Functional structure of the skull

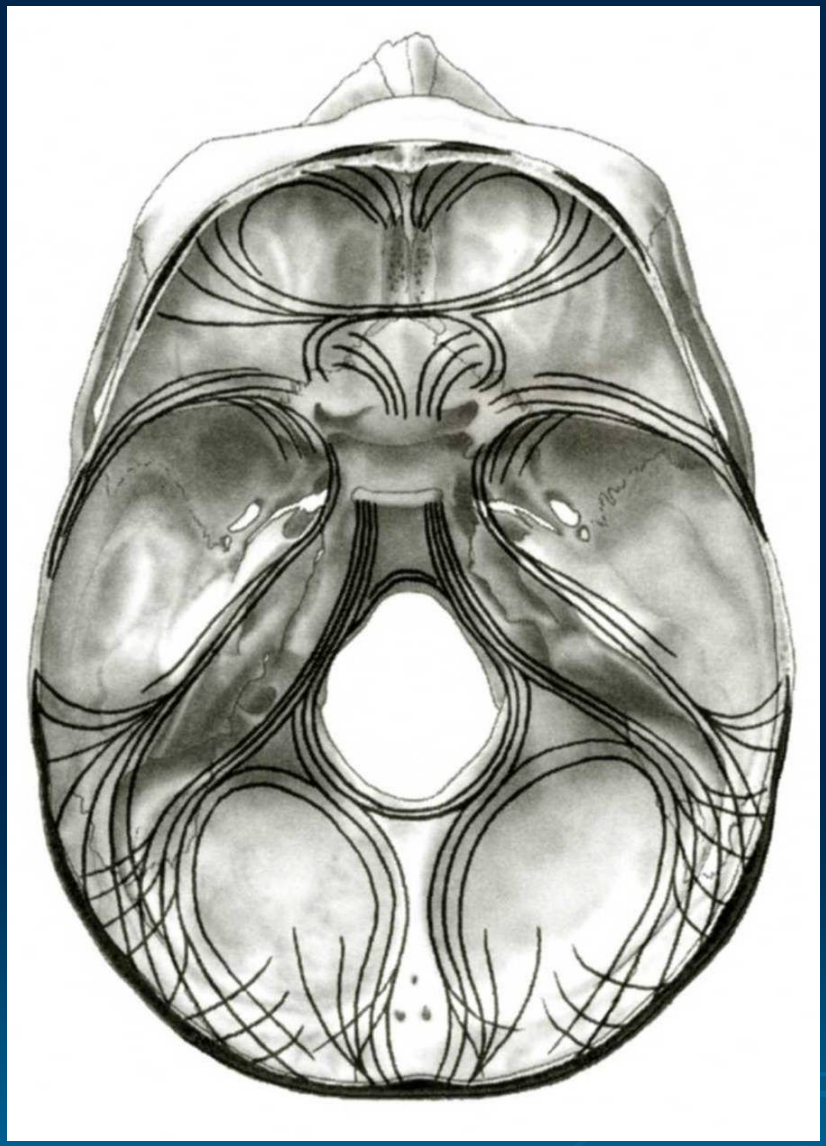
and

Fractures of the skull

Thickened and thinner parts of the skull

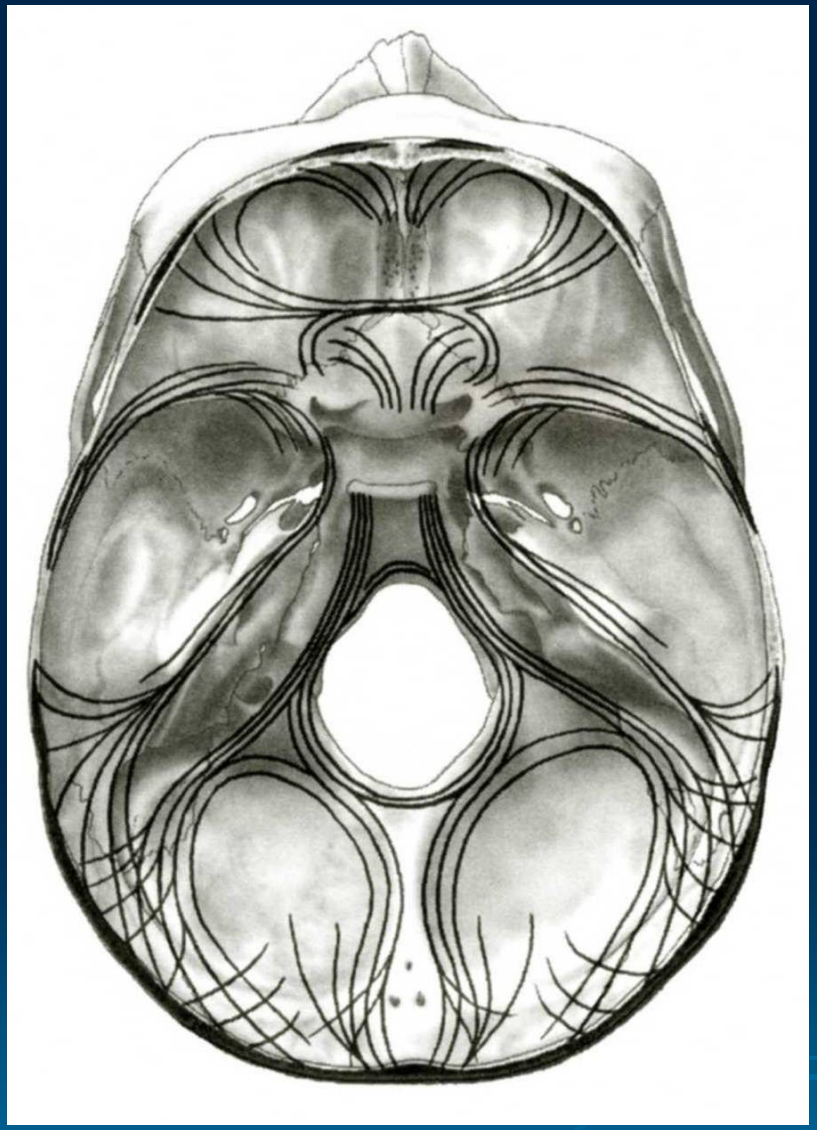
= important base for understanding of the **functional structure of the skull** →

- the transmission of masticatory forces
- fracture predilection



Thickned parts:

- sagittal line
- ventral lateral line
- dorsal lateral line



Thinner parts:

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

Thickned 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

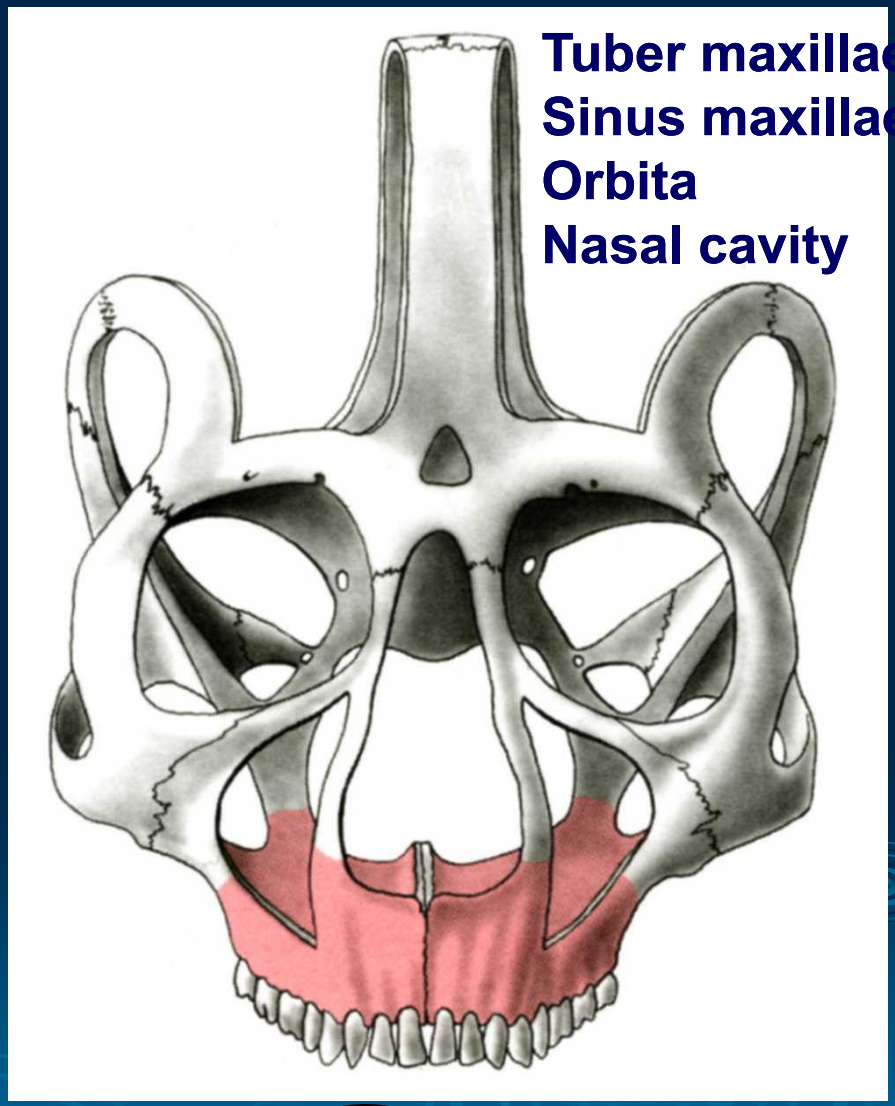
- Is formed by strong frontal, maxillary, zygomatic and sphenoid bones and their attachments to one another

Vertical buttress

- nasomaxillary
- zygomaticomaxillary
- pterygomaxillary

Horizontal buttress

- glabella
- orbital rims
- zygomatic processes
- maxillary palate



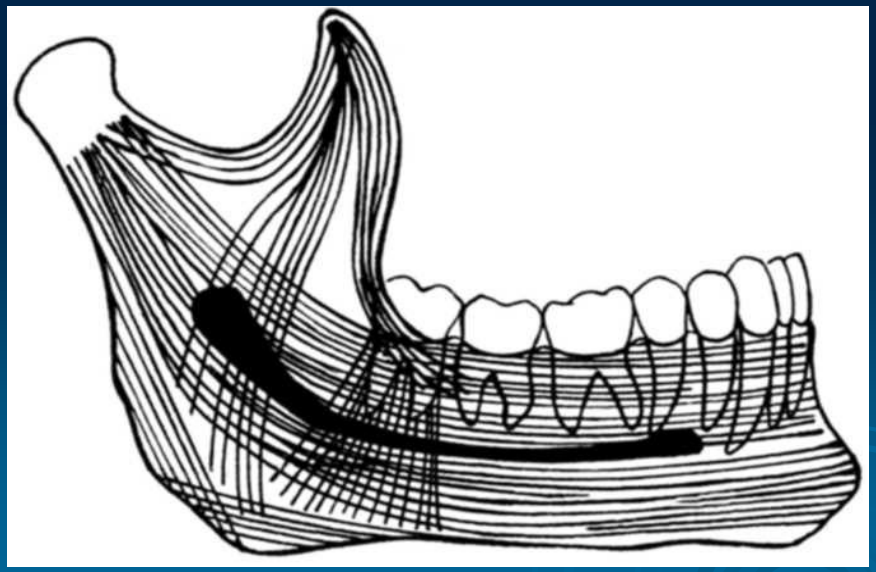
- The buttress system absorbs and transmits forces applied to the facial skeleton

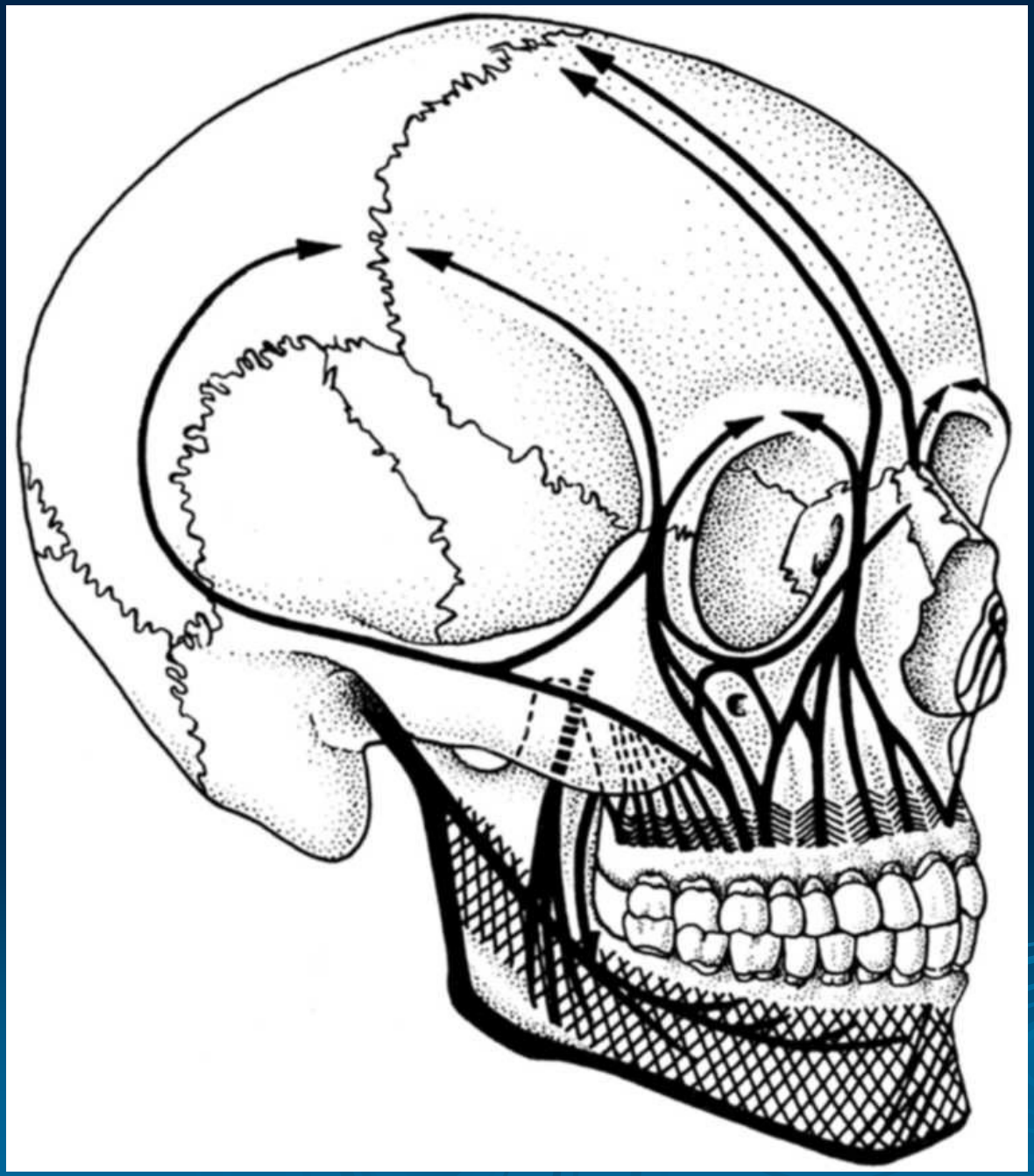
- Masticatory forces are transmitted to the skull base primarily through the vertical buttresses, which are joined and additionally supported by the horizontal buttresses

- 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

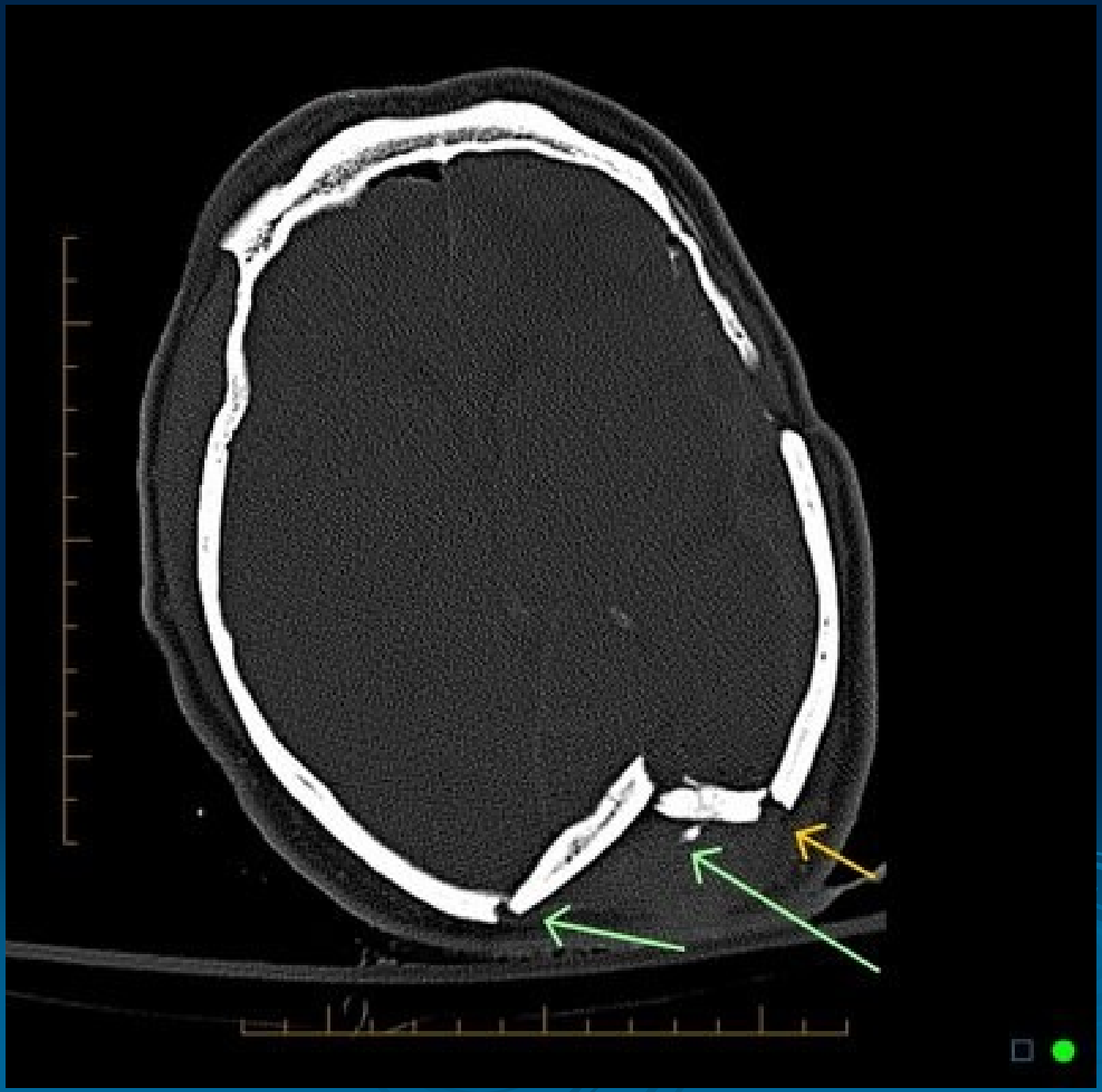
- Most common, comprising 2/3 of all cases
- Involve a break in the bone but no displacement
- Usually the result of low-energy transfer
- Due to blunt trauma over a wide surface area of the skull
- Are of little clinical significance

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

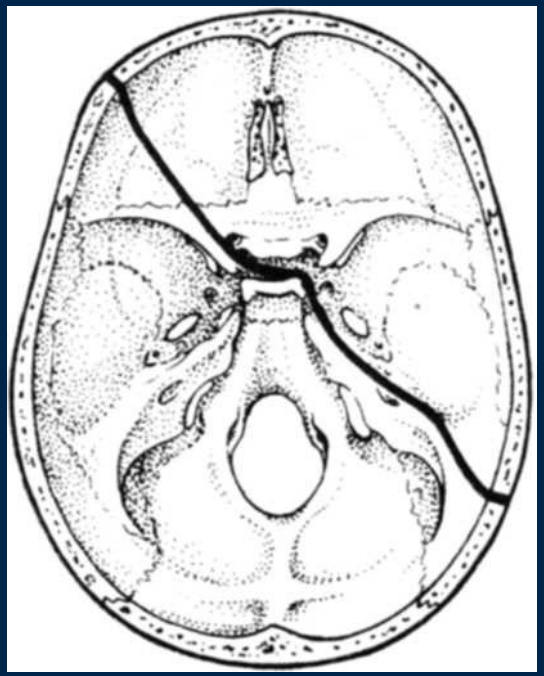
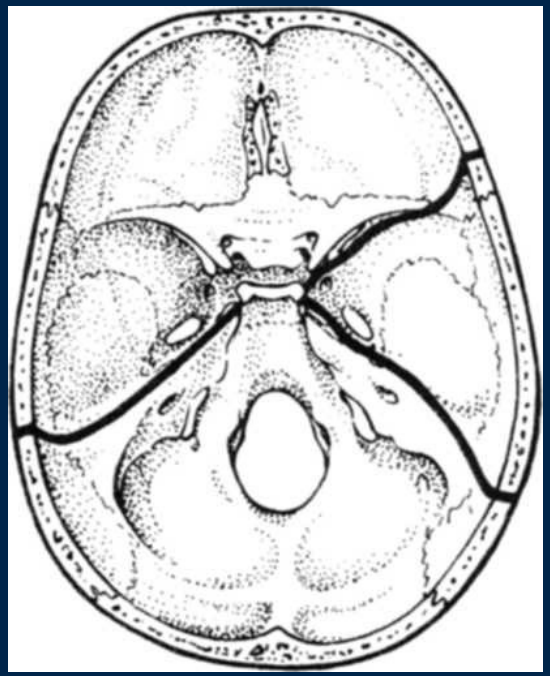
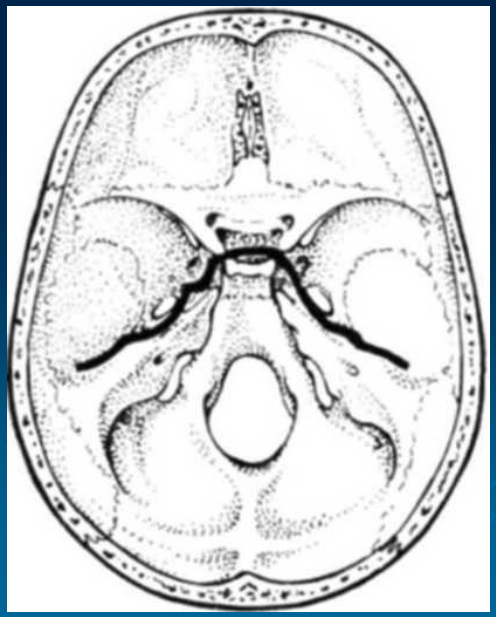
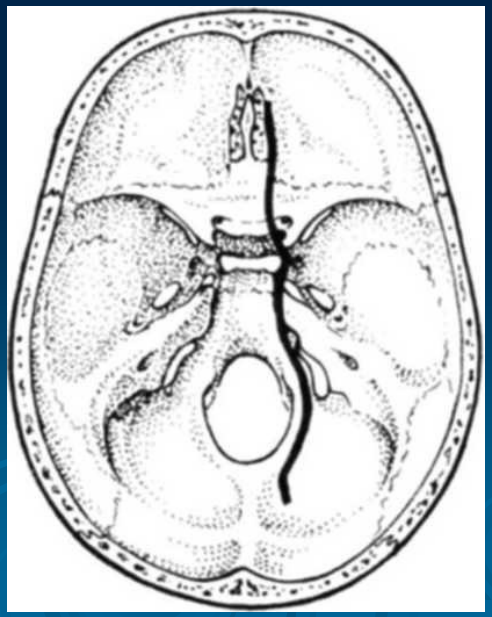
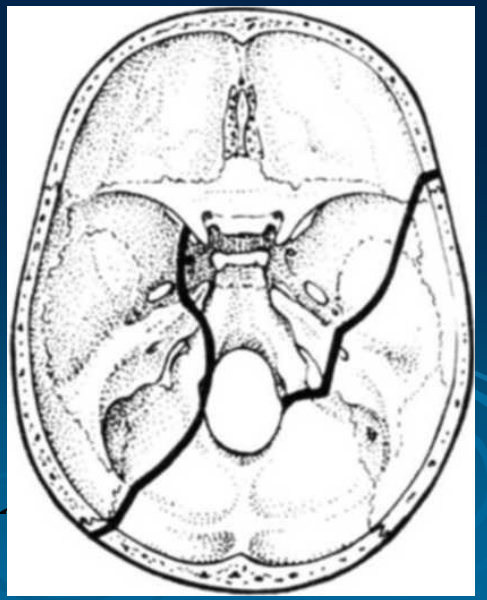


3. Basilar skull fractures

- 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
  subarachnoideal
  intracerebral


Rhinorrhea

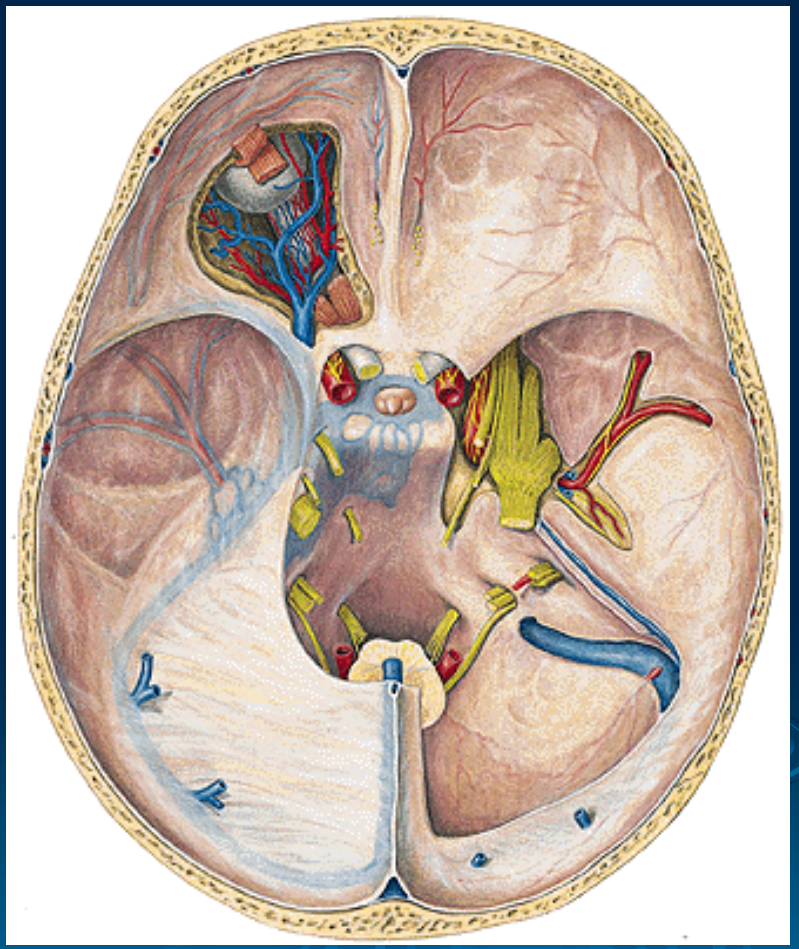

Otorrhea

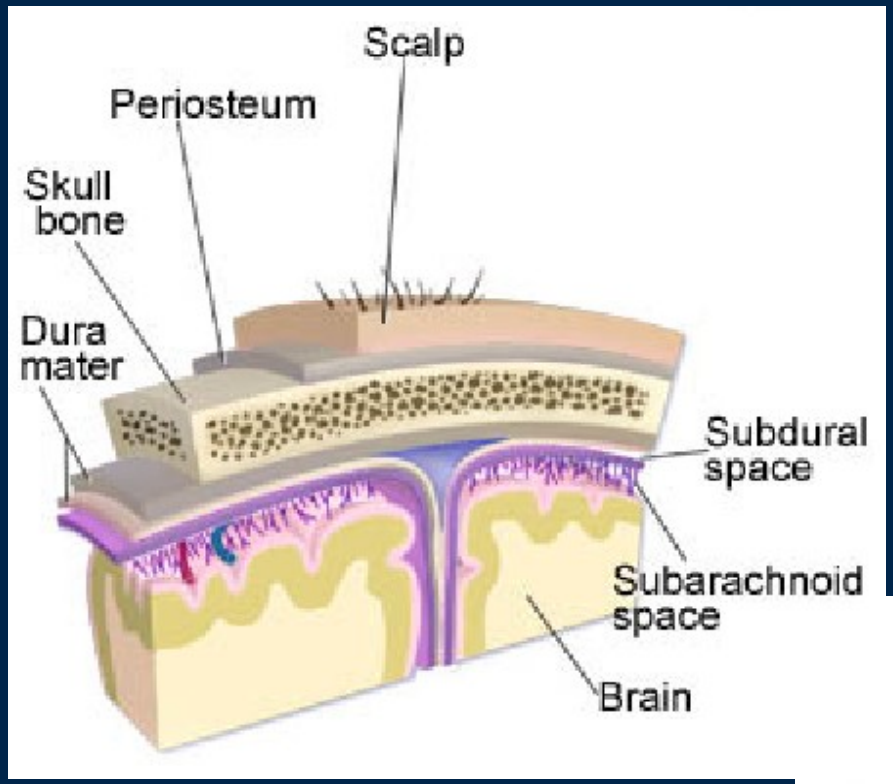

Battle´s sign

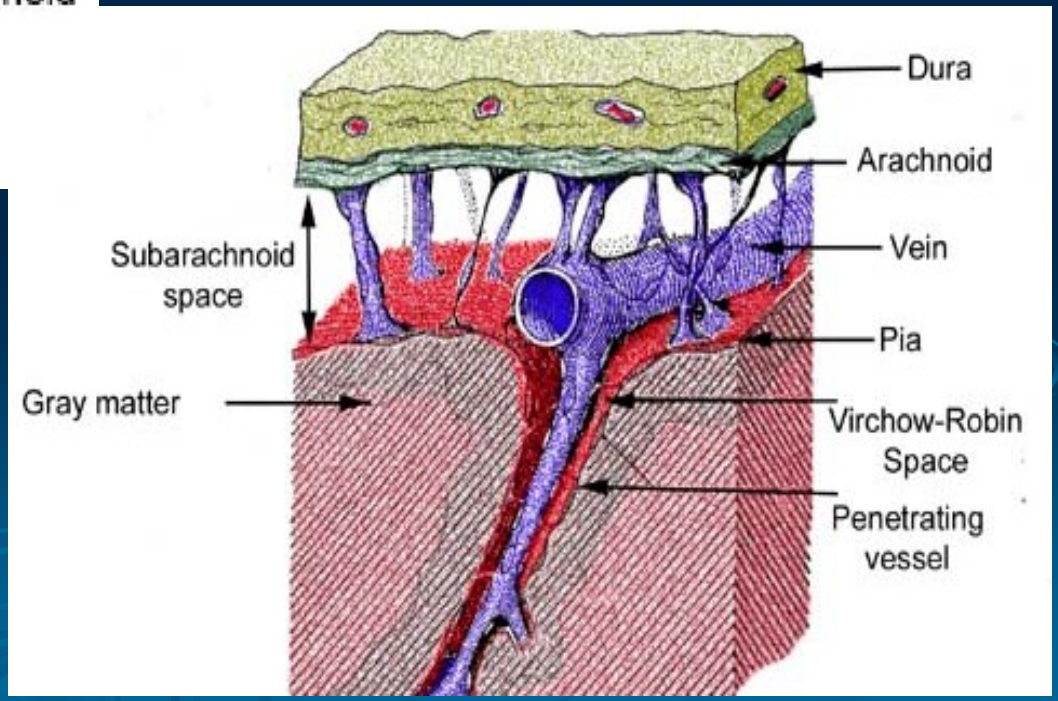

Raccoon eyes –
bilateral ecchymosis

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




Scalp
Periosteum
Skull bone
Dura mater
Subdural space
Subarachnoid space
Brain


Dura
Arachnoid
Vein
Subarachnoid space
Pia
Gray matter
Virchow-Robin Space
Penetrating vessel

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

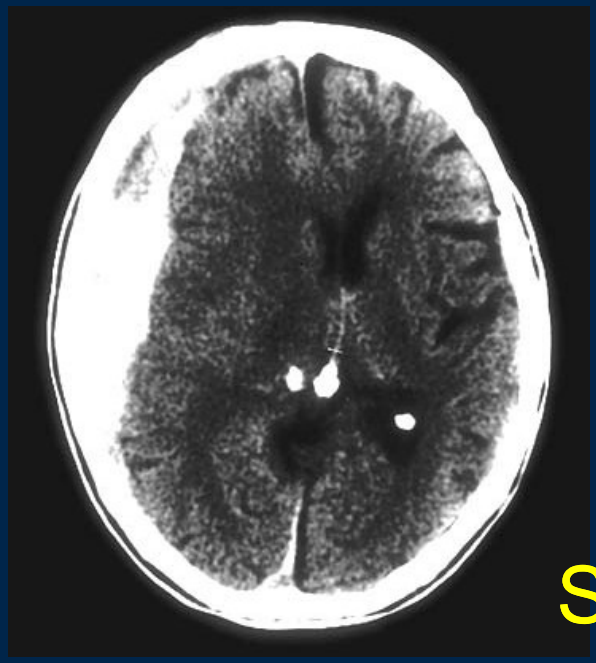
- A result of a ruptured intracranial arterial aneurysm or trauma
- Beneath arachnoid

Intracerebral hemorrhage

- A result of a ruptured atheromatous intracerebral arteriole, vasculitis, ruptured intracranial arterial aneurysm, or trauma

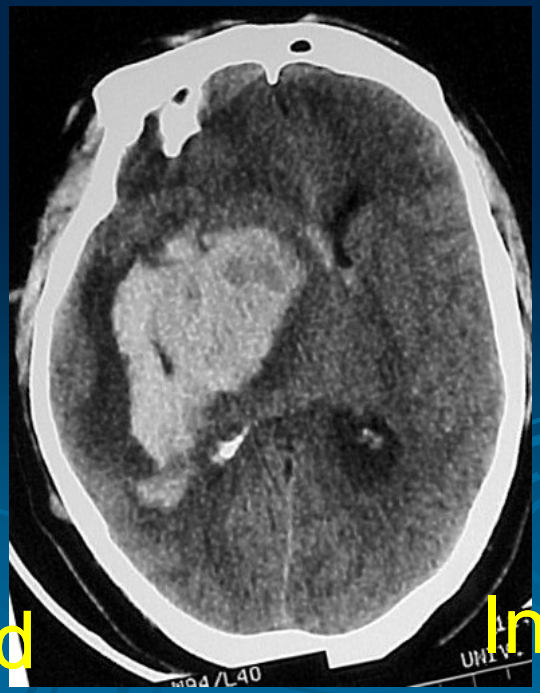
- Traumatic intracerebral hemorrhage is usually due to extension of hemorrhage from surface contusions deep into the substance of the brain

Extradural



Subdural

Subarachnoid

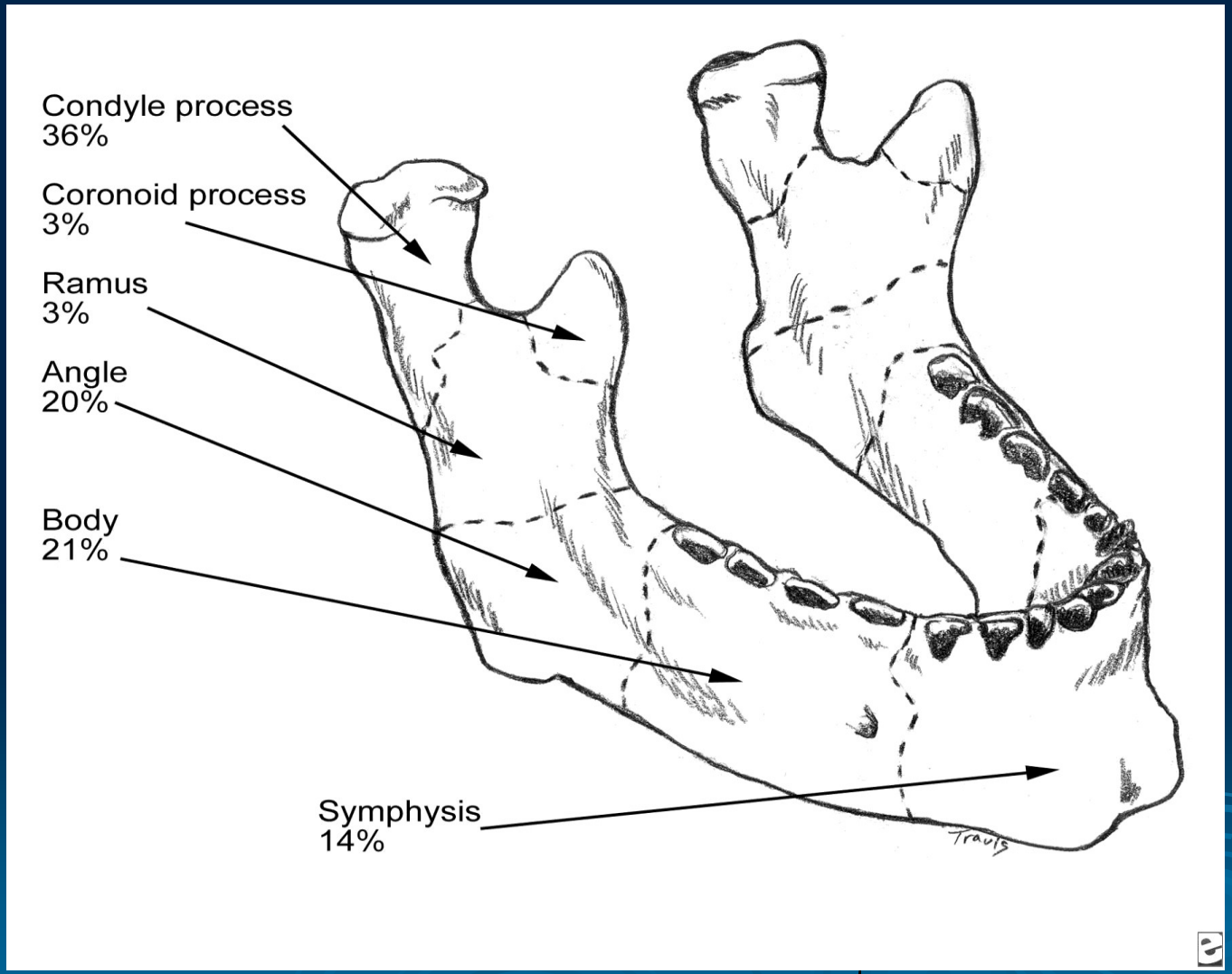


Intracerebral

II. Craniofacial Fractures

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

1. Fracture of the mandible

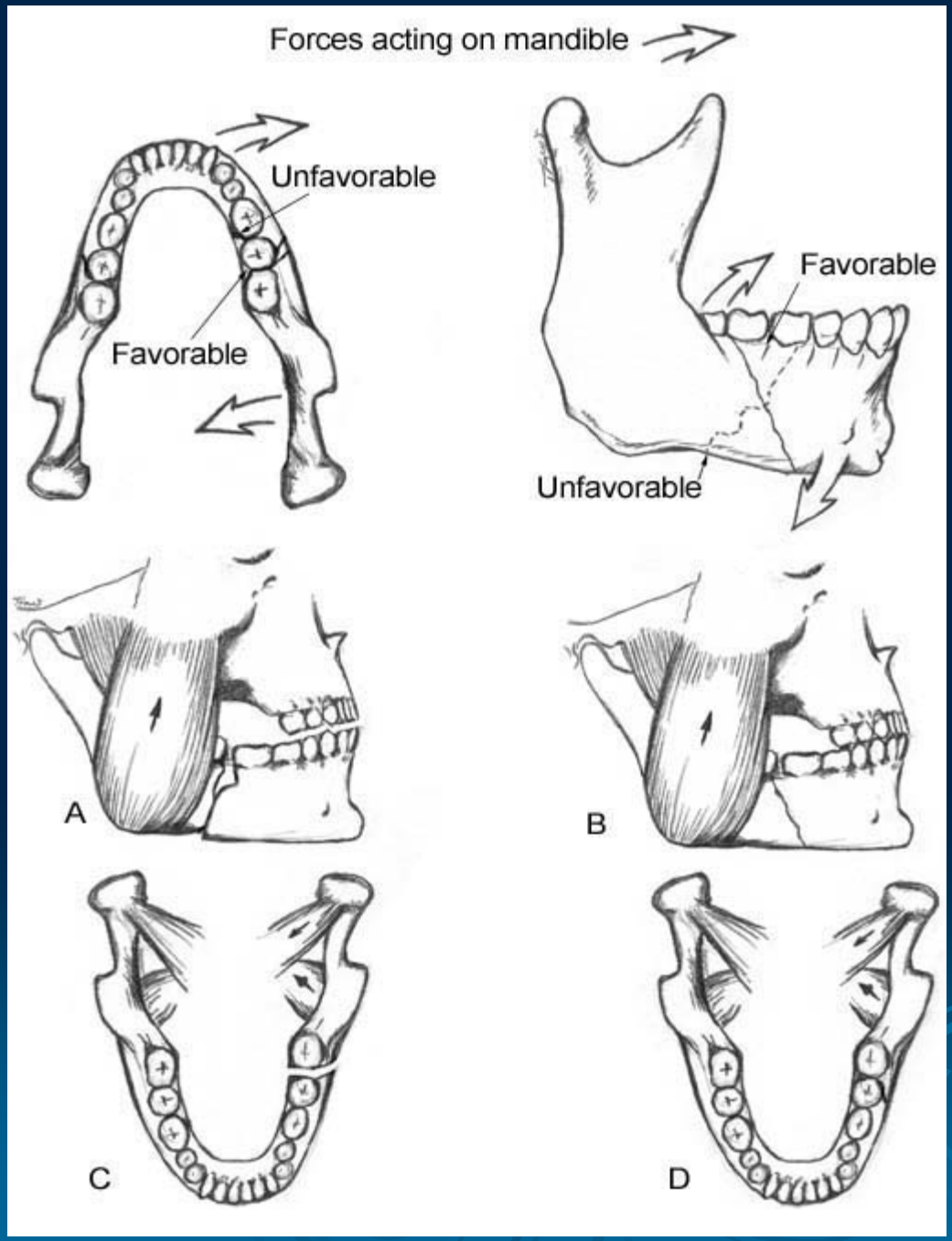


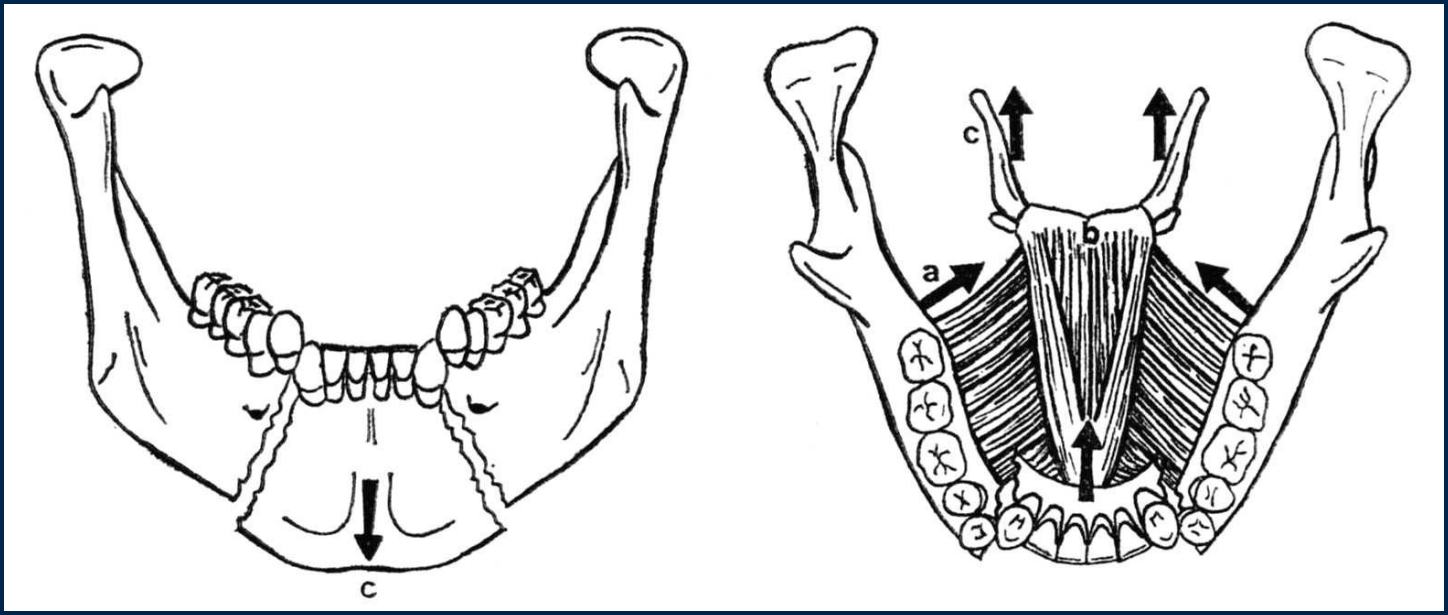
Body fractures

- 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
Unfavorable
Favorable
Favorable
Unfavorable
A
B
C
D


c
c
a
b

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

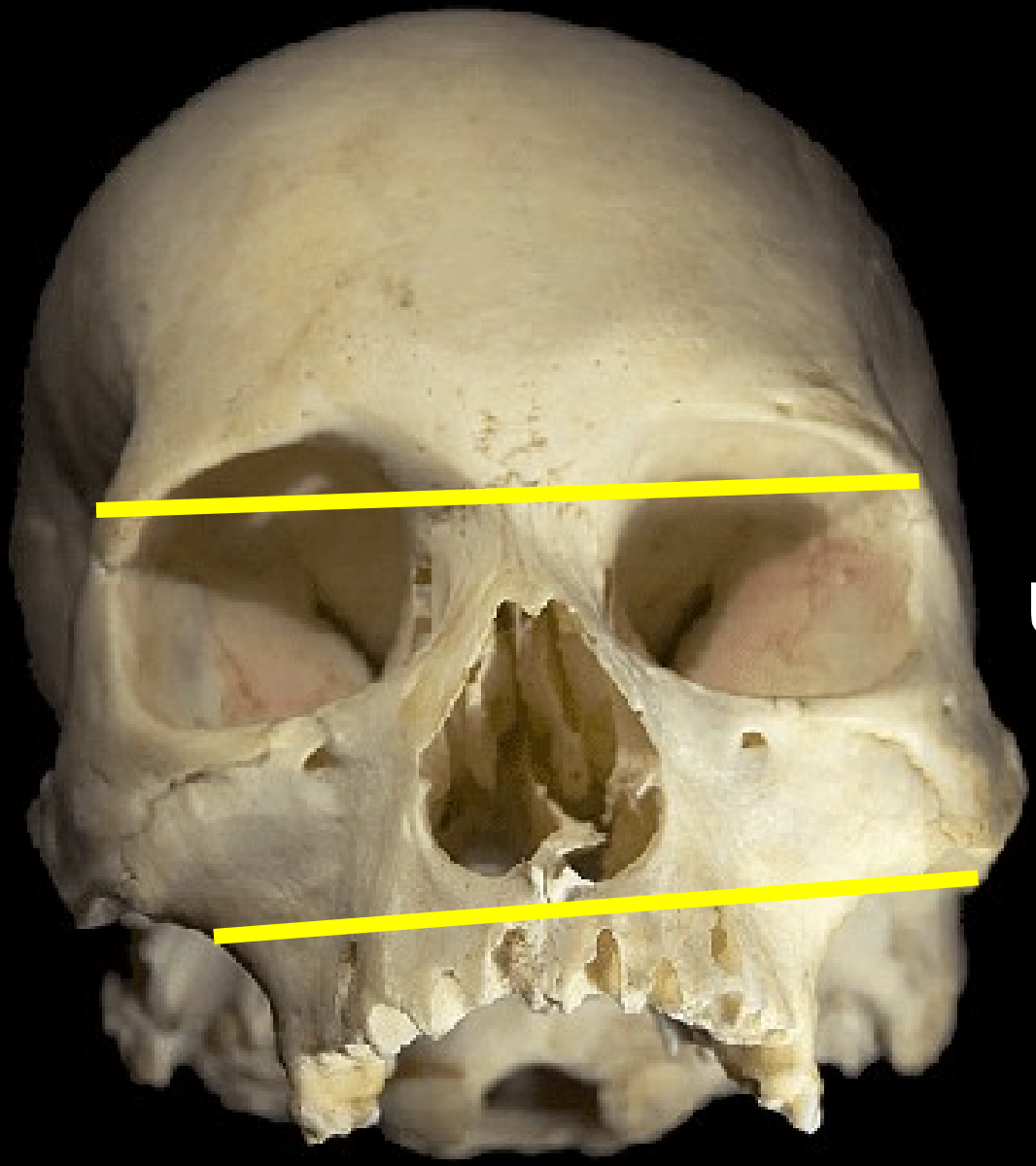
- In the midline of the mandible are classified as symphyseal
- When teeth are present, the fracture line passes between the mandibular central incisors
- In the area of the mandible from cuspid to cuspid, but not in the midline, are classified as parasymphyseal

Condylar process fractures

- Classified as extracapsular, intracapsular and subcondylar

- The lateral pterygoid muscle tends to cause anterior and medial displacement of the condylar head

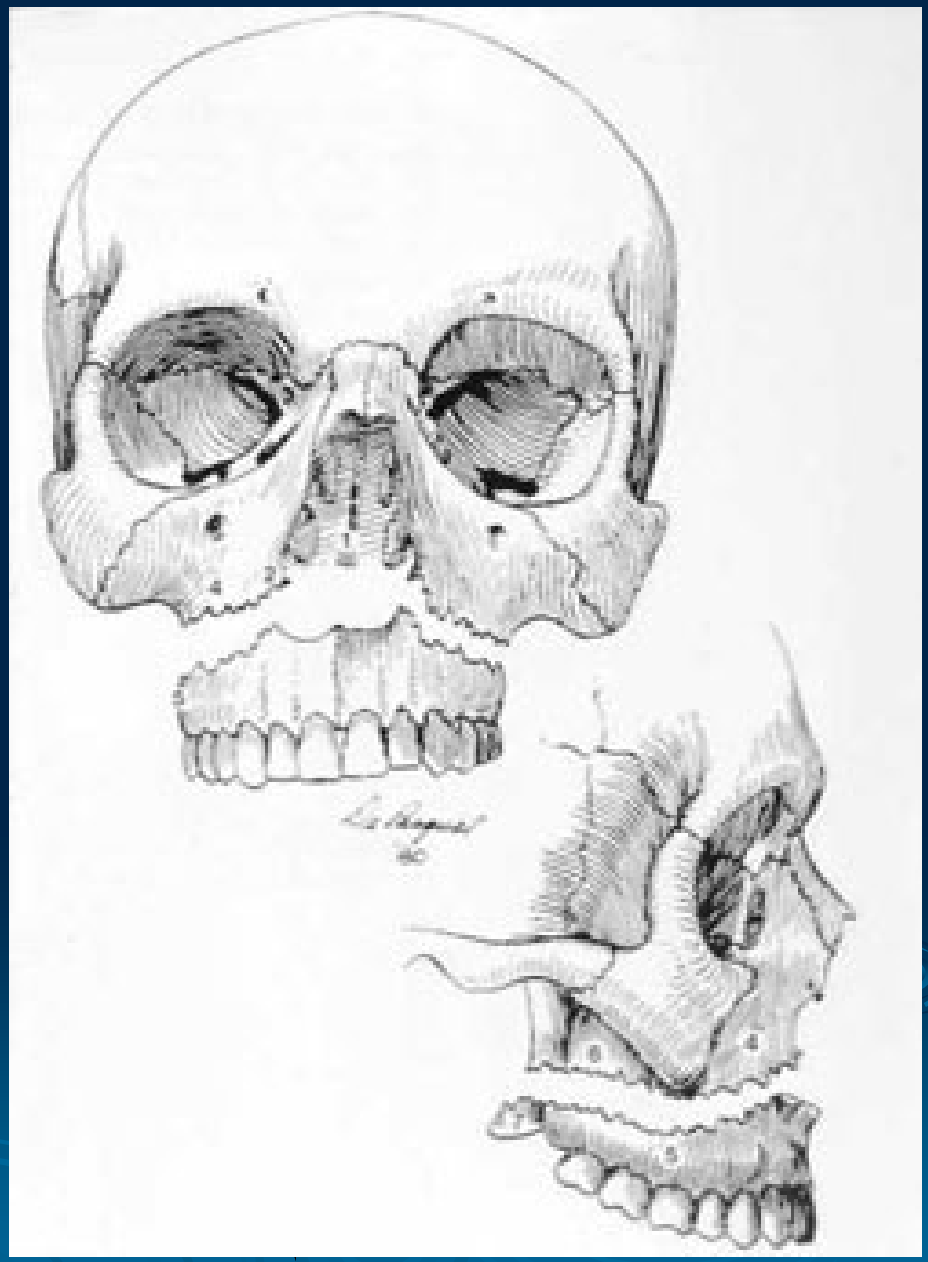
- Type I is a fracture of the neck of the condyle with relatively slight displacement of the head. The angle between the head and the axis of the ramus varies from 10-45°.
- Type II fractures produce an angle from 45-90°, resulting in tearing of the medial portion of the joint capsule.
- Type III fractures 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

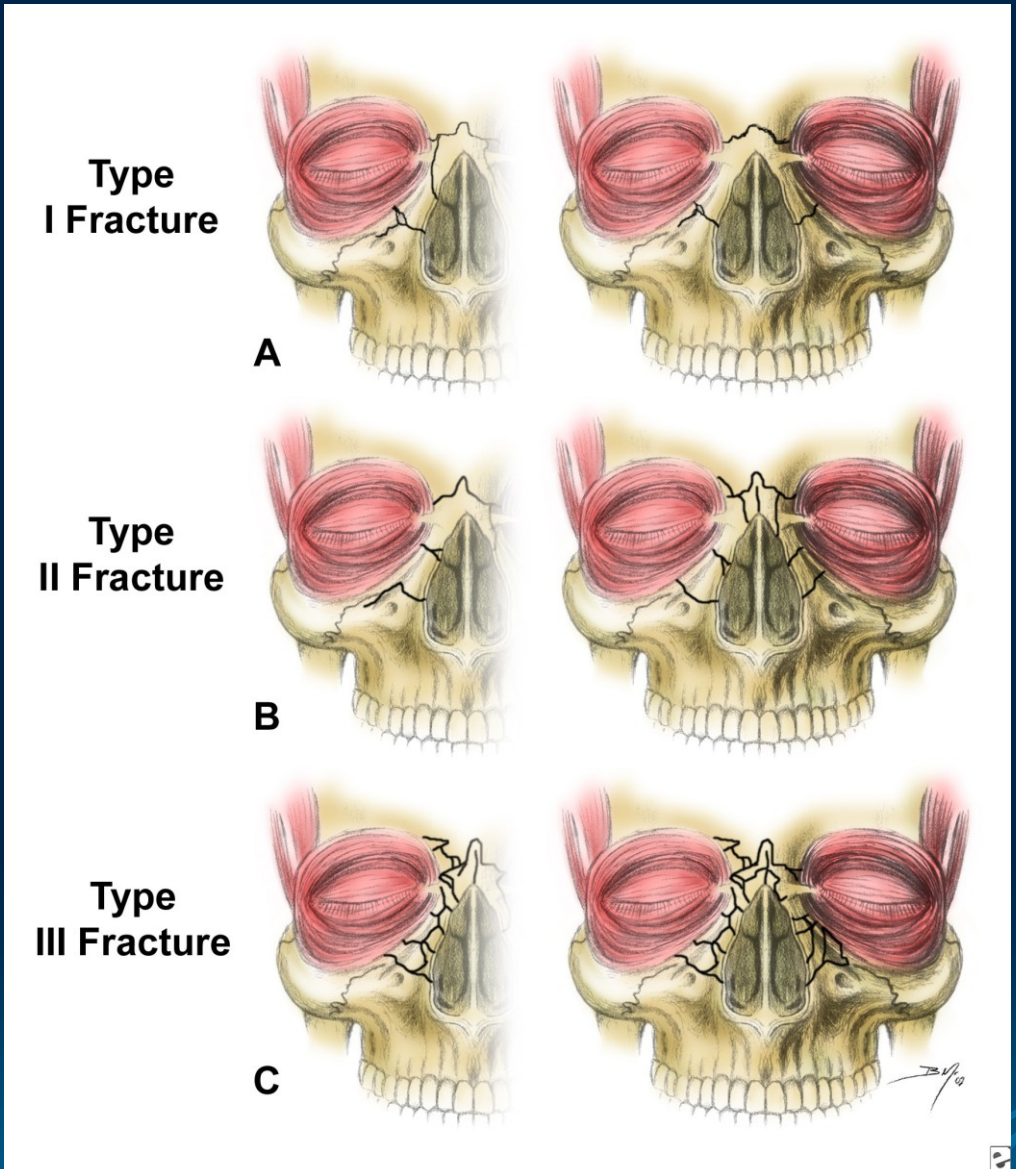
- The NOE complex represents a bony onfluence that separates the nasal, orbital, and cranial cavities (the nasal, frontal, maxillary, ethmoid, lacrimal, and sphenoid bones)

- 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 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

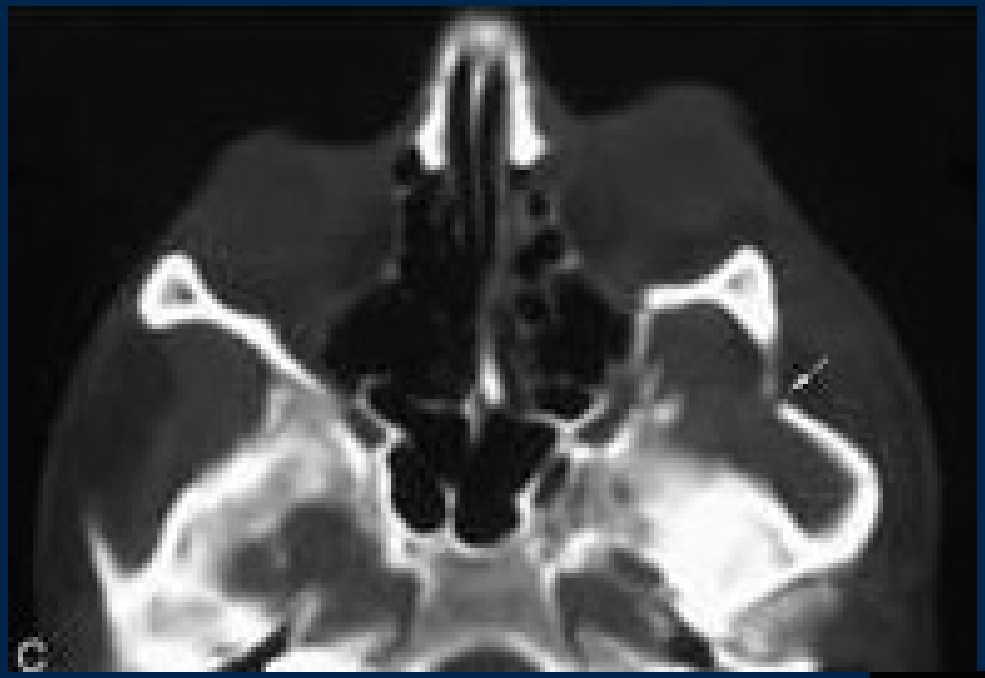

Telecanthus

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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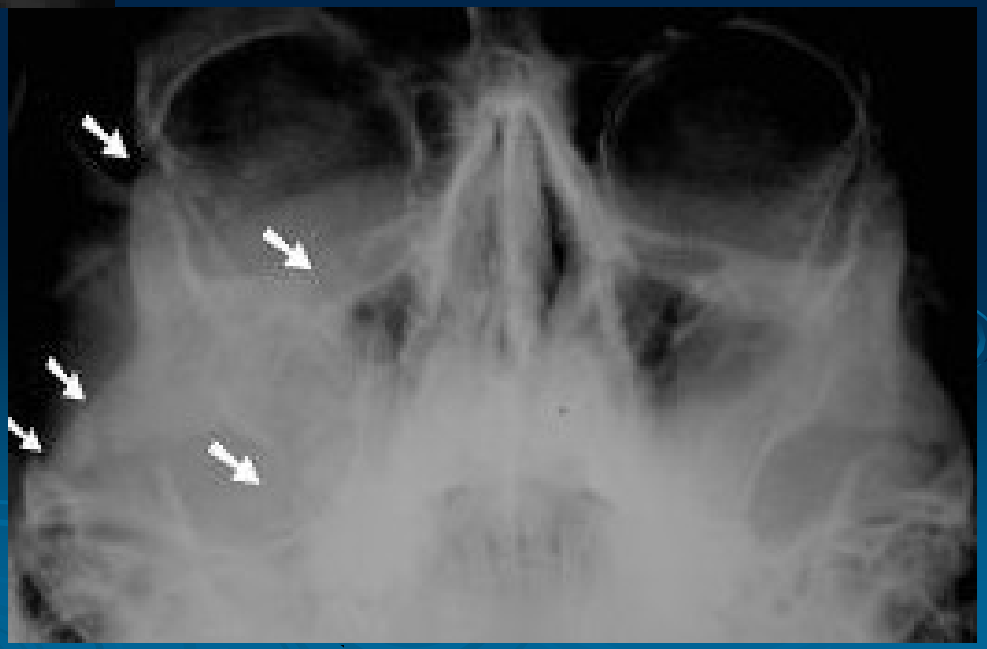


c) Orbital Fractures

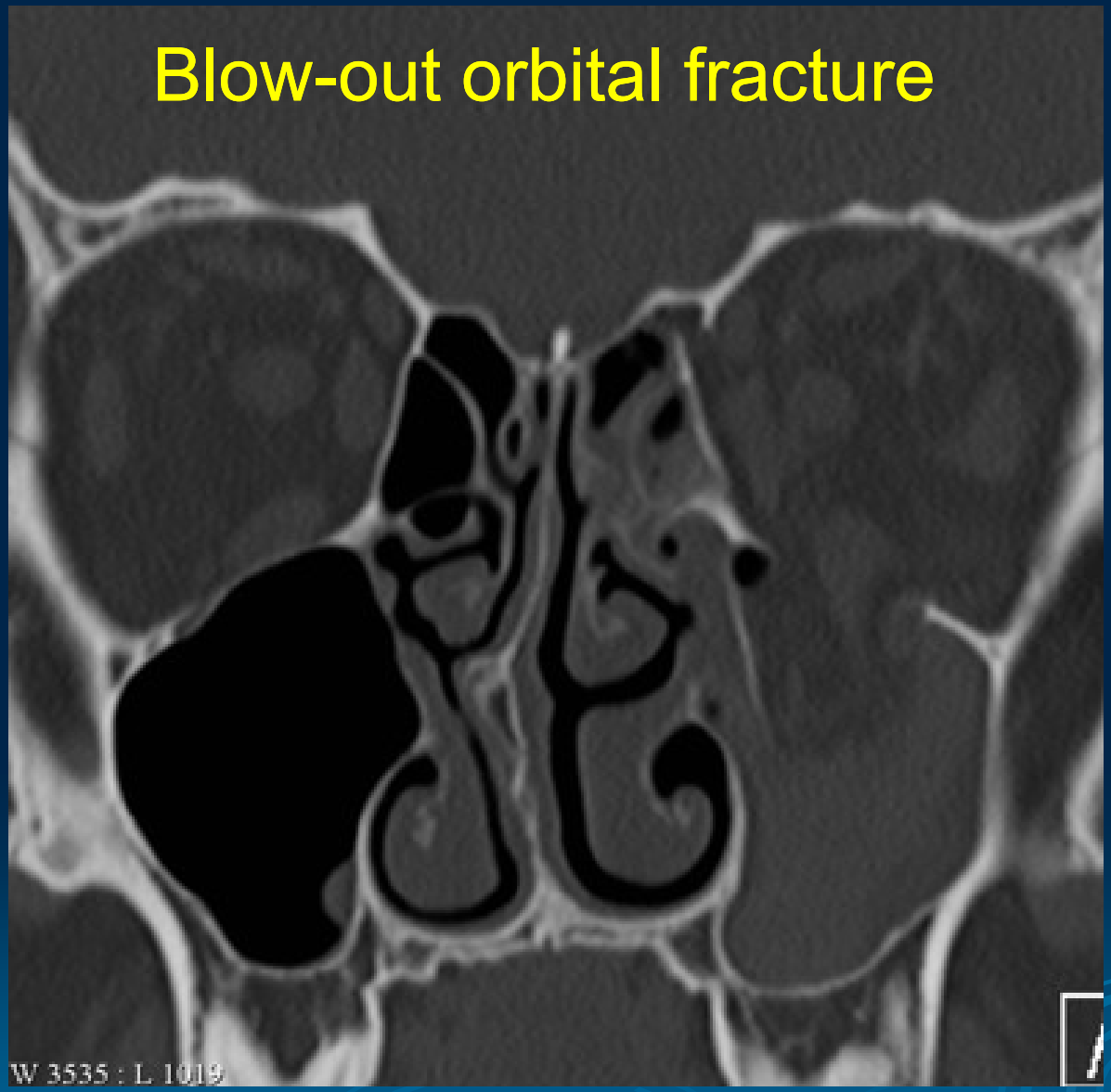
The internal orbital skeleton includes blow-out and blow-in patterns, as seen in isolated fractures of the orbital floor, medial wall, and roof the orbital rim

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

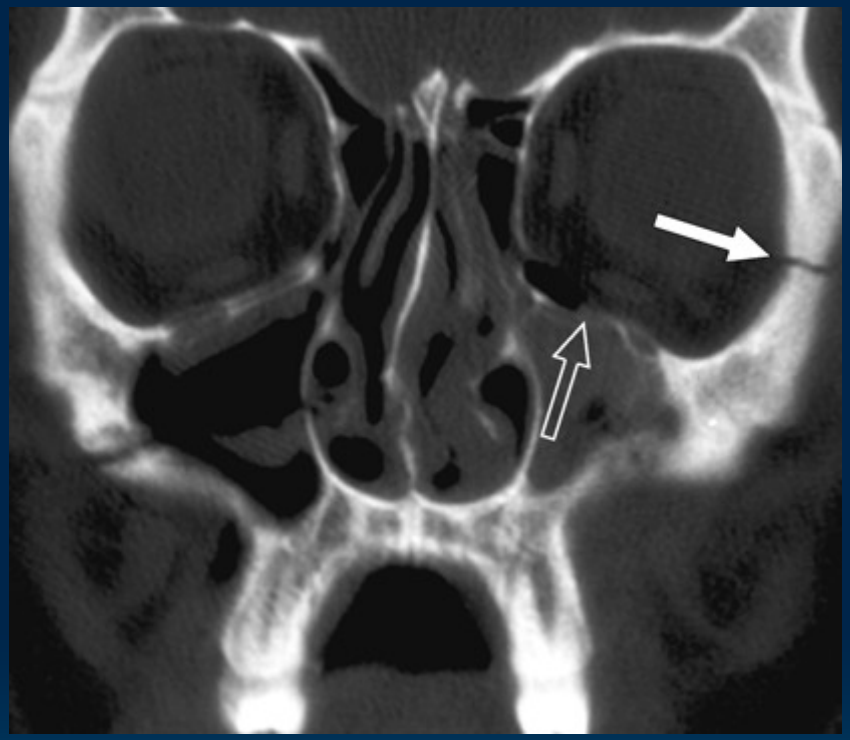
- Periocular ecchymosis and oedema
- The position of the globe should be assessed
- Enophthalmos is rarely evident in the first days after injury because of edema of the orbital tissues
- A degree of proptosis is evident early
- Hypoglobus may be seen with severe floor disruption with a subperiosteal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

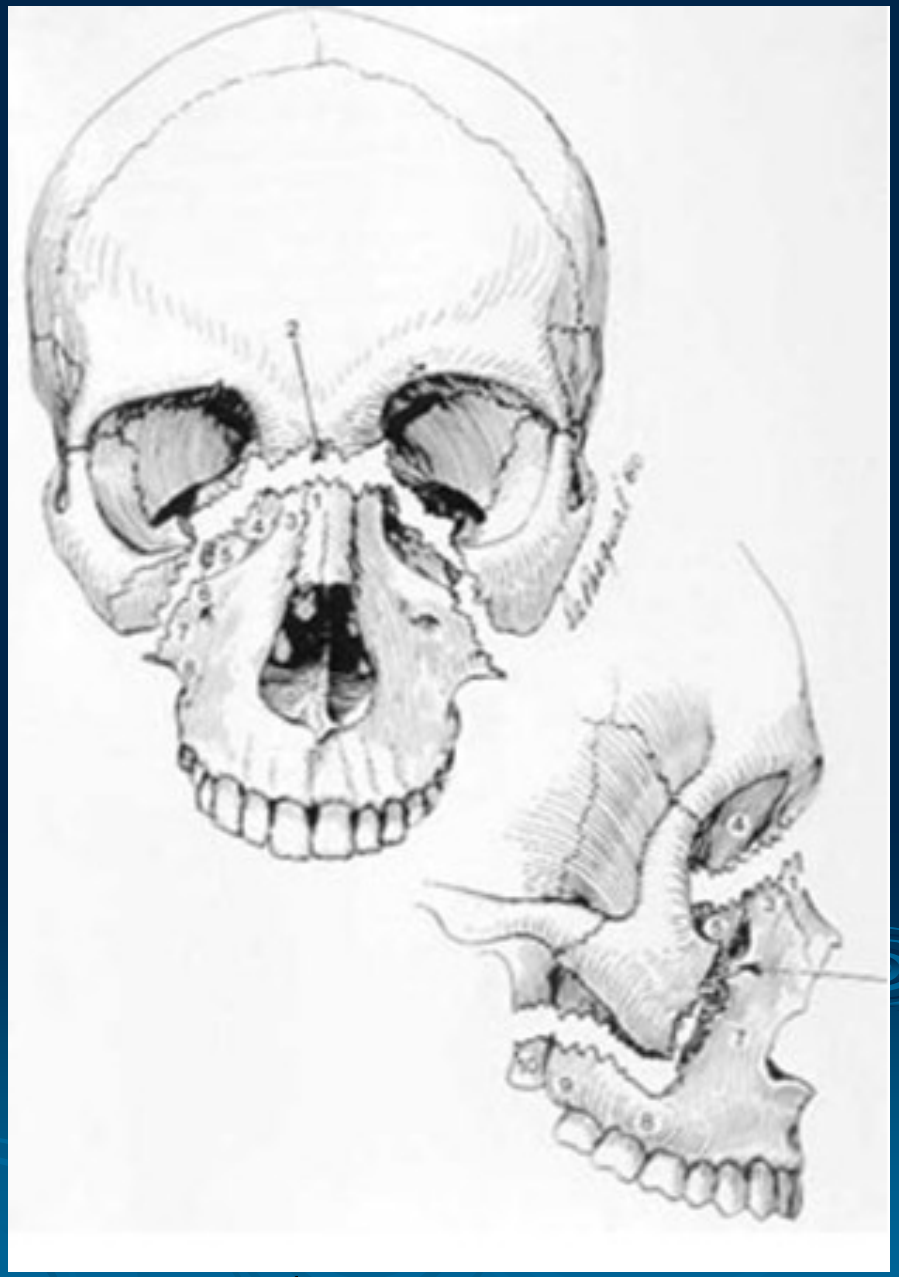
Blow-out orbital fracture



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

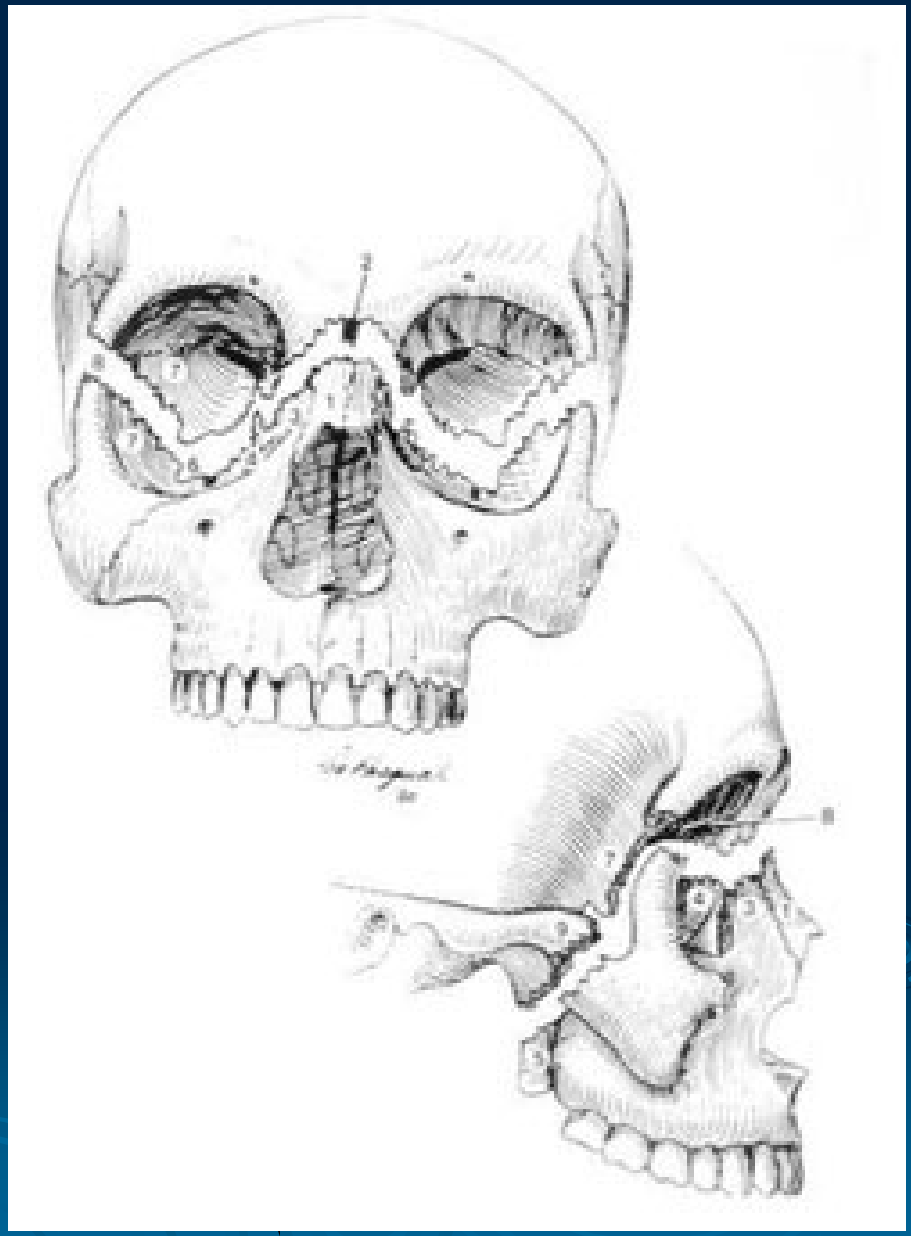


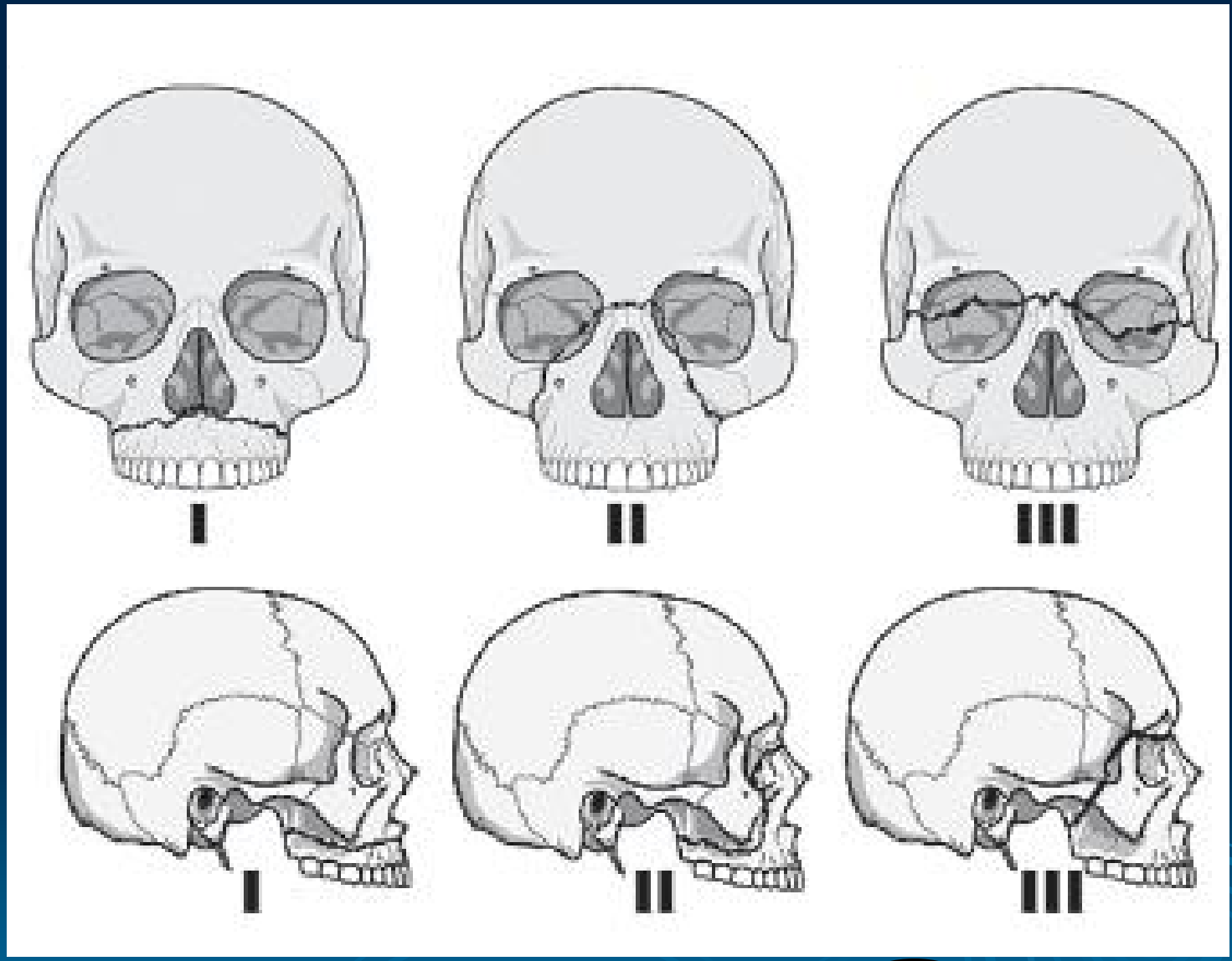


e) Le Fort III fractures (transverse)

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




I
II
III
I
II
III

4. Craniobasal-facial

Combinations of different fractures