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Functional structure of the skull

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Functional structure of the skull

- According to forces acting on the skull bones we have **thickened** and **thinner parts of the skull**

- Thinner parts of the skull are predilection sites for fractures

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Functional structure of the skull - Facial buttresses system

•thin (fragile) segments of bone are encased and supported by more **rigid framework of "buttresses"**

•the midface is anchored to the cranium through this framework

• formed by thickened parts of frontal, maxillary, zygomatic and sphenoid bones and their attachments to o ne another

•the buttresses support against the force of mastication, which sends force from the mandible all the way through the maxilla to the skullbase and calvaria

• vertical x horizontal buttresses

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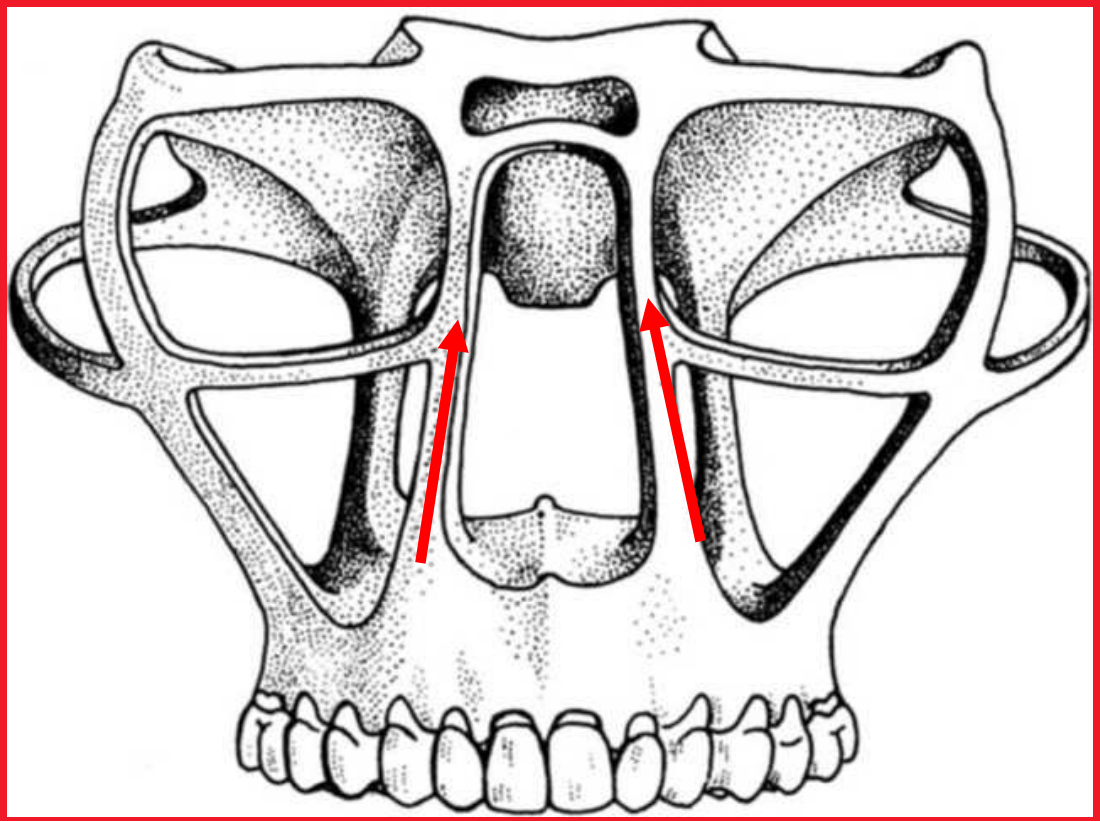
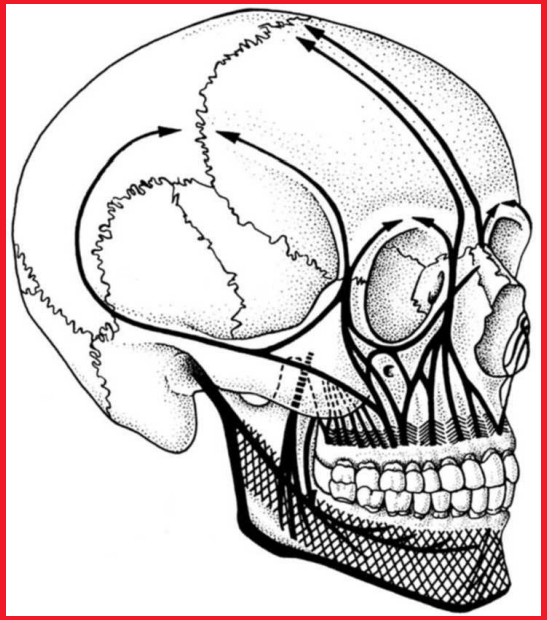
Vertical buttreesses





Medial maxillary buttress

- from the maxilla in the region of the canines accros the nasofrontal junction to the frontal bone
- runs cranially along the medial border of the maxillary sinus

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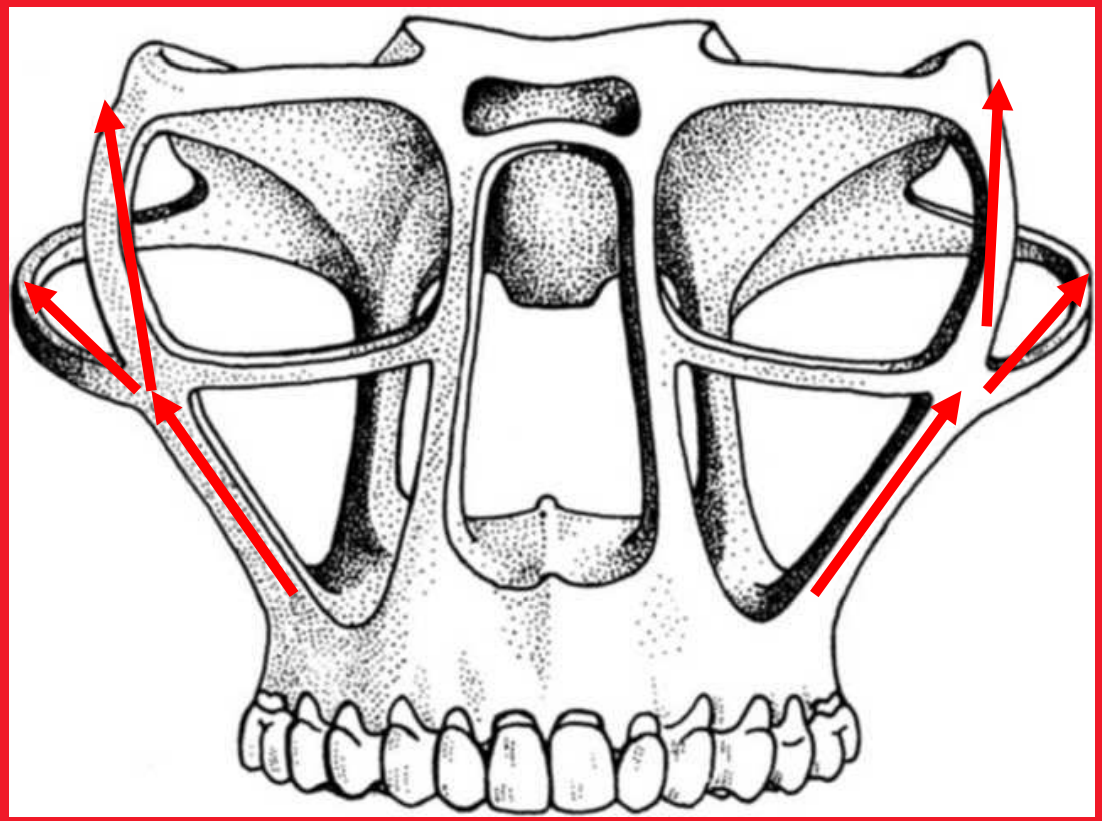
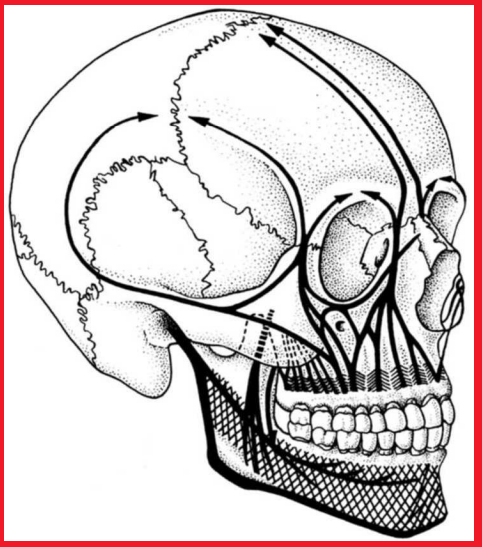
Vertical buttreesses





Lateral maxillary buttress

- from the maxilla across the zygomatocomaxillary suture and body of the zygoma, extending superiorly along the lateral orbital rim to the frontal bone and
- Second branch runs horizontally towards the zygomatic arch and radiates to the squamous part of the temporal bone

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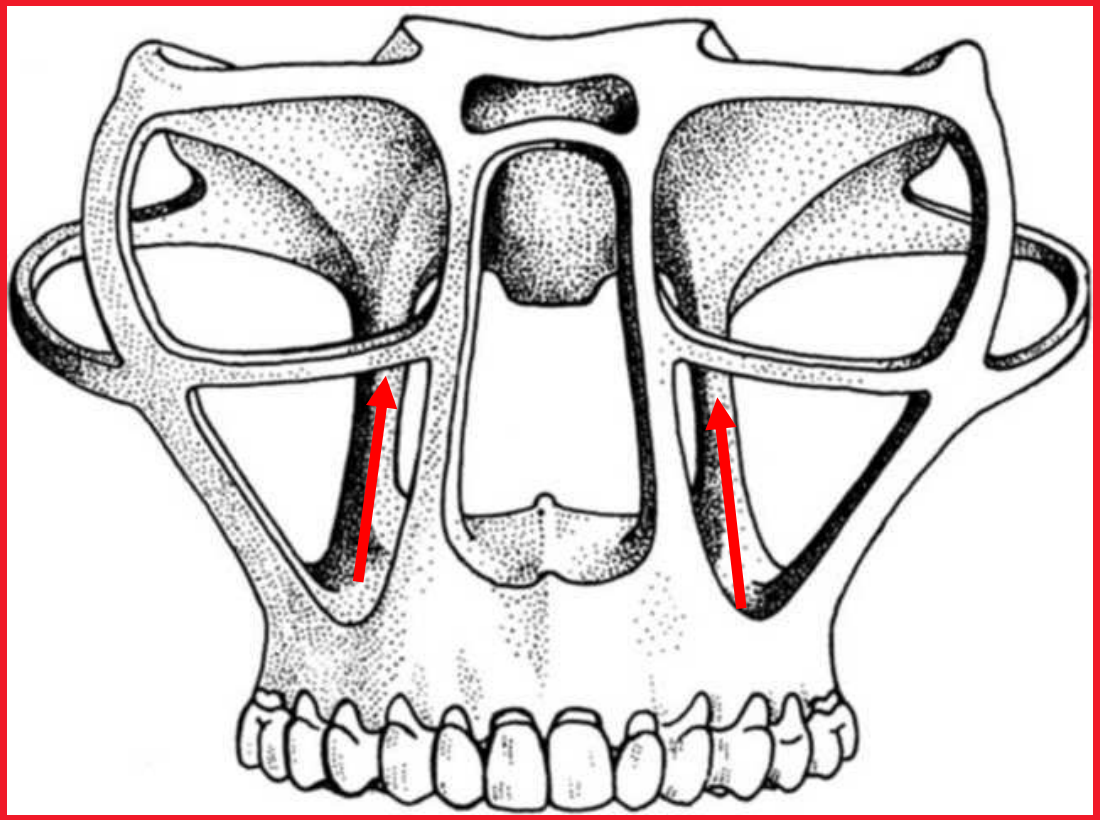
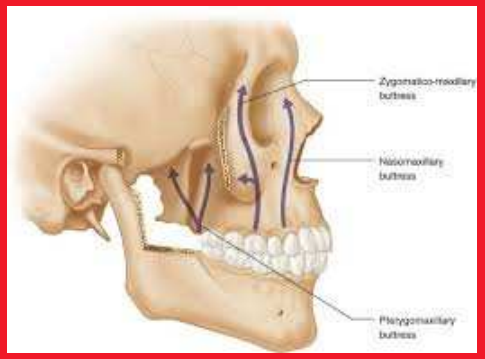
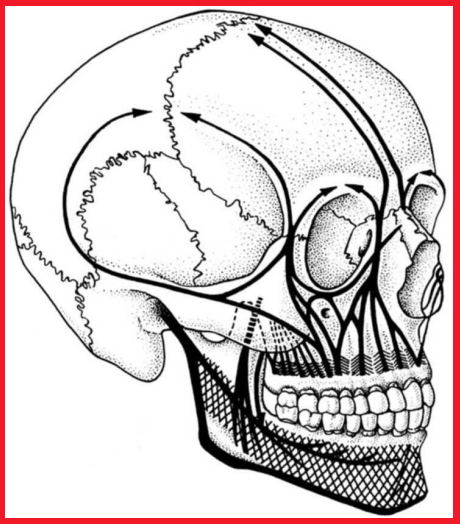
Vertical buttreesses







Posterior maxillary buttress

- formed by the fusion of the posterior and medial surfaces of the maxilla with the lower half of the pterygoid process
- originates from the region of the posterior alveoli M2-M3 and transmits pressure from the posterior teeth to the body of the sphenoid bone
- runs along the posterior wall of the maxillary sinus

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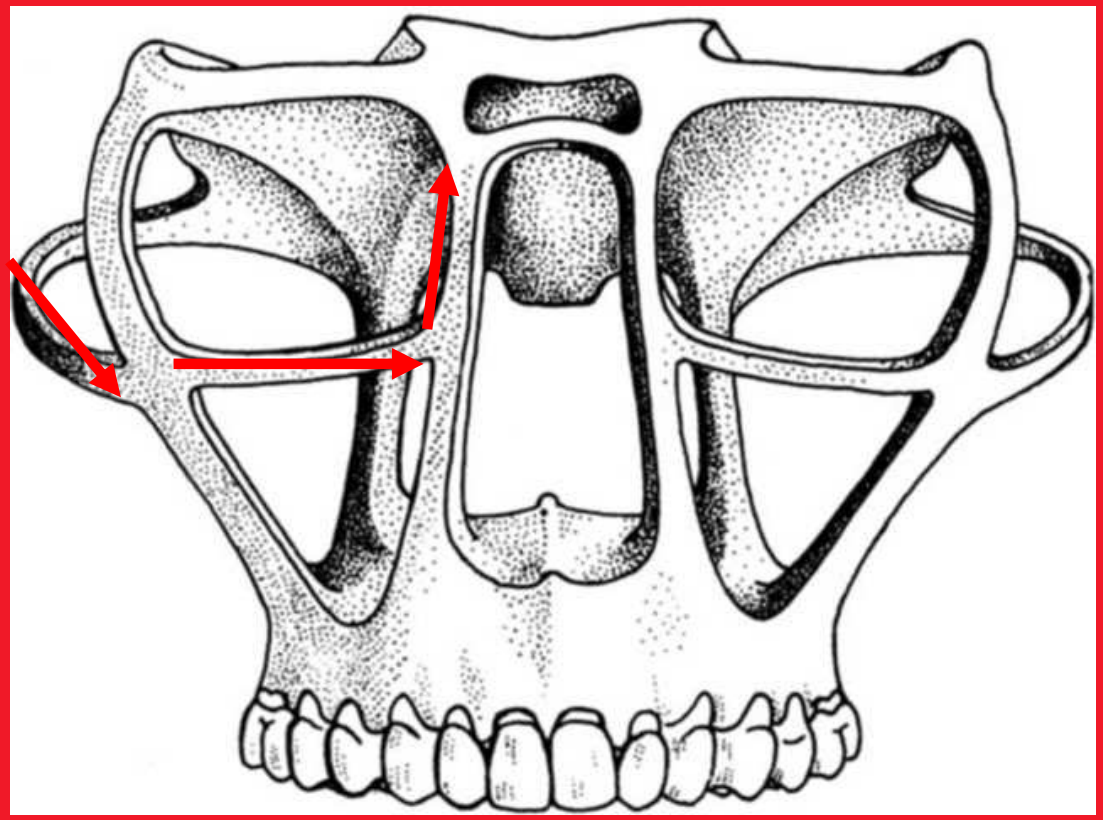
Horizontal buttresses



Upper transverse (maxillary)

- zygomatic arch along the floor of the orbit/roof maxillary sinus/ going posterior through the orbital floor

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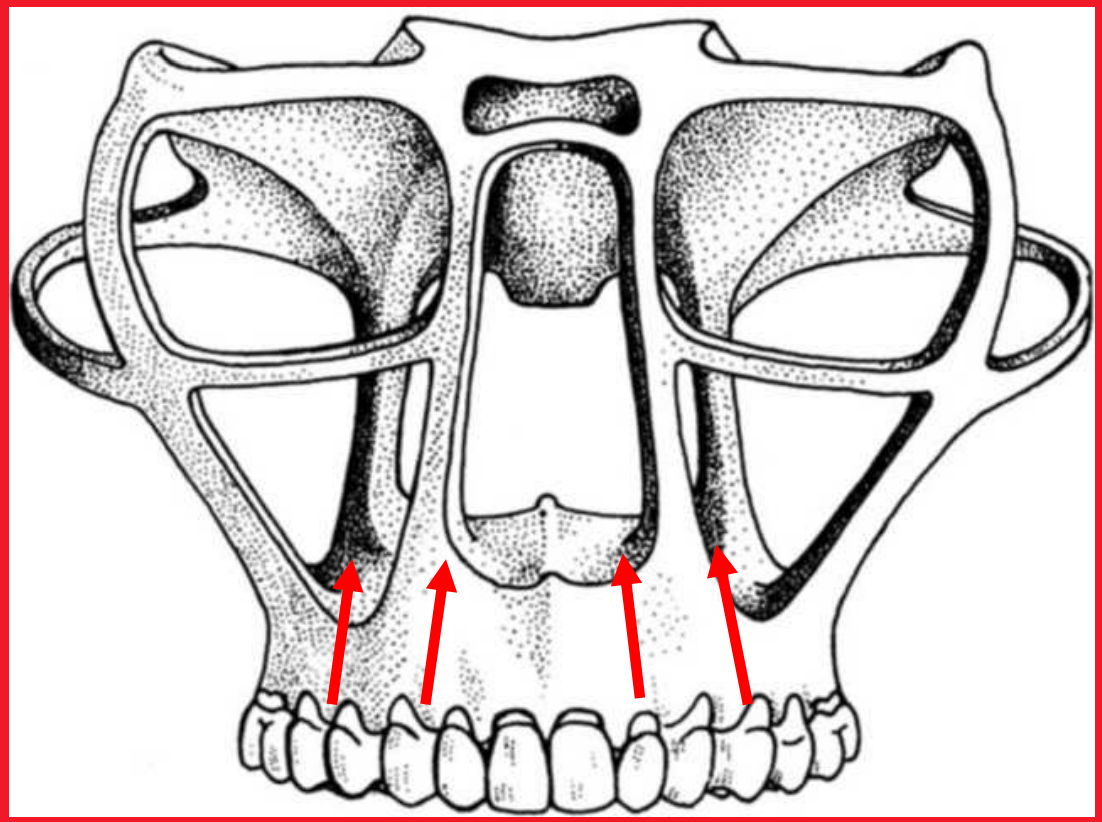
Horizontal buttresses



Lower transverse (maxillary)

- along the maxillary alveolar ridge (base of the maxillary sinus) extending posteriorly along the hard palate

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Calvaria (the top of the skull)

thick parts:

- tubera frontalia (the frontal eminence)
- tubera parietalia (the parietal eminence)
- external occipital protuberance (the highest point of which is referred to as the inion)
- linea temporalis (temporal line) (marks the attachment of the temporalis muscle)
- margin of sulcus sinus sagitalis sup. et transversus

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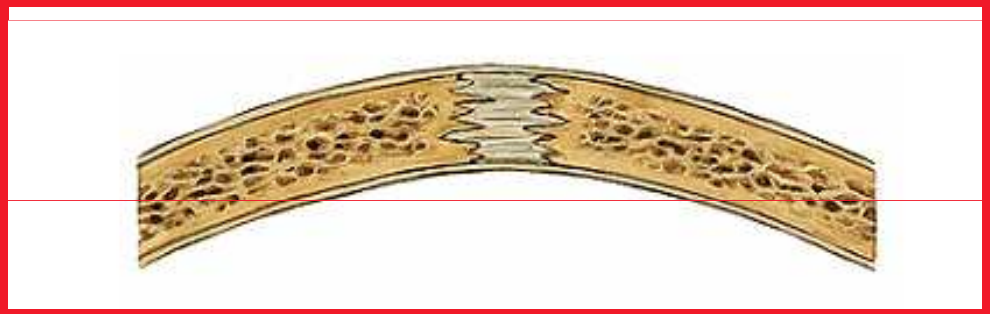
Calvaria (the top of the skull)

The calvaria consist of three layers

- external table (lamina externa) – formed by thick compact bone
- diploe – medullary space of cancellous bone
- internal table (lamina interna)



The bones of the calvaria are joined by sutures (fibrous joints)

Calvaria (the top of the skull)

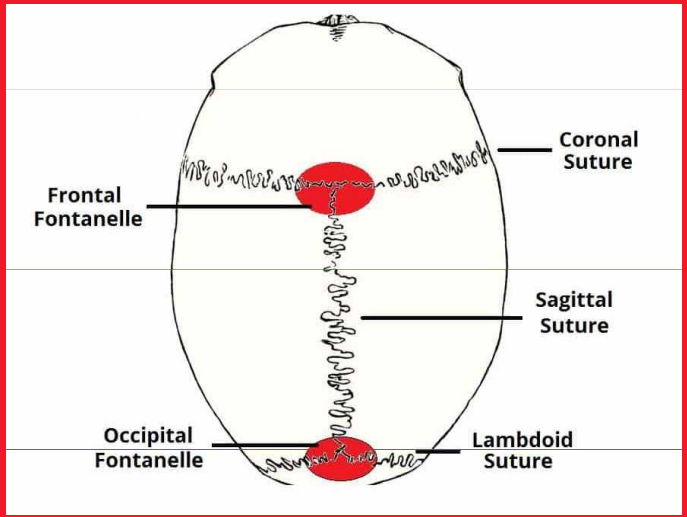
Sutures of the skull - fibrous tissue

- fuse completely around the age of 20
- represent **weakness** points in the skull

Coronal suture - fuses the frontal bone with the two parietal bones
Sagittal suture - fuses both parietal bones to each other
Lambdoid suture - fuses the occipital bone to the two parietal bones

In neonates, the incompletely fused suture joints give rise to membranous gaps between the bones, known as fontanelles

Frontal fontanelle – located at the junction of the coronal and sagittal sutures (disappears within 2 years of life)
Occipital fontanelle – located at the junction of the sagittal and lambdoid sutures (disappears in 2-3 months after birth)



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Craniosynostosis

Craniosynostosis -condition in which one or more of the fibrous sutures prematurely fuses by turning into bone

- skull cannot expand perpendicular to the fused suture
- compensatory growth in the direction parallel to the closed sutures
- complications – elevated intracranial pressure, cosmetic impact

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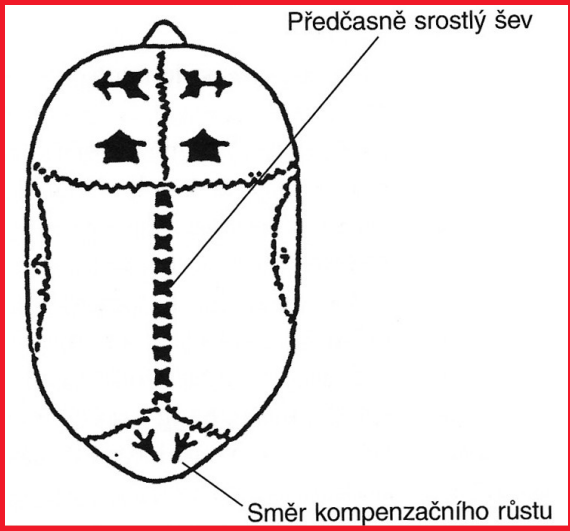
Craniosynostosis

Scaphocephaly

- premature sagittal suture closure which restricts growth in a perpendicular plane
- the head will not grow sideways and will remain narrow
- compensatory growth occurs forward at the coronal suture and backward at the lambdoid suture



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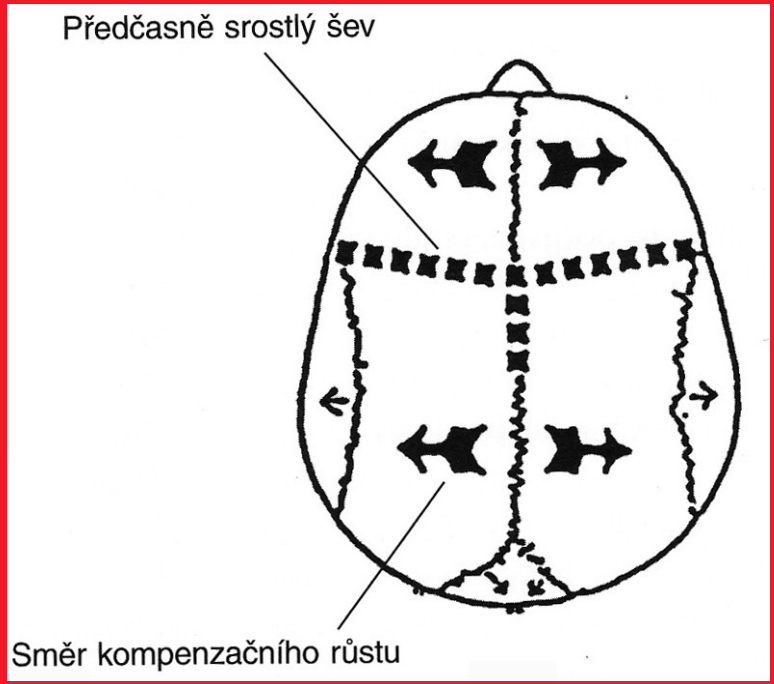
Craniosynostosis

Brachycephaly or a 'short head'

- the result of a closure of both the coronal sutures
- restriction of growth in the forward direction
- compensatory growth will occur sideways, due to the sagittal suture



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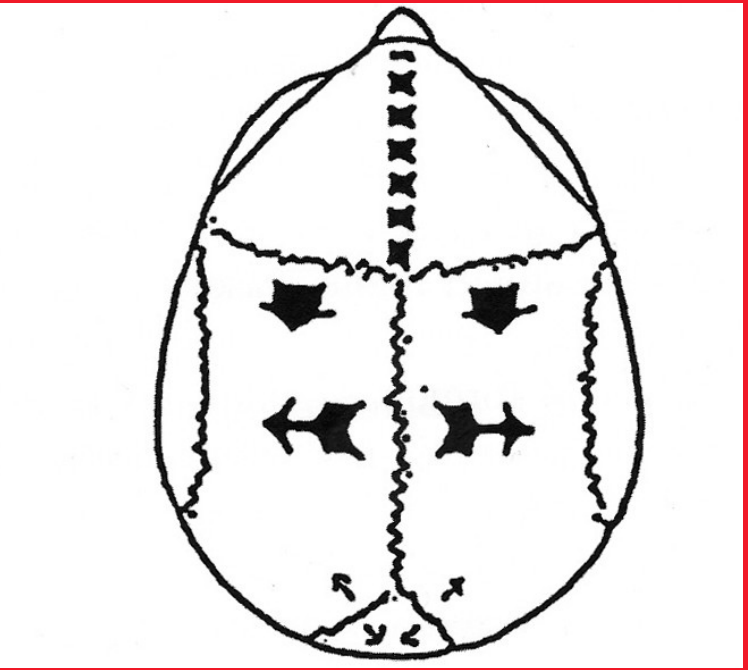
Craniosynostosis

Trigonocephaly

- a result from the premature closure of the metopic suture (divides the frontal bone into two halves, it should fuse by around 9 monthos of age)
- fusion of the metopic suture will result in a narrow forehead,
- compensatory growth occurs at both the coronal sutures
- the resulting shape appears triangular from above



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Craniosynostosis

The primary goal of surgical intervention is to correct an abnormal head shape and allow the growing brain room to expand normaly

- excision of the fused suture – bone will grow in the cut places

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Cranial base - thickened parts:

- the most solid part - pars basilaris ossis occipit.

Craial base - thinner parts of skull base

- sphenoid sinus
- cribriform plate
- foramina, canals, external auditory canal etc…

Thin parts of the base of the skull are predilection sites for fractures !!!

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Head injuries

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Skull fracturess

Skull fractures can be broadly divided in a variety of ways:

- associated with overlying skin injury
  open (the injury broke the skin over the fracture)
  closed
- degree of displacement
  undisplaced
  depressed
- number of fracture lines/fragments
  linear
  comminuted

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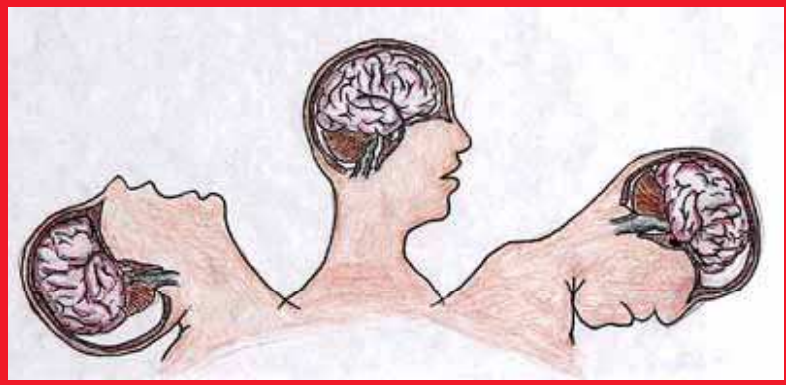
Etiology o head injuries

- hitting the head with a hard object X the impact of the head on a hard object
- compression effect (between 2 objects)
- pulse mechanism without direct mechanism of action on the skull (alternation of acceleration and deceleration - traffic accidents) - brain injury

During an injury, alteration of tensile and compressive forces leads to the brain damage!!!



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- skull fractures are best imaged with CT of the brain as discontinuities in the bone and may or may not be displaced

- uncomplicated skull fractures themselves rarely produce neurologic deficit

Skull fractures associated with brain injury may have serious neurologic consequences !

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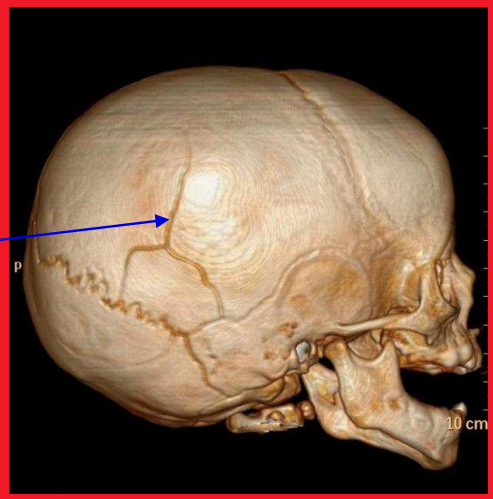
Linear skull fracture

- Most common
- involve a break in the bone but no displacement
- usually the result of low-energy transfer
- caused by **blunt trauma over a wide surface area** of the skull
- these fractures often have little clinical significance



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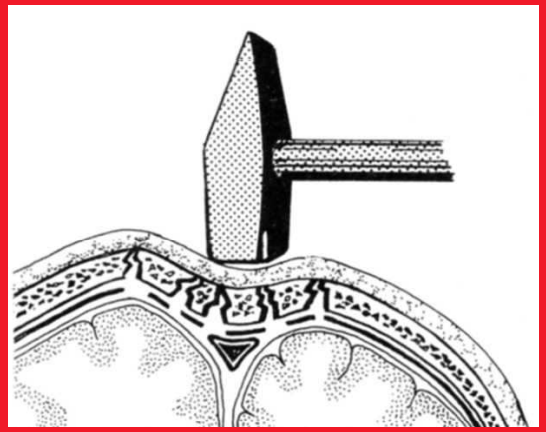
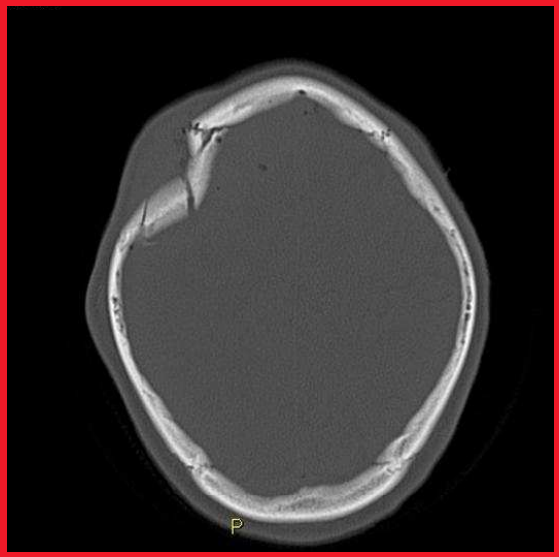
'ping pong' fracture

- there is no visible fracture line
- no fracture but skull bone deformation
- children - elastic bones

Depressed skull fractures



- in case of applying a force to a small area, typically hit with a hammer or ax
- usually associated with brain damage
- dislocation of fragments into the cranial cavity, with damage to soft tissues – open
- CT scan of the head to rule out brain damage and intracranial bleeding and reveal the extent of the skull damage
- clinically significant and requires surgical elevation of the fragments



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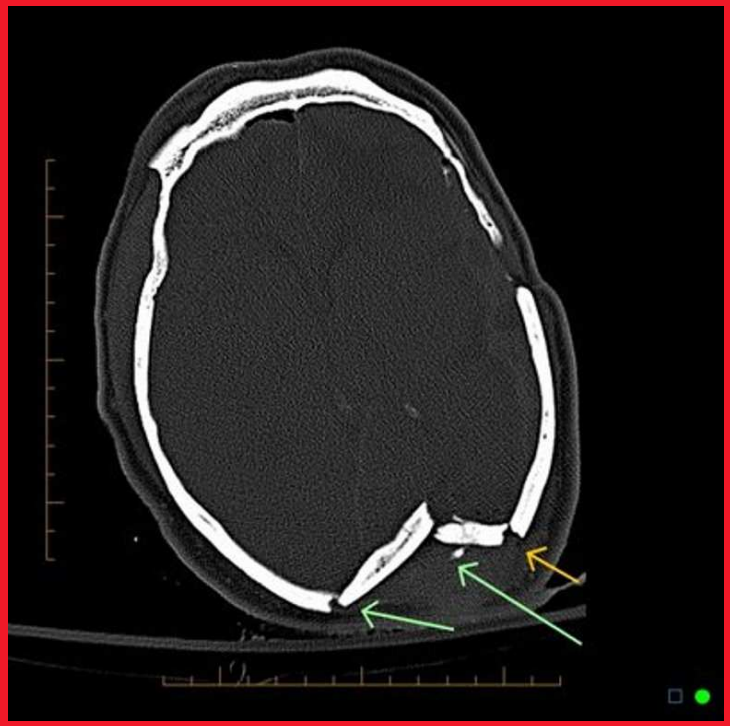
Depressed skull fractures

Depressed fractures are usually **comminuted**,
bone fragments are displaced inward -
and often require surgical intervention to repair underlying tissue damage



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Basilar skull fractures

A basilar skull fracture is a **break of a bone** in the **base of the skull**

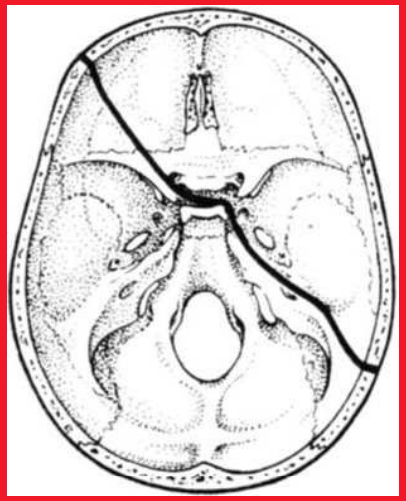
Usually **indirect** force (a punch to the face) - transmission at the base of the skull

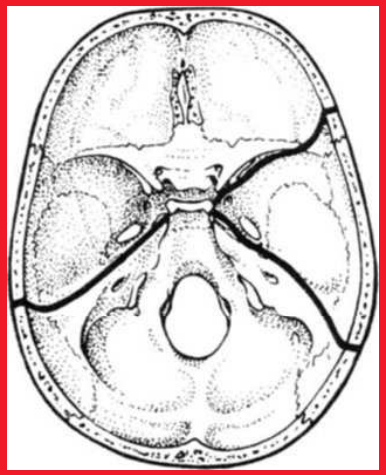
Basilar fractures are the **most serious**! (dmage of brainstem or basal ganglia)

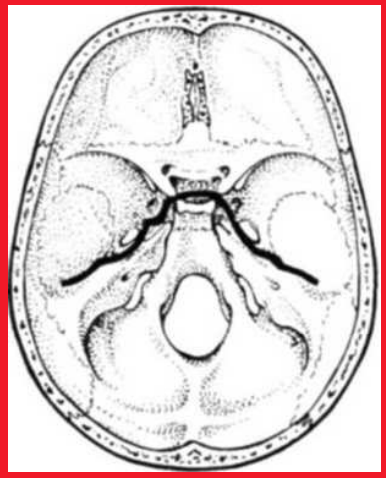
Can be isolated or together with fractures of bones of calvaria

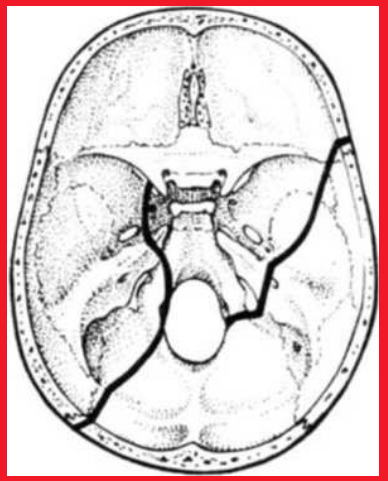
Fracture lines often occur at predilection sites

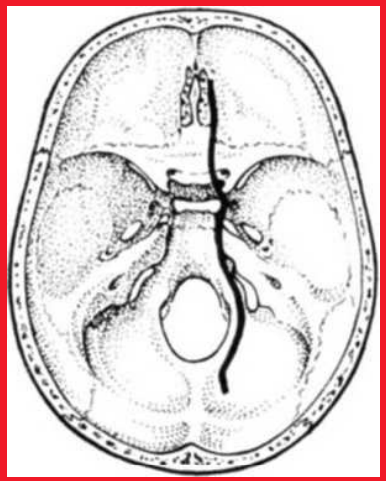
Spreading of the fracture lines











predilection sites
•sphenoid sinus
• cribriform plate
• foramina, canals etc.

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Basilar fractures

characteristic signs:

- blood in the sinuses
- a clear fluid - cerebrospinal fluid (CSF) leaking from the nose (rhinorrhea) or ears (otorrhea) - tearing of the dura mater over the fracture
- periorbital ecchymosis often called 'raccoon eyes
- retroauricular ecchymosis known as ”battle's sign„
- pneumocephalus – air bubles around the brain
- intracranial hemorrhage: epidural, subdural and intracerebral hematoma
- damage of the brain, brain oedema, hypoxy, posttraumatic epilepsy, meningitis …

A cerebrospinal fluid (CSF) leak can result in fluid leaking from the nose or ear

High risk of infection!

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Battle's sign, also known as **mastoid ecchymosis**, is an indication of fracture of middle cranial fossa of the skull. These fractures may be associated with underlying brain trauma.
Battle's sign consists of bruising over the mastoid process as a result of extravasation of blood along the path of the posterior auricular artery

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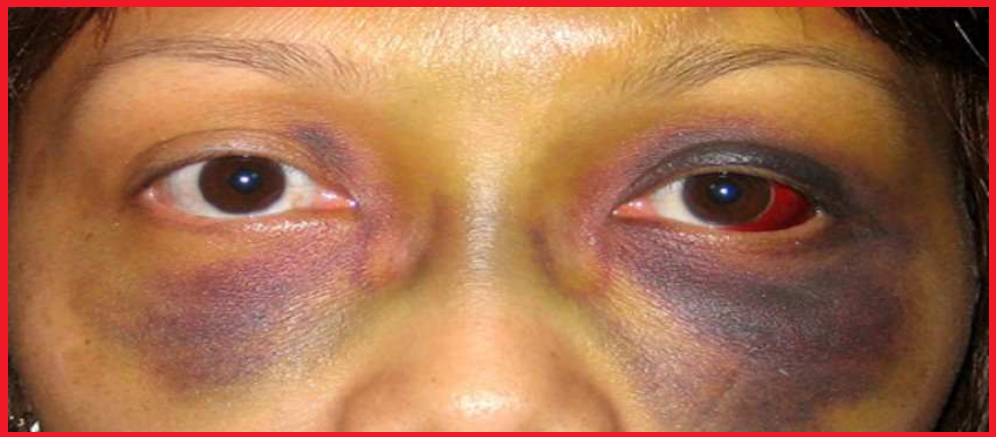
Raccoon eyes – periorbital ecchymosis



They are most often associated with fractures of the anterior cranial fossa

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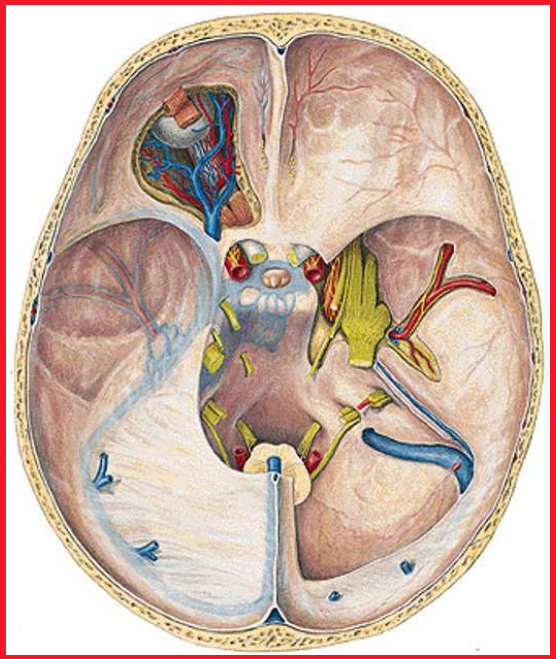
Cranial nerve lesion

I. (Olfactory n.) - loss of smell (anosomia)
II. (Optic n.) - loss of vision, abnormal pupillary reflex
III. (Oculomotor n.) -loss of accommodation, lateral strabism
VI. (Abducens n.) - medial strabism, double vision
VII. (Facial n.) - paralysis of facial mimic muscles
VIII. (Auditory n.) - hearing loss



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Pneumocephalus

- presence of intracranial air
- most often occurs following trauma or surgery
- headache (forehead area)
- air is spontaneously absorbed in a few days

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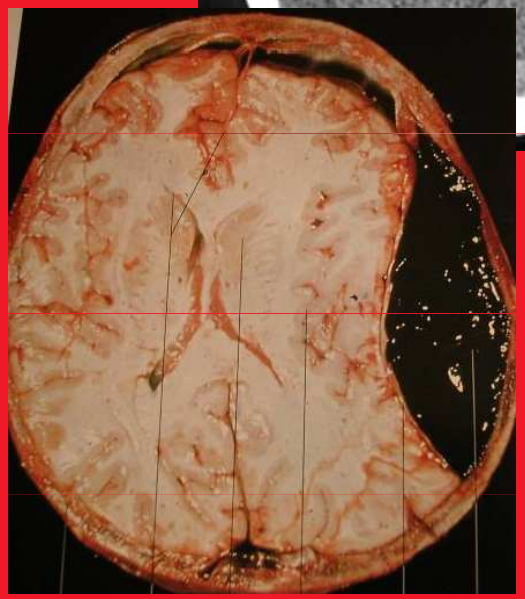
Epidural hemorrhage

- The cause is usually a fracture of the temporal bone and bleeding from the **middle meningeal artery**
- Between the inner skull table and dura matter
- The temporal bone is usually the thinnest part of the skull - fractures are common
- Epidural hematomas usually appear convex in shape



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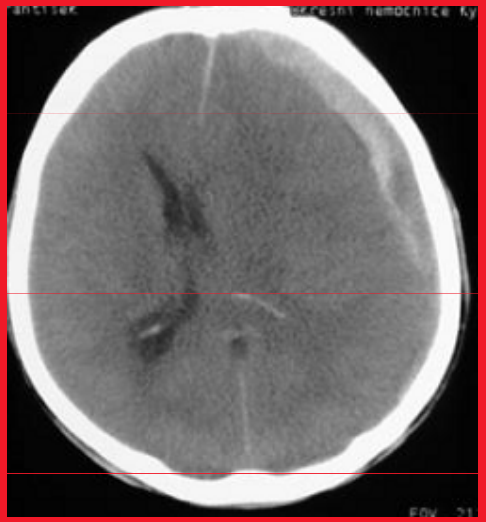
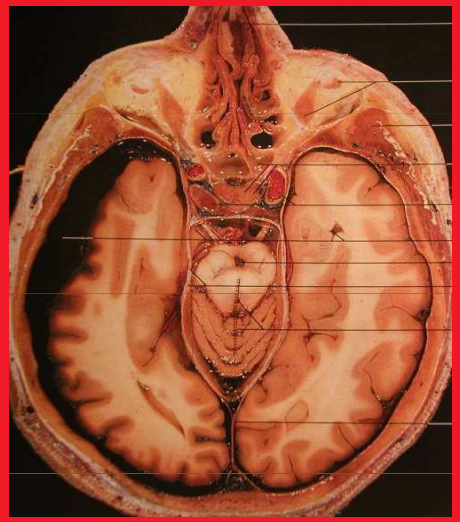
Subdural hemorrhage

- usually results from tears of the small veins that bridge the gap between the dura and the cortical surface of the brain
- collection of blood between the dura matter and arachnoid
- life-threatening condition
- subdural hematomas are classically crescent-shaped on CT scan, with a concave surface away from the skull





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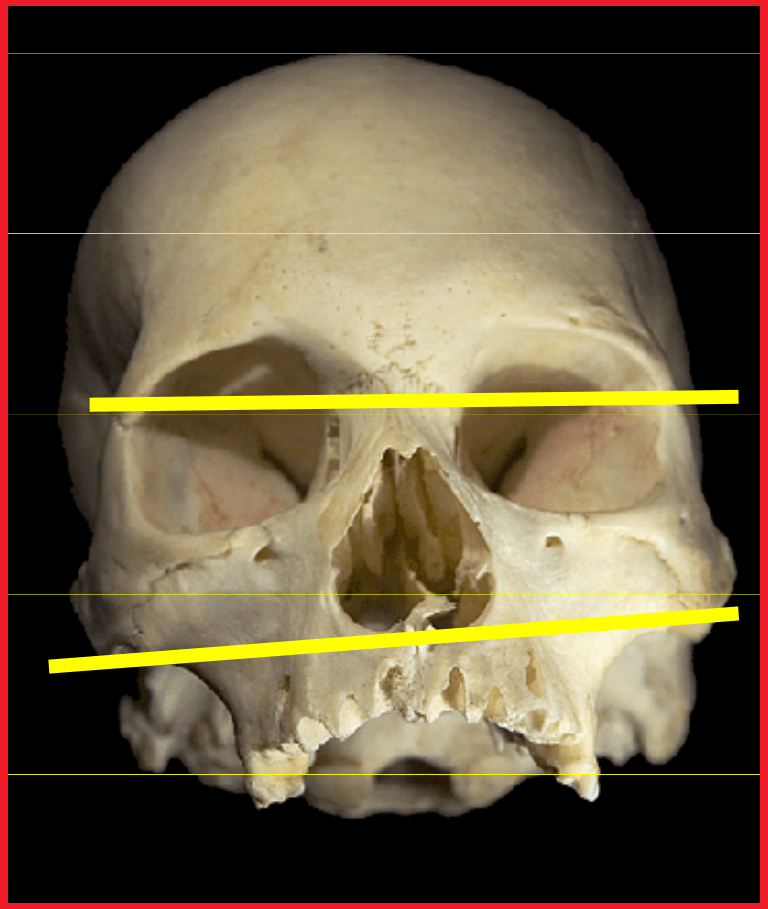
Intracerebral hemorrhage

Traumatic intracerebral hemorrhage is usually due to extension of hemorrhage from surface contusions deep into the substance of the brain
- not frequent



Craniofacial fractures

Upper midfacial fractures

Lower midfacial fractures

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Le Fort fractures

Le Fort fractures are fractures of the midface, which involve separation of all or a portion of the midface from the skull base

The commonly used classification is as follows:

- Le Fort type I
- Le Fort type II
- Le Fort type III

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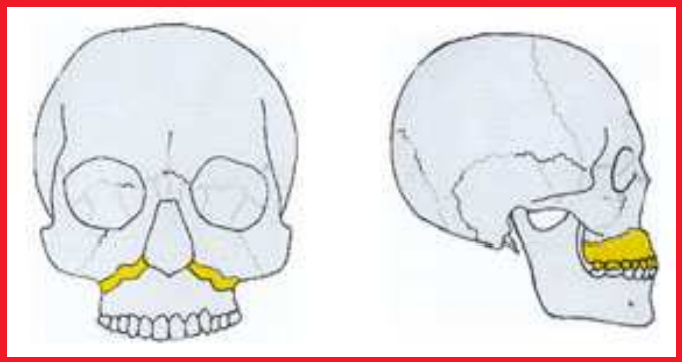
Lower midfacial fracture
Le Fort type I or low horizontal fractures

- horizontal maxillary fracture, separating the teeth from the upper face
- fracture line passes through the alveolar ridge, lateral nose and inferior wall of the maxillary sinus



traumatic changes of occlusion

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Upper midfacial fracture

- Naso-orbitoethmoid fractures
- zygomaticomaxillary complex
- orbital fractures
- Le Fort II
- Le Fort III

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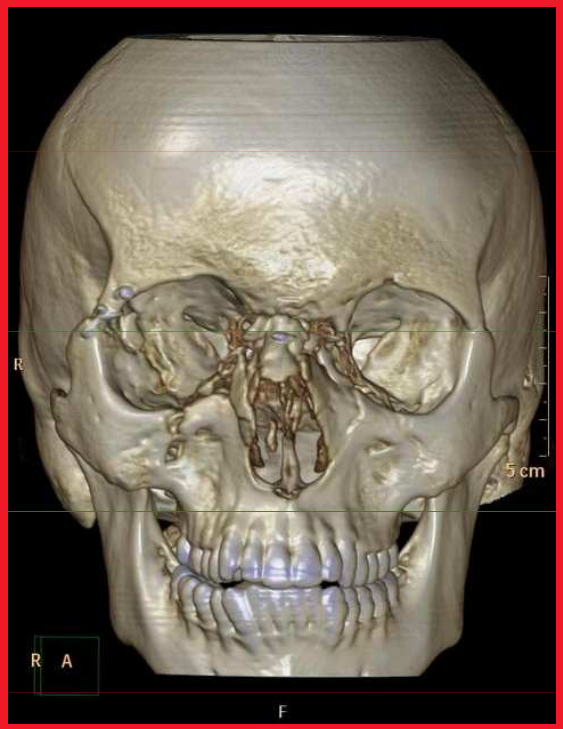
Naso-orbitoethmoid fractures

- naso-orbitoethmoid fractures are caused by a high-impact force applied anteriorly to the nose and transmitted posteriorly through the ethmoid bone
- comminution of both nasomaxillary buttresses involving the nasal bones and septum, ethmoid sinuses, and medial orbital walls.



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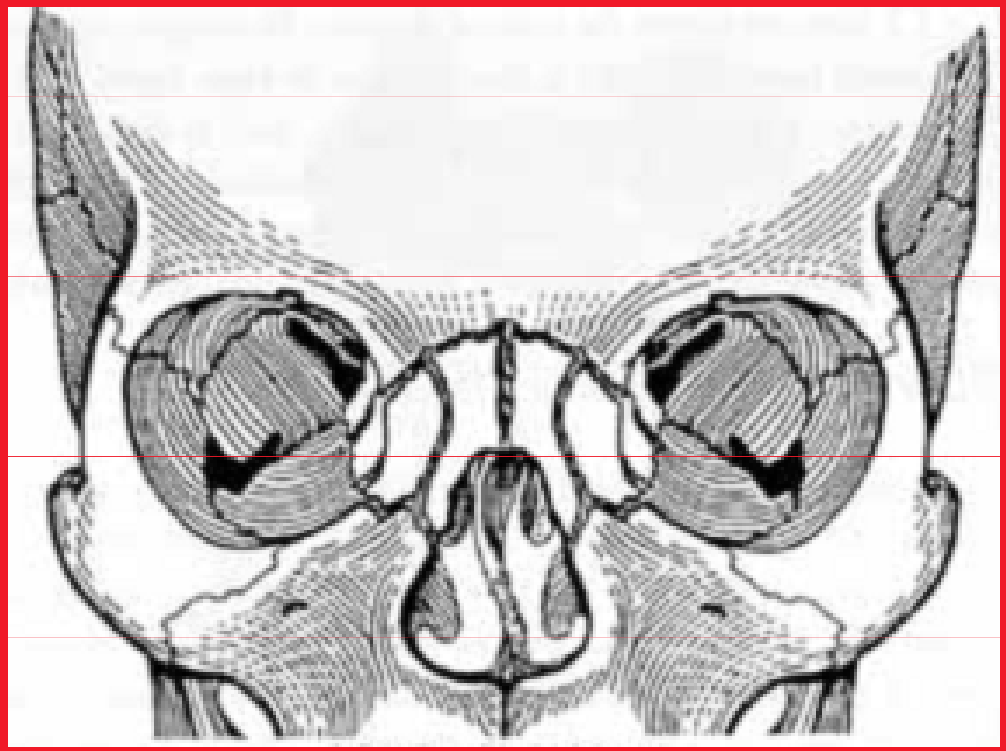
Naso-orbitoethmoid fractures

- In patients with comminution, the bony segments may spread medially into the nasal cavity, superiorly to the anterior cranial fossa, and laterally into the orbit



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Naso-orbitoethmoid fractures

damage of the inner corner of the eye -> enlargement of the interorbital distance
= telecanthus

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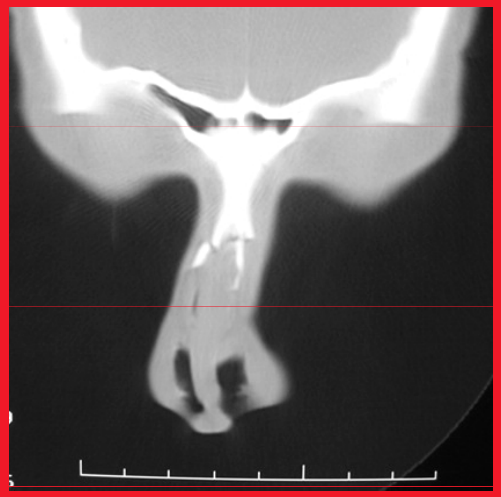
Isolated fractures of nasal bones



It usually results from a blunt injury and is one of the most common facial fracture (cosmetically serious)

deviation of the nose to the side

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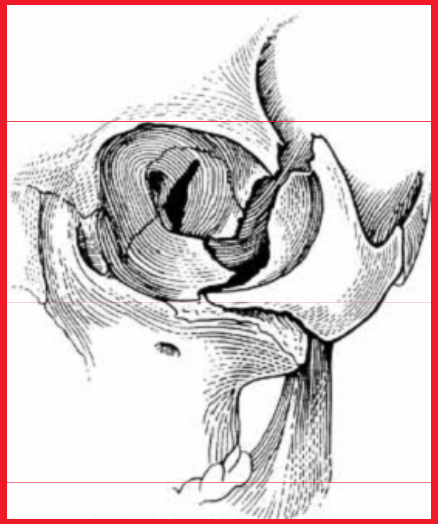
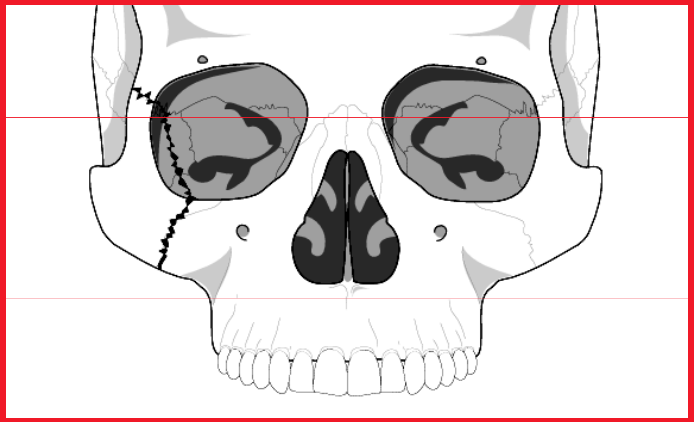
Zygomaticomaxillary Complex

- fracture lines usually run through the infraorbital rim, and extend to the inferior orbital fissure

- all zygomatic complex fractures involve the orbit, making visual complications

- the affected eye may have impaired motility, resulting in double vision





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Zygomaticomaxillary Complex

SYMPTOMS:

- Periocular (bruises) and oedema
- Epistaxis, cerebrospinal fluid leakage, lacrimal drainage problems
- Diplopia (double vission)
- Enopthalmus X Exopthalmus (posterior X anterior displacement of the globe within the orbit.

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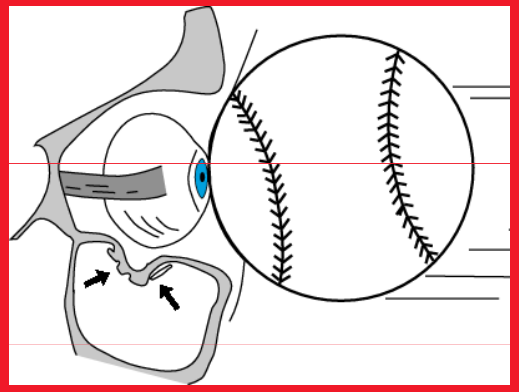
Orbital blow-out fractures

- the fractures of orbital skeleton
- occur when there is a fracture of one of the walls of orbit but the orbital rim remains intact
- typically caused by a direct blow to the central orbit from a fist or ball.



fracture of the floor ot the orbit

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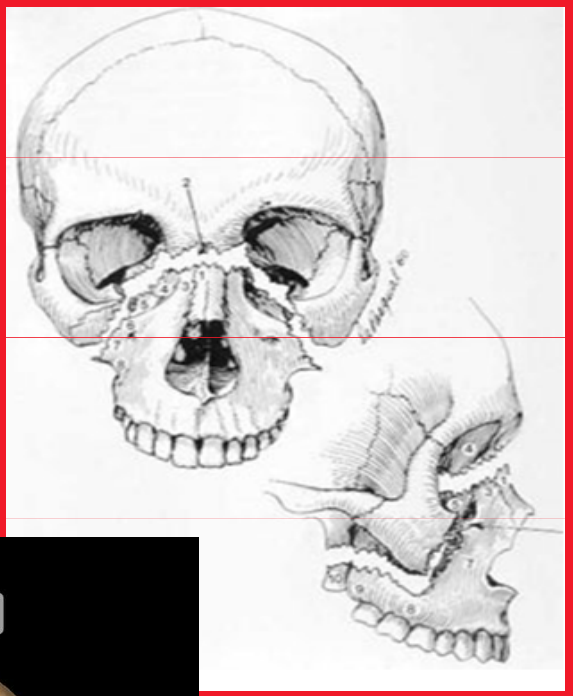
Le Fort type II (pyramidal)



- pyramidal fracture, with the teeth at the pyramid base, and nasofrontal suture at its apex
- fracture line passes through the posterior alveolar ridge, lateral walls of maxillary sinuses, inferior orbital rim and nasal bones
- uppermost fracture line can pass through the nasofrontal junction or the frontal process of the maxilla

traumatic changes of occlusion

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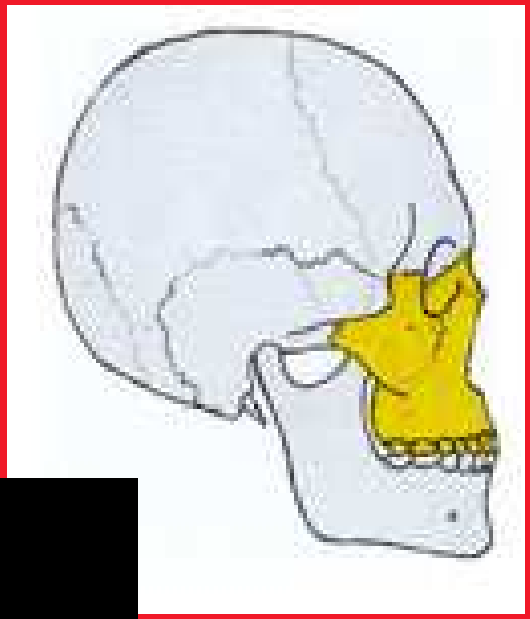
Le Fort type III (transverse)



- craniofacial disjunction - because of the involvement of the zygomatic arch
- transverse fracture line passes through nasofrontal suture, maxillo-frontal suture, orbital wall, and zygomatic arch/zygomaticofrontal suture
- unsurprisingly type III fractures have the highest rate of CSF leak

traumatic changes of occlusion

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Thank you for your attention

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