

**Functional structure
of the skull**

and

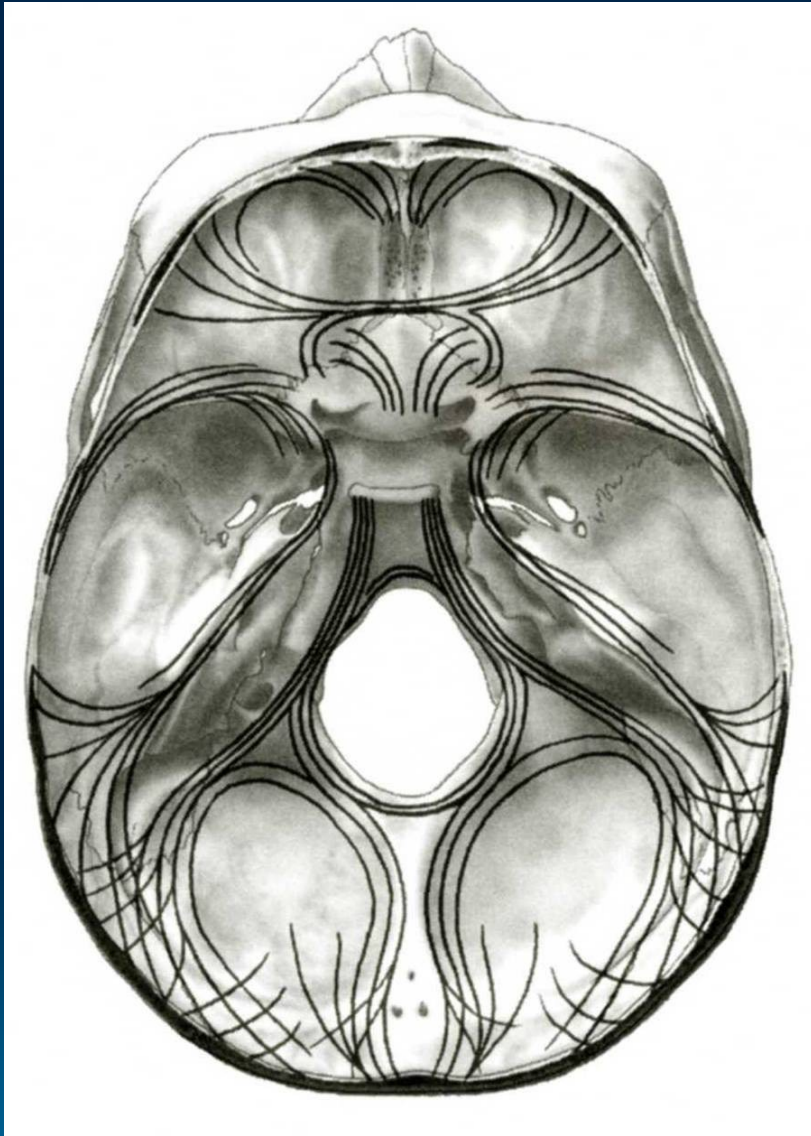
**Fractures of the
skull**

The background of the slide is a solid dark blue. In the lower right quadrant, there are several decorative elements consisting of concentric circles in a lighter shade of blue, resembling ripples in water. These circles are of varying sizes and are arranged in a somewhat scattered pattern.

Thickened and thinner parts of the skull

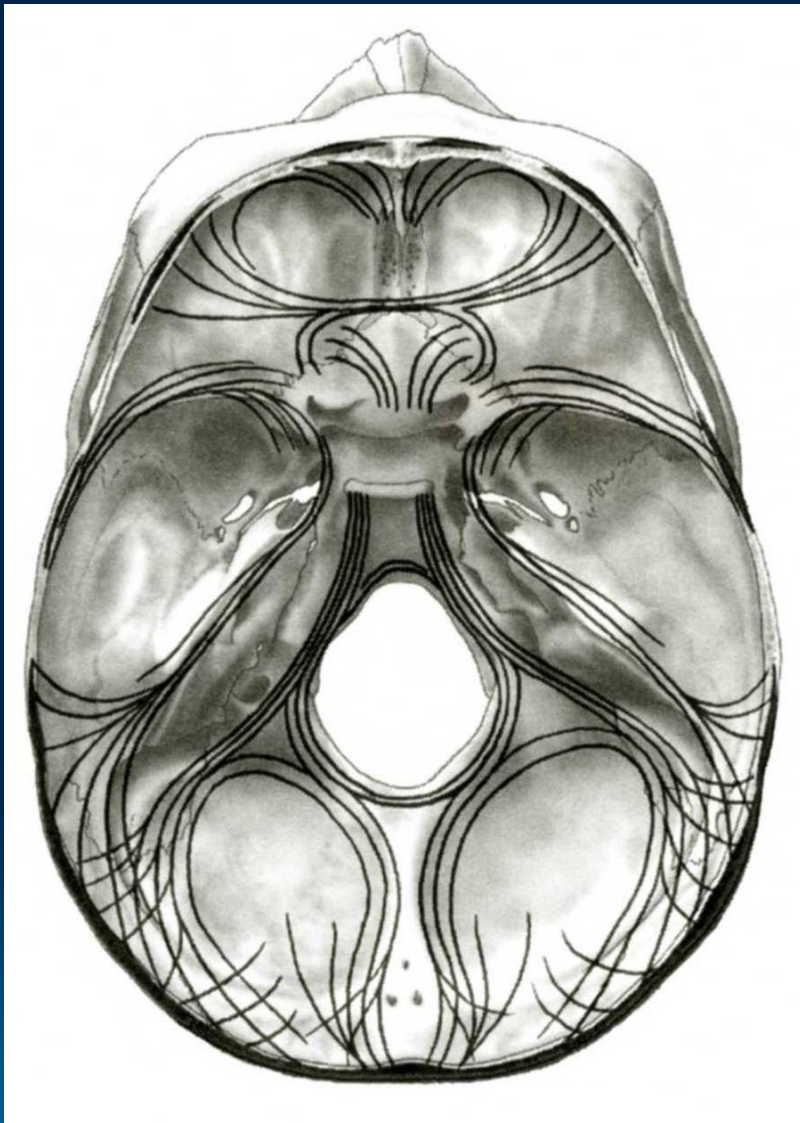
= important base for understanding of the **functional structure of the skull** →

- the transmission of masticatory forces
- fracture predilection



Thickened parts:

- sagittal line
- ventral lateral line
- dorsal lateral line



Thinner parts:

- articular fossa
- cribriform plate
- foramina, canals and fissures
- anterior, medial and posterior cranial fossa



Thickened parts:

- tuber parietalis
- mastoid process
- protuberantia occipitalis
ext. et int.
- linea temporalis
- margin of sulcus sinus:
 - sagitalis sup.
 - transversus

Functional structure of the skull

Facial buttresses system

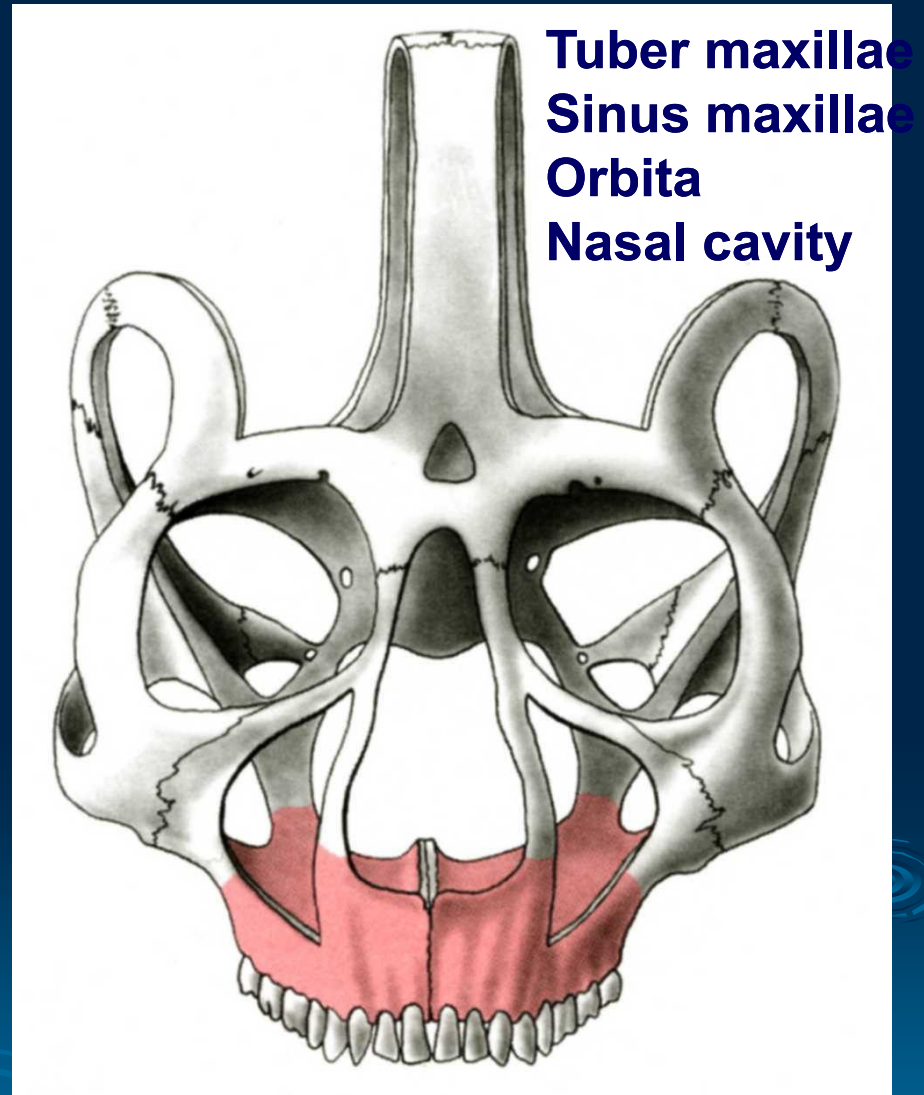
- Of thin segments of bone encased and supported by a more rigid framework of "buttresses"
- The midface is anchored to the cranium through this framework
- Is formed by strong frontal, maxillary, zygomatic and sphenoid bones and their attachments to one another

Vertical buttress

- nasomaxillary
- zygomaticomaxillary
- pterygomaxillary

Horizontal buttress

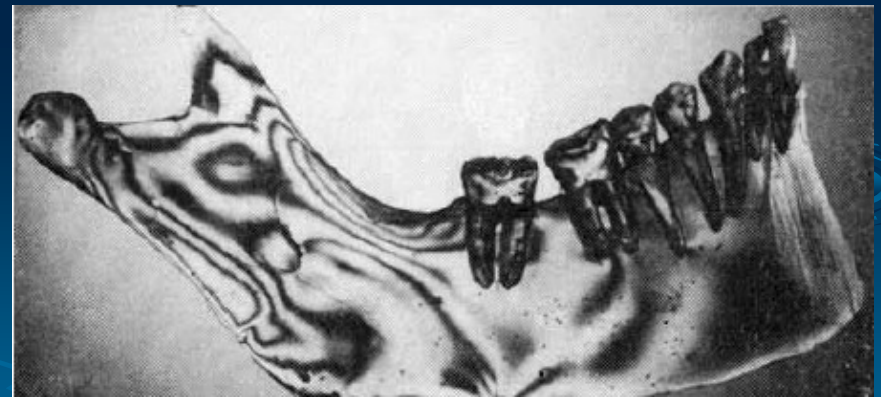
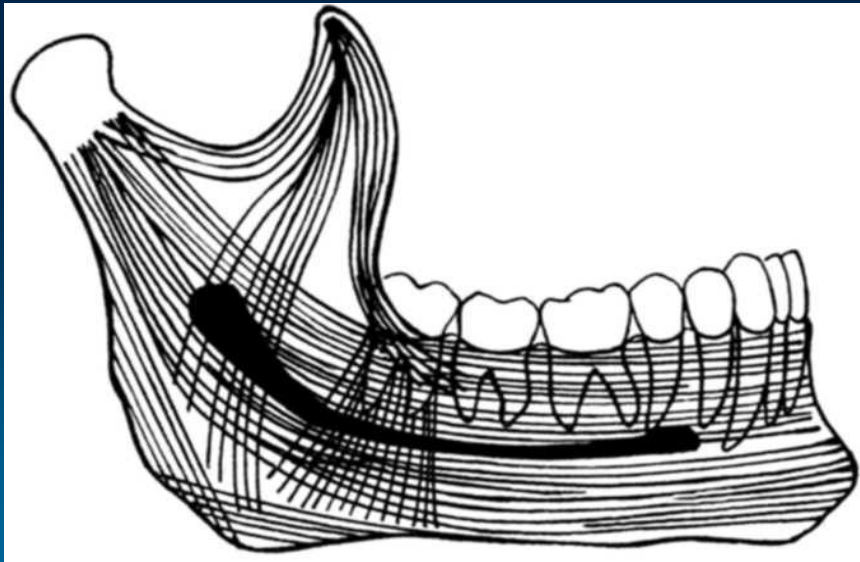
- glabella
- orbital rims
- zygomatic processes
- maxillary palate

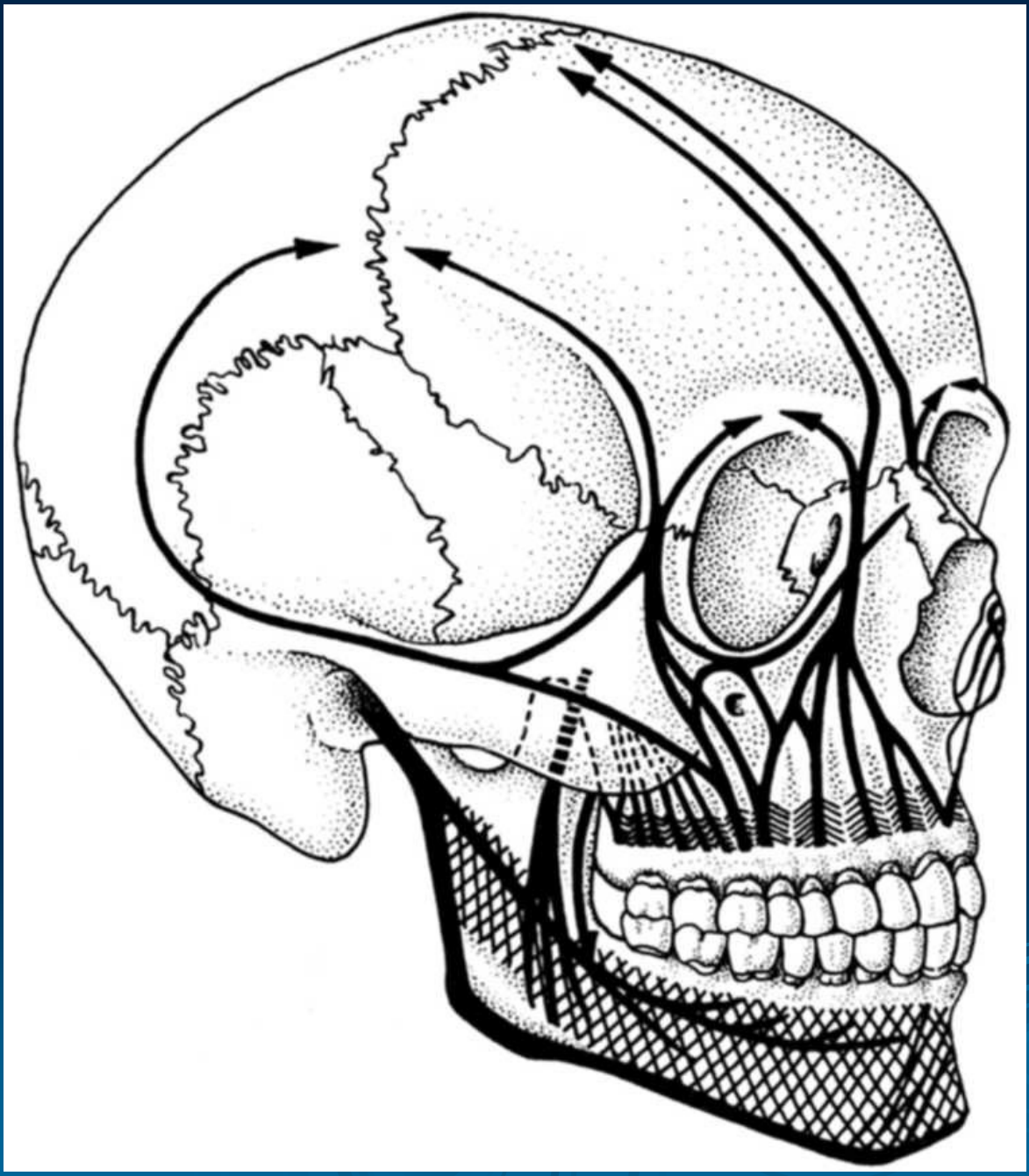


- The buttress system **absorbs and transmits forces applied to the** facial skeleton
- Masticatory forces are transmitted to the skull base **primarily through the vertical buttresses**, which are joined and additionally supported by the horizontal buttresses
- When external forces are applied, these components prevent disruption of the facial skeleton until a critical level is reached and then fractures occur

Stress that occurs from mastication or trauma is transferred from the inferior of the mandible via various **trajectory lines** → to the condyles glenoid fossa → temporal bone

The main alveolar stress concentration were located interradicularly and interproximally





Fractures of the skull



**I. Neurocranial
fractures**


**II. Craniofacial
fractures**



I. Neurocranial fracture

- A break in the skull bone are generally occurs as a result of a direct impact
- If the force and deformation is excessive, the skull fractures at or near the site of impact
- Uncomplicated skull fractures themselves rarely produce neurologic deficit, but the associated intracranial injury may have serious neurologic sequelae

1. Linear skull fracture

- Most common, comprising 2/3 of all cases
 - Involve a break in the bone but no displacement
 - Usually the result of low-energy transfer
 - Due to blunt trauma over a wide surface area of the skull
 - Are of little clinical significance
- 
- A decorative graphic consisting of several sets of concentric circles, resembling ripples in water, is located in the bottom right corner of the slide. The circles are light blue and vary in size and opacity, creating a subtle background element.



2. Depressed skull fractures

A fracture is clinically significant and requires elevation when a fragment of bone is depressed deeper than the adjacent inner table

Closed or compound (open)

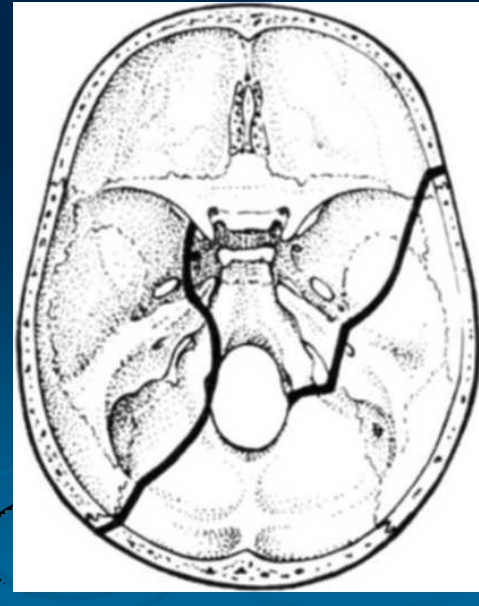
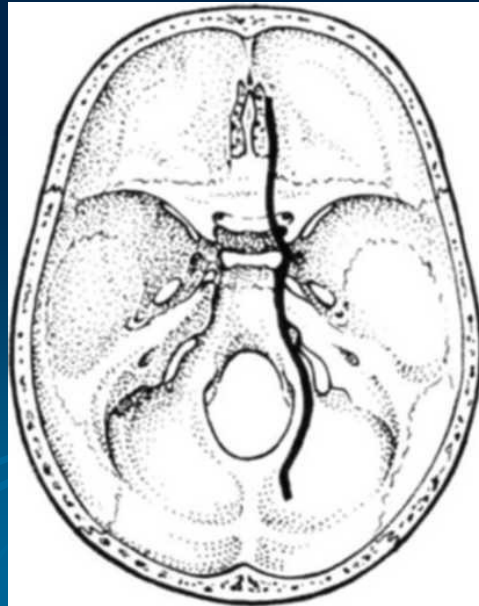
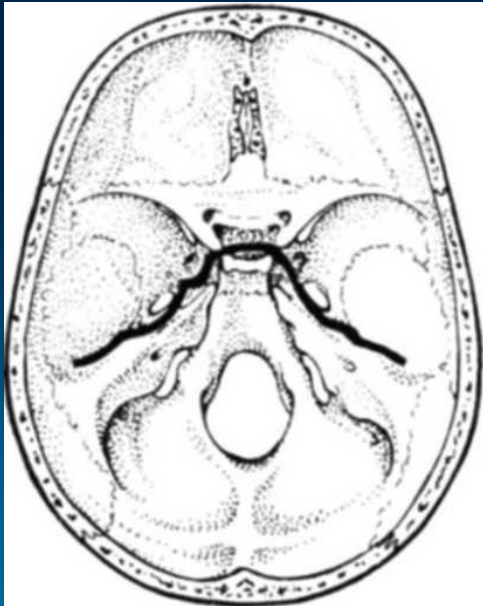
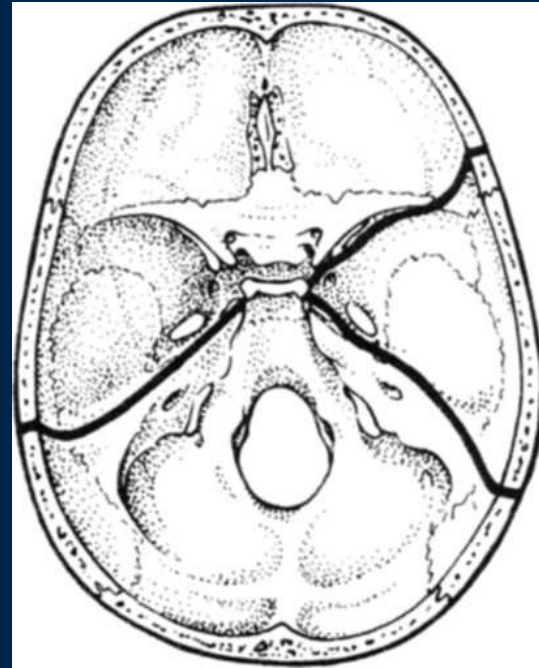
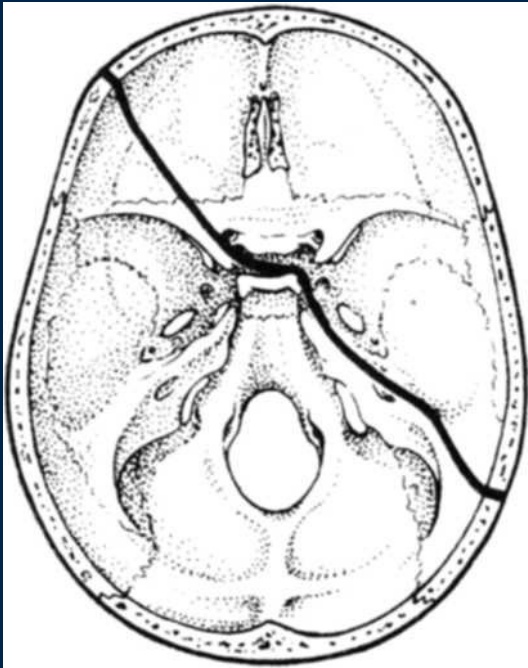
Compound fractures may be exposed when they are associated with a skin laceration or when the fracture extends into the paranasal sinuses and the middle-ear structures

Inner lamina is more subjected to compression



3. Basilar skull fractures

- Basilar fractures are the most serious and involve a linear break in the bone at the base of the skull
- Fractures line often occur at predilection sites (no accidental injury)
- Are often associated with dural tears, of which cerebrospinal fluid (CSF) rhinorrhea and otorrhea are known complications



Symptoms and complications of skull fracture

- Otorrhea, rhinorrhea
- Battle's sign
- Raccoon eyes
- Cranial nerve lesion

- Intracranial hemorrhage: extradural
subdural
subarachnoidal
intracerebral



Rhinorrhea



Otorrhea

Battle's sign



Raccoon eyes –
bilateral ecchymosis



Cranial nerve lesion

I. (Olfactory n.) - loss of smell
(anosomia)

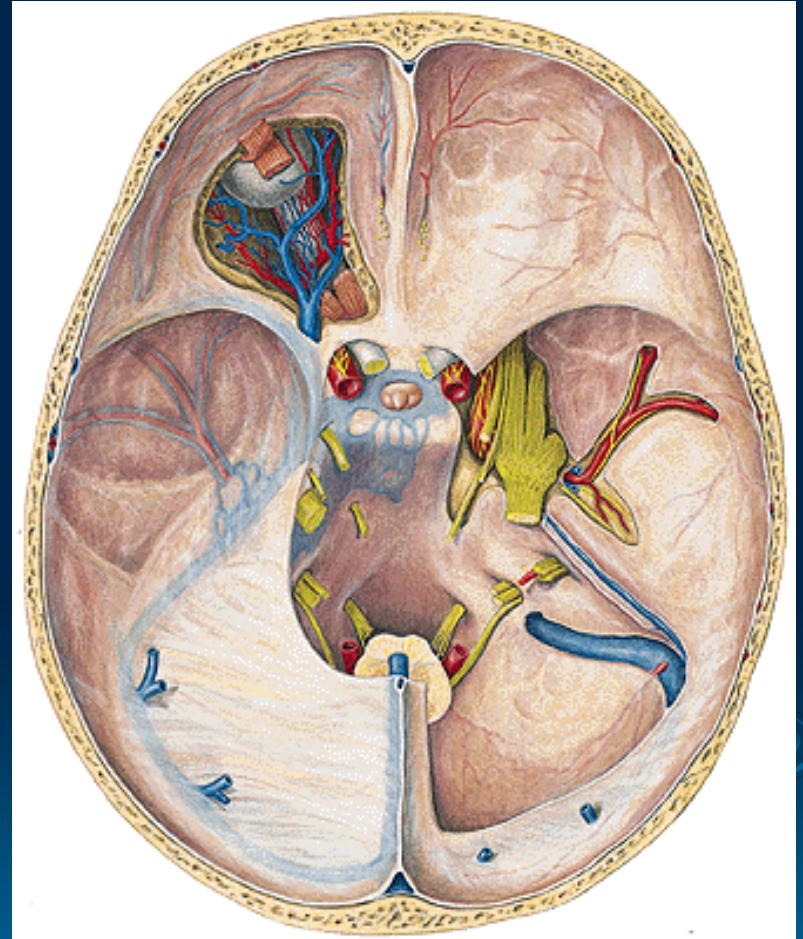
II. (Optic n.) - loss of vision,
abnormal pupillary reflex

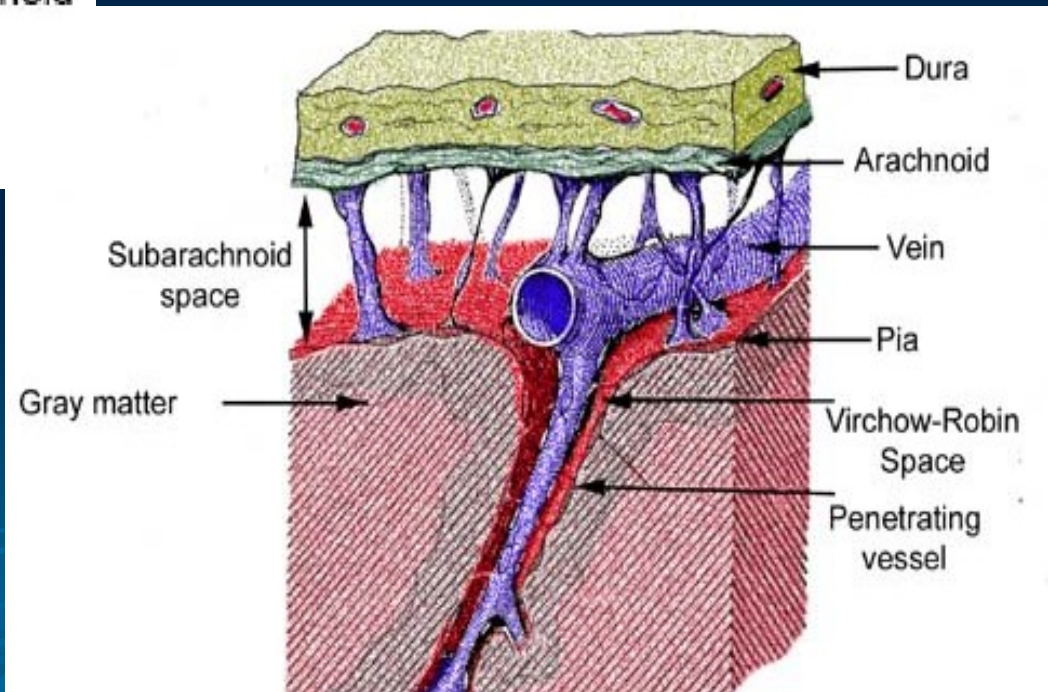
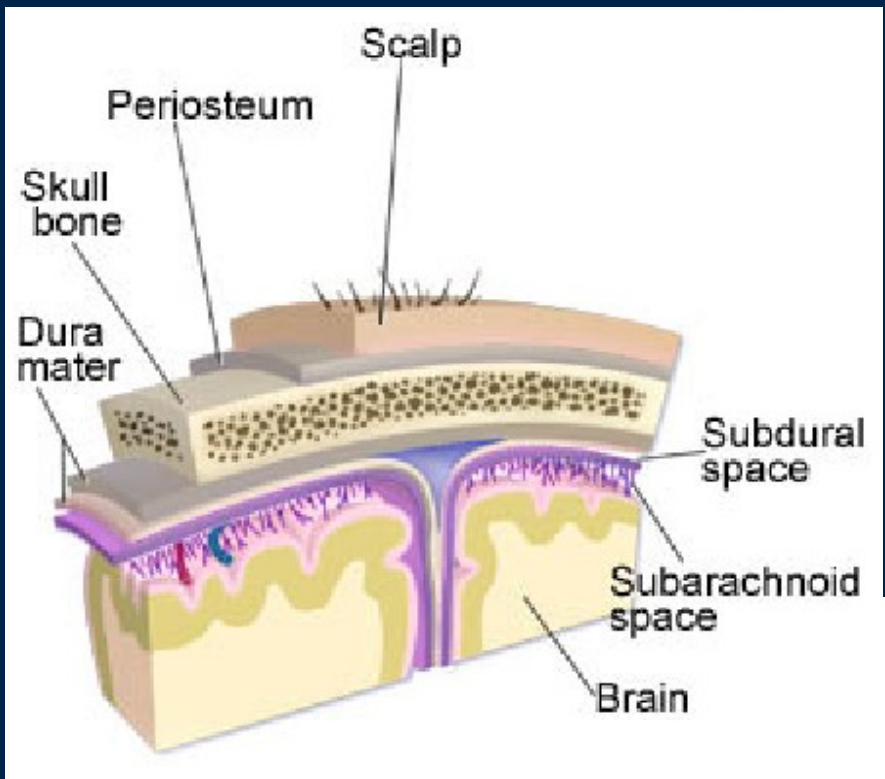
III. (Oculomotor n.) - loss of
accommodation, lateral
strabismus

VI. (Abducens n.) - medial
strabismus

VII. (Facial n.) - paralysis

VIII. (Auditory n.) - hearing loss





Extradural hemorrhage

- An arterial bleed from a **middle meningeal artery** accumulates and forming a hematoma
- Between the inner skull table and dura matter
- The temporal bone is usually the thinnest part of the skull

NOTE! Extradural = epidural

Subdural hemorrhage

- Shears and tears of the **small veins** that bridge the gap between the **dura** and **the cortical surface of the brain**
- Between the dura matter and arachnoid
- Common in the elderly, children, and individuals with alcoholism



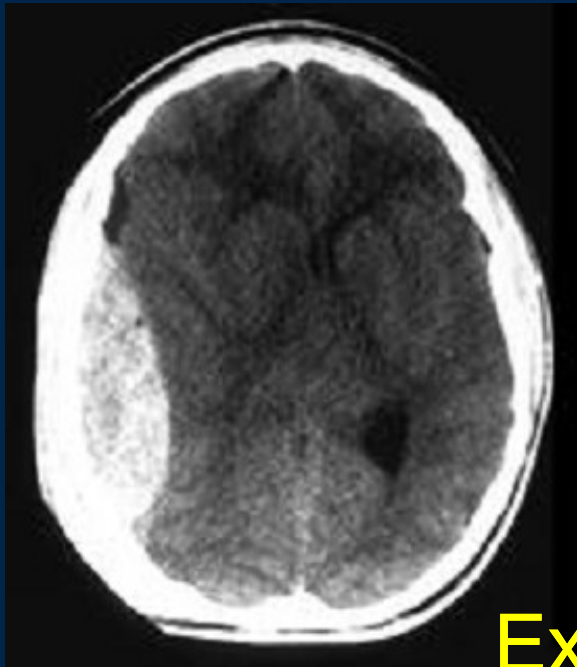
Subarachnoid hemorrhage

- A result of a ruptured **intracranial arterial aneurysm** or **trauma**
- Beneath arachnoid



Intracerebral hemorrhage

- A result of a ruptured **atheromatous intracerebral arteriole, vasculitis, ruptured intracranial arterial aneurysm, or trauma**
- Traumatic intracerebral hemorrhage is usually due to extension of hemorrhage from surface contusions deep into the substance of the brain



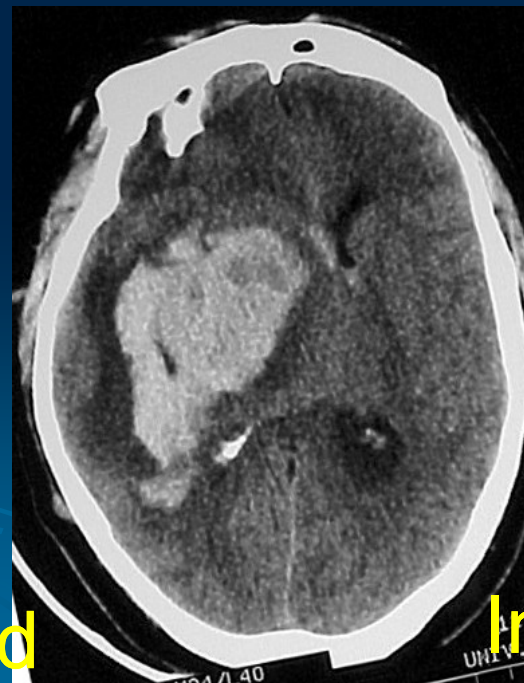
Extradural



Subdural



Subarachnoid

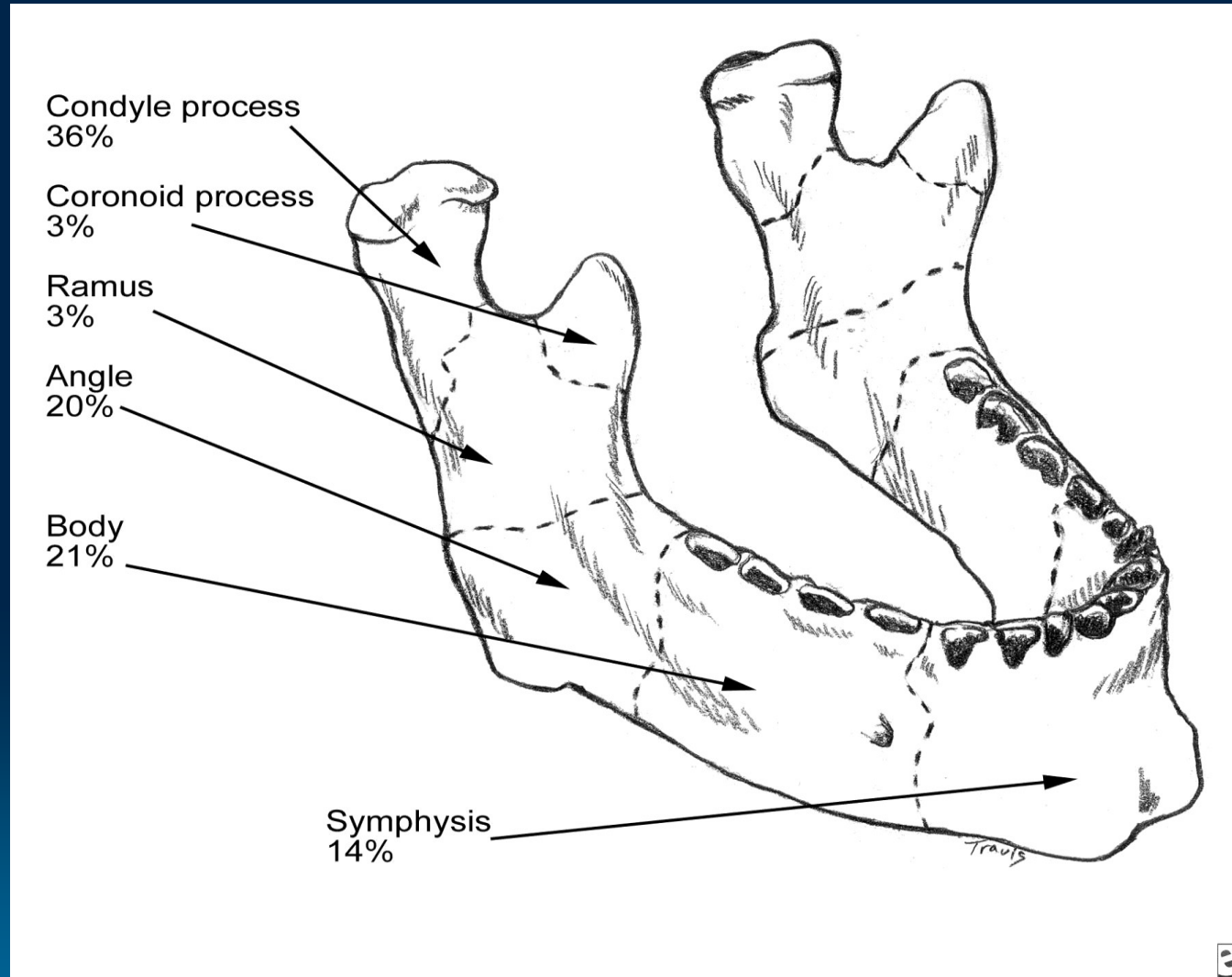


Intracerebral

II. Craniofacial Fractures

1. Mandible
2. Lower mid-face
3. Upper mid-face
4. Craniobasal-facial

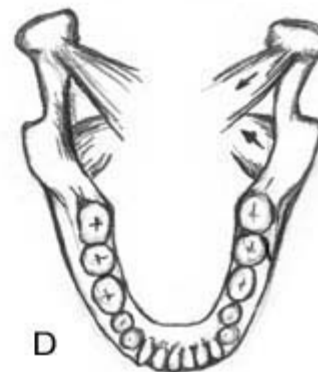
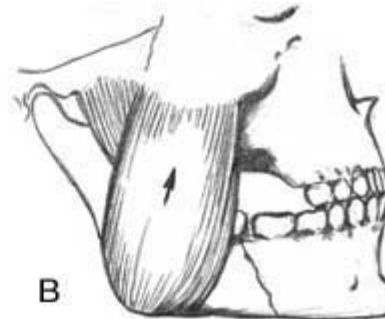
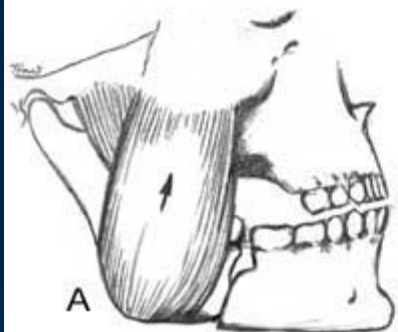
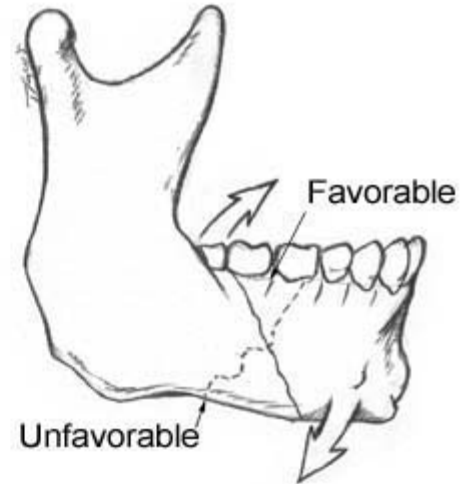
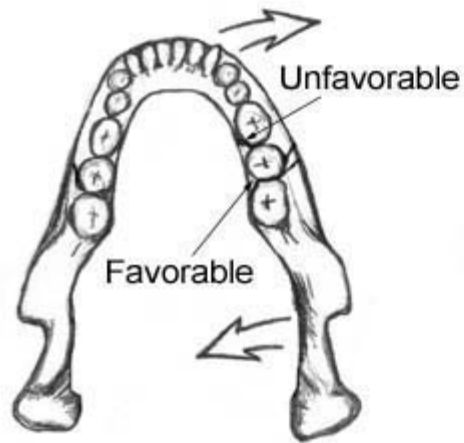
1. Fracture of the mandible

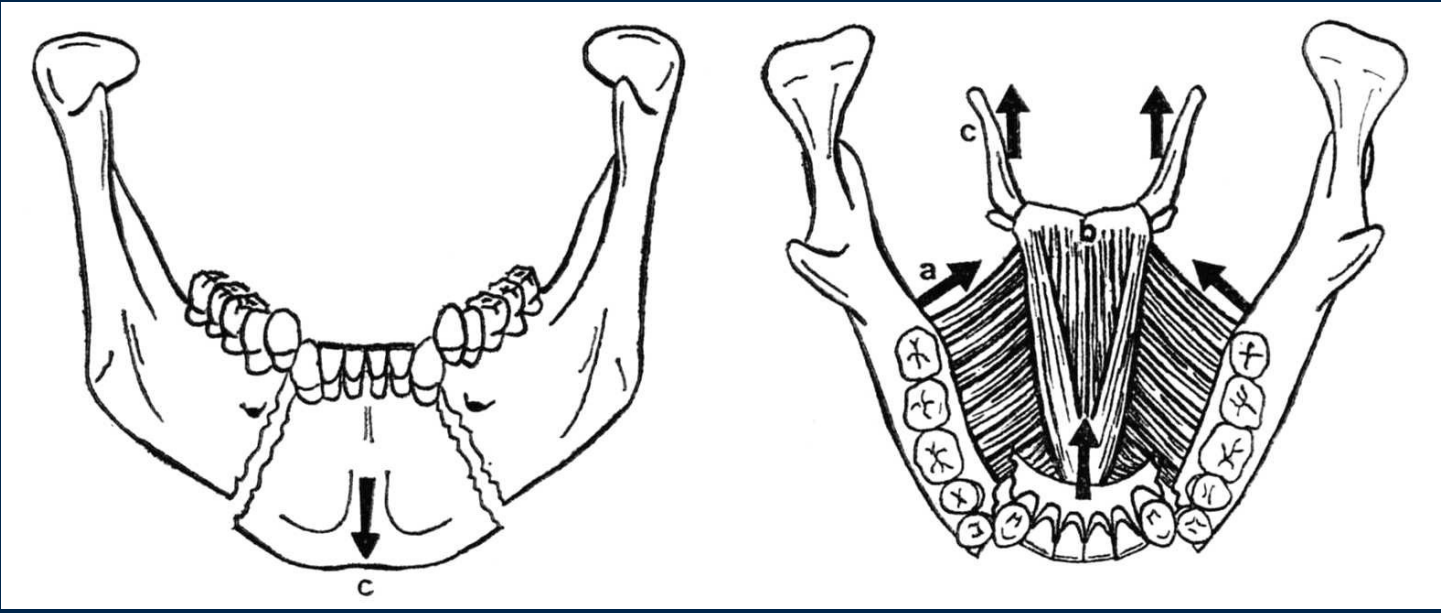


Body fractures

- Between the distal aspect of **the canines** and a hypothetical line corresponding to **the anterior attachment of the masseter**, proximal to the third molar
- The actions of the masseter, temporalis, and medial pterygoid muscles distract the proximal segment **superomedially**
- The mylohyoid muscle and anterior belly of the digastric muscle may contribute to the displacing the fractured segment **posteriorly and inferiorly**

Forces acting on mandible →





Angle fractures

- Occur in a **triangular region** between the **anterior** border of the masseter and the **posterosuperior** insertion of **the masseter**, distal to the third molar
- The actions of the masseter, temporalis, and medial pterygoid muscles distract the proximal segment **superomedially**



Symphyseal and parasymph. fractures

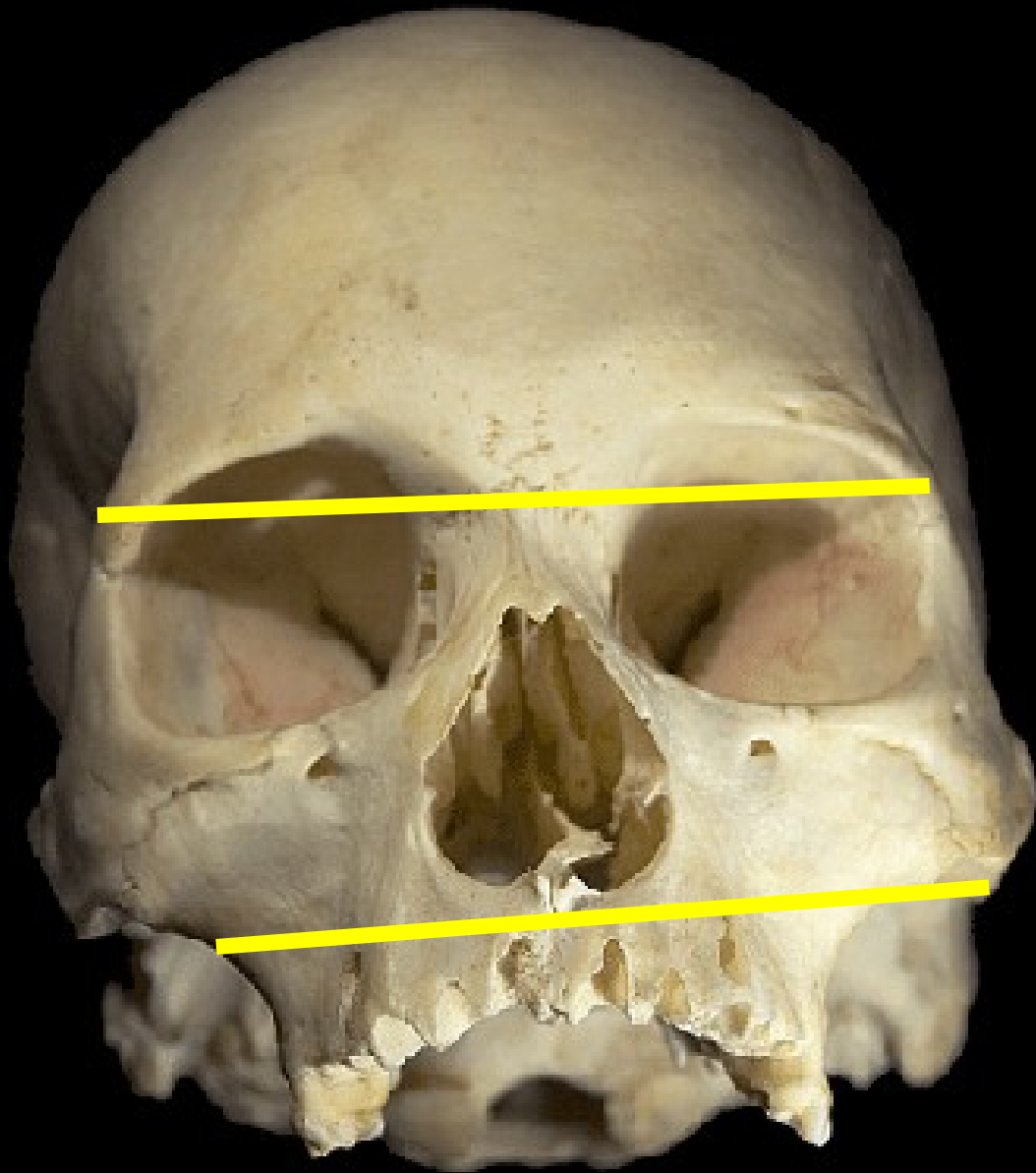
- In the midline of the mandible are classified as **symphyseal**
- When teeth are present, the fracture line passes between the mandibular central incisors
- In the area of the mandible from cuspid to cuspid, but not in the midline, are classified as **parasymphyseal**

Condylar process fractures

- Classified as **extracapsular, intracapsular** and **subcondylar**
- The lateral pterygoid muscle tends to cause **anterior and medial** displacement of the condylar head

- Type I is a fracture of the neck of the condyle with relatively slight displacement of the head. The angle between the head and the axis of the ramus varies from 10-45°.
- Type II fractures produce an angle from 45-90°, resulting in tearing of the medial portion of the joint capsule.
- Type III fractures are those in which the fragments are not in contact, and the head is displaced medially and forward. The fragments are confined within the area of the glenoid fossa. The capsule is torn, and the head is outside the capsule.
- Type IV fractures of the condylar head articulate on or in a forward position with regard to the articular eminence.
- Type V fractures consist of vertical or oblique fractures through the head of the condyle.





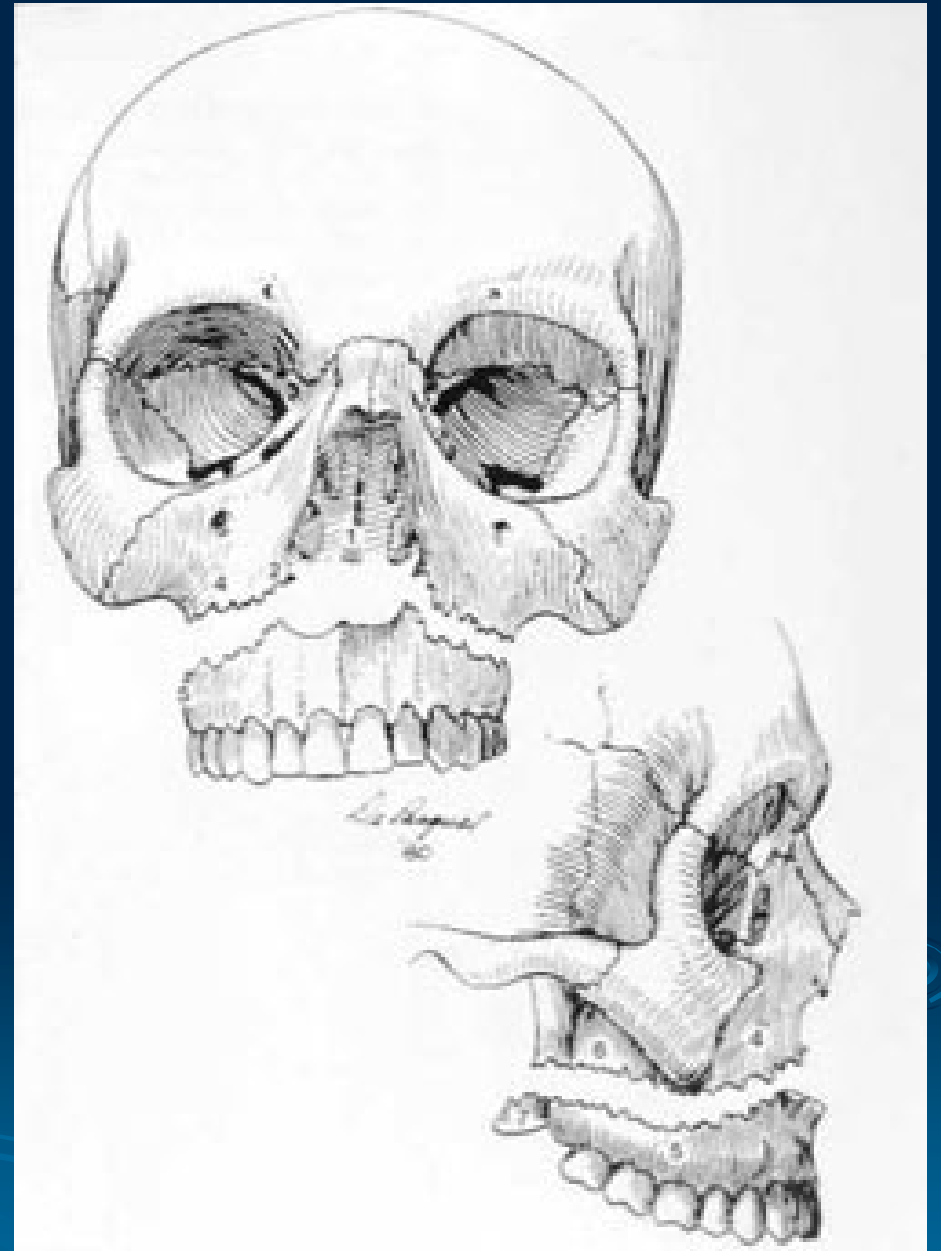
Upper mid-face

Lower mid-face

2. Lower midfacial fracture

Le Fort I or low horizontal fractures:

From **nasal septum** to the lateral pyriform rims
→ horizontally **above the teeth apices**
→ below the **zygomaticomaxillary junction**,
and traverses the pterygomaxillary junction
to interrupt **the pterygoid plates**



3. Upper midfacial fracture

- a) Naso-orbitoethmoid Fractures**
- b) Zygomaticomaxillary Complex**
- c) Orbital fractures**
- d) Le Fort II**
- e) Le Fort III**

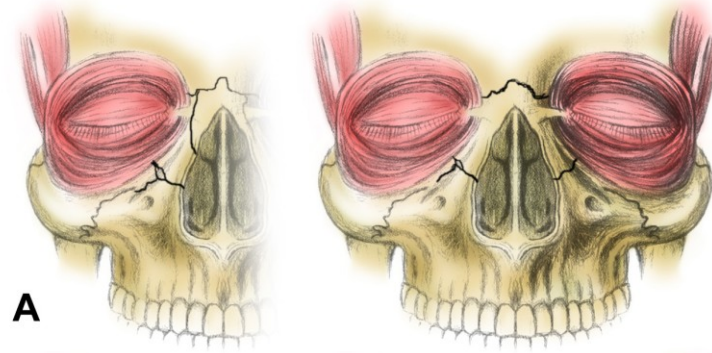


a) Naso-orbitoethmoid Fractures

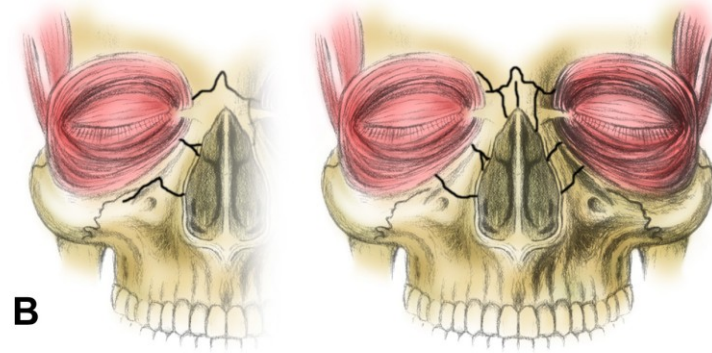
- The NOE complex represents a bony onfluence that separates the nasal, orbital, and cranial cavities (the nasal, frontal, maxillary, ethmoid, lacrimal, and sphenoid bones)
- If there is bilateral comminution an displacement, the nasofrontal ducts are disrupted-predisposes the patient to future mucocele formation

- If the fracture segments are displaced, **nasal bones** and **frontal process** of the maxilla may be telescoped posteriorly beneath the frontal bone
- 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
- For this reason, high-energy impact may lead to **cerebrospinal fluid** (CSF) leak, cerebral injury, or globe injuries

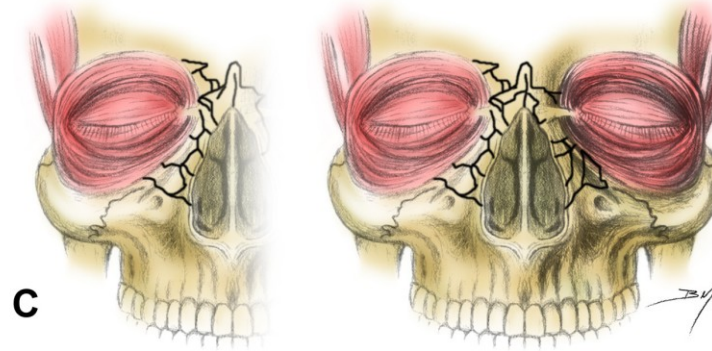
Type I Fracture



Type II Fracture



Type III Fracture



Type I fractures involve a single, noncomminuted, central fragment without medial canthal tendon disruption

Type II fractures involve comminution of the central fragment without medial canthal tendon disruption

Type III fractures result in severe central fragment comminution with medial canthal tendon disruption

Telecanthus



b) Zygomaticomaxillary Complex

- Fracture lines usually run through the **infraorbital rim**, involve the posterolateral orbit, and extend to the **inferior orbital fissure**
- The fracture line then continues to the **zygomatic sphenoid suture** area and on to the **frontozygomatic suture** line
- All zygomatic complex fractures involve the orbit, making visual complications a frequent occurrence



c) Orbital Fractures

The internal orbital skeleton includes **blow-out and blow-in** patterns, as seen in isolated fractures of the orbital floor, medial wall, and roof the orbital rim

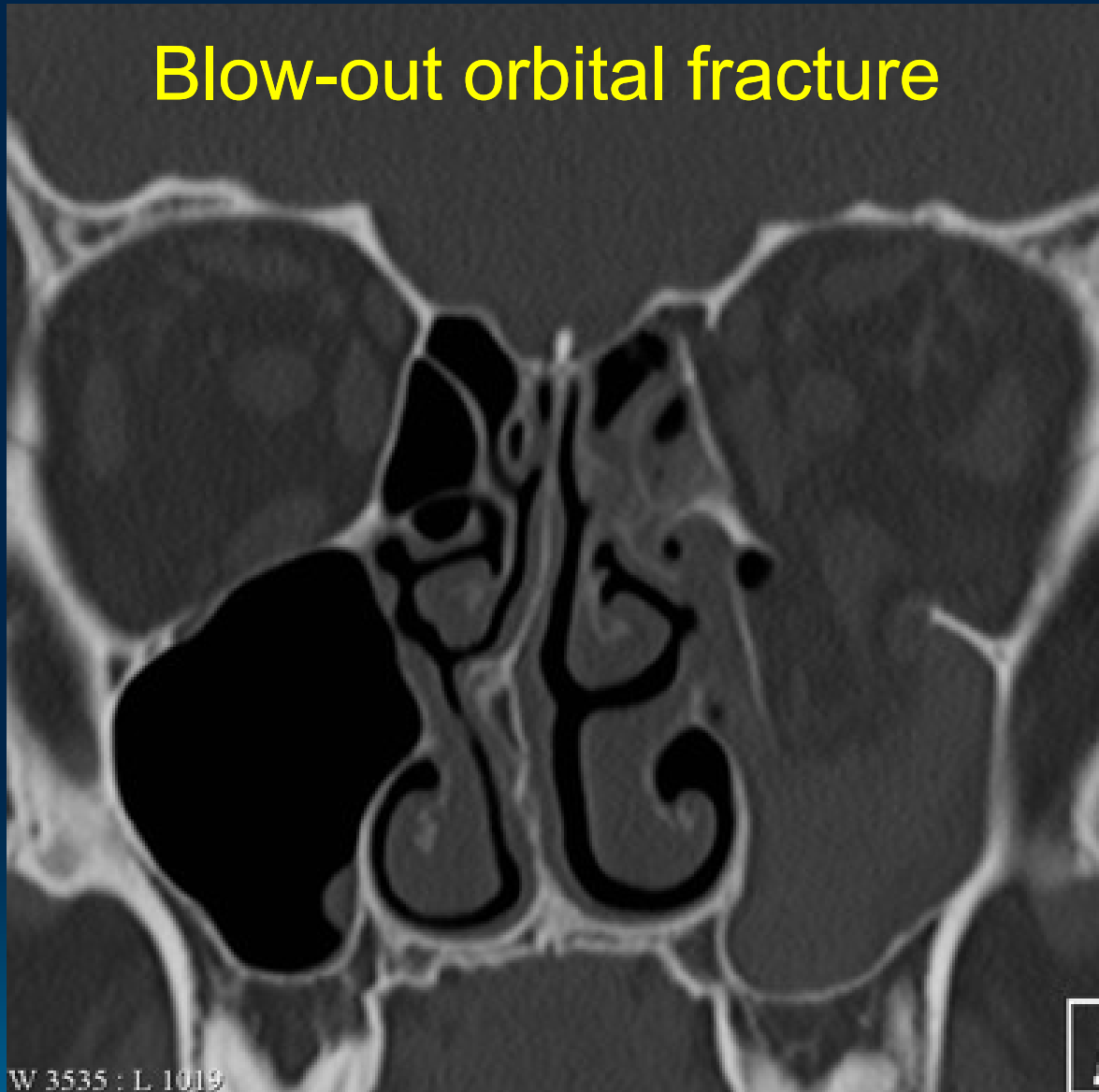
Fractures associated with other fractures of the facial skeleton (zygomaticomaxillary, naso-orbito-ethmoid, frontal-sinus, Le Fort II, and Le Fort III fracture)

Orbital apex fractures - associated with damage to the neurovascular structures of the superior orbital fissure and optic canal

- Periorbital ecchymosis and oedema
- The position of the globe should be assessed
- Enophthalmos is rarely evident in the first days after injury because of edema of the orbital tissues
- A degree of proptosis is evident early
- Hypoglobus may be seen with severe floor disruption with a subperiosteal hematoma of the roof
- Epistaxis, cerebrospinal fluid leakage, lacrimal drainage problems
- Diplopia



Blow-out orbital fracture



d) Le Fort II fractures (pyramidal)

below the **nasofrontal suture**

→ the **frontal processes** of the maxilla

→ the **lacrimal bones** and **inferior orbital floor**
and rim

→ the **inferior orbital foramen**

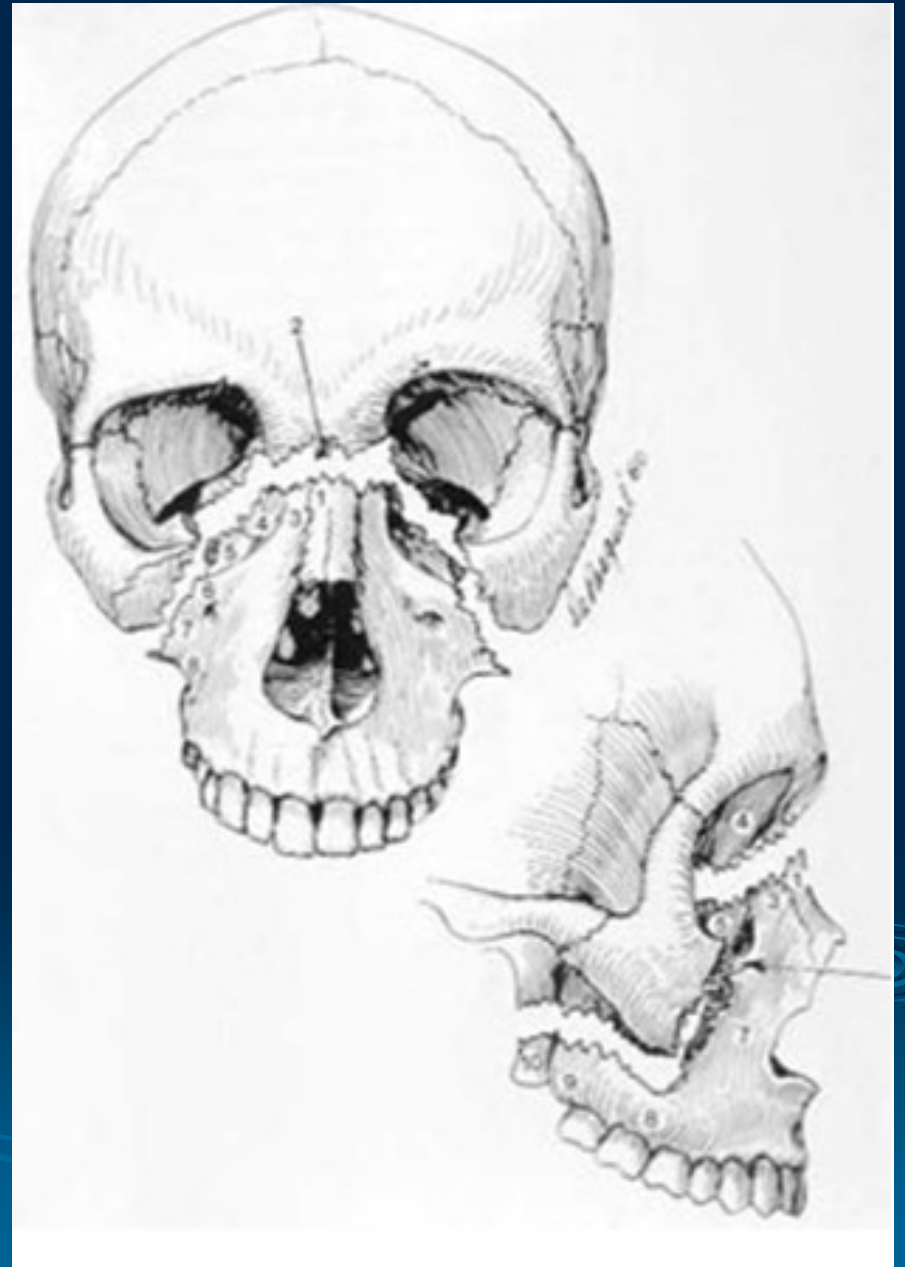
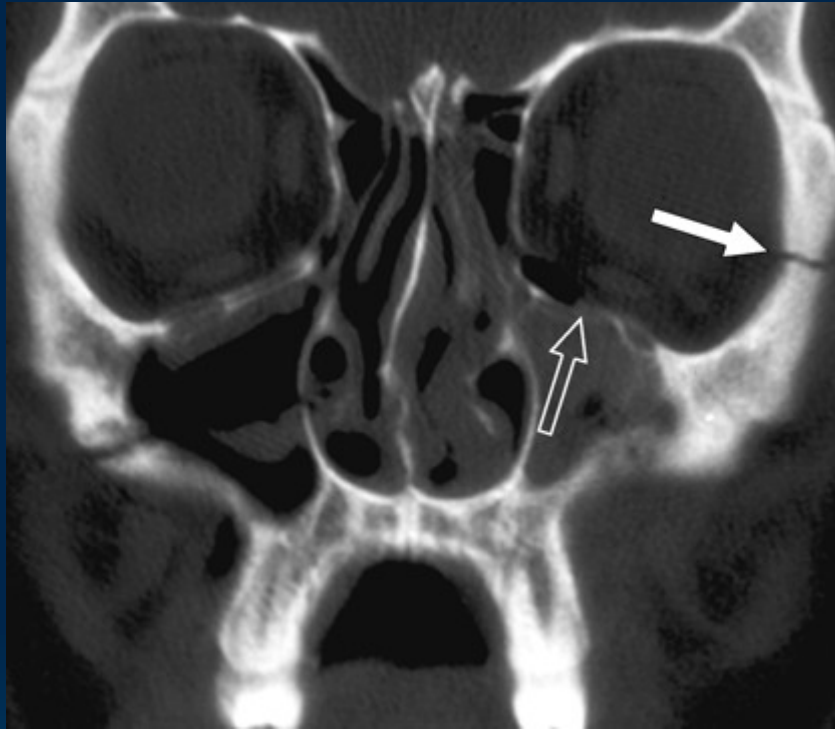
→ the anterior wall of the **maxillary sinus**

→ under the zygoma

→ **the pterygomaxillary fissure**

→ the **pterygoid plates**





e) Le Fort III fractures (transverse)

The **nasofrontal** and **frontomaxillary** sutures

→ along the medial wall of the orbit

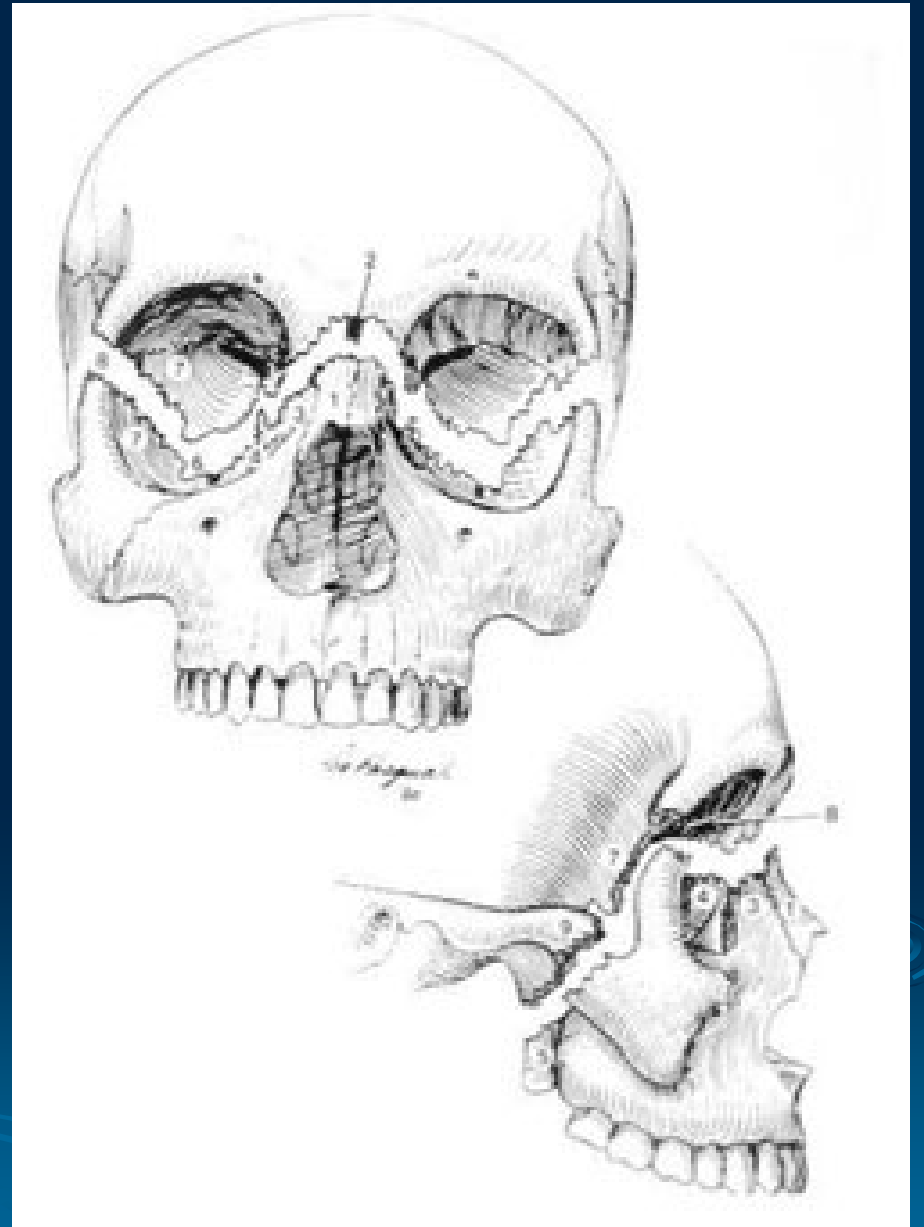
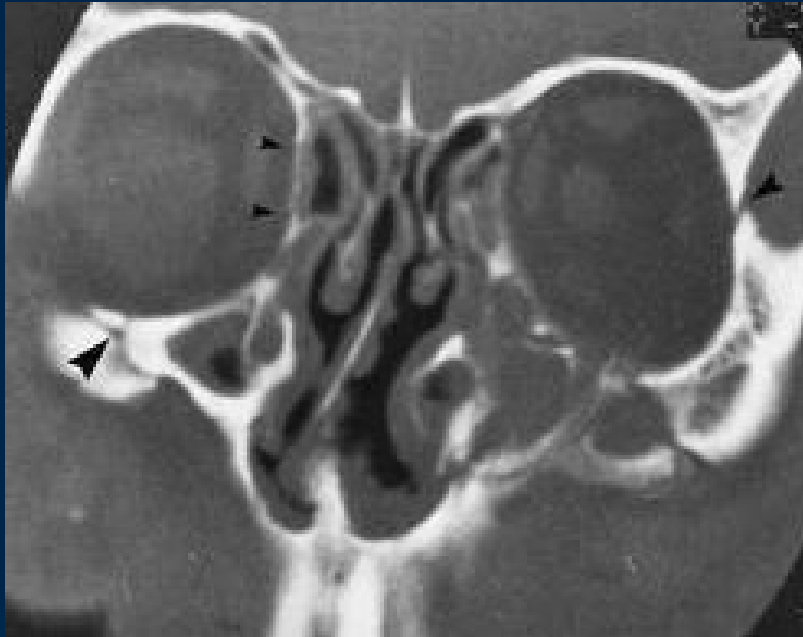
→ through **nasolacrimal groove** and **ethmoid bones**

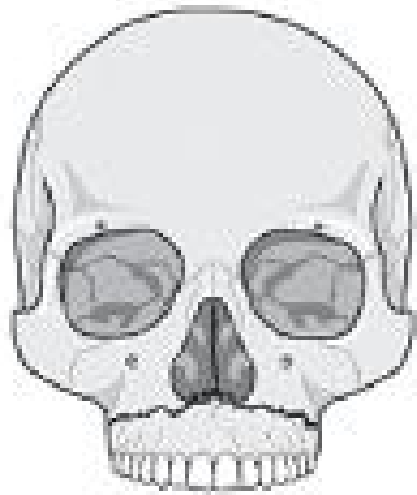
→ along the floor of the orbit

→ along the **inferior orbital fissure**

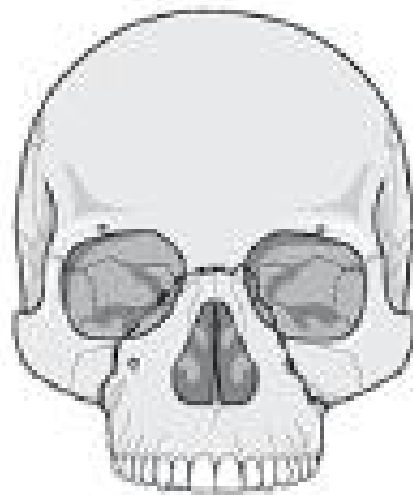
→ through the lateral orbital wall, **zygomaticofrontal junction** and the **zygomatic arch**

Intranasally: through the base of the **perpendicular plate** of the ethmoid, through the **vomer**, and through the interface of the pterygoid plates to the base of the sphenoid

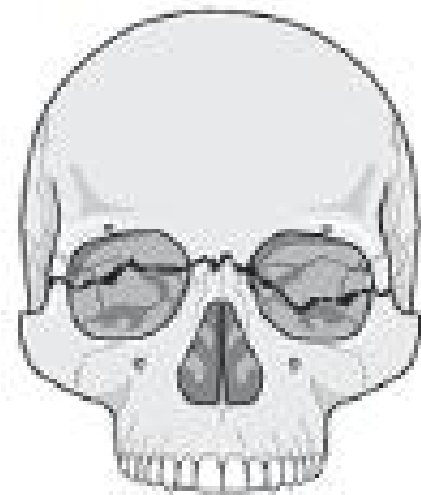




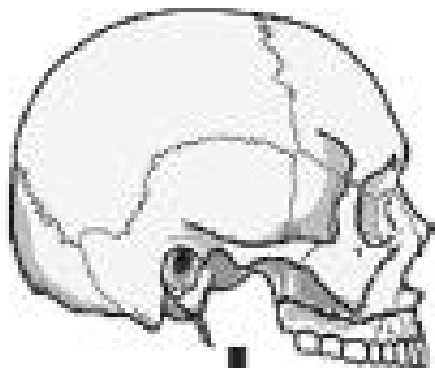
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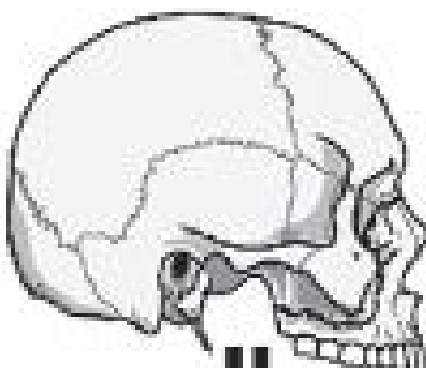
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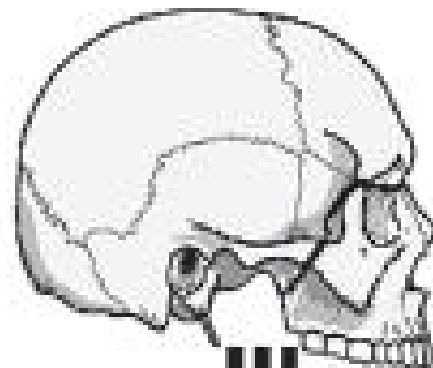
III



I



II



III

4. Craniobasal-facial

Combinations of different fractures

