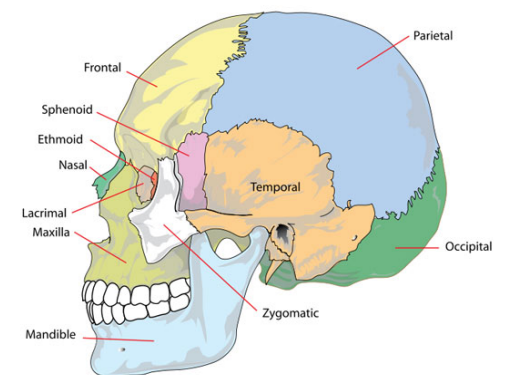
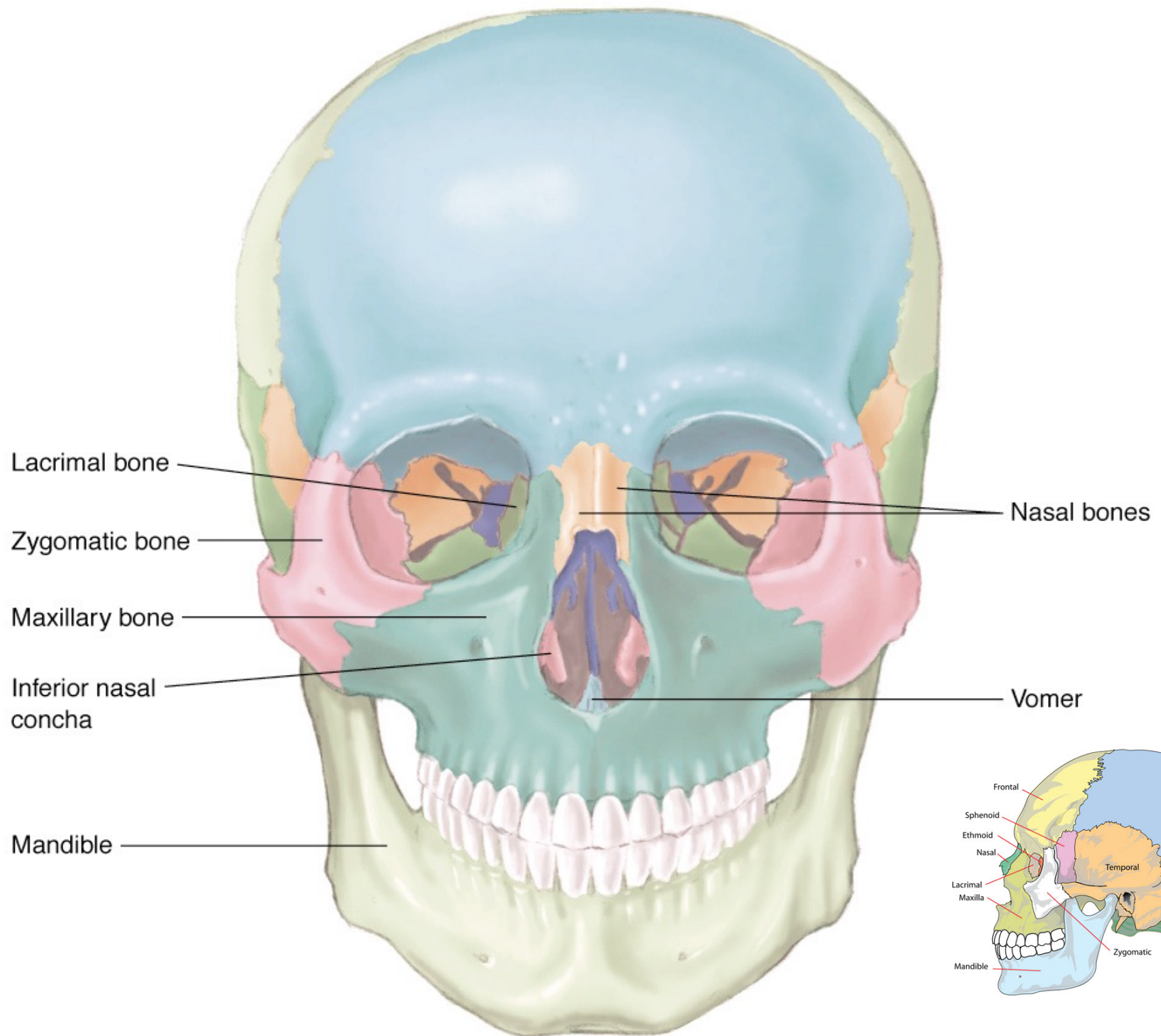
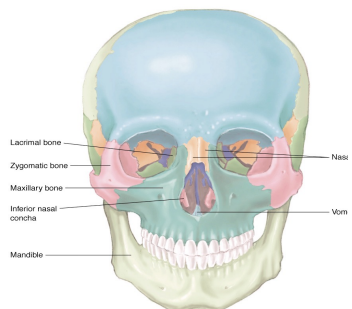
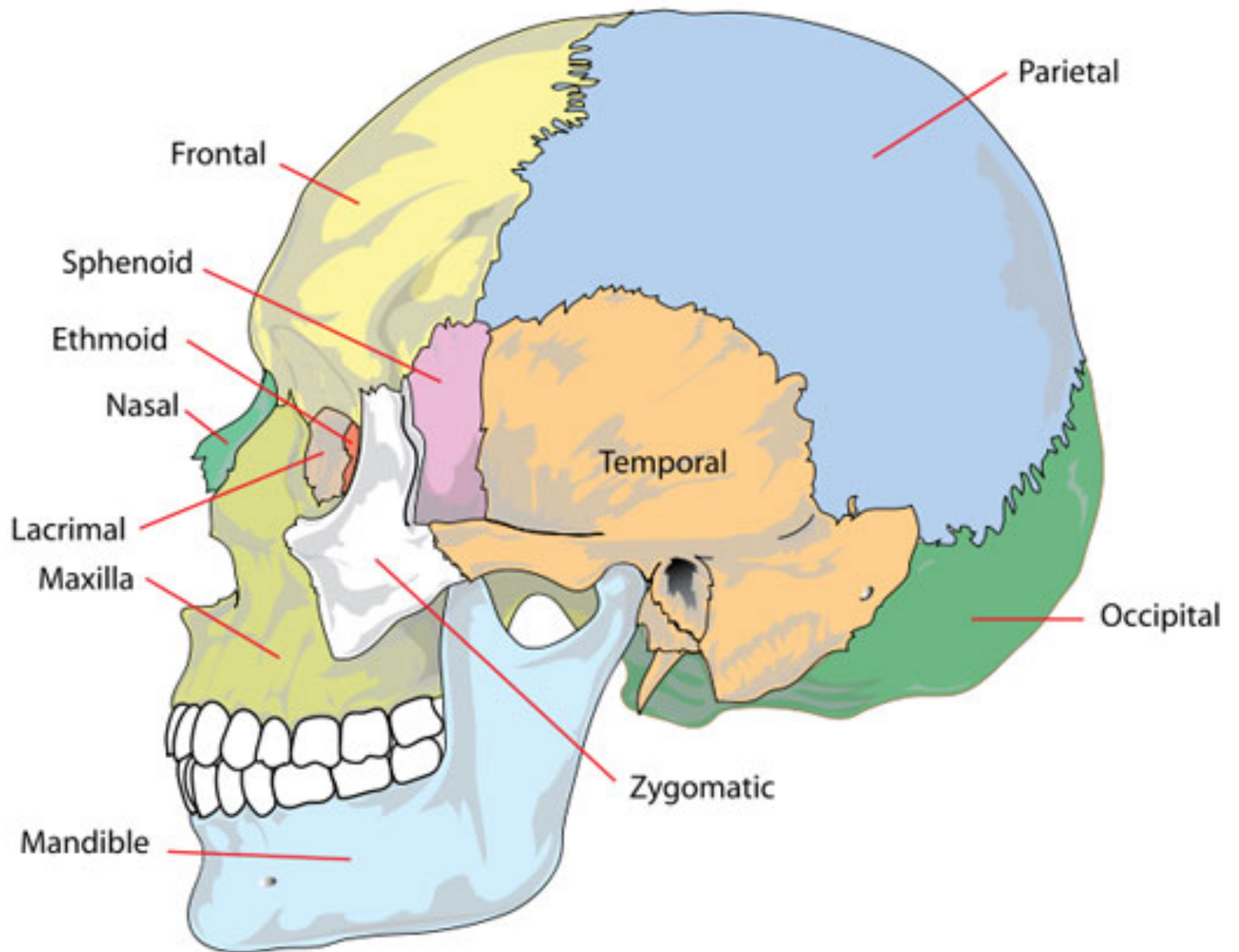
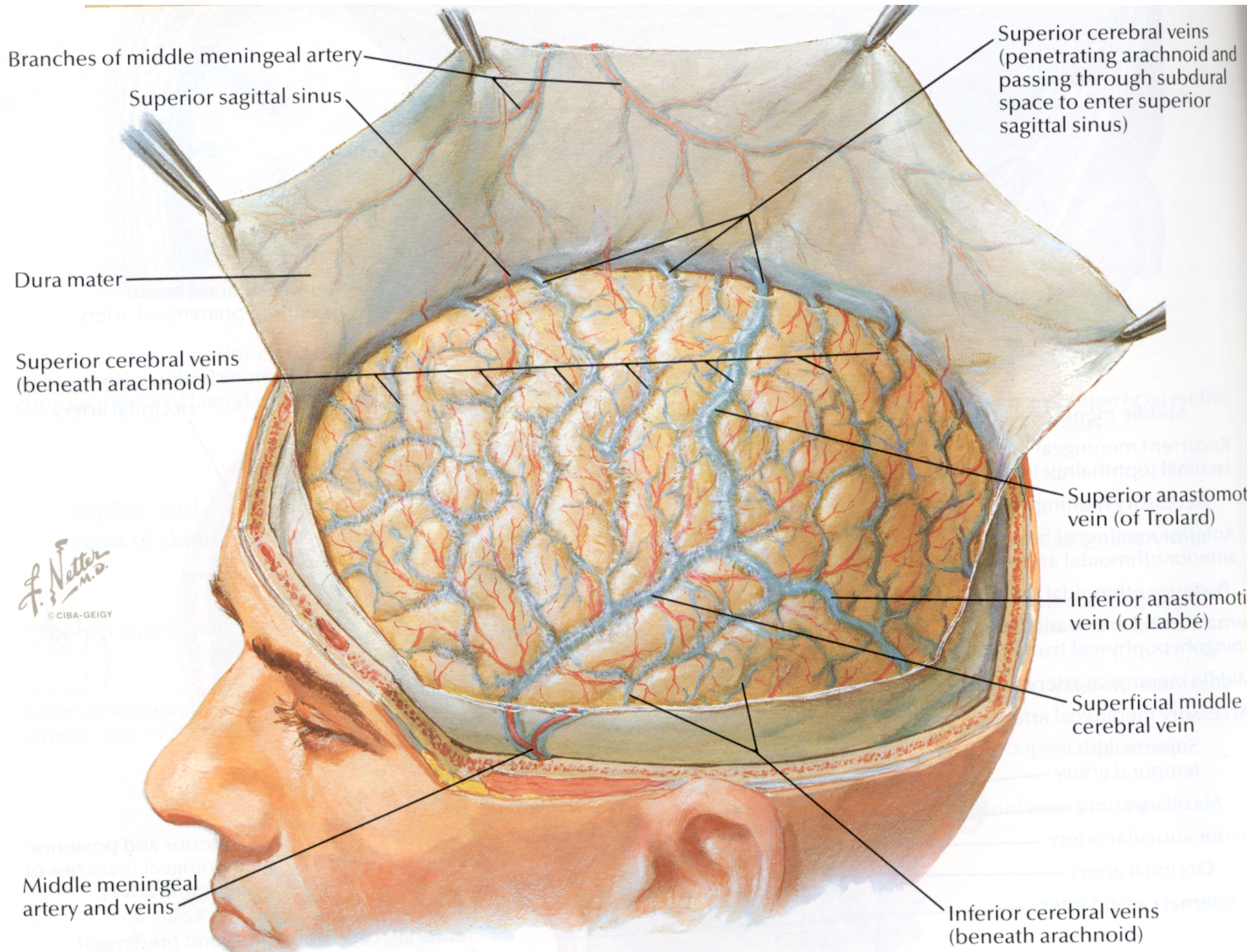
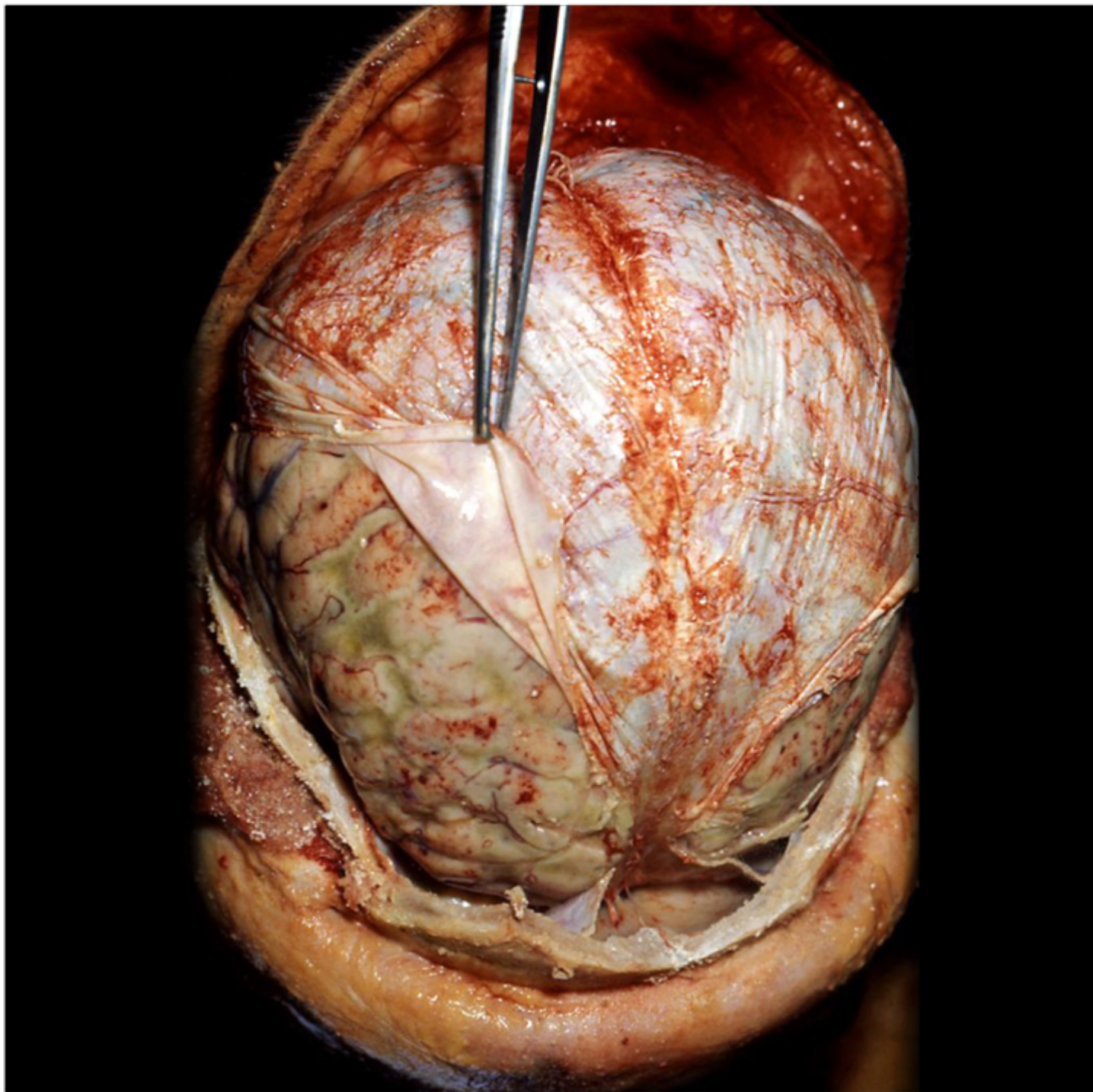
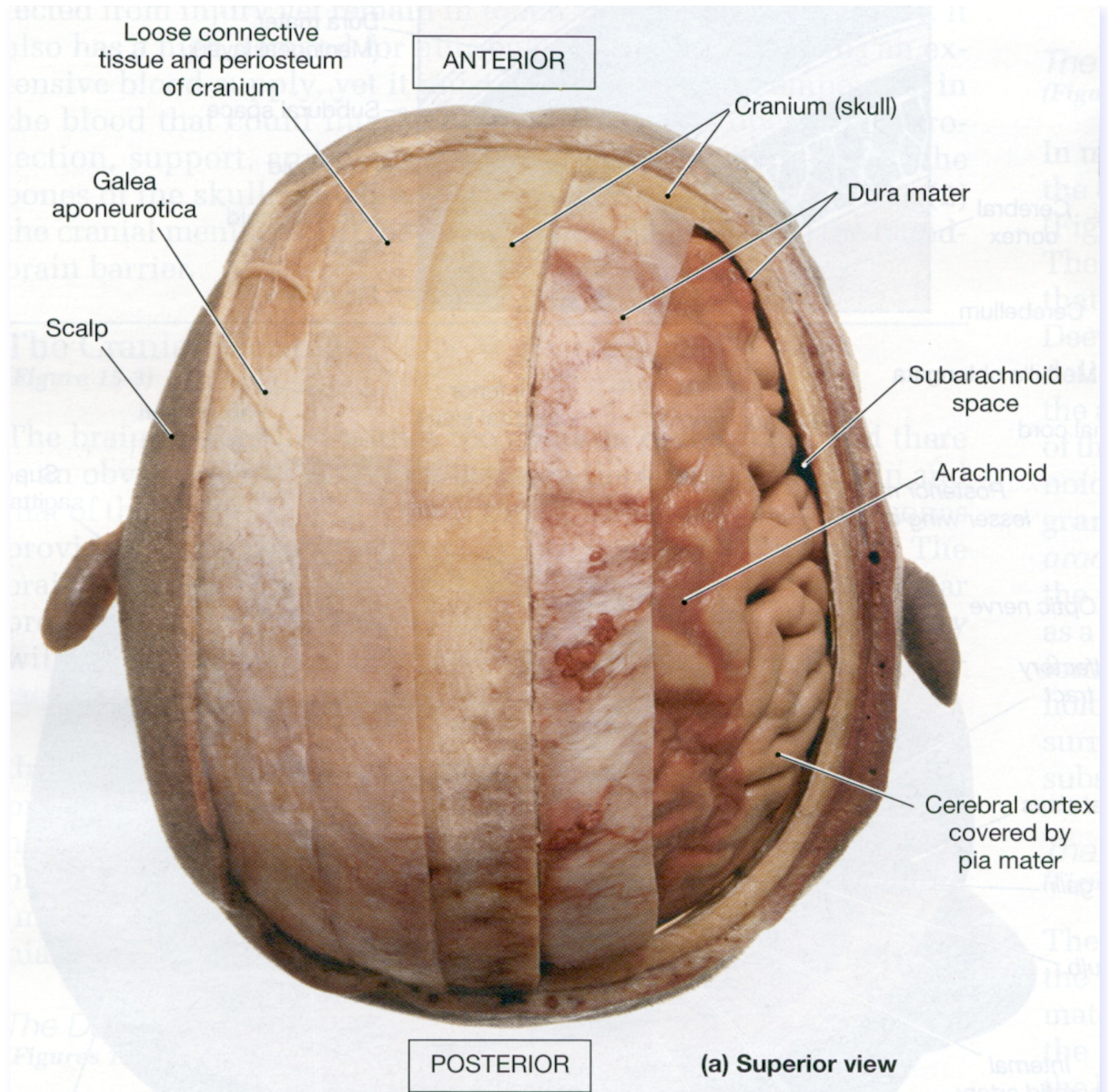












## The Meninges

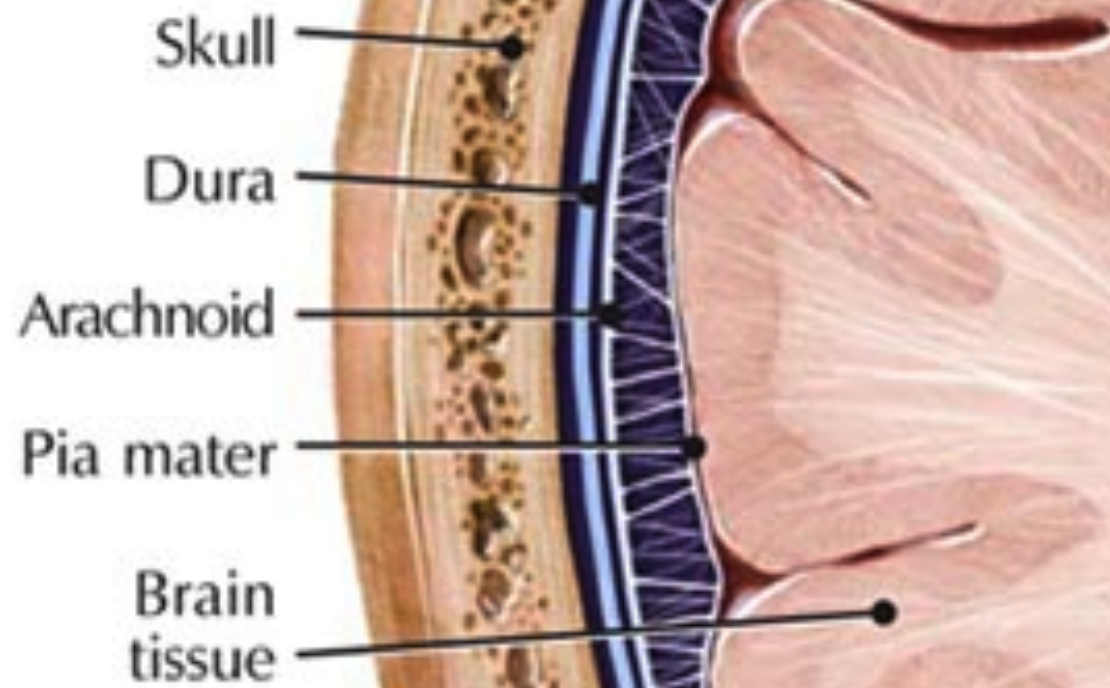
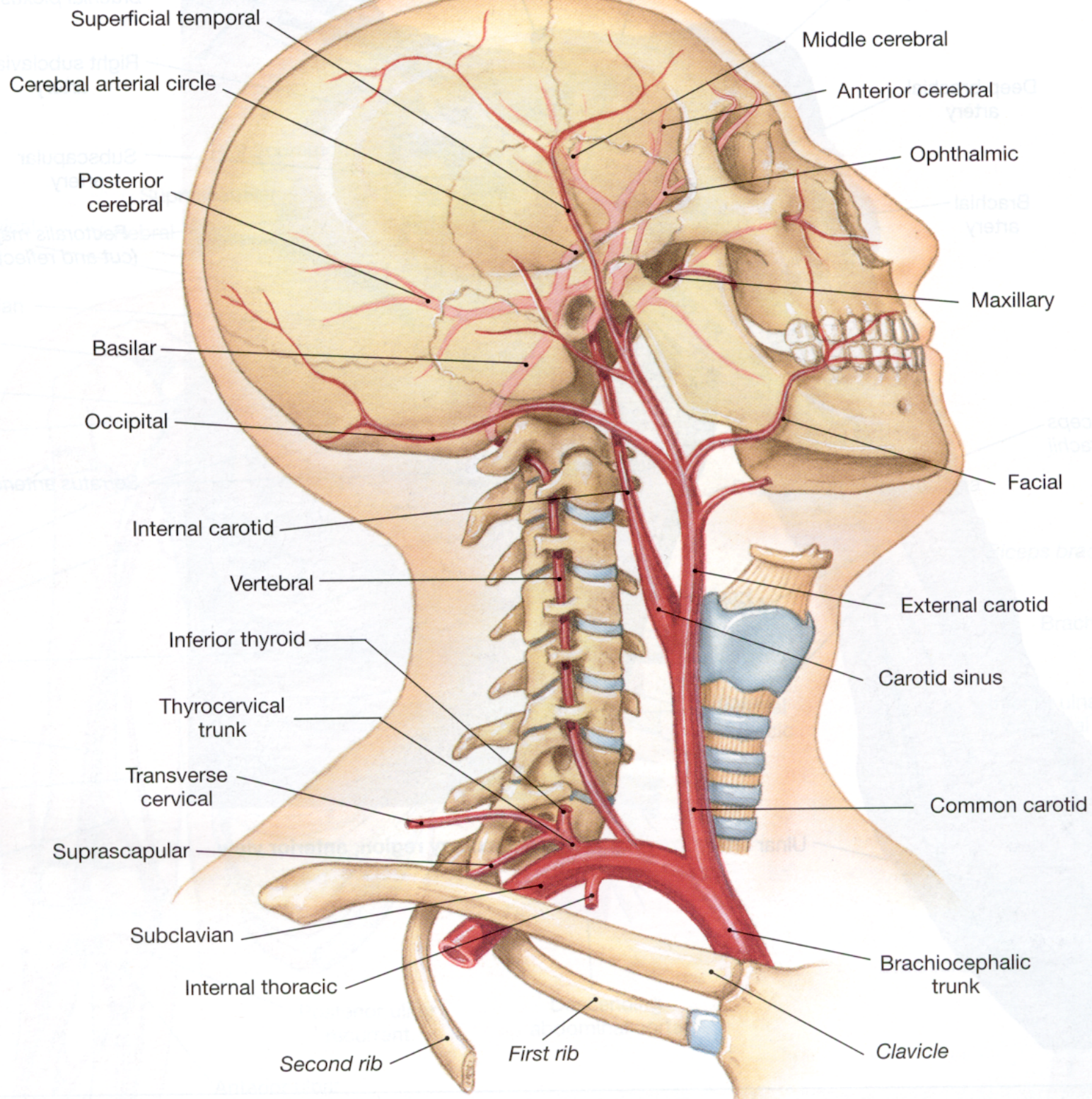
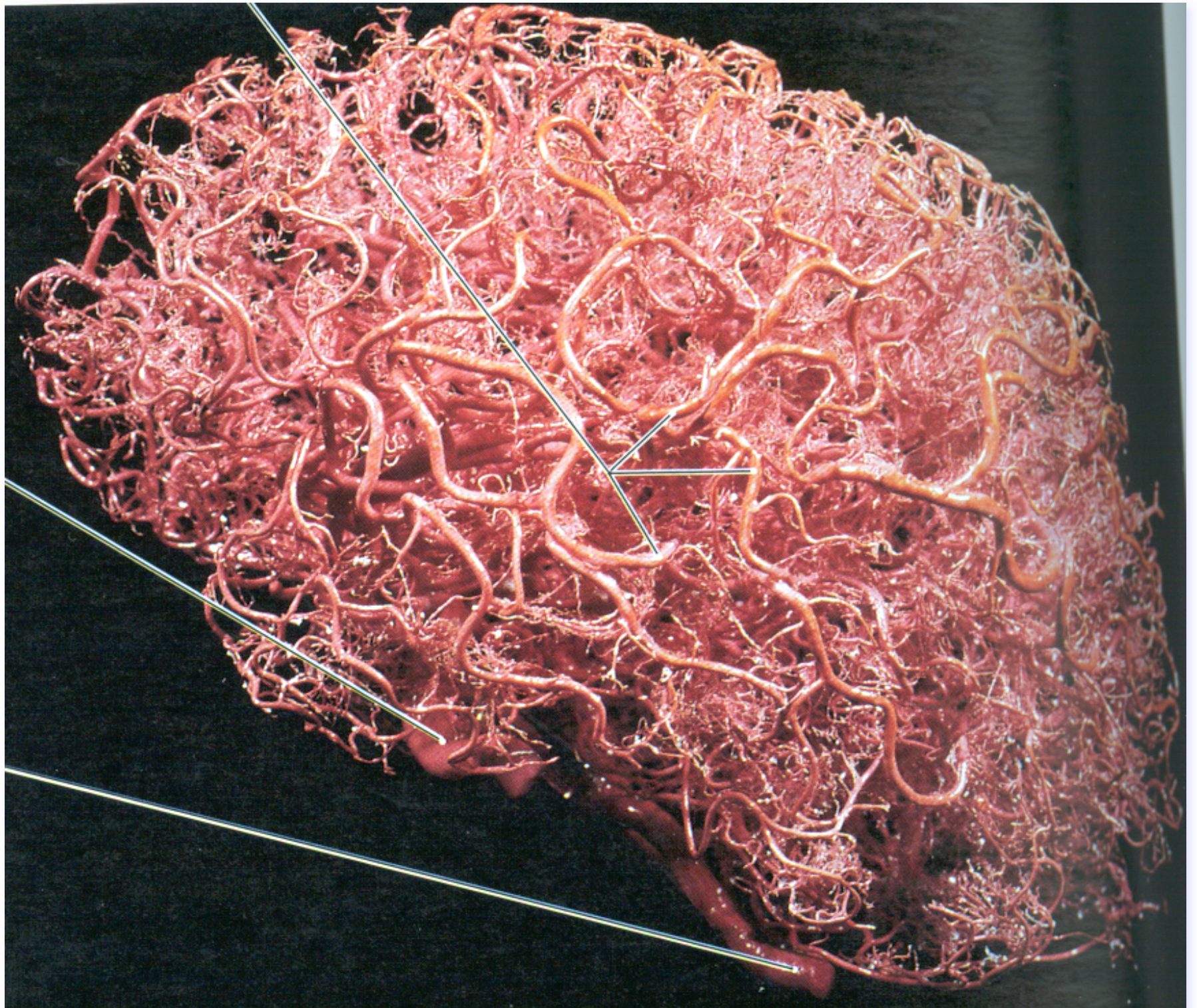


Fig. 2





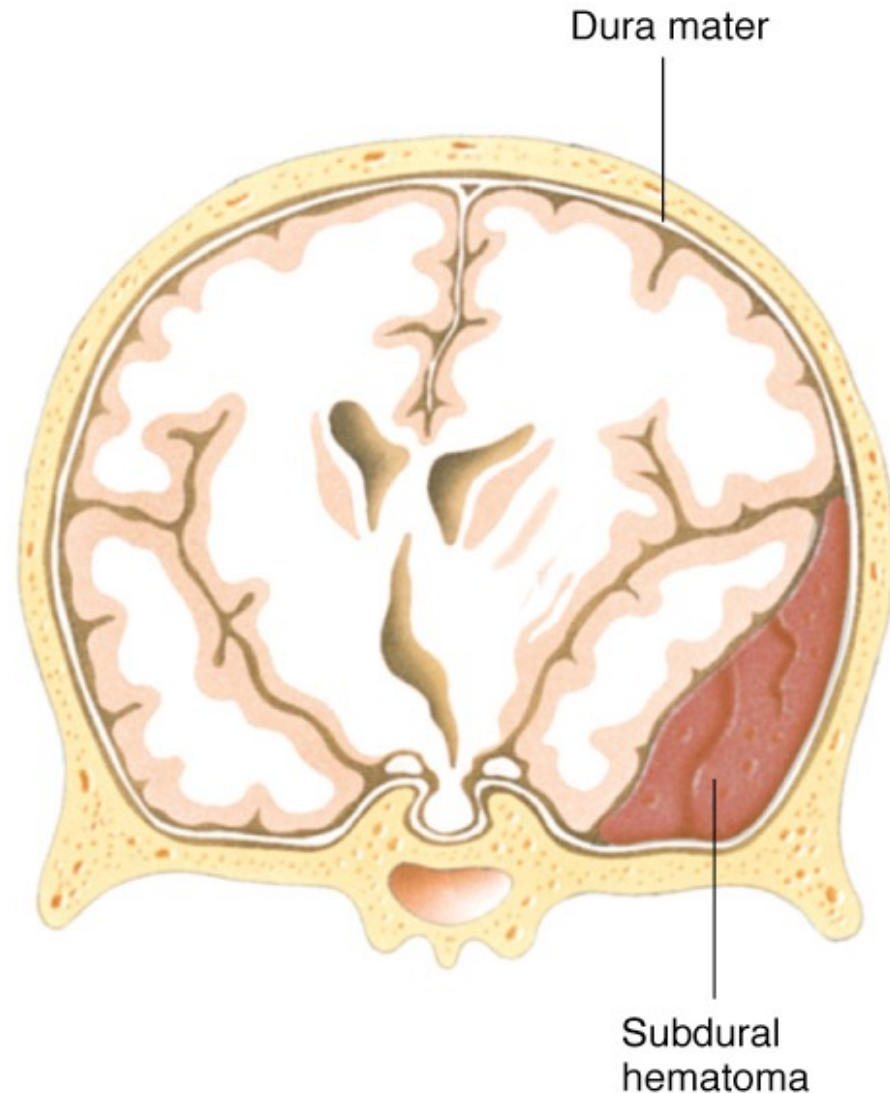
# Case 1

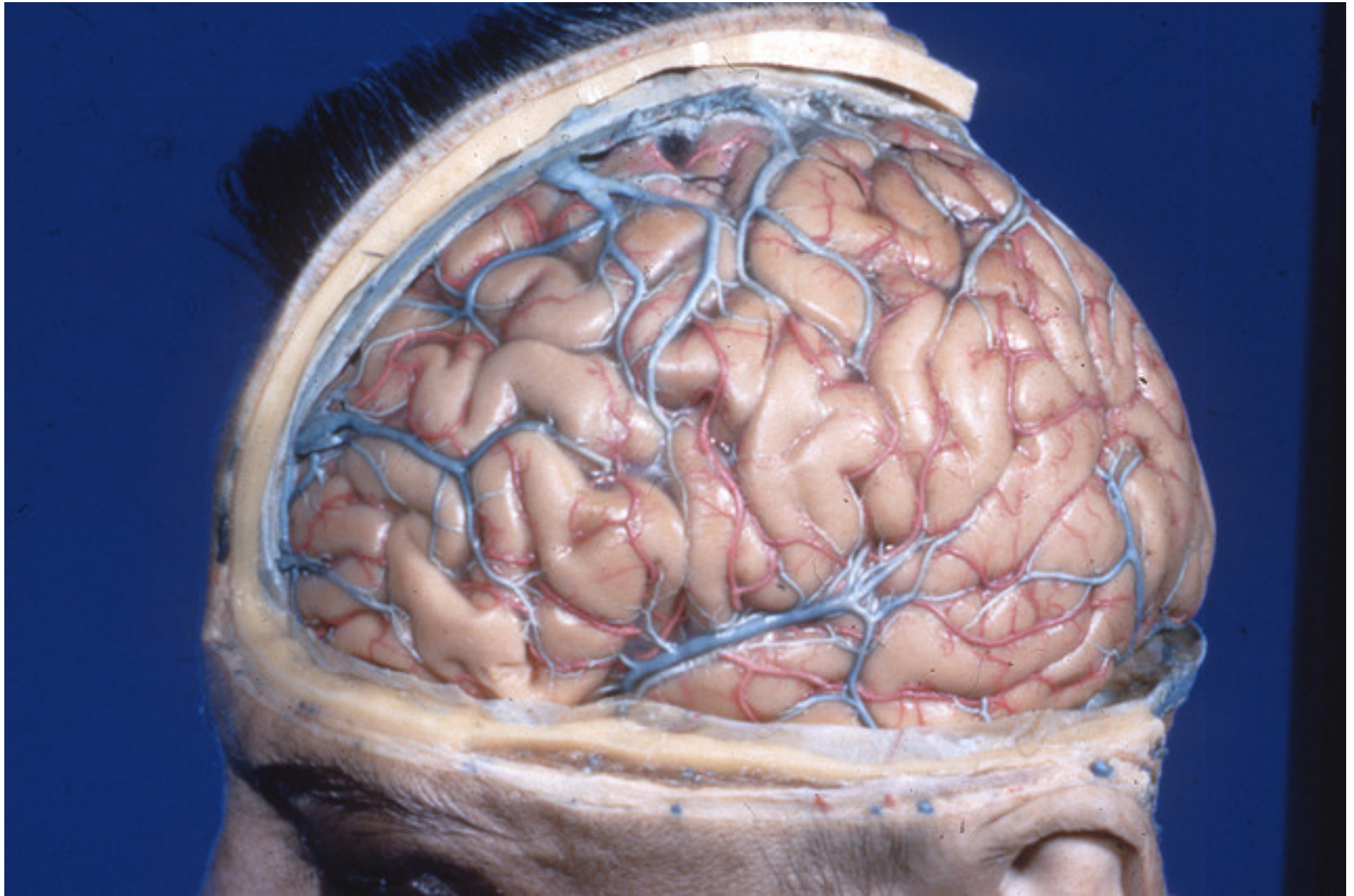
# Ddx

Epidural Hematoma  
Subdural Hematoma  
Concussion

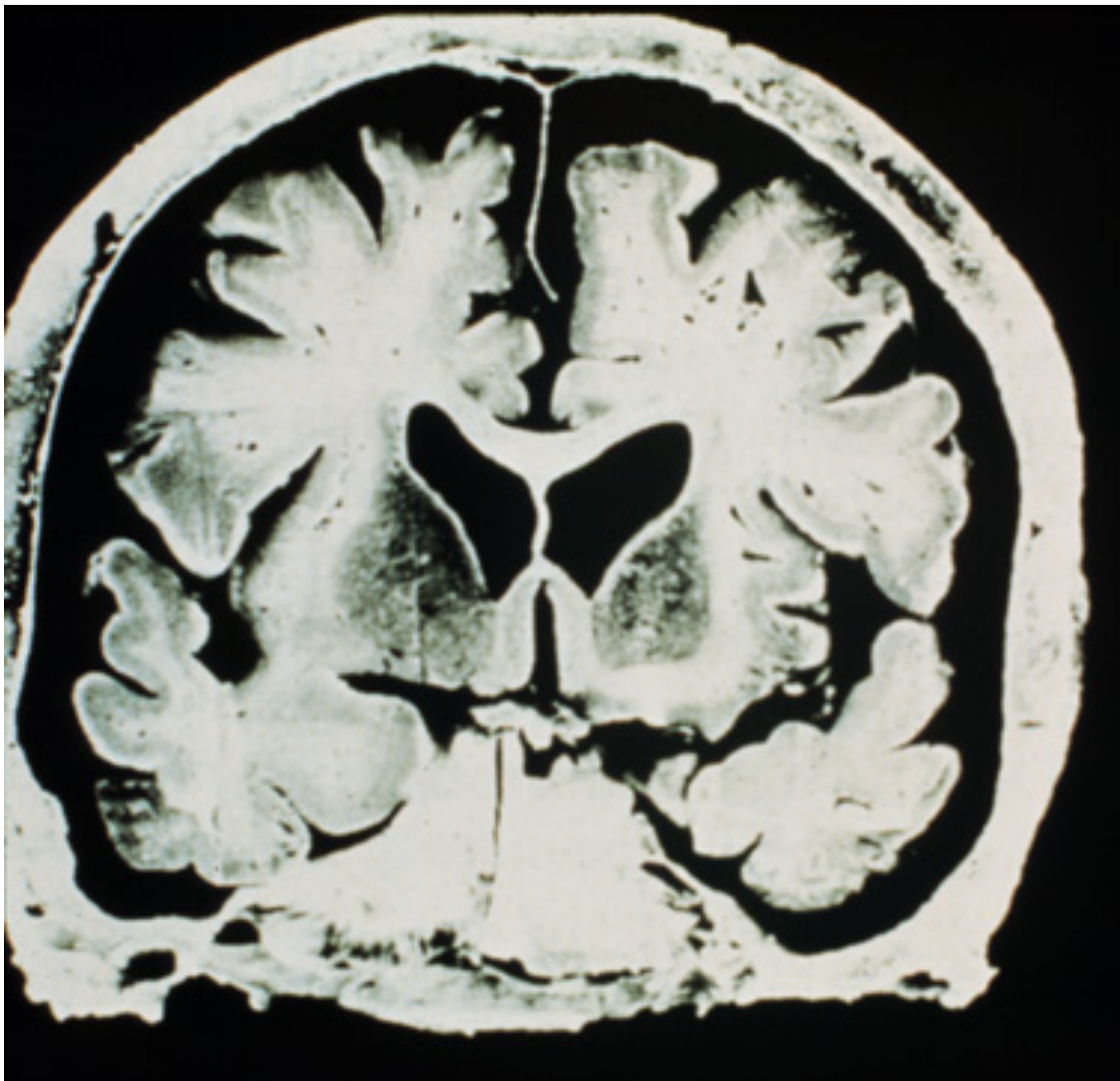
# Subdural Hematoma

- Bleeding within meninges
  - Beneath dura mater and/or within subarachnoid space
  - Above pia mater
- Slow bleeding
  - Superior sagittal sinus
- Signs progress over several days or weeks
  - Slow deterioration of mentation
- More common than epi's, esp in elderly, alcoholics







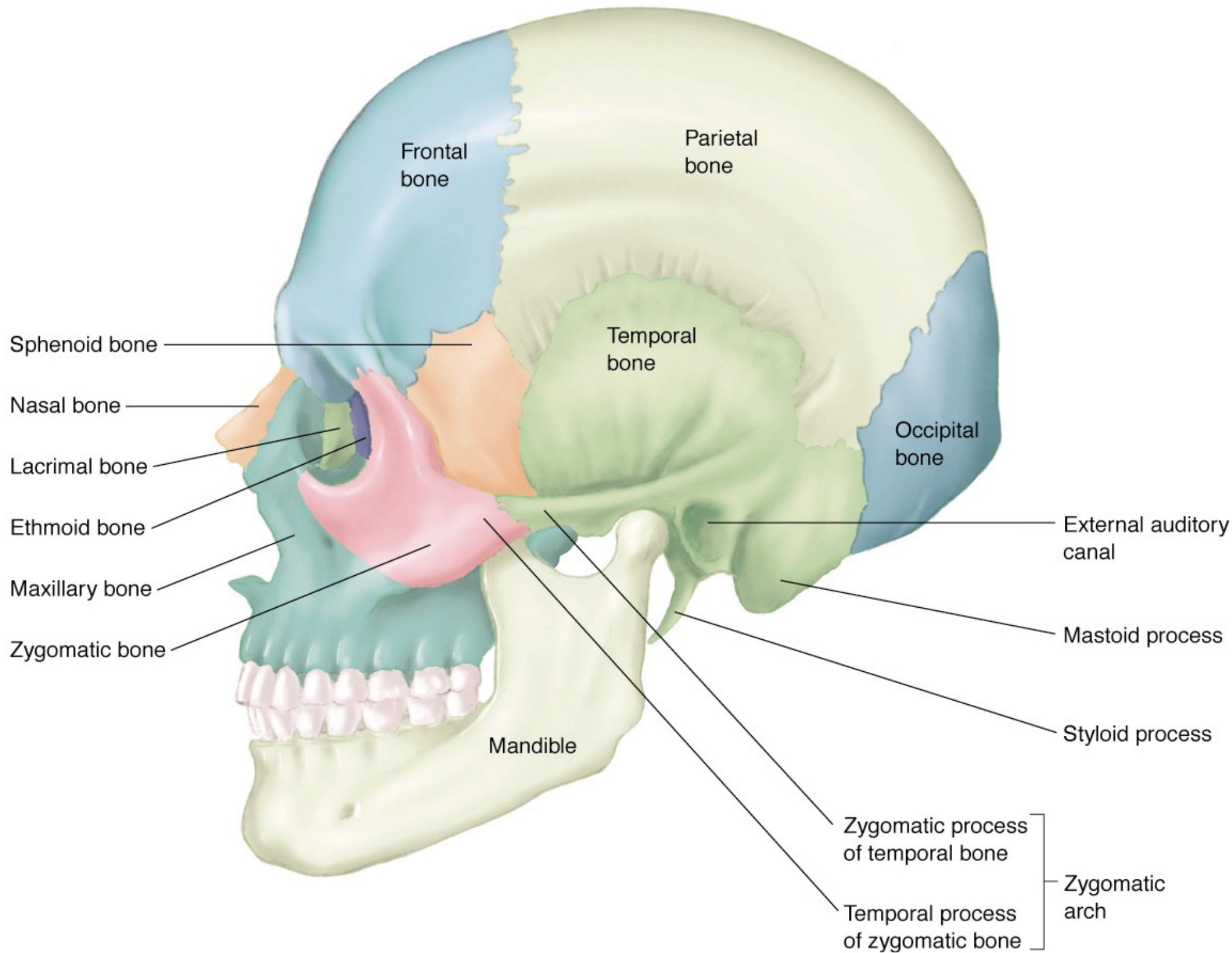


# Case 2

# Ddx

Epidural Hematoma  
Subdural Hematoma  
Concussion

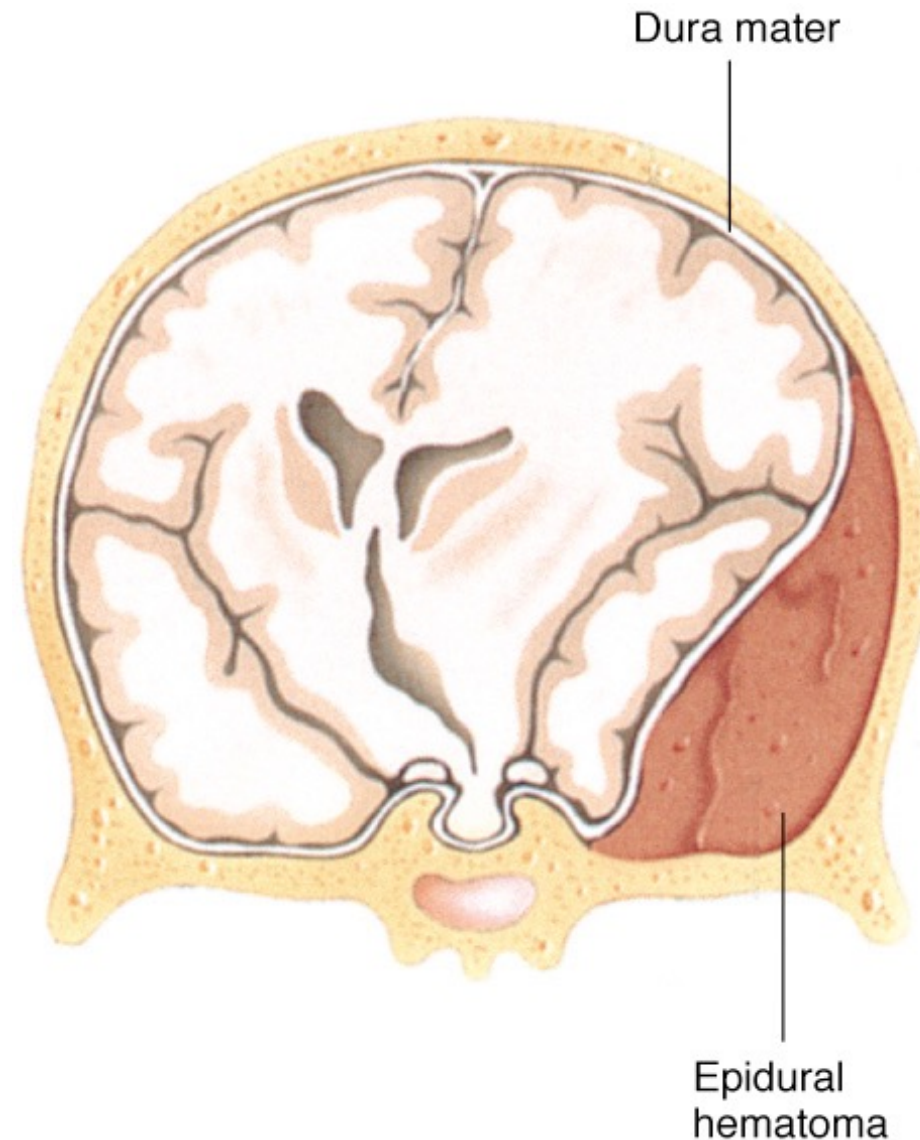
# Epidural Hematoma

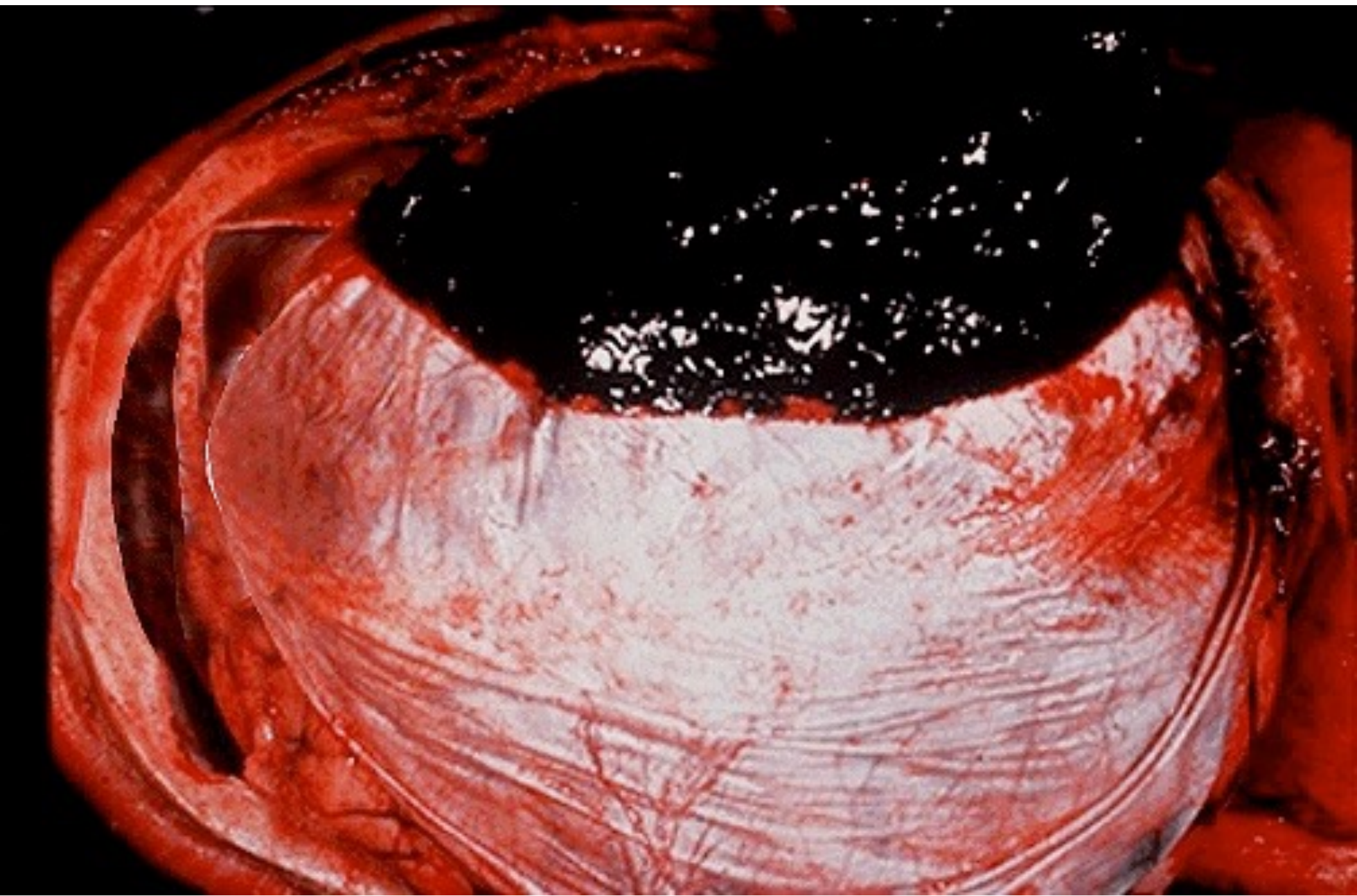




# Epidural Hematoma

- Bleeding between dura mater and skull
- Involves arteries
  - Middle meningeal artery most common
- Rapid bleeding & increased pressure = reduction of oxygen to tissues
- Herniates brain toward foramen magnum

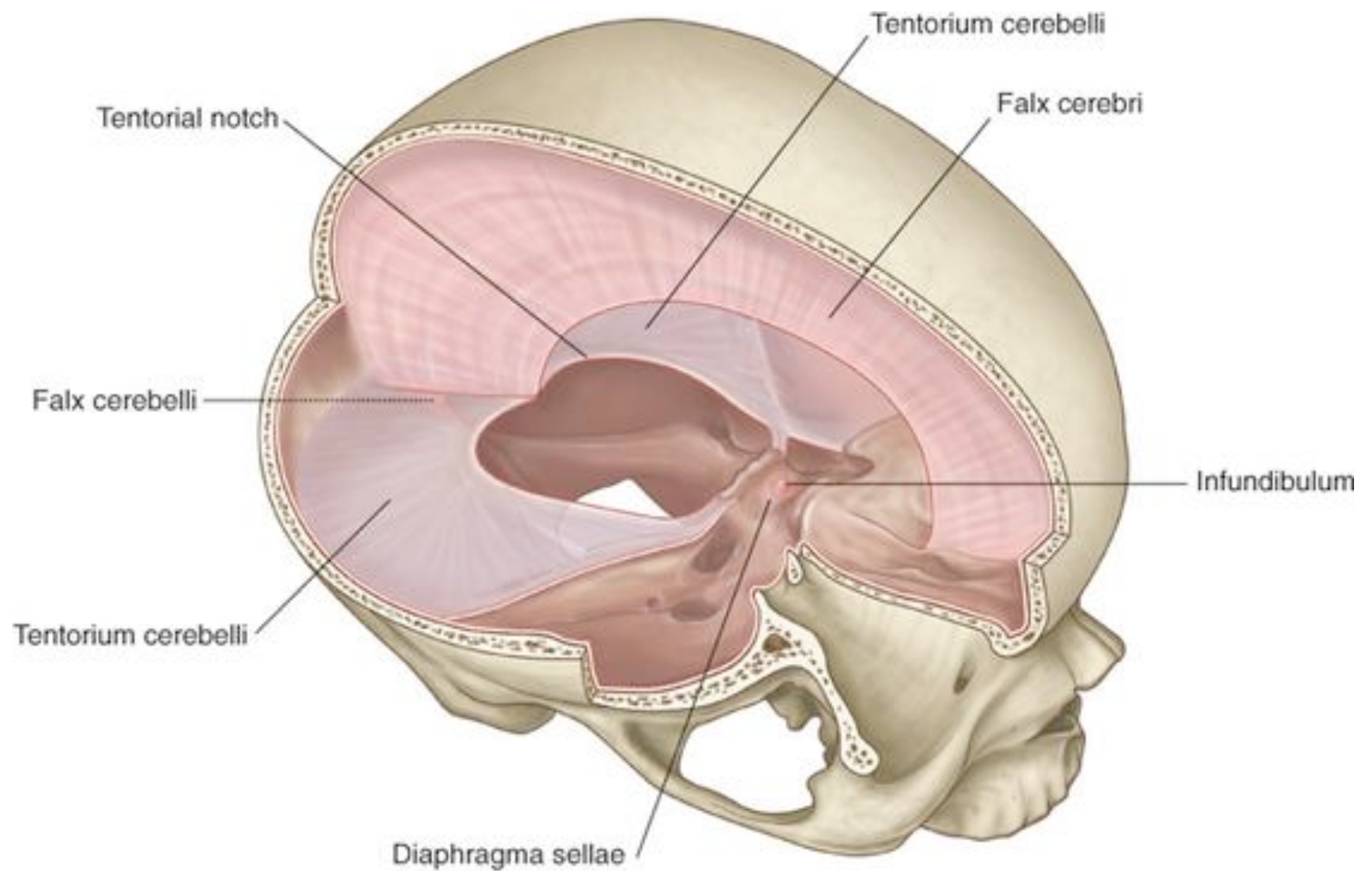












Drake: Gray's Anatomy for Students, 2nd Edition.  
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# Cerebral Cortex/Upper Brain Stem

- BP ↑, HR ↓
- Pupils reactive
- Cheyne-Stokes resps
- First localizes stimuli, then withdraws, then flexion (decorticate)
- Can be reversed at this stage!

# Middle Brain Stem

- HR ↓ ↓, BP ↑ ↑
  - Wide PP, bradycardia
- Pupil nonreactive or sluggish
- Extension (decerebrate)
- Seizures
- Good luck. Poor outcome.

# Lower BS/Medulla

- Blown pupil
- Ataxic respirations
- Flaccid
- Fluctuating HR
- Decreased, fluctuating BP
- Not survivable

# What Kills The Head Injured Patient?

- Unmanaged airways and inadequate ventilation
- Uncontrolled ICP
- Decreased cerebral perfusion

# How Can We Decrease Morbidity & Mortality in Head Injured Patients?

- Open & clear Airway. Keep it so.
- Ventilate and Oxygenate
  - Ventilate at 20/min if signs of severe head injury present
- Elevate head to 30°
- Drive real fast to trauma center

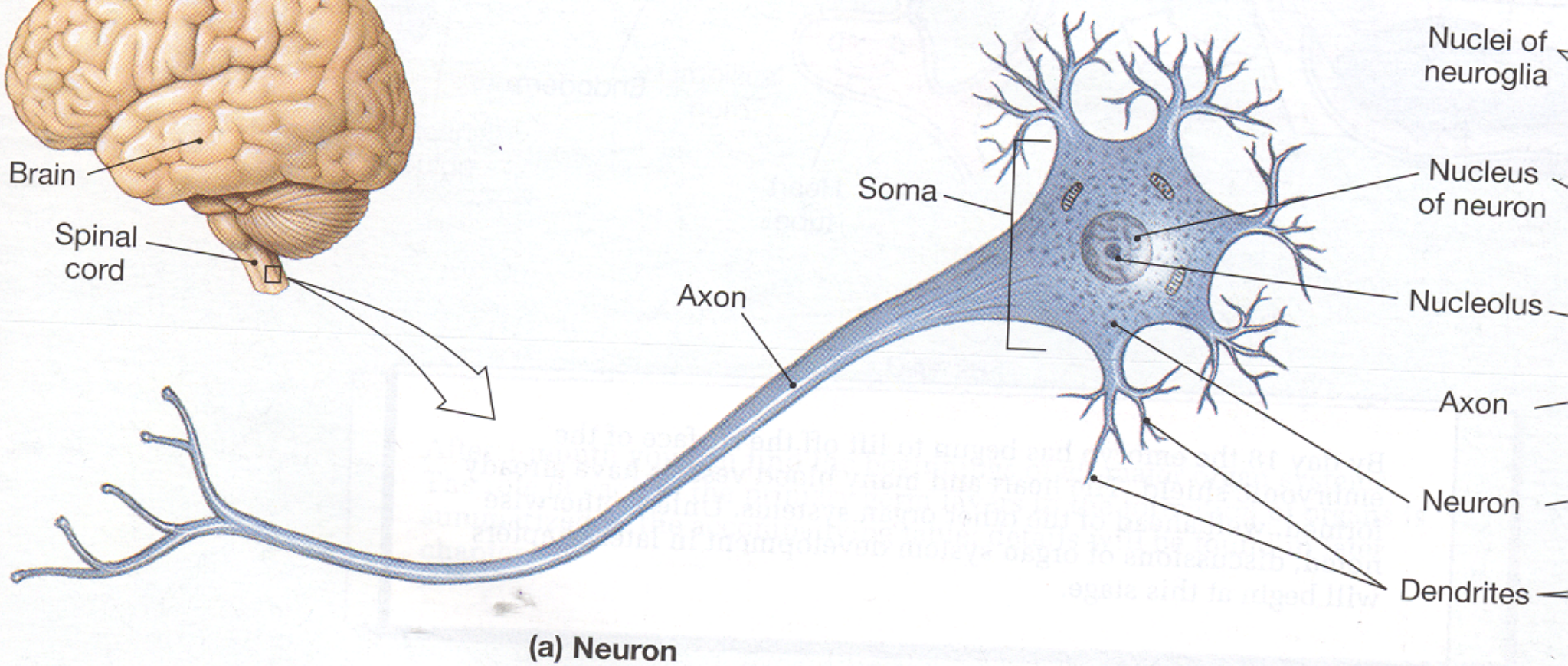
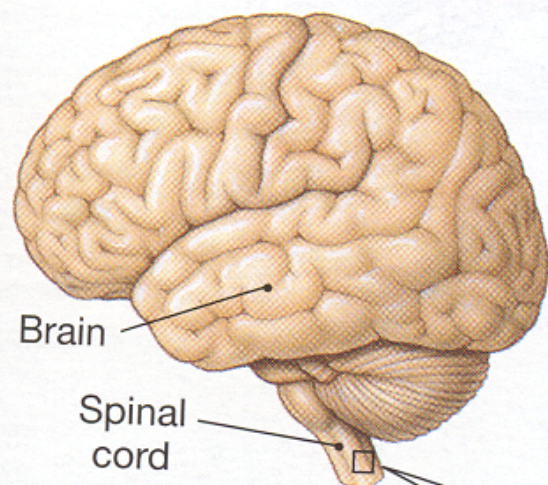
# Case 3

# Quick Case



# Diffuse Brain Injury

- Due to stretching forces placed on axons
- Pathology distributed throughout brain
- Types
  - Concussion
  - Moderate Diffuse Axonal Injury
  - Severe Diffuse Axonal Injury



# Mild Diffuse Axonal Injury

- Concussion
  - Nerve dysfunction without anatomic damage
- Transient episode of
  - Confusion, disorientation, event amnesia
- Management
  - ABC's, c-spine considerations!
  - ALS!
  - Frequent reassessment of mentation

# Moderate Diffuse Axonal

- “Classic Concussion”, 45 % of all DAI
- Same mechanism as concussion
  - Additional: Minute bruising of brain tissue
- Unconsciousness
  - If cerebral cortex and RAS involved

- Signs & Symptoms
  - Unconsciousness or persistent confusion
  - Loss of concentration, disorientation
  - Retrograde/antegrade amnesia
  - Visual and sensory disturbances
  - Mood or Personality changes
- Management:
  - Same as mild DAI
  - Watch for worsening!

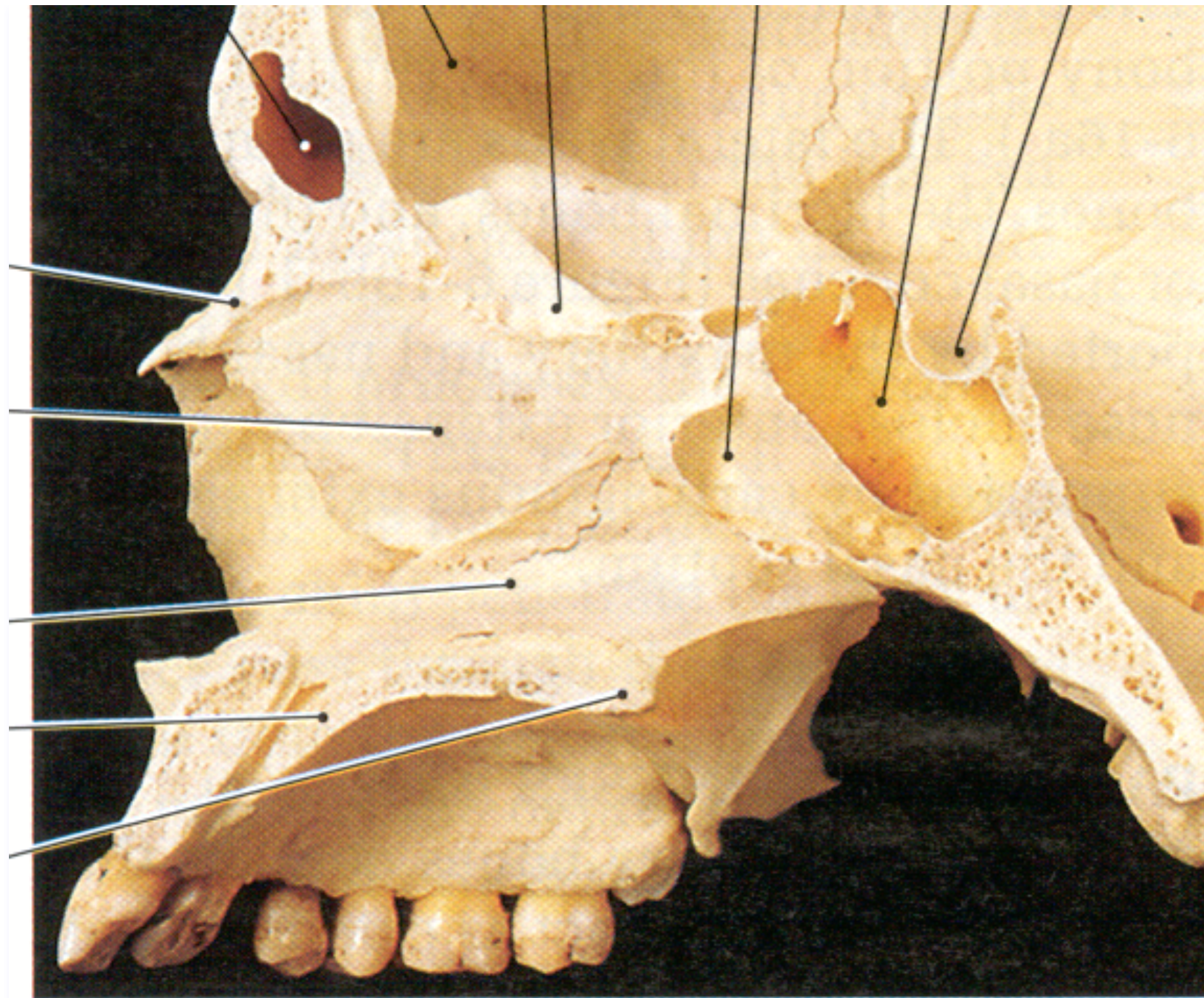
# Severe Diffuse Axonal Injury

- Brainstem Injury
- Significant mechanical disruption of axons
  - Cerebral hemispheres and brainstem
- High mortality rate
- Signs & Symptoms
  - Prolonged unconsciousness
  - Cushing's reflex
  - Decorticate or decerebrate posturing

- Management
  - C-spine considerations
  - ABC's
    - Airway a priority!
    - Hyperventilate 20/min, normal TV!
  - ALS



18-17



# Cranial Injury

- Basilar Skull Fracture
  - Tear Dura Mater
    - Permit CSF to drain through an external passageway
    - May mediate rise of ICP
    - Evaluate for “Target” or “Halo” sign









# Cranial Injury

- Basal Skull Fracture Signs

- Battle's Signs

- *Retroauricular Ecchymosis*
    - Associated with fracture of auditory canal and lower areas of skull

- Raccoon Eyes

- *Bilateral Periorbital Ecchymosis*
    - Associated with orbital fractures



Retroauricular ecchymosis (Battle's sign).



Bilateral periorbital ecchymosis (raccoon eyes).



# Management: Skull Fracture

- C-spine precautions
- ABC's
  - OPA, NPA?
  - BVM/ET if necessary
    - Rate? TV?
- ALS
- Do not push on skull!
- Leave impaled objects in place!
  - Secure adequately

CT HiSpeed Adv SYS#ECT2  
Ex:11934

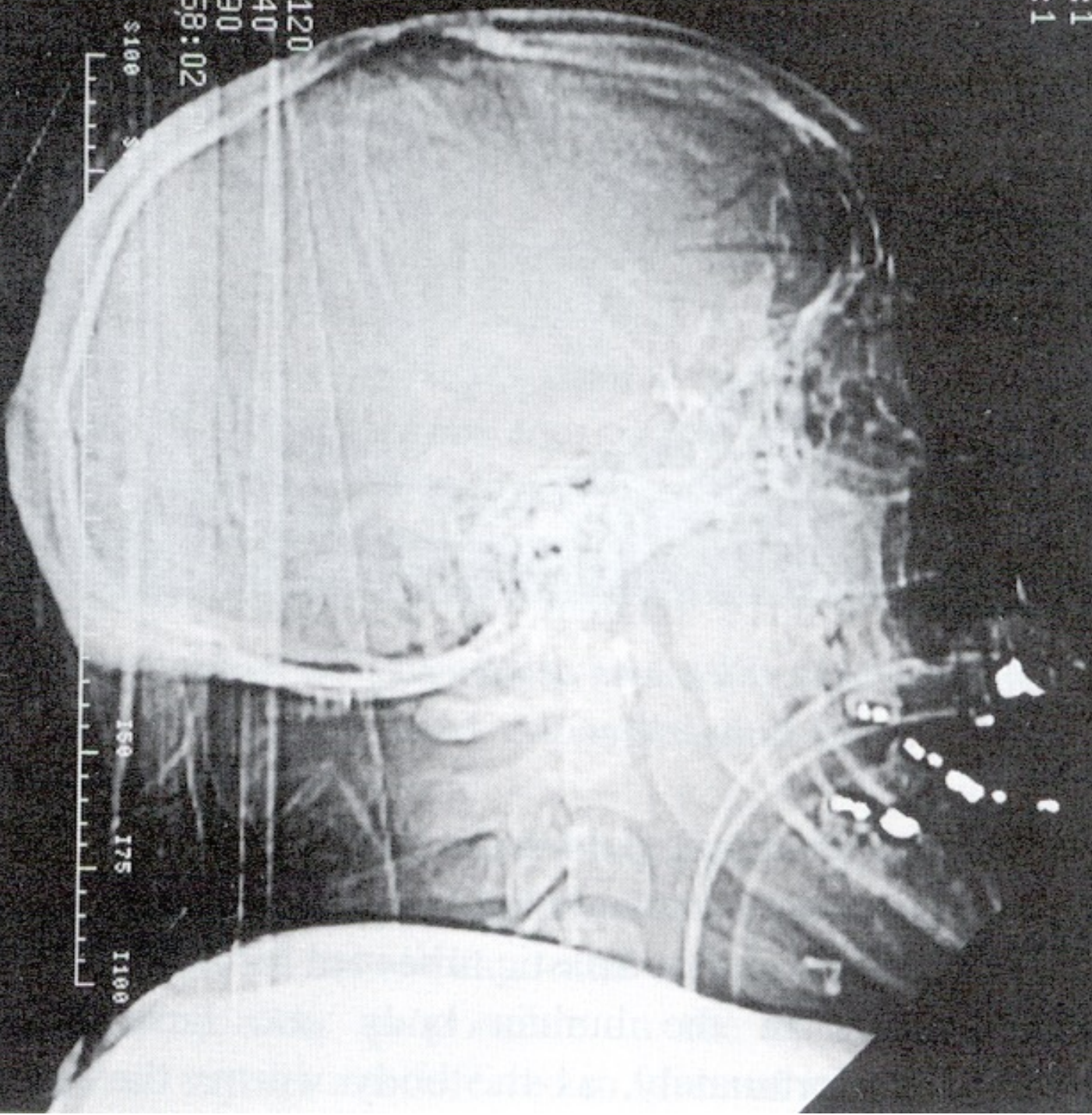
A141

Se:1  
Im:1

S 1 2 8 m m

kV 120  
mA 40  
Az 90  
01:58:02

= 538 L = -90 g



100

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175

1100

CT HiSpeed Adv SYS#ECT2

Ex:11934

Se:2

EA S34.0

Im:10

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L

kV 120

mA 280

Adult Head

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# Brain Injury: Causes

- Direct
  - Primary injury caused by forces of trauma
- Indirect
  - Secondary: caused by edema, hemorrhage, infection, pressure, and inadequate perfusion
  - Tertiary: caused by apnea, hypotension, pulmonary resistance, and dysrhythmia

# Mechanism For Brain Injury

- ICP starts to increase
- As ICP increases, cerebral blood flow decreases
  - Swelling compresses arteries =  $\downarrow$  CBF =  $\downarrow$   $O_2$
  - Cell death = edema around necrotic tissue =  $\uparrow$  ICP
  - $CO_2$  accumulation = vasodilation =  $\uparrow \uparrow$  ICP

# Levels of Increasing ICP

- Cerebral cortex/upper brain stem
- Middle brain stem
- Lower brain stem/medulla



# Cerebral Cortex/Upper Brain Stem

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