The University of Jordan

Lectures in Pictures

Brain Trauma

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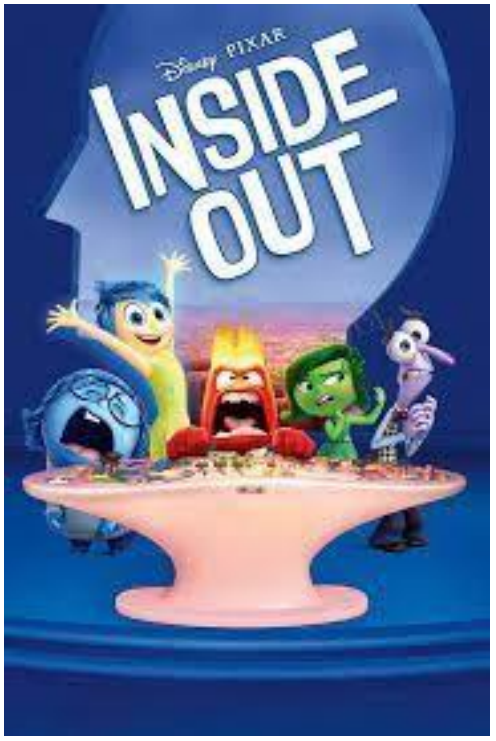
Modified version by:
Mohammad Abusido


Disney PIXAR
INSIDE OUT

Neurosurgery is the 2nd most difficult profession in the world only next to hiking

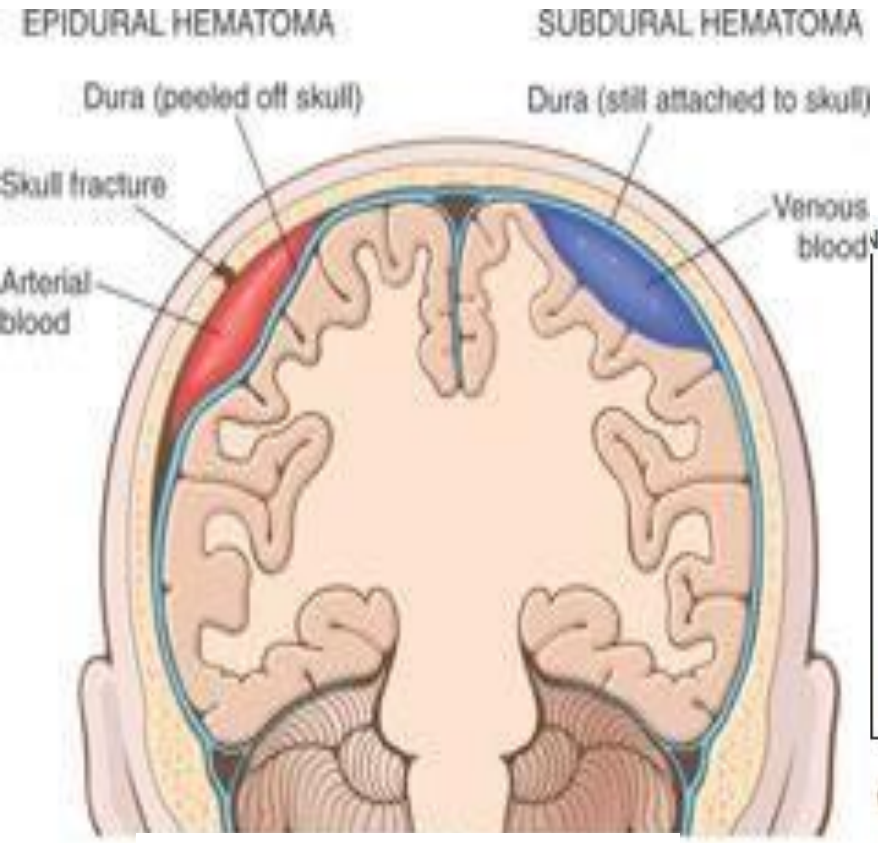
Trepanation:
Drilling a hole (fenestration) into the skull to expose dura and brain and treat related problems like dainage of a subdural hematoma.
Same as **Burr hole**.

Craniotomy:
Removing a bone flap from the skull in order to perform surgery on dura or brain and fixing it back.

Craniectomy:
Removing a bone flap away from the skull and not putting it back again in order to decompress the brain.
Either because replacing the flap isn't possible due to swelling of the brain or because the flap itself is damaged.

Cranioplasty:
Putting back something else than the bone flap like titanium mesh or bone cement.

Craniotomy is an ancient practice!
The oldest skull thought to have been artificially altered dates as far back as 10,000 years ago and is attributed to the Inca and Maya civilizations of ancient Latin America.



Epidural: above the dura
Usually arterial
Middle meningeal Artery

Subdural: under the dura and above the brain
Usually venous
Bridging Veins
Venous sinuses

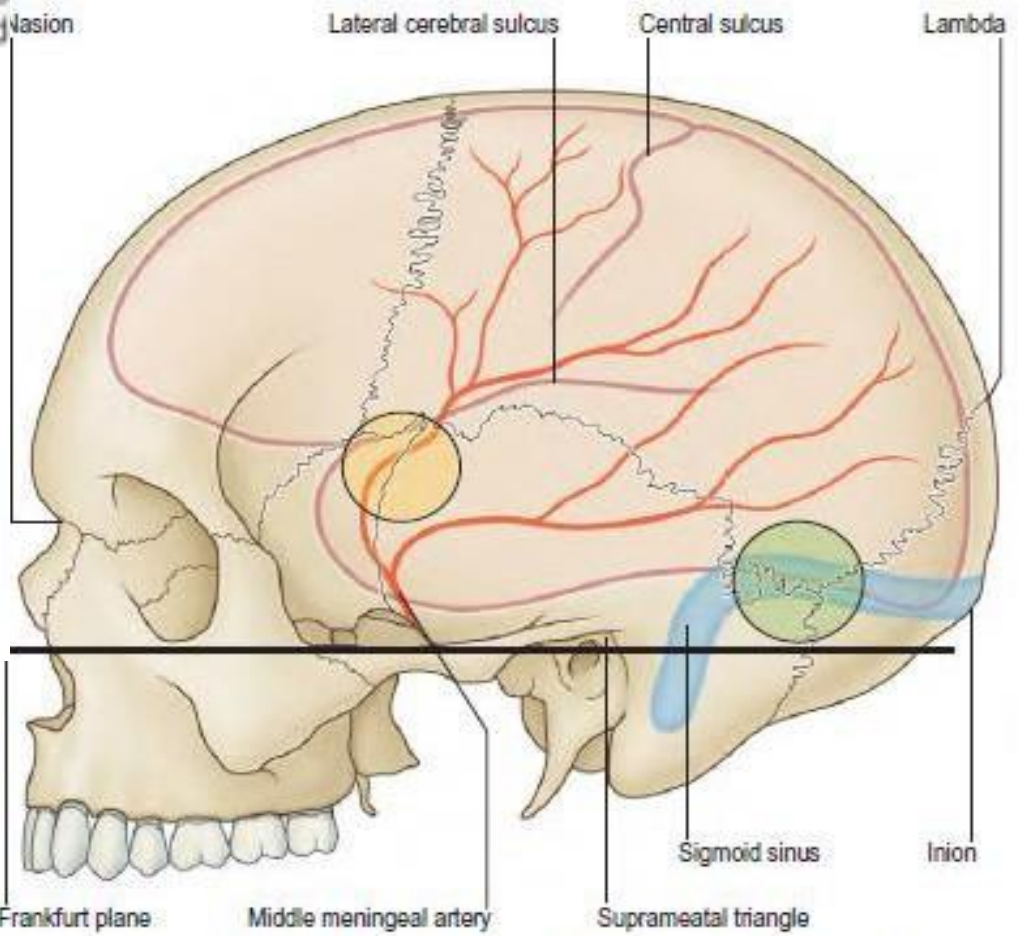


Fig. 27.7 The relations of the brain, the middle meningeal artery and the transverse and sigmoid sinuses to the surface of the skull. Area enclosed in yellow circle (including the pterion) for trephining over the frontal branch of the middle meningeal artery and lateral Sylvian fissure; area enclosed in green circle for trephining over the transverse sinus.

Epidural = Extradaural hematoma

Typical appearance of EDH on CT scan :

Bi convex lense shape

- **Arterial bleeding due injury to anterior (frontal) branch of middle meningeal artery.**
- **Usually due to trauma over the pterion (weak point = المقتل أو الصدغ)**
- **Treatment: craniotomy and evacuation of blood clot as it cannot be sucked out through a Burr hole.**

This is due to the gelatinous nature of the clotted blood.

Lucid interval

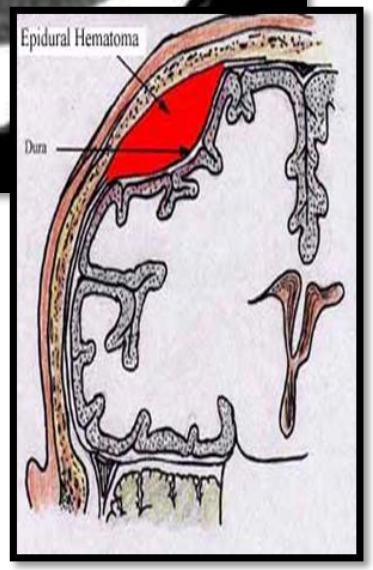
Lucid interval is a temporary improvement in a patient's condition after a traumatic brain injury, after which the condition deteriorates.

It occurs after the patient is knocked out by the initial concussive force of the trauma, then lapses into unconsciousness again after recovery when bleeding causes the hematoma to expand past the point at which the body can no longer compensate.

A lucid interval is especially indicative of an epidural hematoma.

An estimated 20 to 50% of patients with epidural hematoma experience such a lucid interval.

It can last minutes or hours.



To stop the hemorrhage, the torn artery or vein must be ligated or plugged. The hole through the skull wall should be placed about 1 to 1.5 in. (2.5 to 4 cm) above the midpoint of the zygomatic arch (through the pterion).

This is another reason as to why a craniotomy is necessary in case of an epidural hematoma, as opposed to drilling a Burr hole.

Subdural Hemorrhage

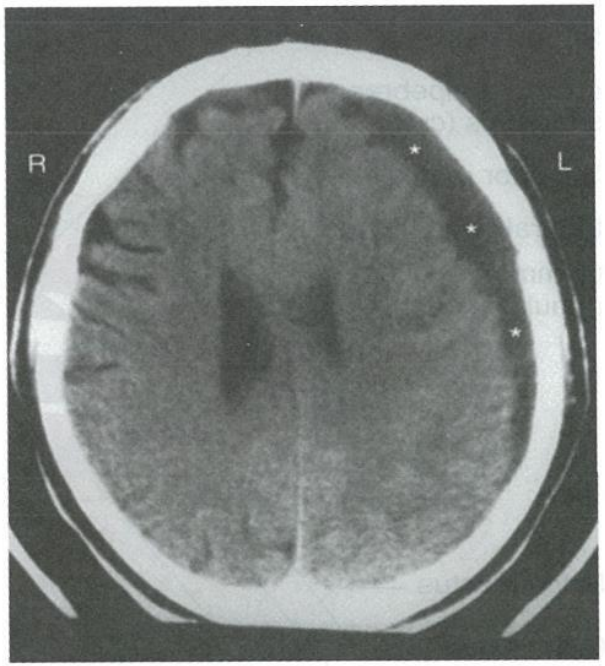
A subdural hemorrhage is caused by a violent shaking of the head (e.g., child abuse or car accident) and commonly occurs in alcoholics and elderly..

The blood vessels involved are the **superior cerebral veins ("bridging veins"). Clinical features include:**

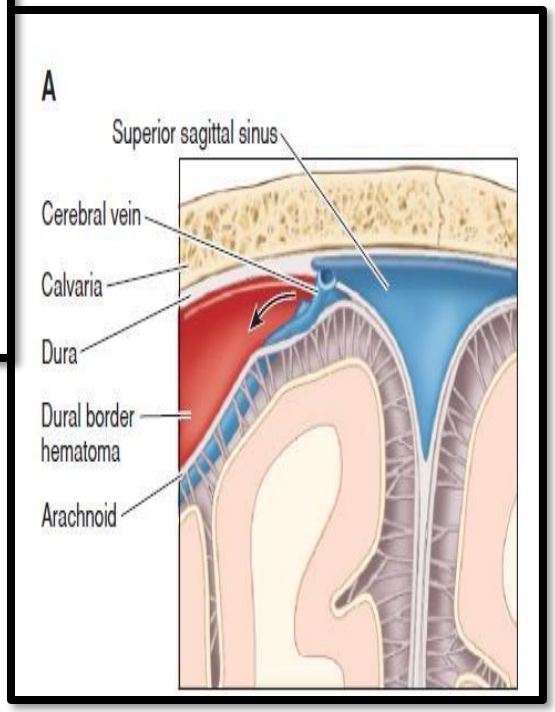
A CT scan shows a **thin, crescent-shaped hyperdensity that hugs the contours of the brain;**

venous blood is located between the dura and arachnoid; blood accumulates slowly (days to weeks after trauma);

- **No blood in the CSF after lumbar puncture.**



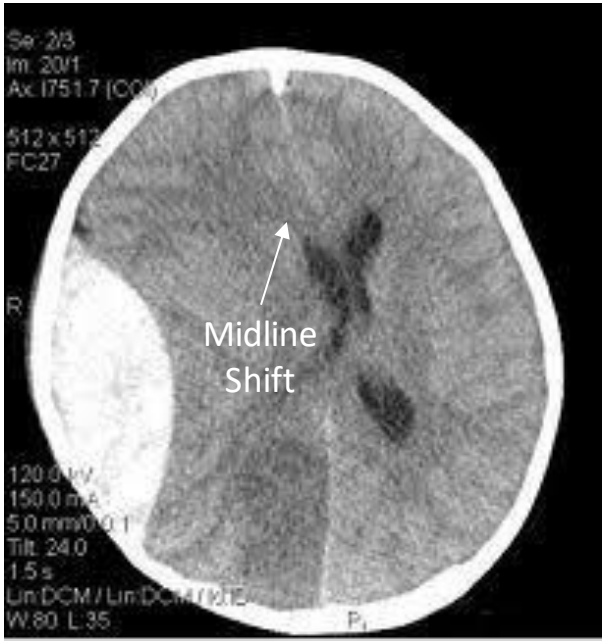
B. Subdural Hematoma*

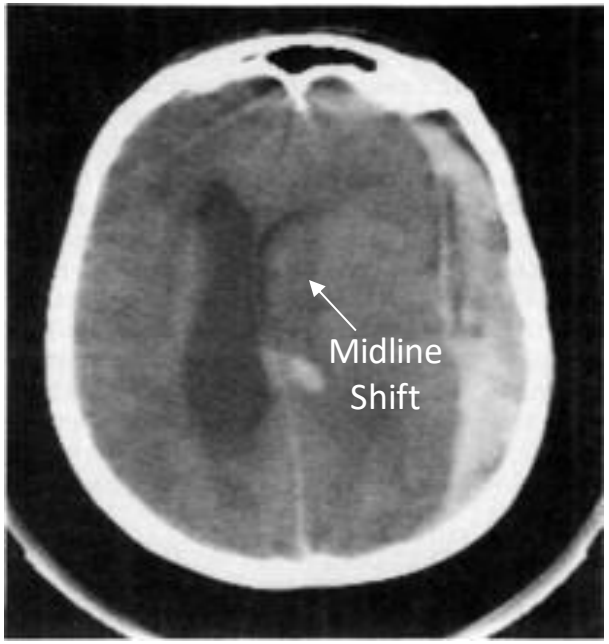


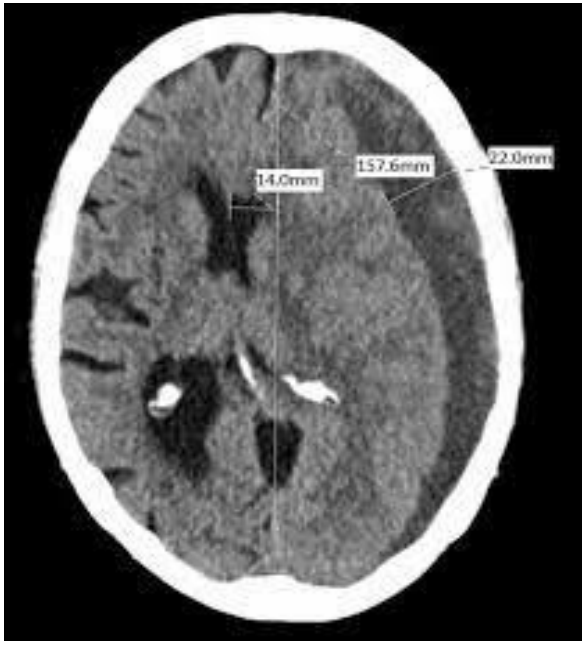
A subdural hematoma can be acute or chronic, with each case having its different pathophysiology.

- As the brain atrophies with age, it decreases in size, and this puts strain on the bridging veins that drain blood from the cerebral cortex to the superior sagittal sinus. As a result of this stretching, these veins become extremely fragile, and any small hit to the head may cause them to tear slightly and start leaking blood into the subdural space (especially if the person regularly takes blood thinners, which is common in old patients). In this case, blood accumulates underneath the dura relatively slowly, and the symptoms only appear after a while from the initial hit, this is what's known as a chronic subdural hematoma.
- Chronic subdural hematomas require trepanation or drilling a Burr hole through the skull to drain out the accumulated blood. The blood spilling out of the hole in this case is not gelatinous, instead it is described as dark motor oil-like fluid due to it being decomposed blood.

- Acute subdural hematomas on the other hand usually result from an injury to the venous sinus itself instead of the bridging veins, resulting from a major trauma to the head such as a fall and leading to massive bleeding. In this case a trepanation won't suffice and a craniotomy is necessary.







Typical EDH on CT scan:
Bi convex lens shape
Always acute
Arterial bleeding

Typical acute SDH on CT scan:
Lunar shaped
Bleeding is Hyperdense:
White color, like bone
Venous bleeding

Typical chronic SDH on CT scan:
Lunar shaped
Bleeding is Hypodense:
Darker color, like CSF
Venous bleeding

*The reason for the formation of the bi convex lens shape is the very limited space for the leaked blood to accumulate in as it is contained in between the cranium and the dura mater (which is bound to the cranium via sutural ligaments). This results in the hematoma pushing the brain inwards, hence giving it this special appearance.

*Acute bleeding always has a white-dense appearance in CT scan images whether from an epidural or subdural hemorrhage.
*Acute hemorrhages are more serious than chronic ones, the massive bleeding builds up pressure causing the brain to shift in what's known as a midline shift or a subfalcine herniation (due to the displacement of brain tissue under the falx cerebri, check the white arrows).
Subfalcine herniation is the most common form of brain herniation.

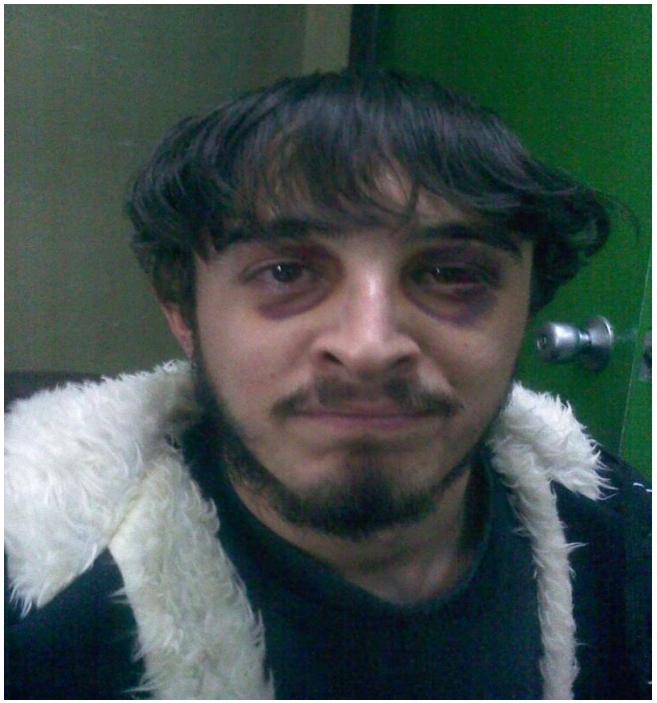
Raccoon eyes :

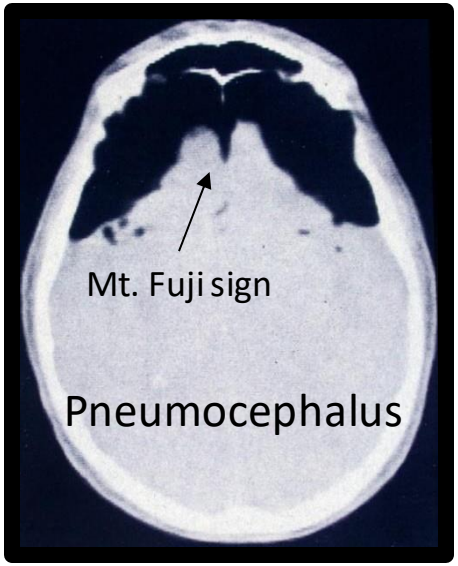
Indicates base of skull fracture even if we cannot see it on a CT scan.

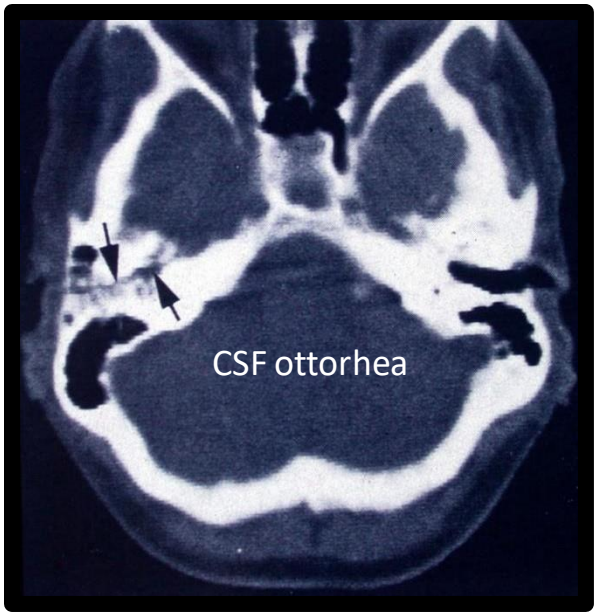
What other signs of base of skull fracture do you know??

- Battle sign: hematoma behind the ear.
- Pneumocephalus : subdural air in CT scan.
- Why is it important to identify??

Because of possible serious complications like CSF rhinorea or ottorhea and then meningitis.







Prognosis (مآل الحالة المرضية) is the likely course of a medical condition.

The prognosis of any head trauma **improves** immediately if a skull fracture is detected. The presence of a skull fracture is a sign that most of the force of the hit was absorbed by the skull instead of getting transferred internally to the brain, sparing the sensitive internal structures from most of the subsequent damage. This is one reason why it's important to be able to detect all the signs of a skull fracture if present.

Signs of a present skull fracture:

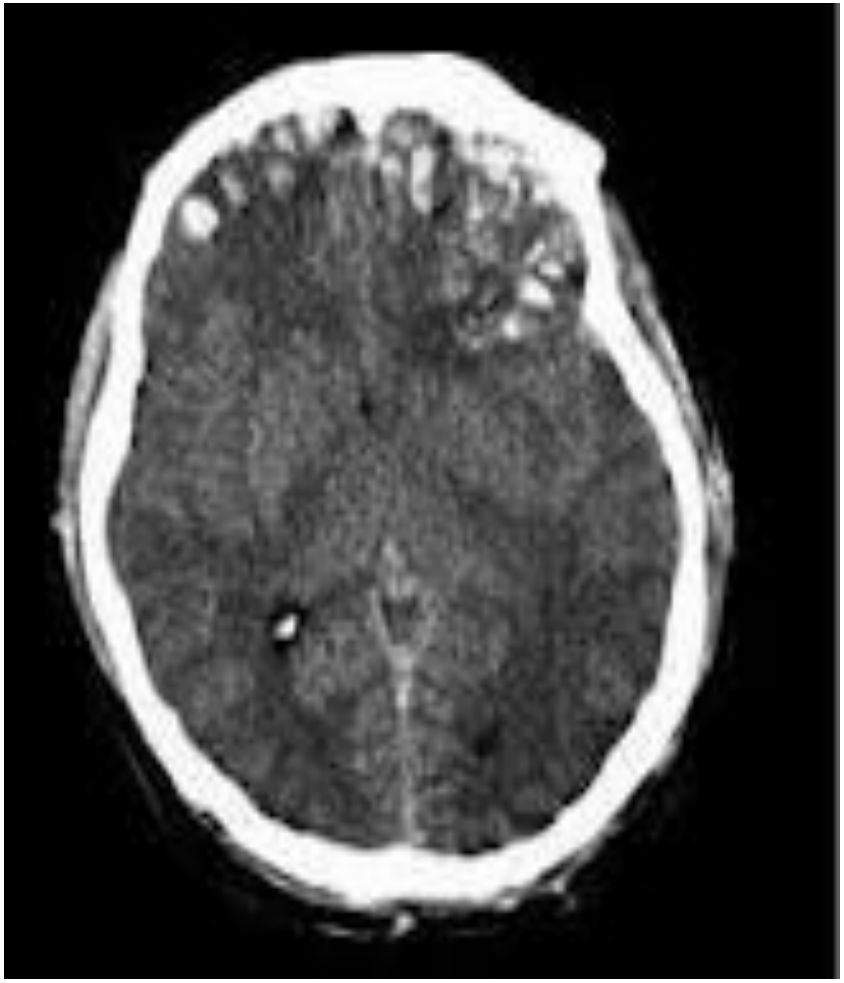
- **Raccoon eyes**: Form due to the diffusion of blood from the sight of injury through the loose areolar connective tissue of the scalp and its gathering under the skin of the eyelids (peri-orbital hematoma).

Signs that specifically indicate base of the skull fractures:

- **Battle sign**: Redness or bruising behind the ears due to mastoid process fracture (blood seeps through the mastoid air cells from the base of skull fracture into the skin behind the ear).
- **Otorrhagia** (bleeding for the ear) is commonly seen in base of the skull fractures. Epistaxis or Rhinorrhagia (nosebleeds) however, can be due to any blow to the nose.
- **CSF rhinorrhea** and **CSF otorrhea**: CSF dripping out of the nasal and auditory openings. Even if it's not visibly apparent, it might be discovered by the patient having a salty taste in their mouth (this is due to the relatively high concentrations of chloride ions in the CSF).
- **Vomiting** after trauma may also indicate base of skull injury.
- **Pneumocephalus**: presented as Mt. Fuji sign in a CT scan image, is the presence of air in the meningeal spaces of the brain which creates tension towards the cerebral lobes.

•Brain Contusion :

-Intra-parynchymal localized bleeding (bruising of brain tissue: رضّة دماغية).



-If it exceeds 3 cm then it is an intracerebral hematoma.

-Evacuation of the hematoma is done via craniotomy.

This is a brain MRI :

-We can see a lesion in Rt Parietal Lobe.

-Homogenous but does't have well defined borders.

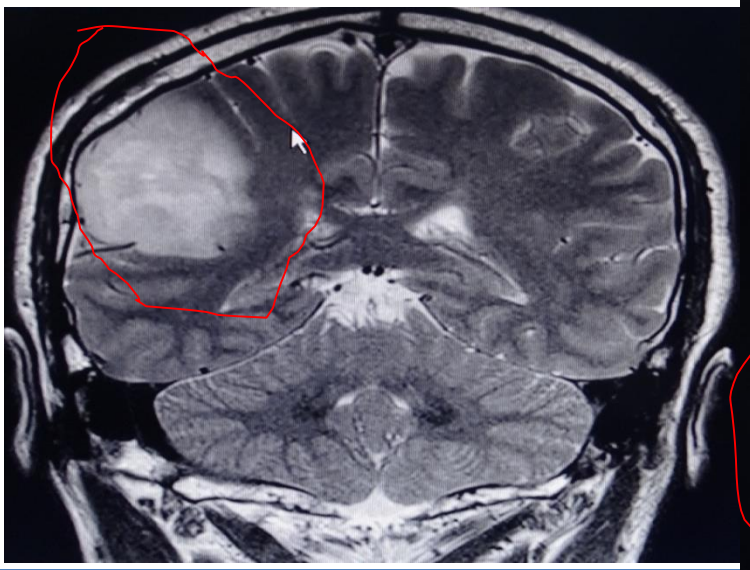
-Typical of low grade primary brain tumor.

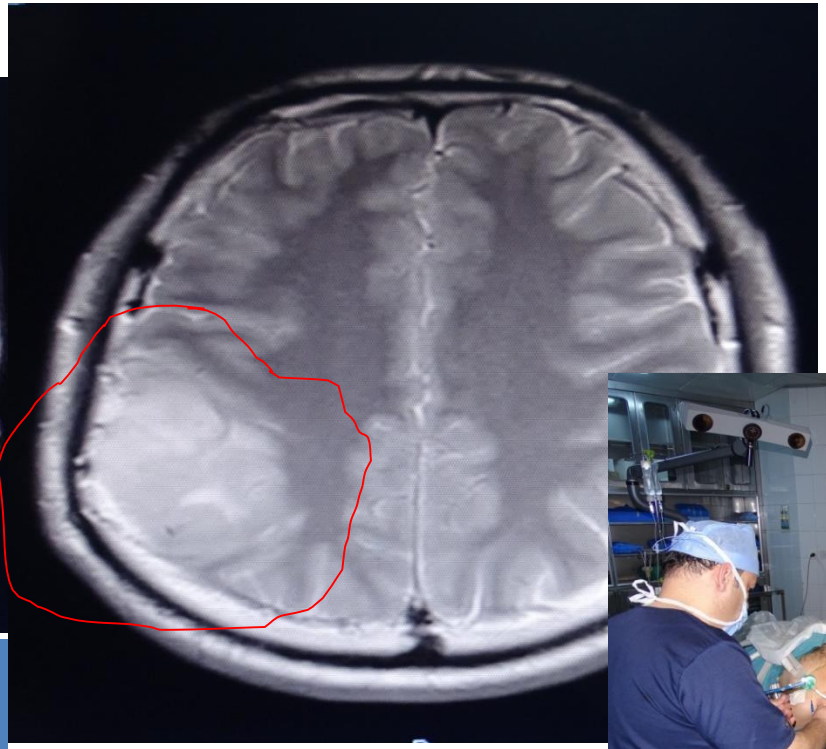
-Best management : Stereotactic biobsy or navigation guided biopsy:

If low grade : Observe

If high grade : Craniotomy (surgery) followed by Radiation

***Note:**
CT scans are also known as CAT scans: Computerized Axial Tomography Scans. They usually provide imaging along one anatomical plane, unlike MRI scans.





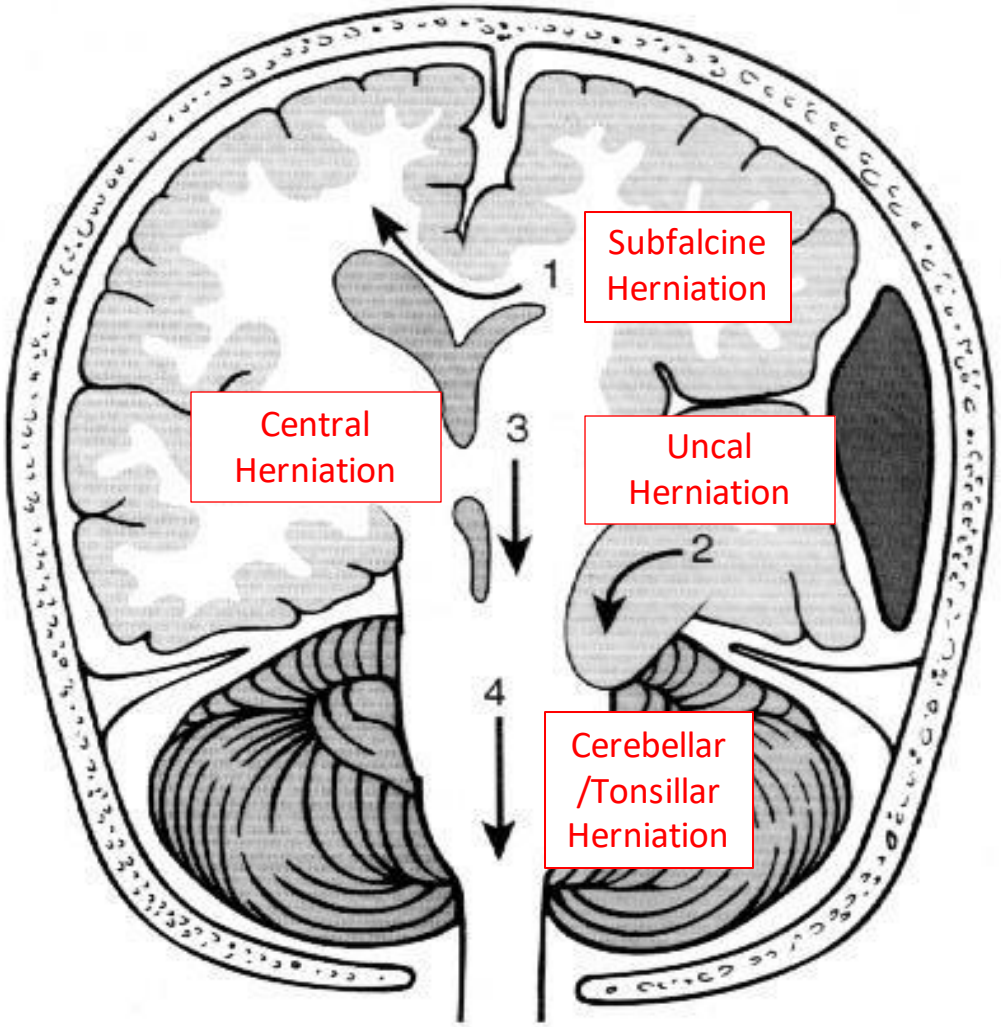
***MRI scans are the preferred way to diagnose brain tumors as they provide more detailed pictures than CT scans.**
Note how the brain is brain is extremely detailed while the skull is just barely visible unlike CT scans.

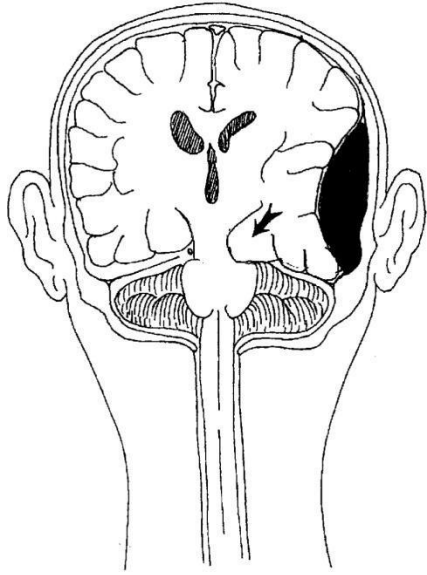
SAH : Subarachnoid hemorrhage :

- The most common cause is trauma.
- Spontanous SAH : most common cause is the rupture of berry aneurysm (seen in convensional Angiogram here) .
- Presentation: worst headache of my life, decrease level of consciousness.
- Classification of cases : Hess and Hunt or WHO
- Treatment :
    - Coilling : intervensional radiology
    - Clipping : surgery

How do you describe this brain lesion ???

- Shape: Well circumscribed, rounded
- Contents: Cystic. CSF intensity fluid
- Location: Rt occipital
- No enhancement with contrast
  (i.e no vascularization).
- This is a typical Brain Hydatid cyst.





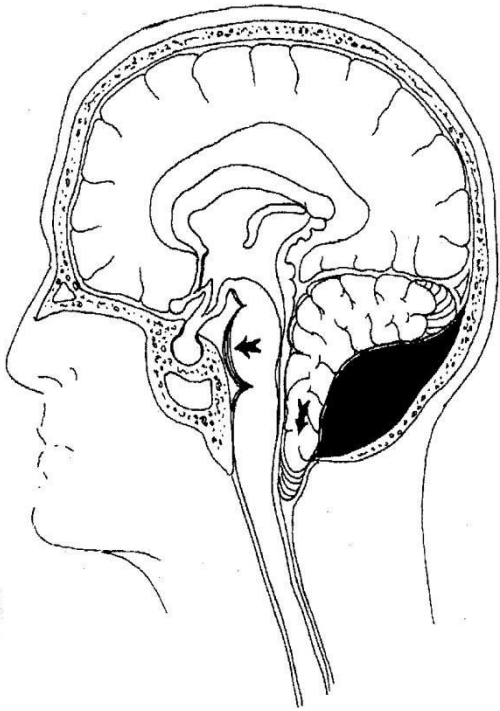


Fig. 3.3 Brain herniations. A lateral supratentorial mass will cause displacement of the lateral ventricles with (1) subfalcine herniation of the cingulate gyrus below the falx cerebri; (2) herniation of the uncus into the tentorial hiatus; (3) caudal displacement of the brain stem. Raised pressure within the posterior fossa may cause herniation of the cerebellar tonsils into the foramen magnum (4). (Adapted from Jennett and Teasdale 1981. Reproduced with permission.)

The size of the skull is limited and is mostly occupied by cerebral matter, leaving very little extra space. Therefore the buildup of intracranial pressure due to any type of intracranial bleeding or due to space occupying lesions in the brain will eventually lead to the movement and herniation of the cerebral matter to different parts of the brain and finally through the openings of the skull.

Types of brain hernias:

1) **Midline shift** or **Subfalcine Herniation**, where part of the brain is transposed underneath the falx cerebri.
2) **Uncal Herniation**, the uncus of the temporal lobe passes through the tentorial notch, also known as **Transtentorial Herniation**. This can result in unilateral/ipsilateral pupil dilation, this is also known as Anisocoria, with the injury occurring on the side of the unresponsive dilated pupil.
3) **Central caudal herniation**.
4) The last opening of the skull for the brain to herniate through is the foramen magnum. This is known as **Cerebellar** or **Tonsillar Herniation** (referring to the downward movement and choking of the tonsils of the cerebellum along with the brain stem through the foramen magnum). This type of herniation is final and fatal, recovery is extremely difficult, and the patient is even possibly considered dead with there being almost nothing to do to prevent this outcome from occurring.

Loss of oculomotor function in both eyes i.e. bilateral fixed dilated pupils indicates Tonsillar herniation, giving a Glasgow Coma Scale (GCS) score of 3/15 (a 15/15 score indicates that the individual is fully conscious and responsive).