep problems along with anxiety, depression, daytime sleepiness, and fatigue are common in patients with STBI during rehabilitation.
- Nurses should use actigraphy, sleep charts, sleep diaries for the assessment and diagnosis of sleep problems

آسیب تروماتیک ستون فقرات

Definitions

Spinal Column




Good
Luck