CT Brain & Spine

Dr. Nidal Abuhadrous MD, MRCS, ABHS(NS)

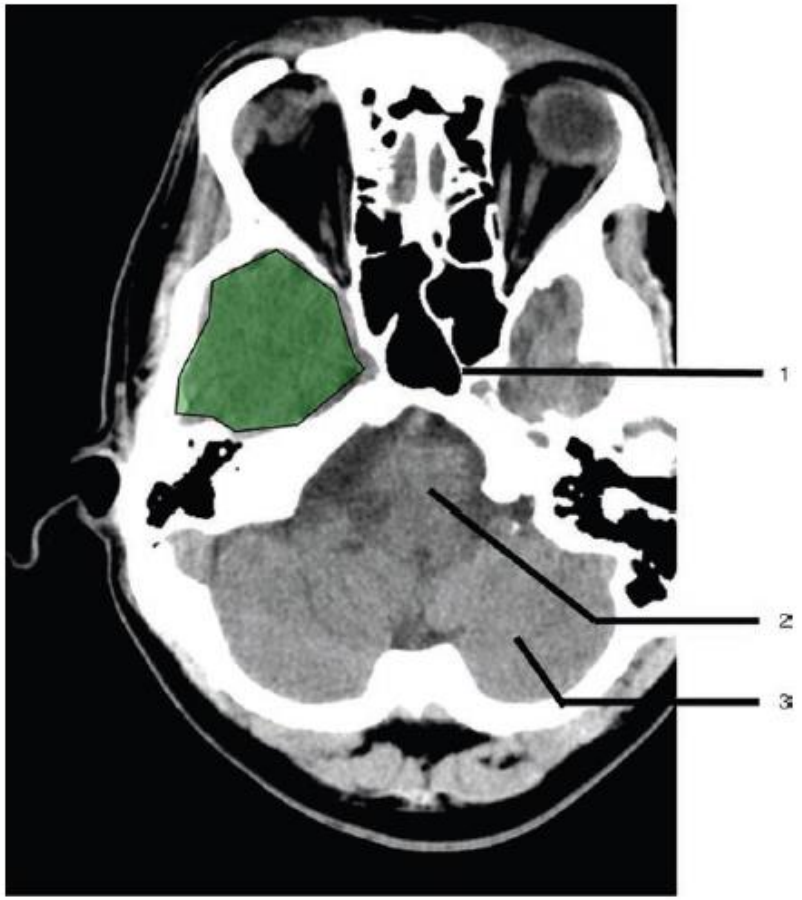
Consultant Neurosurgeon

Head of Neurosurgery – Nasser Medical Complex

Outline

- Normal CT brain
- How to read a brain CT
- Abnormal CT brain (common pathologies)
- How to read a spine CT
- Spine fractures on CT

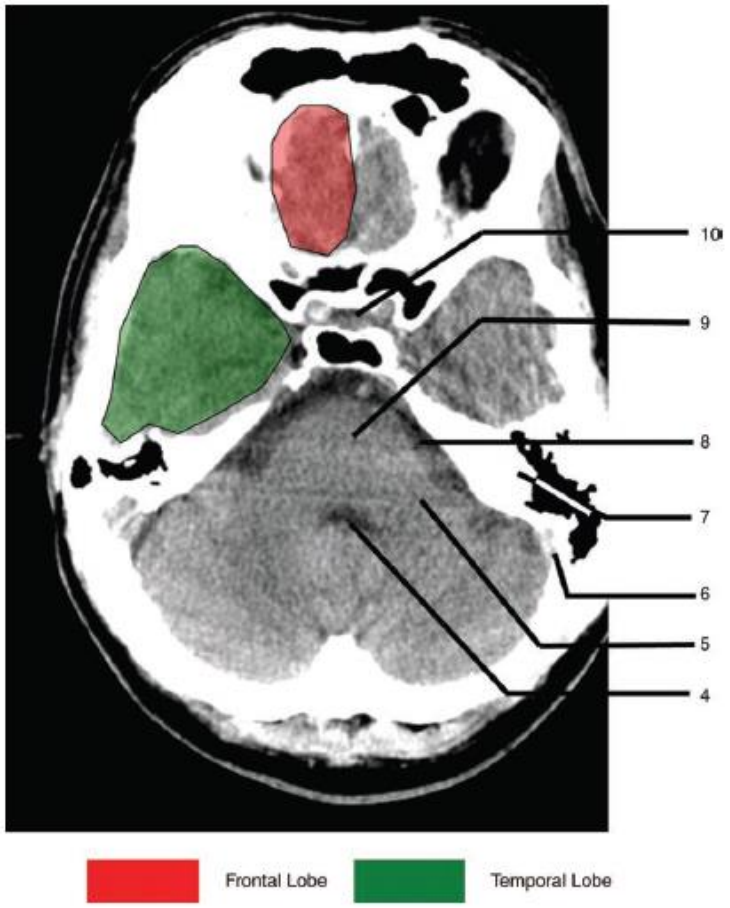
Normal CT Brain - Axial



1. Sphenoid sinus
2. Medulla oblongata
3. Cerebellum

Temporal lobe

CT Brain - Axial



4 = Fourth ventricle

5 = Middle cerebellar peduncle

6 = Sigmoid sinus

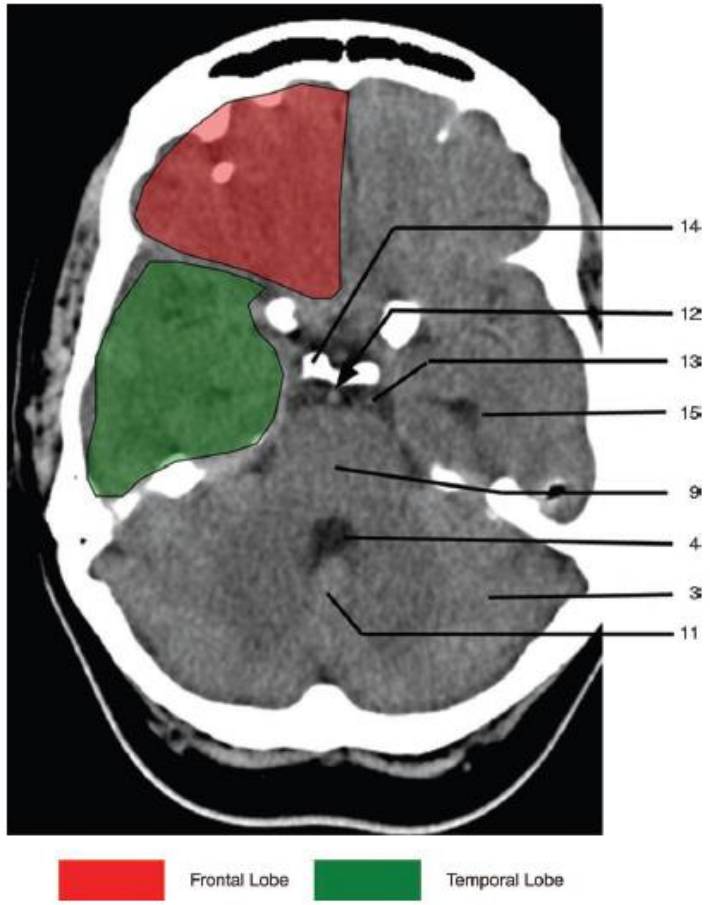
7 = Petrous temporal bone and mastoid air cells

8 = Cerebellopontine angle

9 = Pons

10 = Pituitary fossa

CT Brain - Axial



11 = Cerebellar vermis

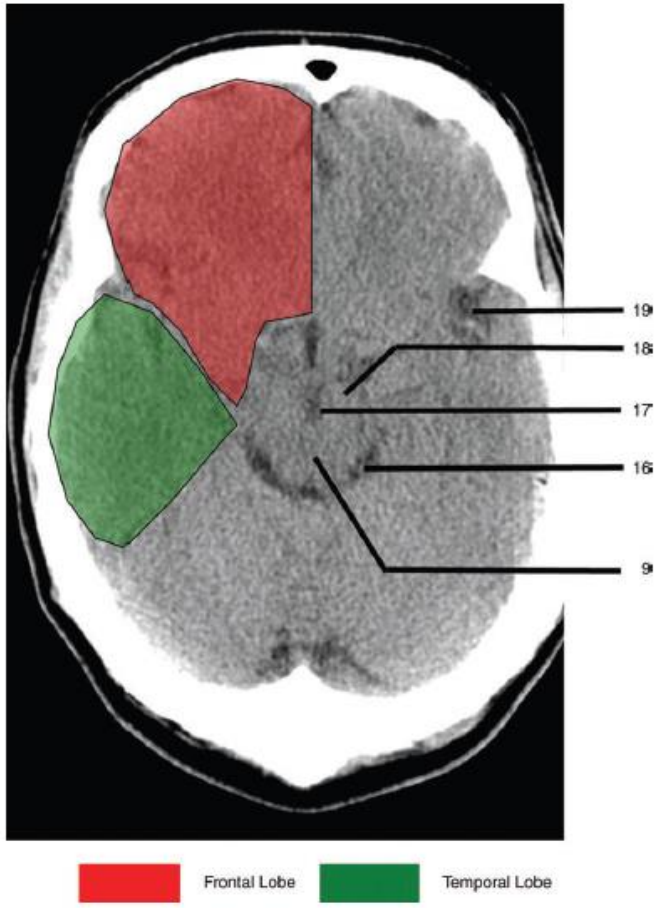
12 = Basilar artery

13 = Prepontine cistern

14 = Dorsum sellae

15 = Temporal horn of lateral ventricle

CT Brain - Axial



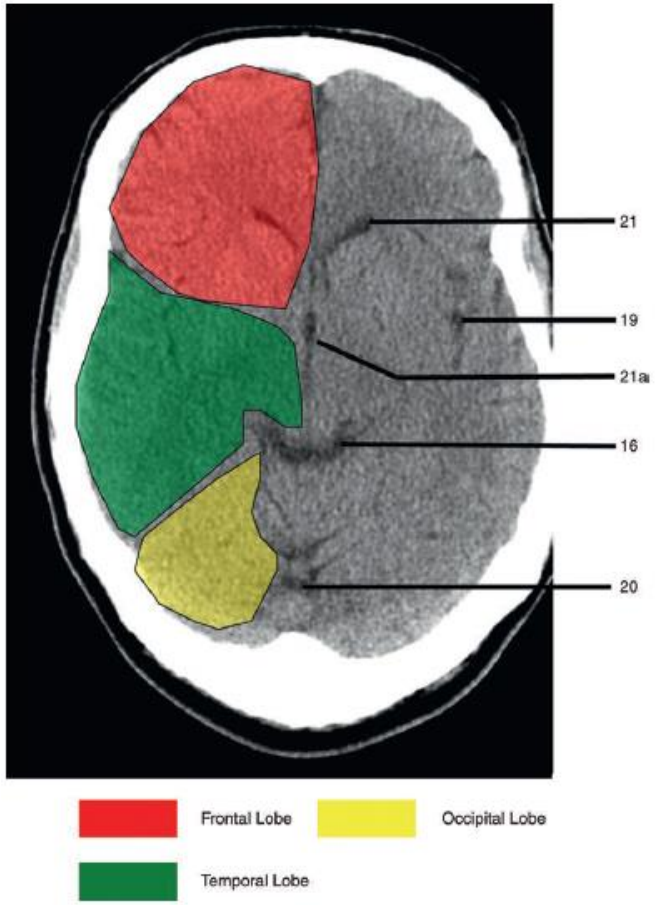
16 = Ambient cistern

17 = Interpeduncular cistern

18 = Cerebral peduncle

19 = Sylvian fissure

CT Brain - Axial

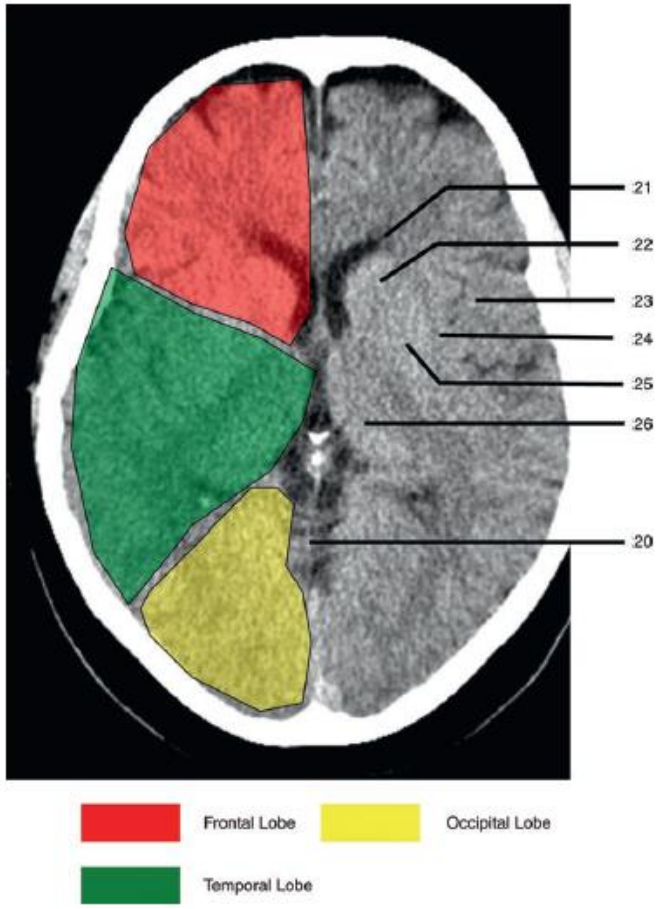


20 = Supra vermian cistern

21 = Frontal horn of lateral ventricle

21a = Third ventricle

CT Brain - Axial



22 = Head of caudate nucleus

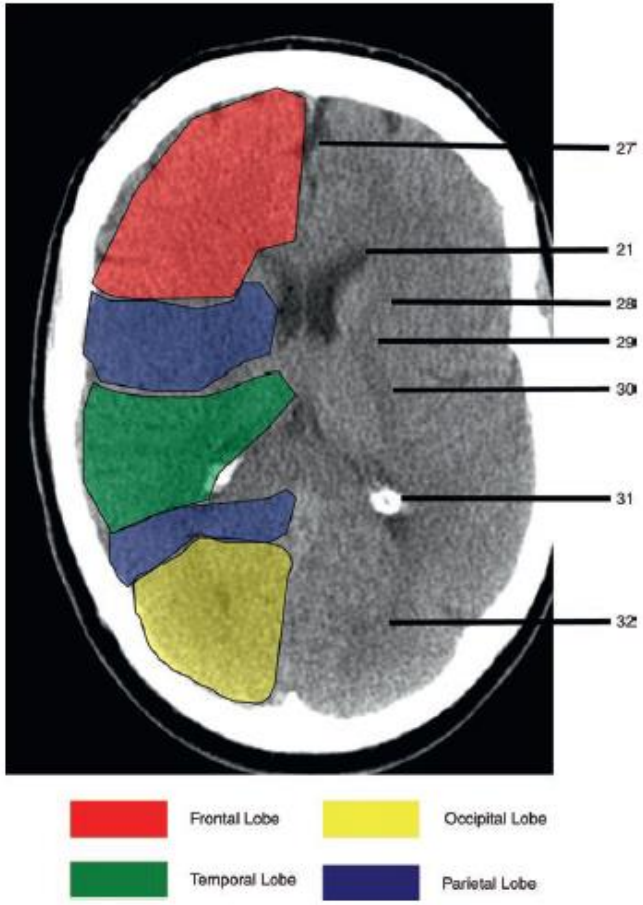
23 = Insular cortex

24 = External capsule

25 = Lentiform nucleus

26 = Thalamus

CT Brain - Axial



27 = Interhemispheric fissure

28 = Anterior limb of internal capsule

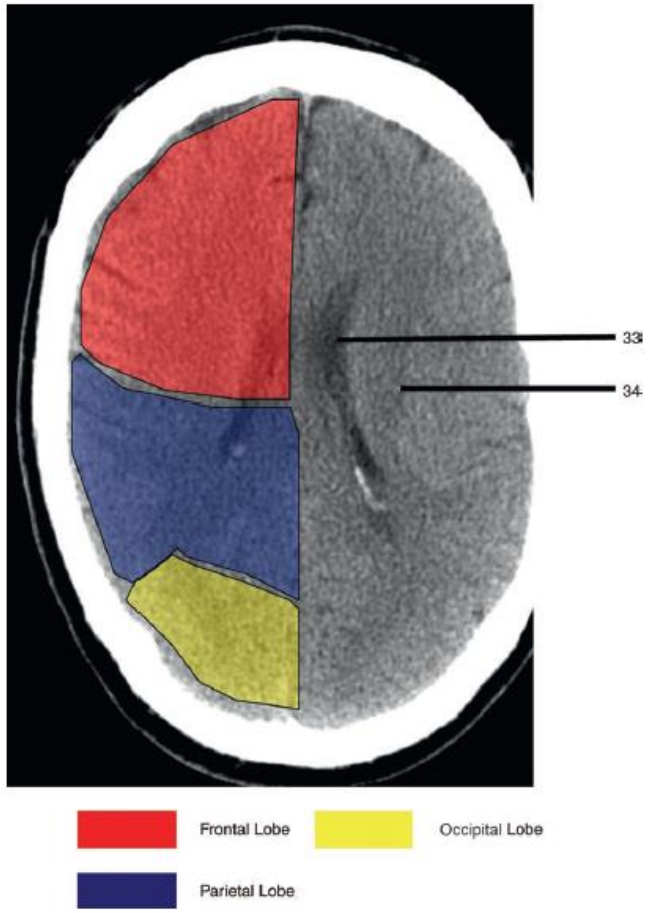
29 = Genu of internal capsule

30 = Posterior limb of internal capsule

31 = Trigone of lateral ventricle and calcified choroid plexus

32 = Occipital horn of lateral ventricle

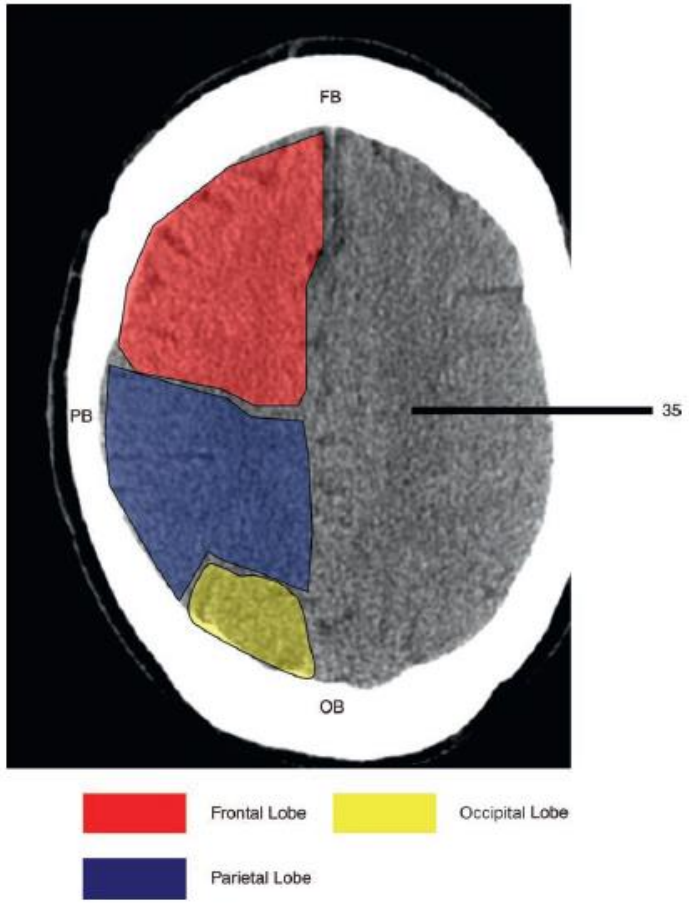
CT Brain - Axial



33 = Body of lateral ventricle

34 = Corona radiata

CT Brain - Axial



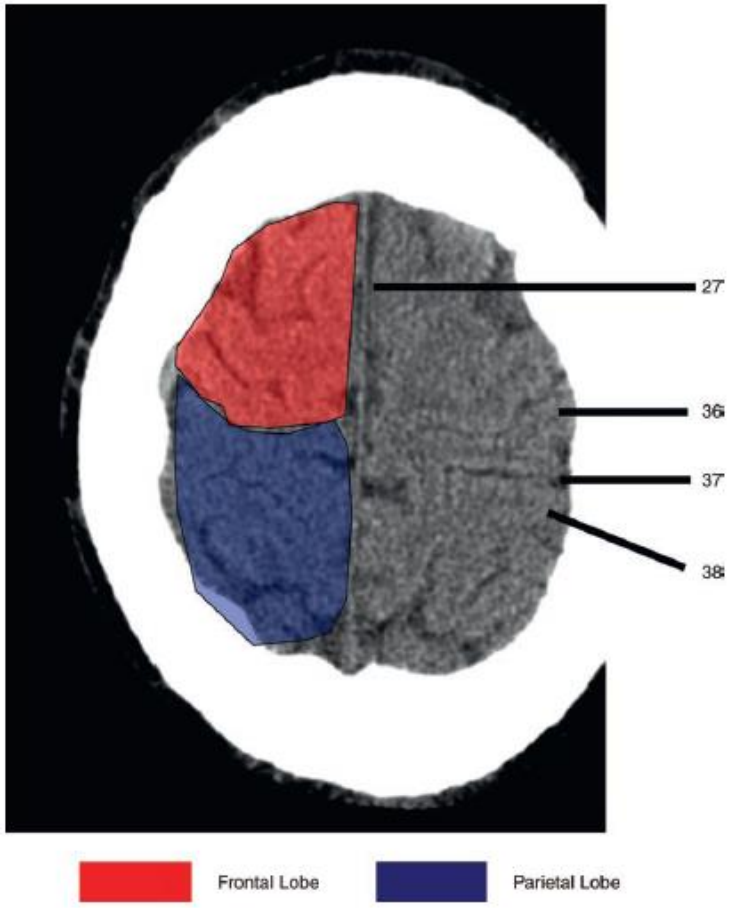
35 = Centrum semiovale

FB = Frontal bone

PB = Parietal bone

OB = Occipital bone

CT Brain - Axial

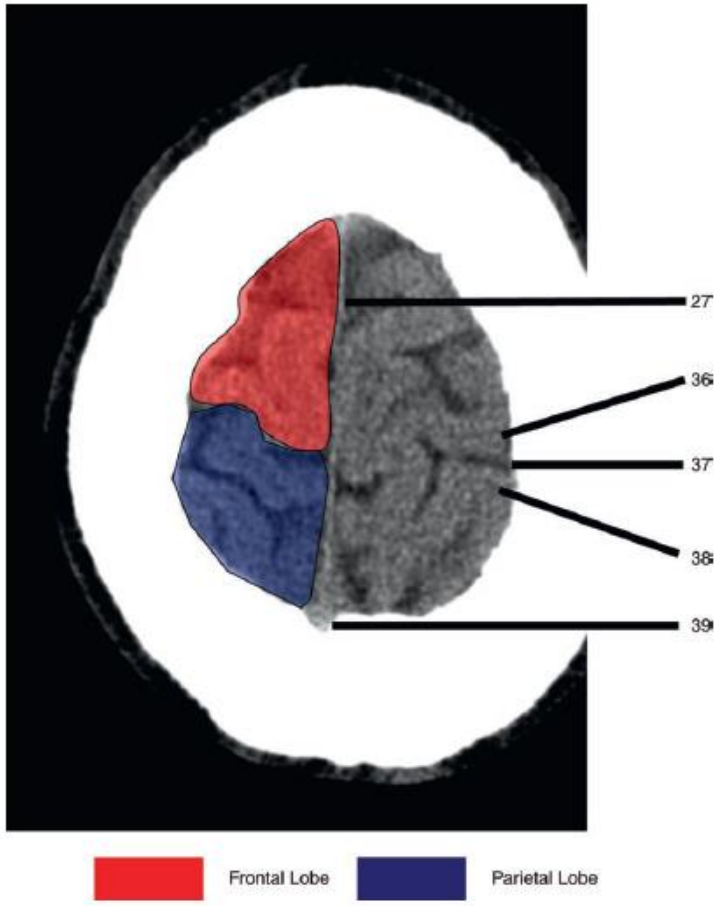


36 = Pre-central gyrus

37 = Central sulcus

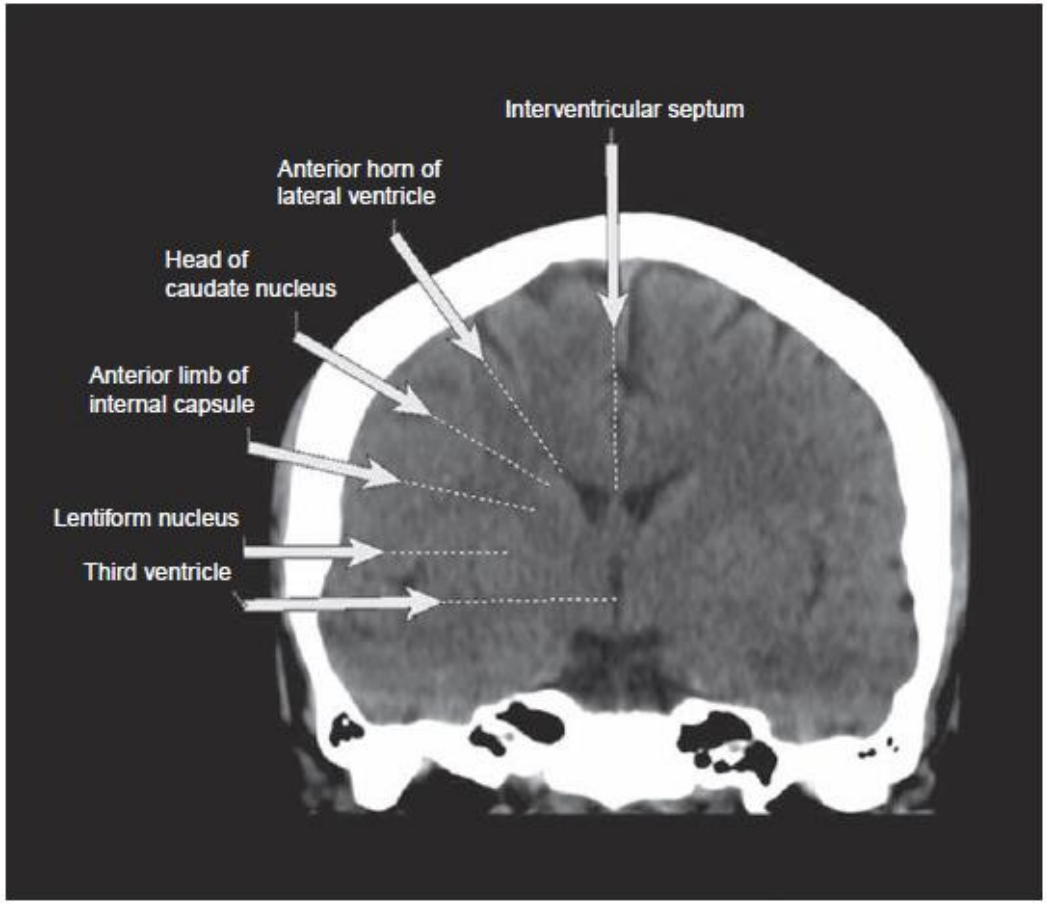
38 = Post-central gyrus

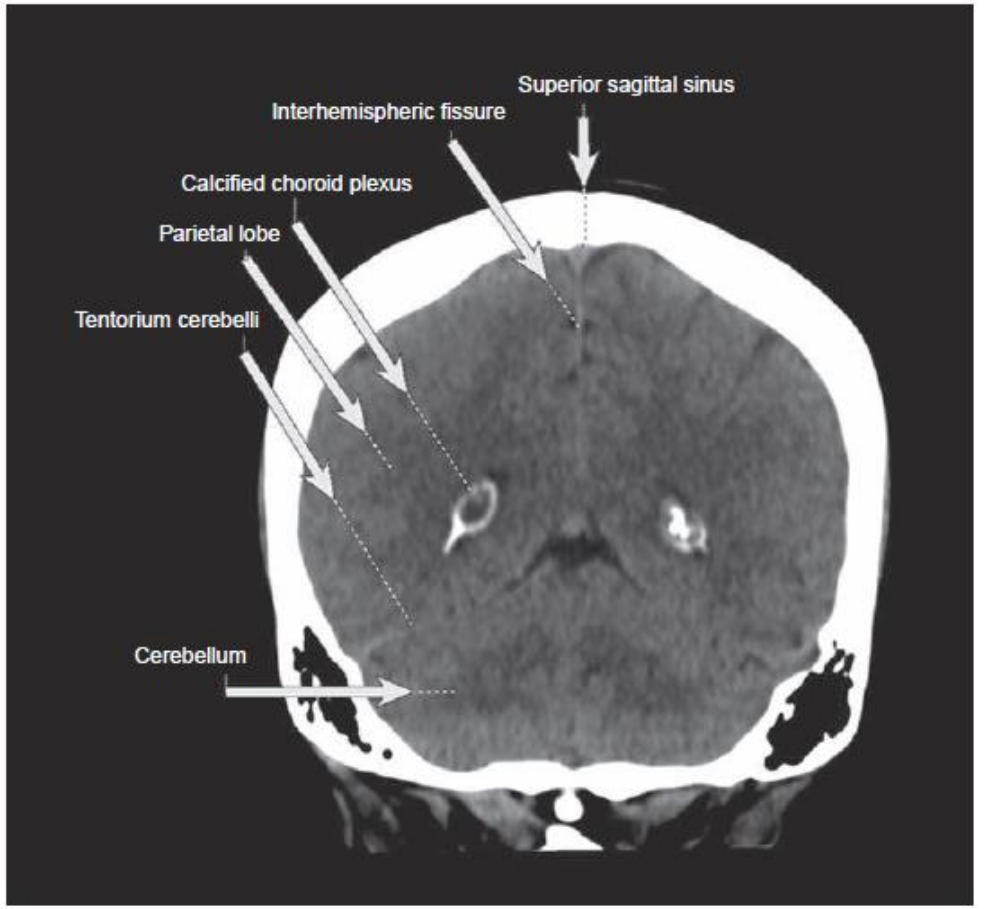
CT Brain - Axial



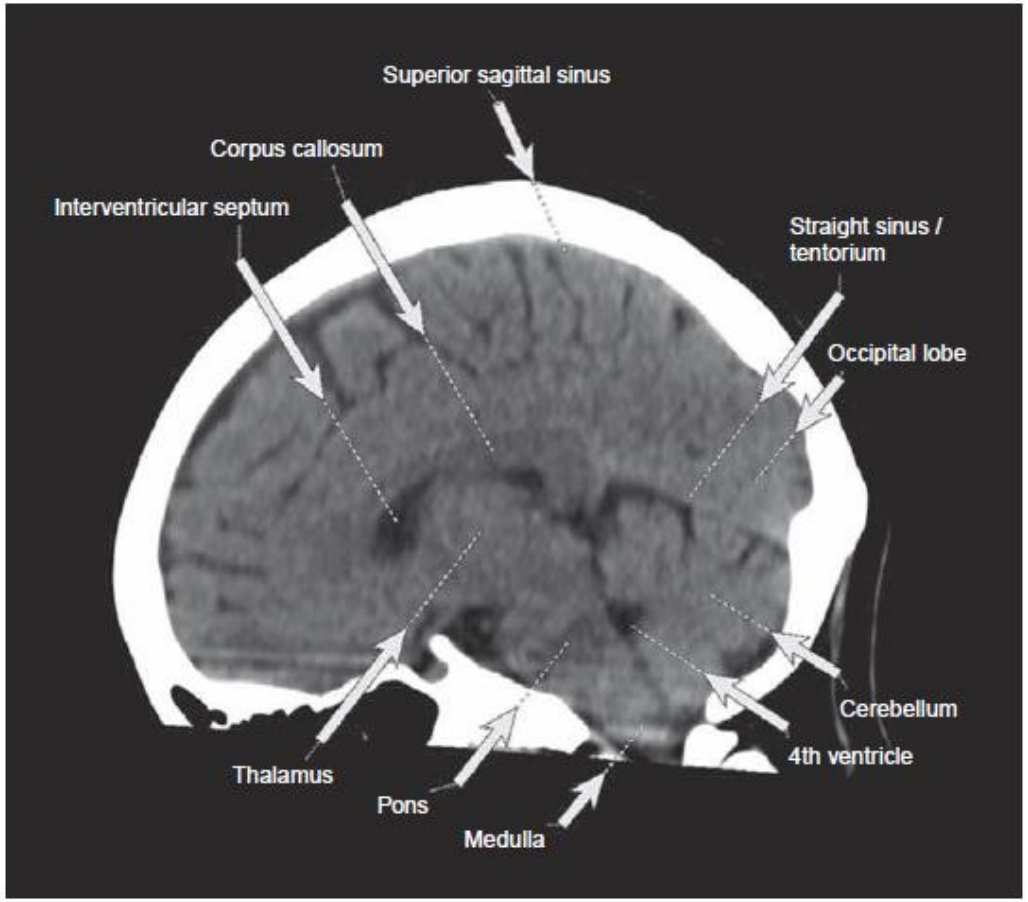
39 = Superior sagittal sinus

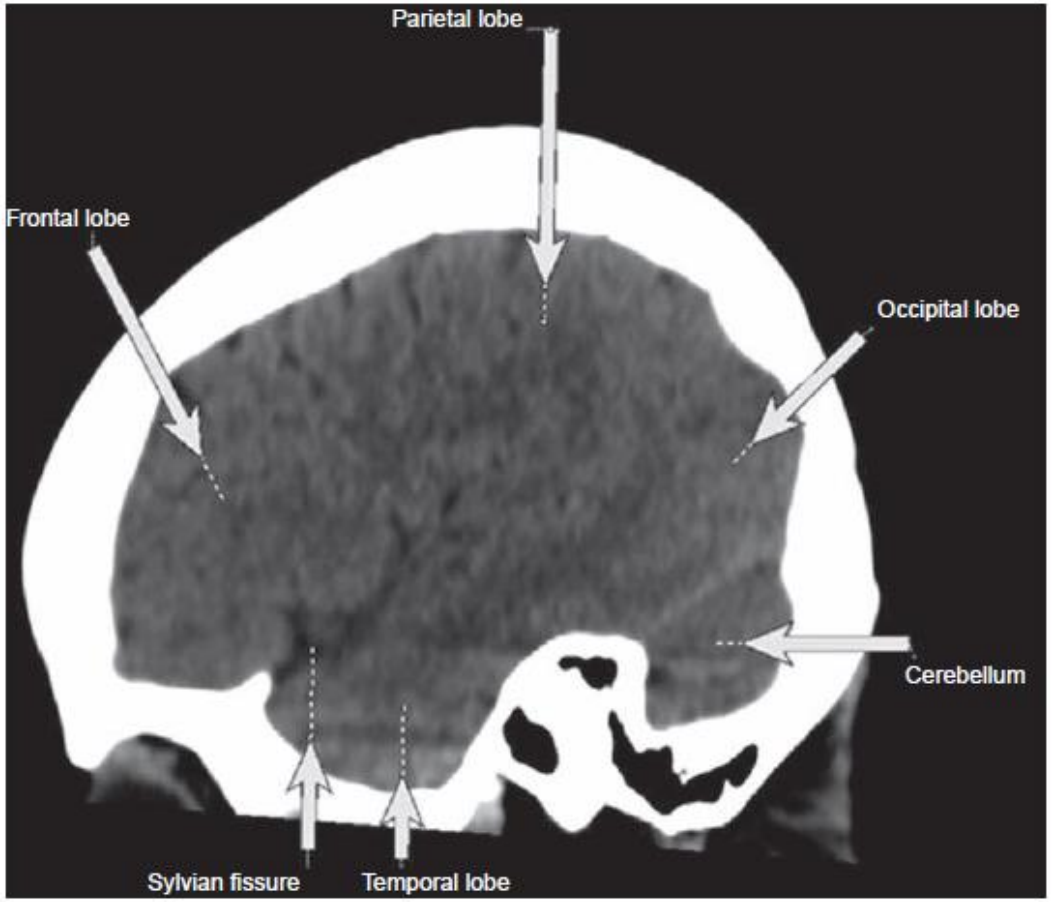
CT Brain - Coronal



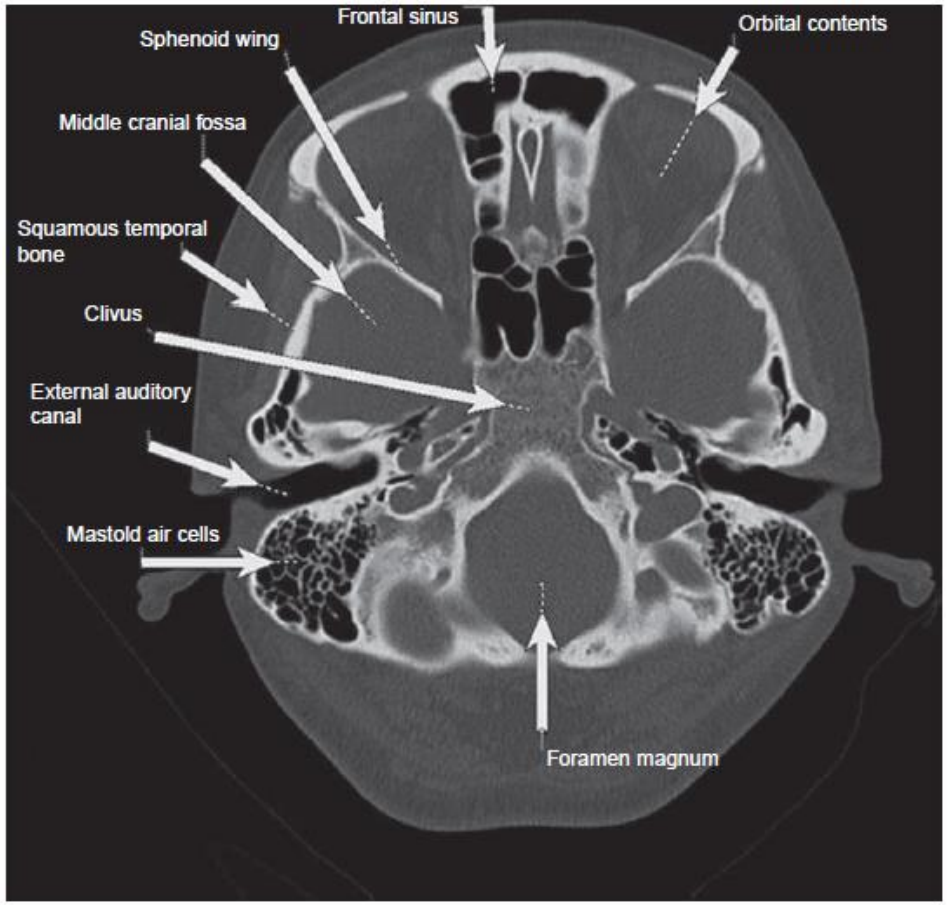


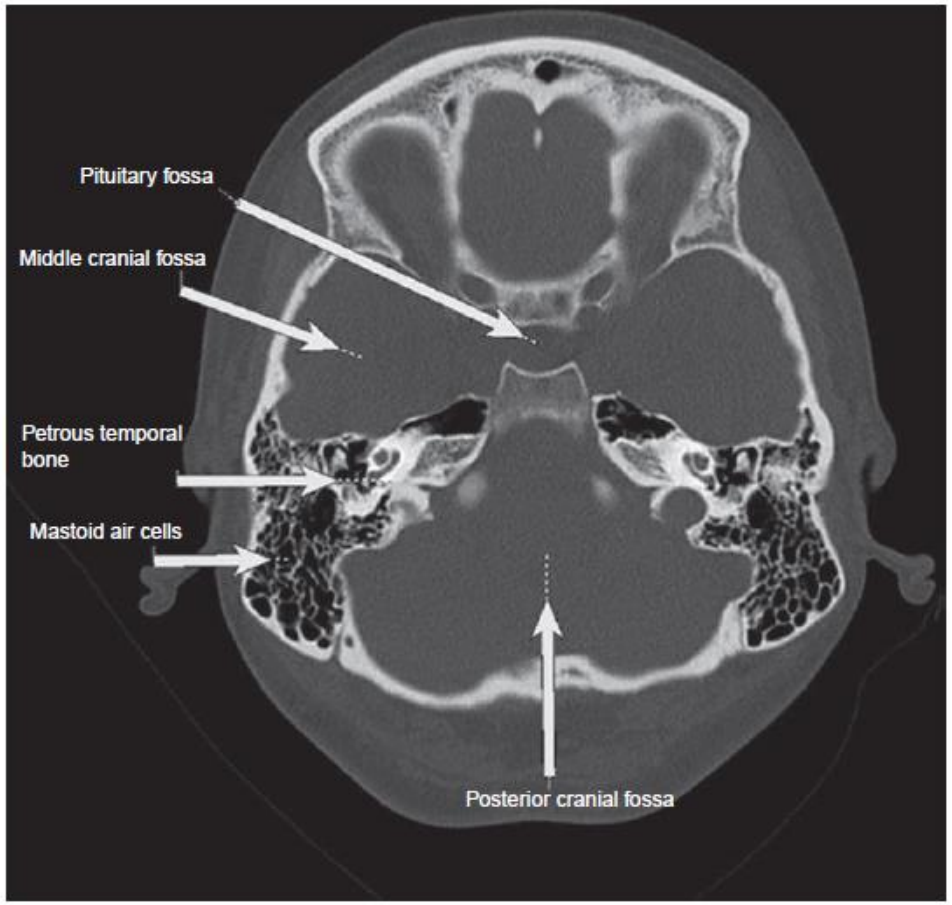
CT Brain - Sagittal



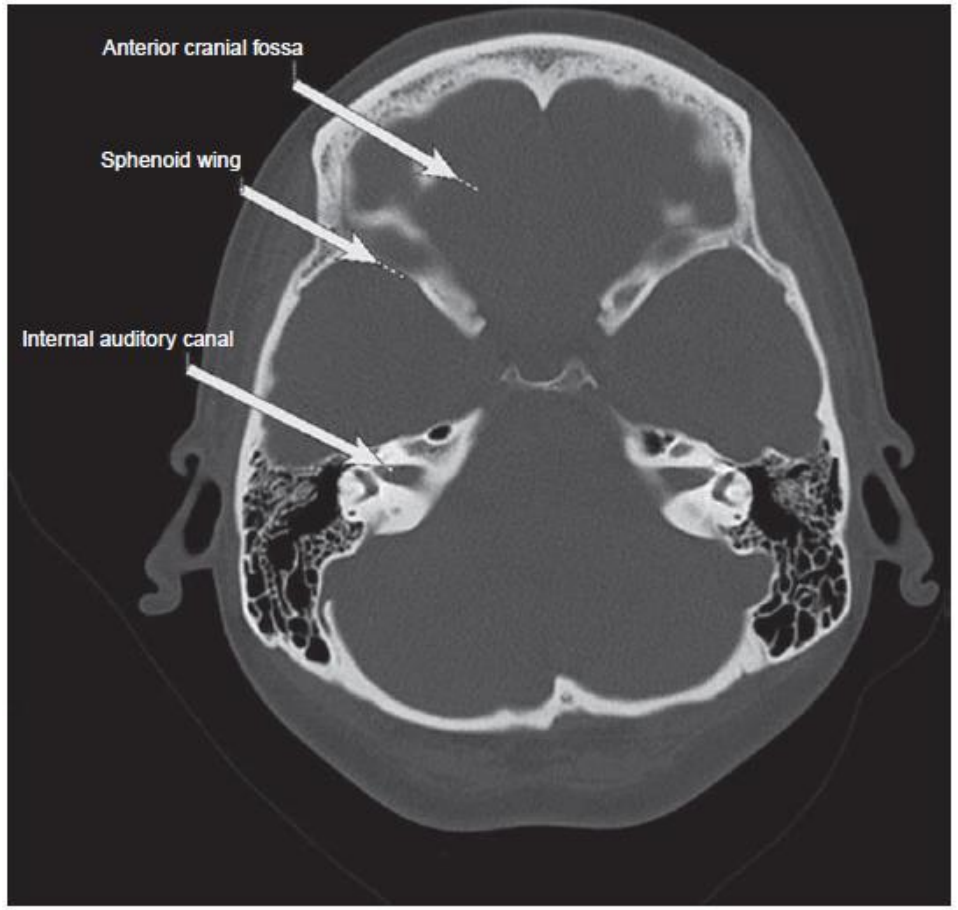


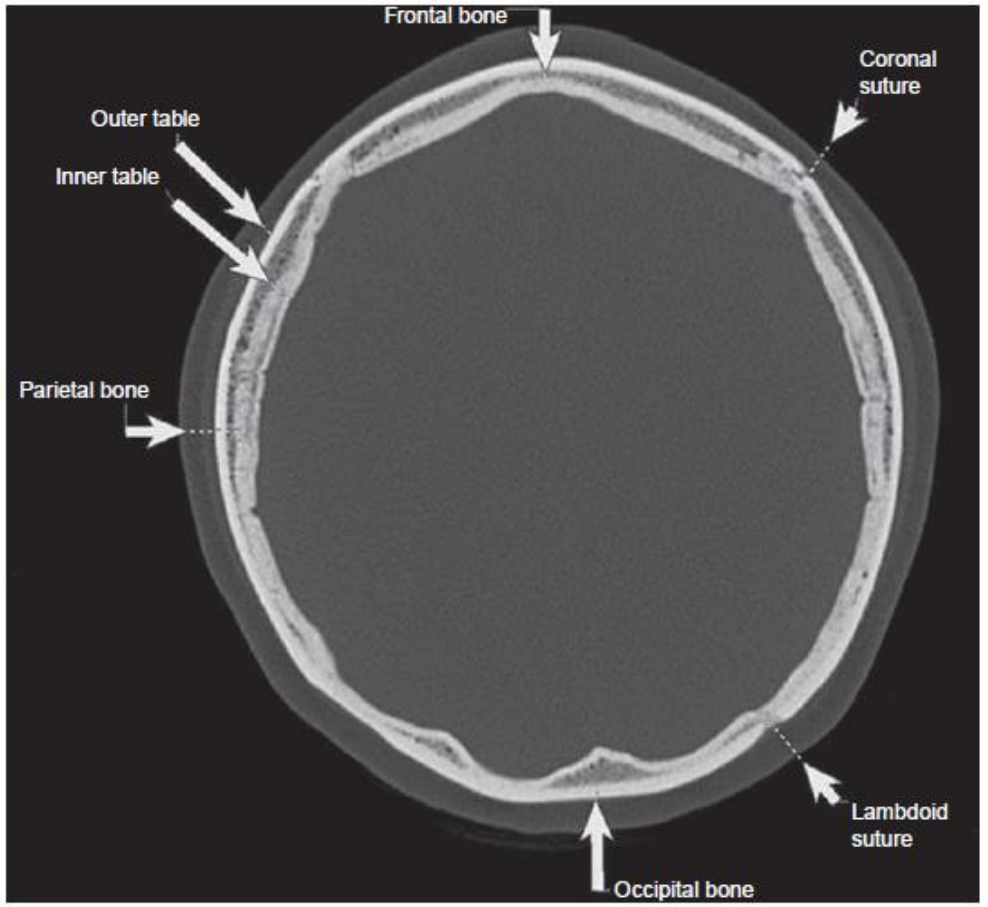
CT Brain - Normal Bony Axial Anatomy



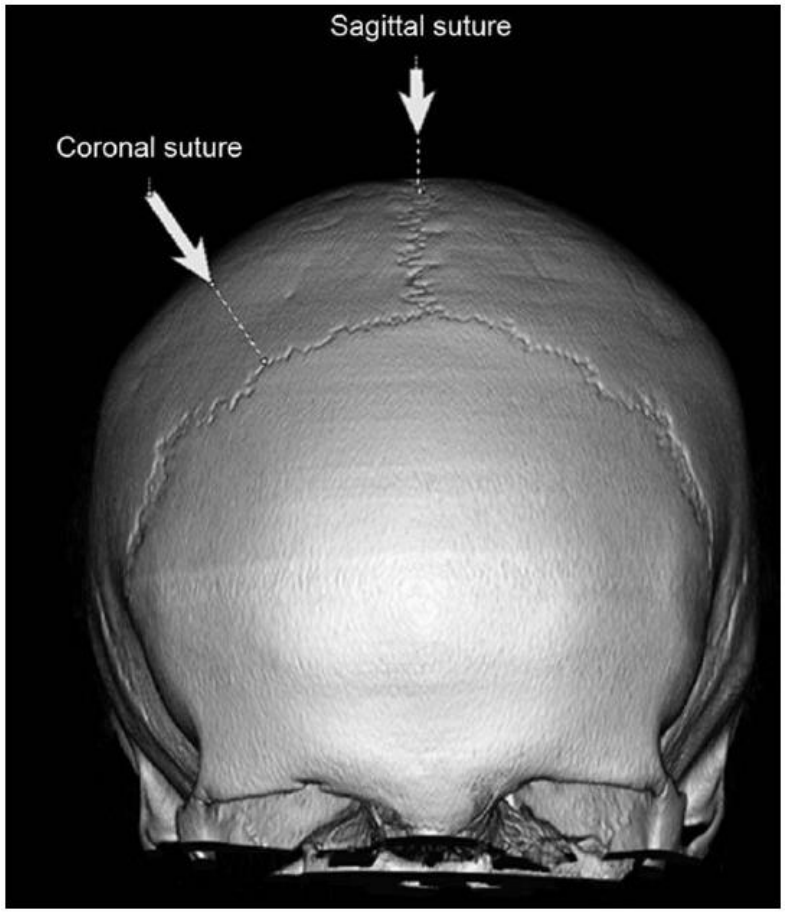


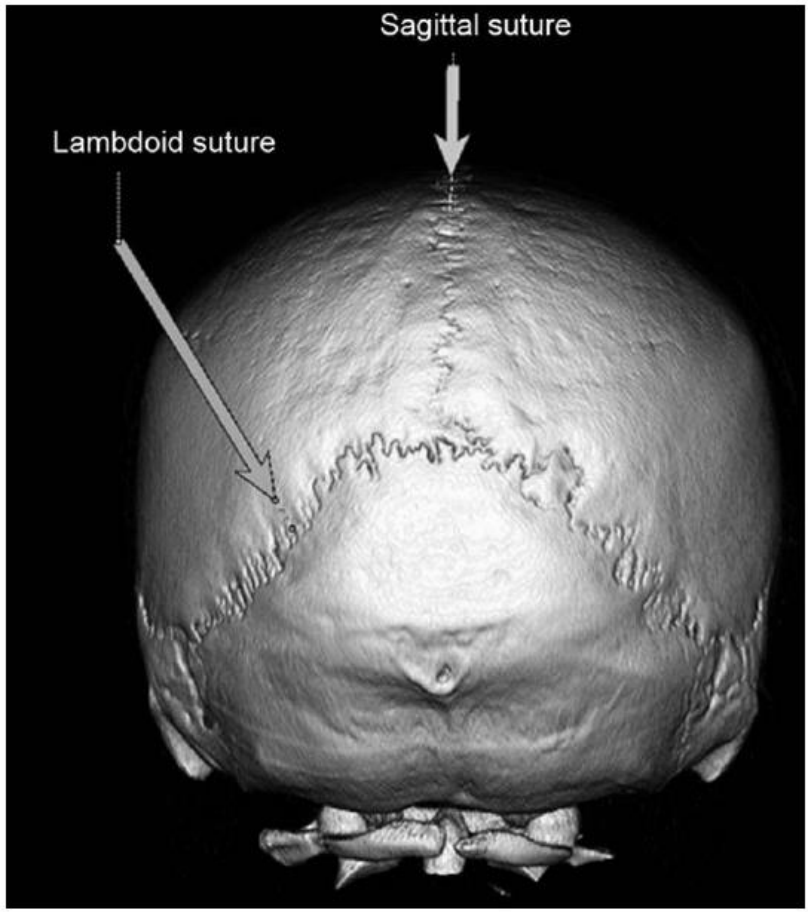
CT Brain - Normal Bony Axial Anatomy





CT Brain - Surface-rendered Bony Anatomy



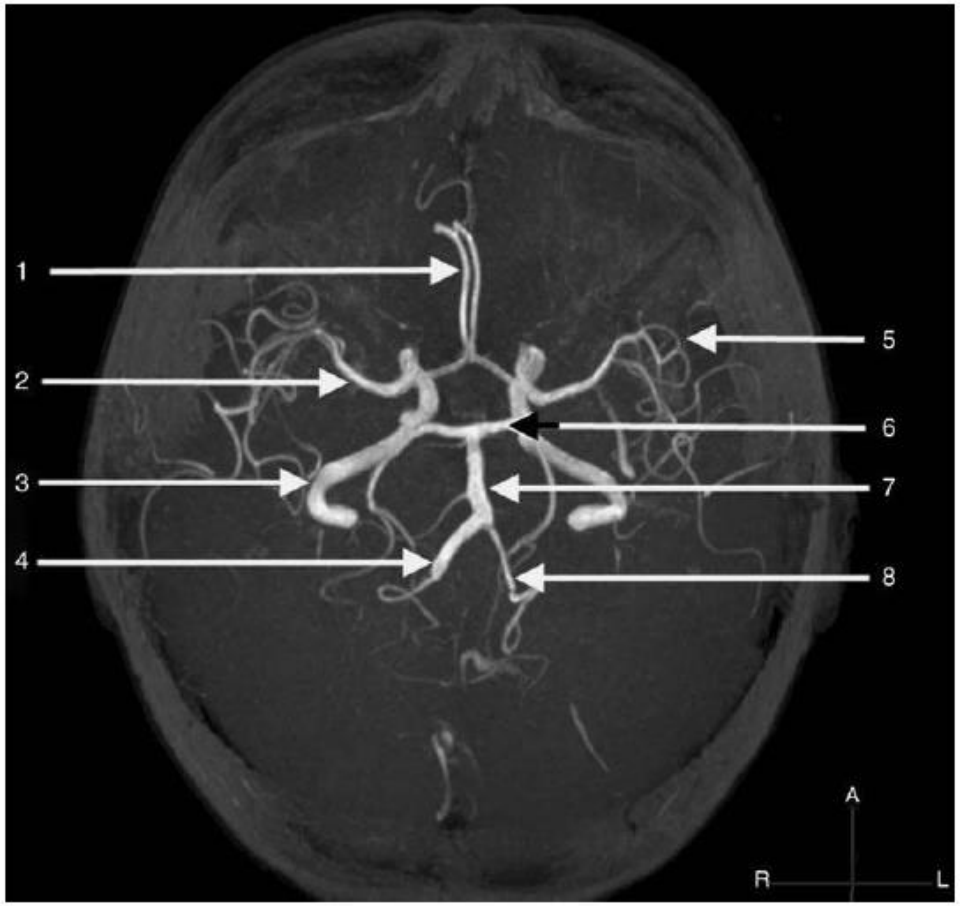


CT Brain - Vascular Territories



- Penetrating branches of the middle cerebral artery
- Terminal branches of the anterior cerebral artery
- Terminal branches of the middle cerebral artery
- Terminal branches of the posterior cerebral artery
- Penetrating branches of the posterior cerebral artery and posterior communicating artery

CT Brain – Angiography (CTA)



1. Anterior cerebral artery
2. Middle cerebral artery
3. Internal carotid artery
4. Right vertebral artery
5. Cortical branches of the middle cerebral artery
6. Posterior cerebral artery
7. Basilar artery
8. Left vertebral artery

CT Brain
Systematic Approach to Interpretation

- Check patient information and review scan protocol (e.g. non-contrast/contrast enhanced).
- Check the scout image. May reveal a fracture or gross abnormality not obvious on the axial images. Review alignment of upper cervical vertebrae.
- A quick ‘first pass’ is recommended, noting gross pathology, followed by a more detailed analysis of the images. Use the mnemonic ‘ABBCS’ to remember important structures.
- Finally, extend search pattern to include orbits, sinuses, oropharynx, ears, craniocervical junction, face, vault and scalp.

CT Brain
ABBCS

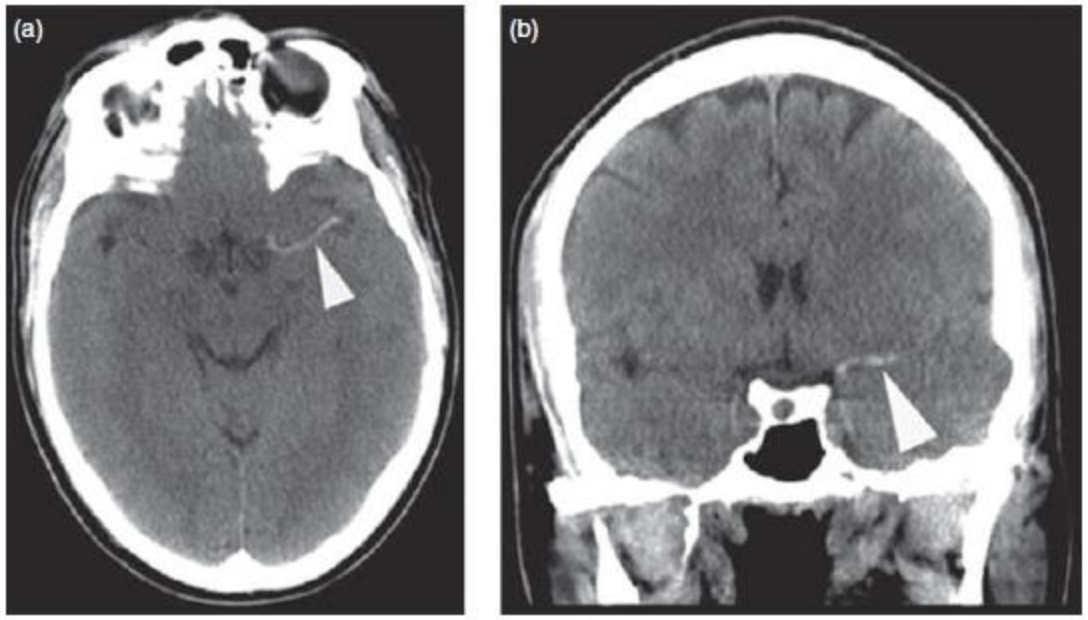
- ‘A’ – Asymmetry (R/O head tilt)
- ‘B’ – Blood (HU_50–100)
- ‘B’ – Brain
  - Density
    - Hyperdensity: acute blood, tumor, bone, contrast, foreign body, …
    - Hypodensity: edema, infarction, air, cyst, …
  - Displacement
    - Midline shift, asymmetry of CSF spaces (effacement of ventricles or loss of sulcal pattern)
  - Differentiation of grey/white matter
    - In an early infarction, edema leads to loss of the normal grey/white matter differentiation

CT Brain
ABBCS

- ‘C’ – CSF spaces
  - Ventricles size, sulci, cisterns and fissures

- ‘S’ – Skull and scalp
  - Assess the scalp for soft tissue injury
  - Assess the bony vault for fractures, lesions

CT Brain – Acute Stroke



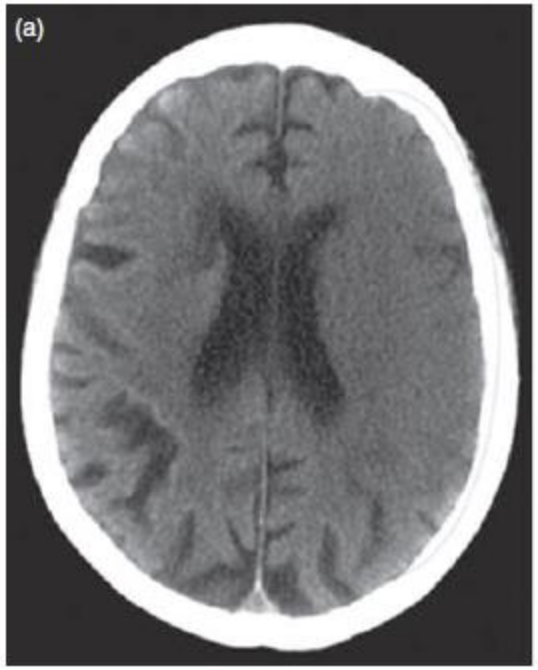
A hyperdense left MCA in keeping with acute intraluminal thrombus

(a) Axial

(b) Coronal

CT Brain – Acute Stroke

Early large left MCA infarct



Large left MCA infarct 1-7 days

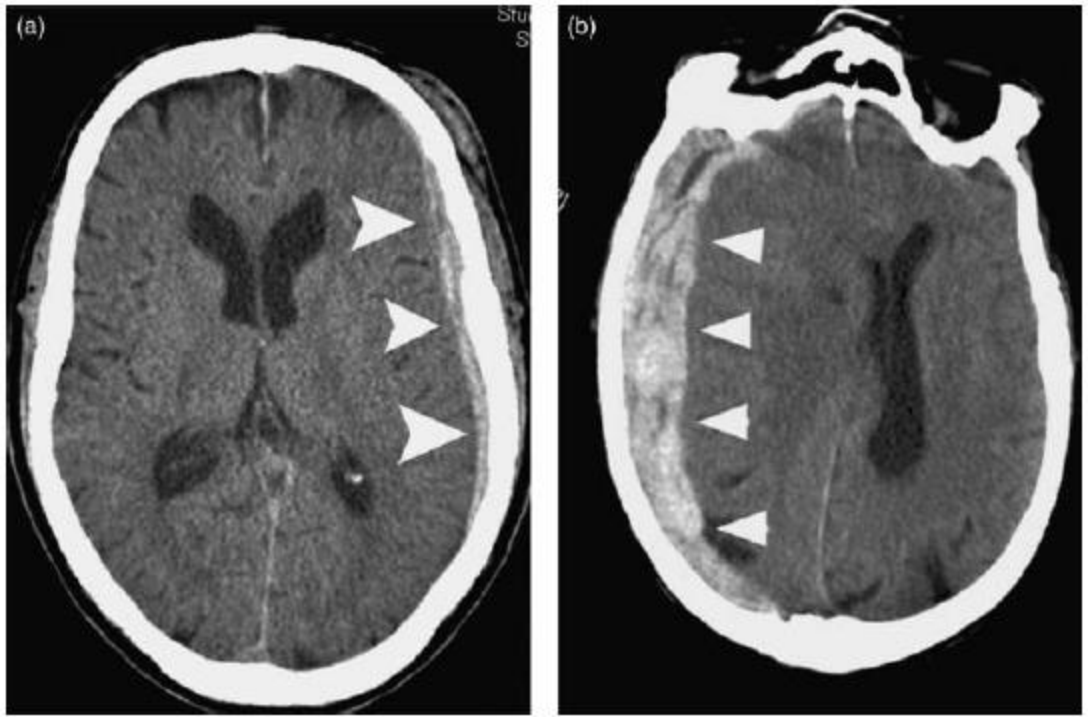


CT Brain – Hemorrhagic Stroke



Acute hemorrhage centered on the right thalamus and lentiform nucleus with intraventricular rupture

CT Brain – Acute Subdural Hematoma



(a) Acute shallow left subdural hematoma (not surgical)

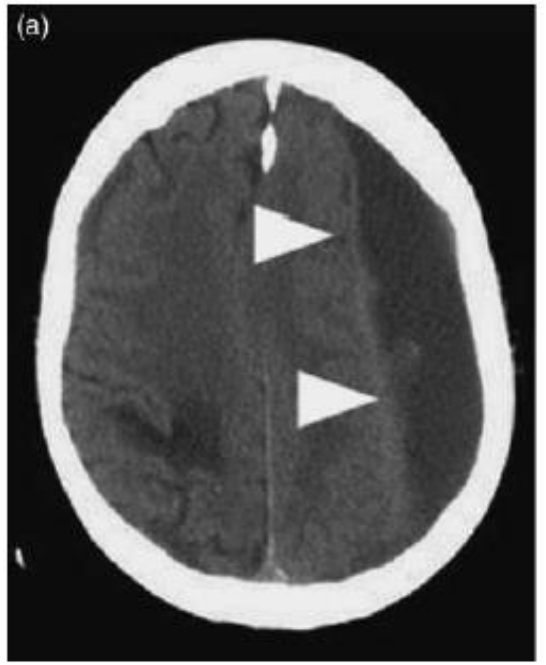
(b) Large acute right subdural hematoma (Surgical)

CT Brain – Subdural Hematoma

Large subacute subdural hematoma (Isodense)



Large left chronic subdural hematoma (Hypodense)

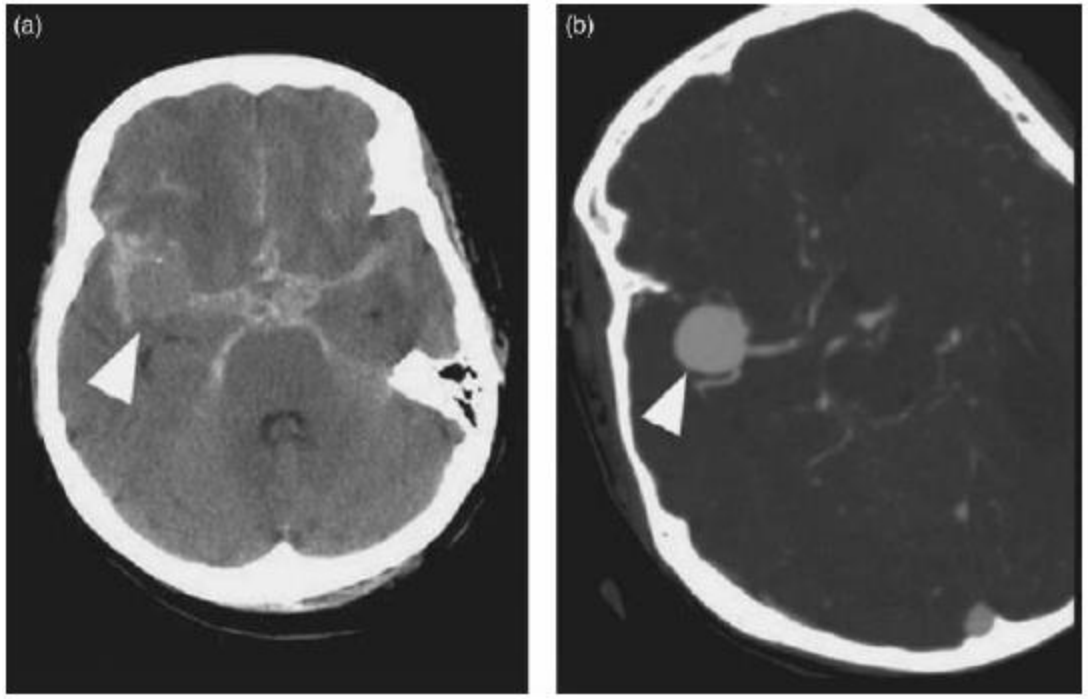


CT Brain – Acute Extradural Hematoma





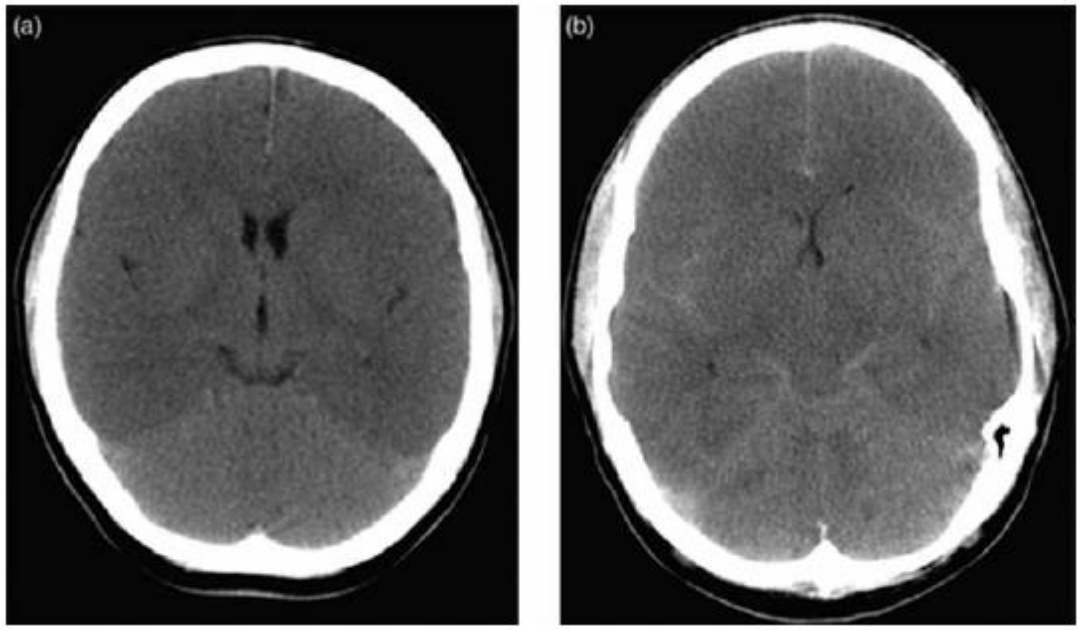
CT Brain – Subarachnoid Hemorrhage



(a) Axial image demonstrating extensive hyperdense subarachnoid blood within the basal cisterns secondary to a ruptured right MCA aneurysm

(b) CT angiogram showing large right MCA aneurysm

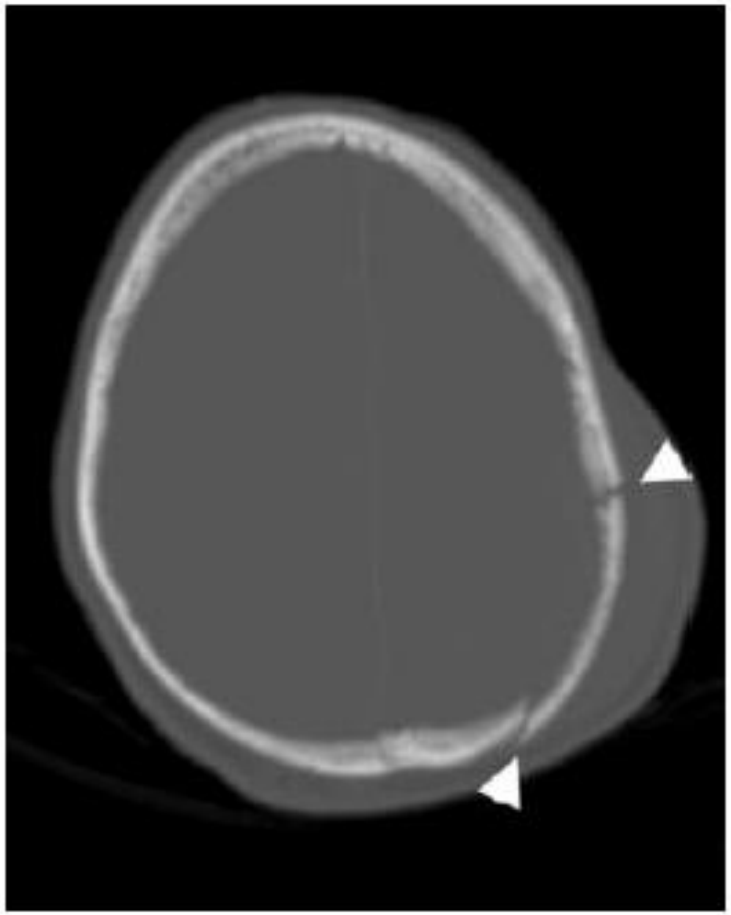
CT Brain – Diffuse Cerebral Edema



a) Diffuse low-attenuation cerebral parenchyma causing relative hyperdensity of the cerebellum – white cerebellum sign

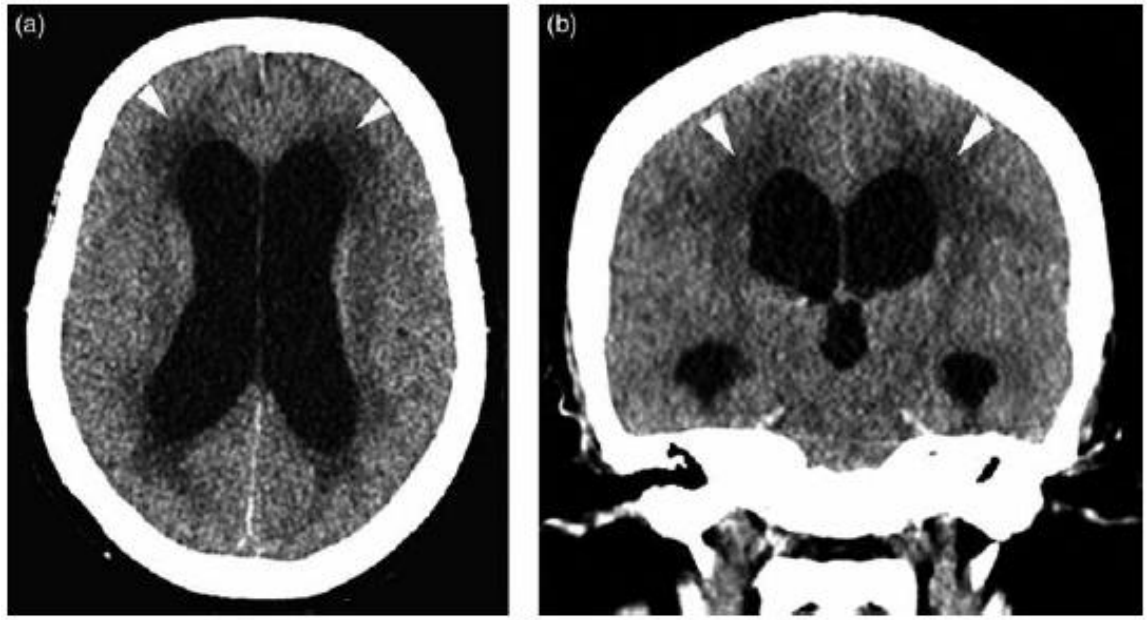
b) Relative hyperdensity of the blood vessels and meninges and effacement of the basal cisterns – pseudo-subarachnoid hemorrhage appearance

CT Brain – Skull Fractures





CT Brain – Hydrocephalus



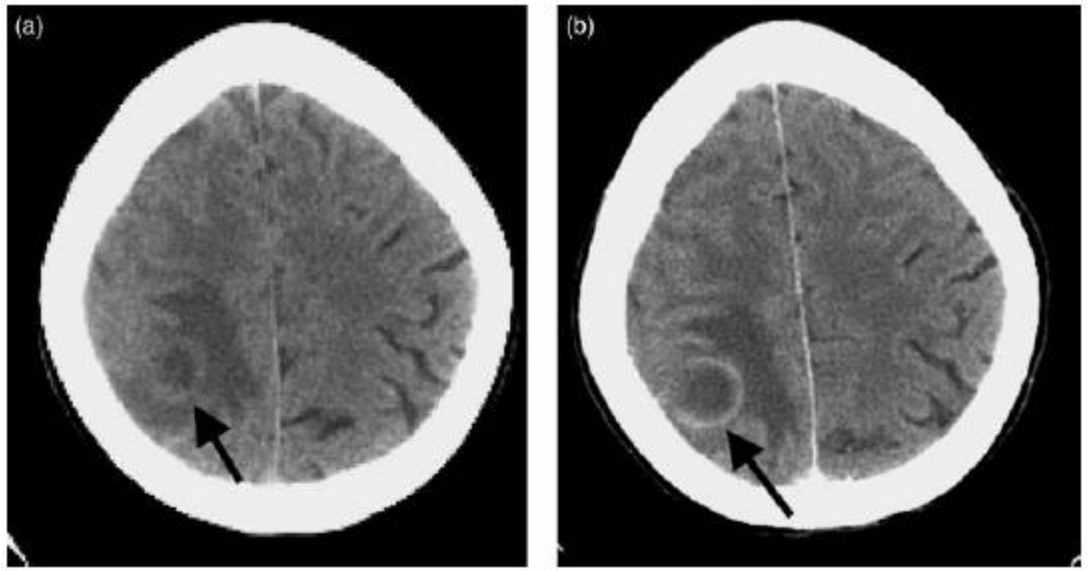
Symmetrical dilatation of the lateral ventricles, and ballooning of the third ventricle. There is periventricular low-attenuation interstitial oedema. Note also generalized effacement of the extra-axial spaces.

CT Brain – Infection

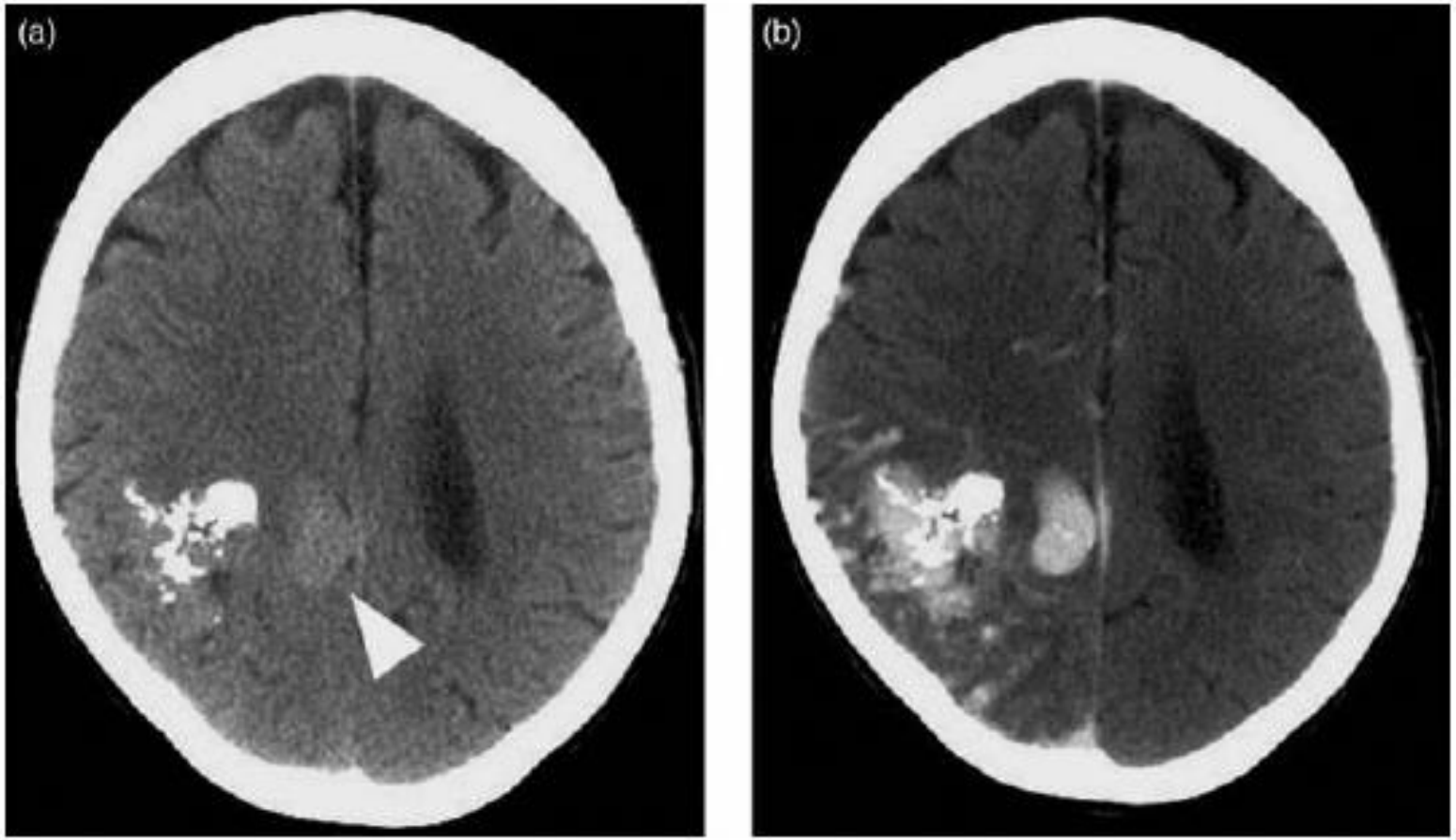
Meningitis, with subdural empyema



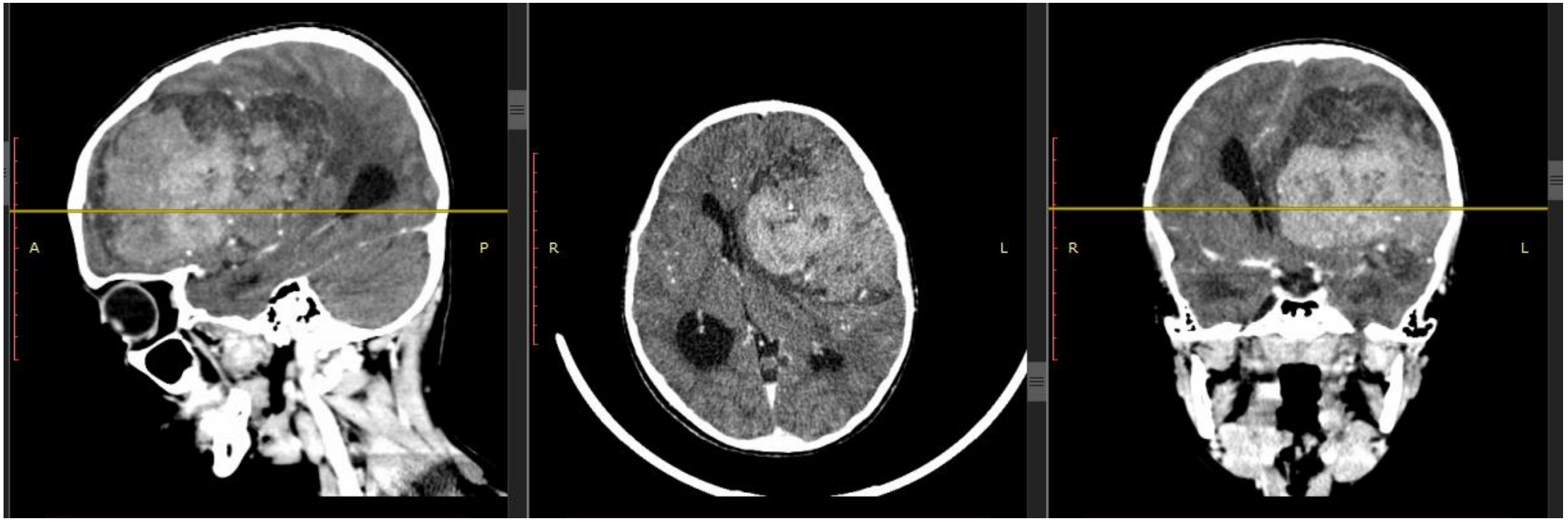
Right superior parietal abscess
(pre & post IV contrast)



CT Brain – AVM (pre & post contrast)



CT Brain – Tumors



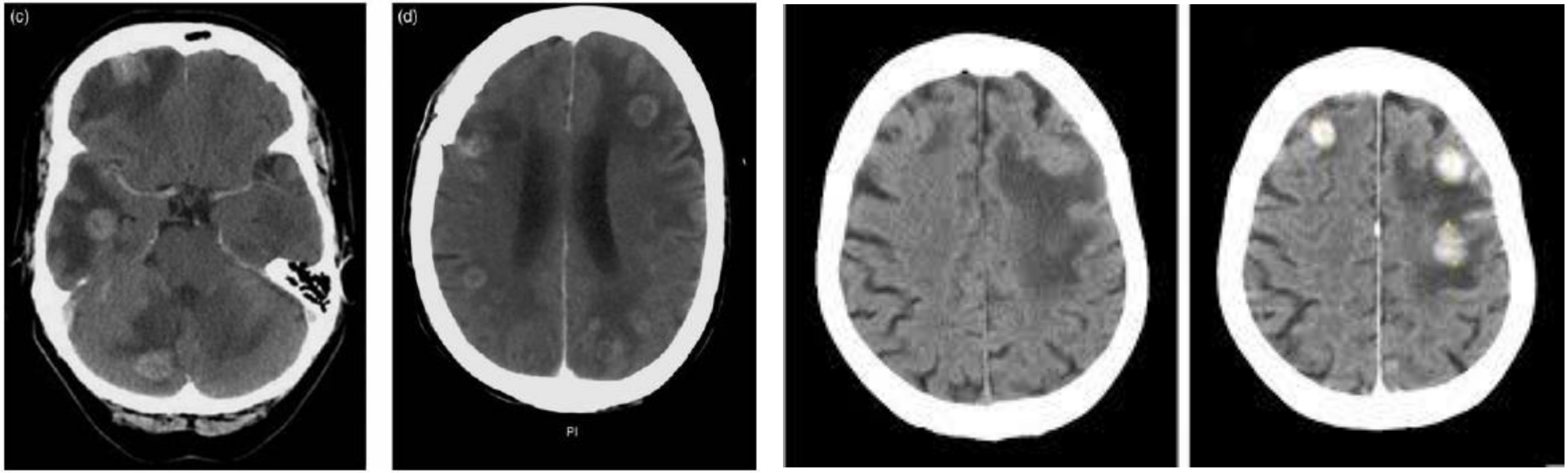
CT Brain – Tumors – Meningioma



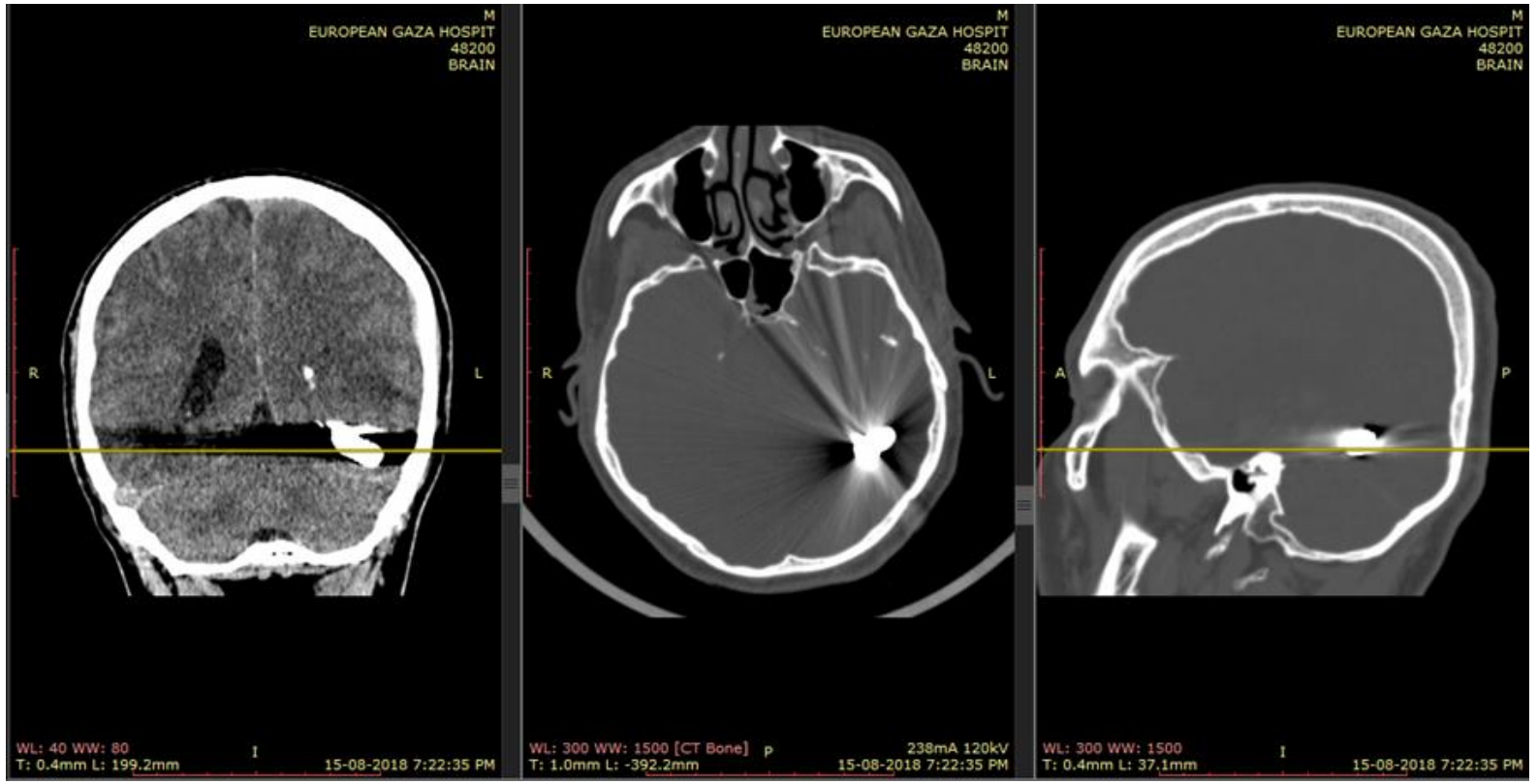
CT Brain – Tumors – Glioblastoma



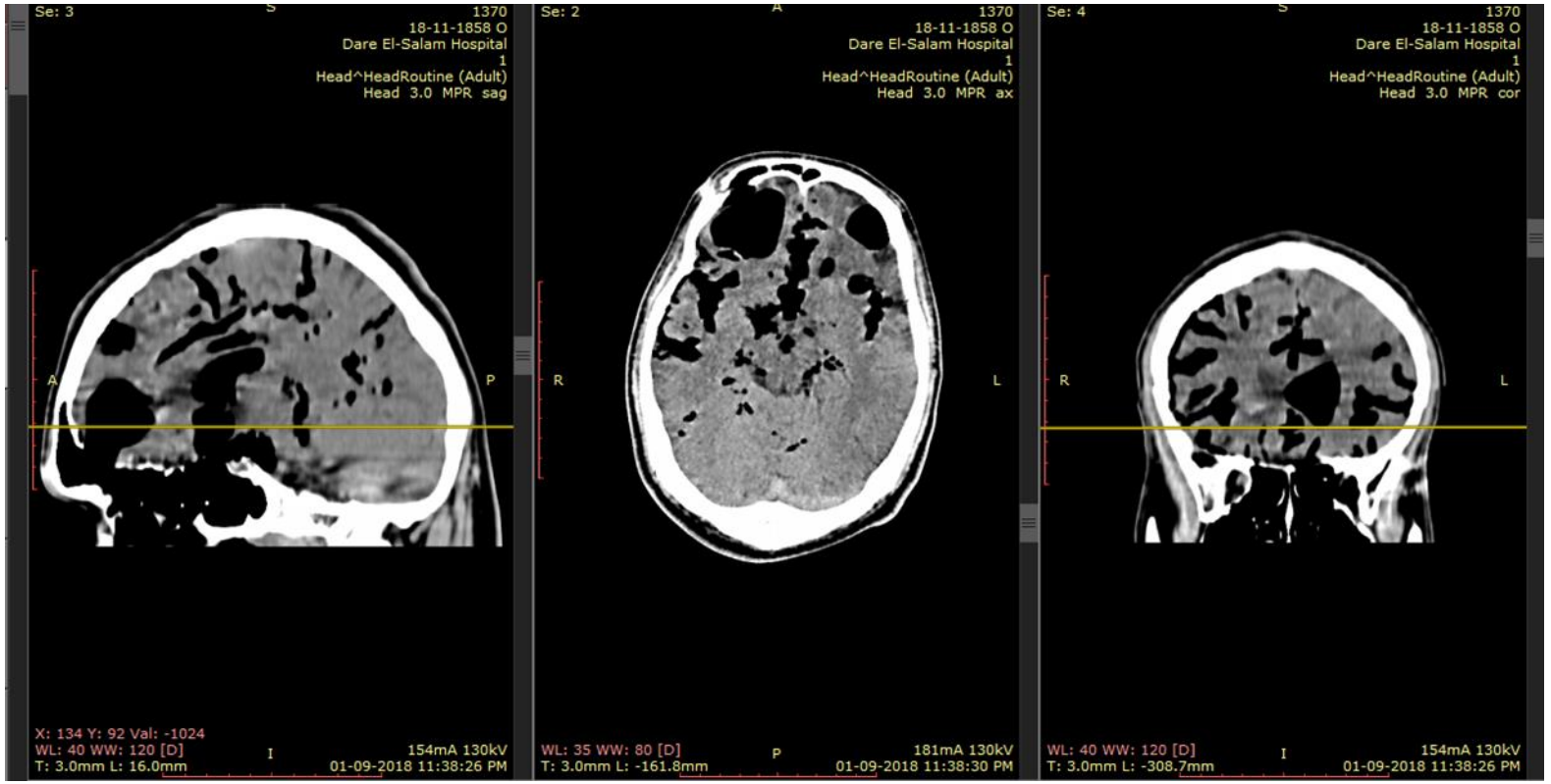
CT Brain – Tumors – Multiple Metastases



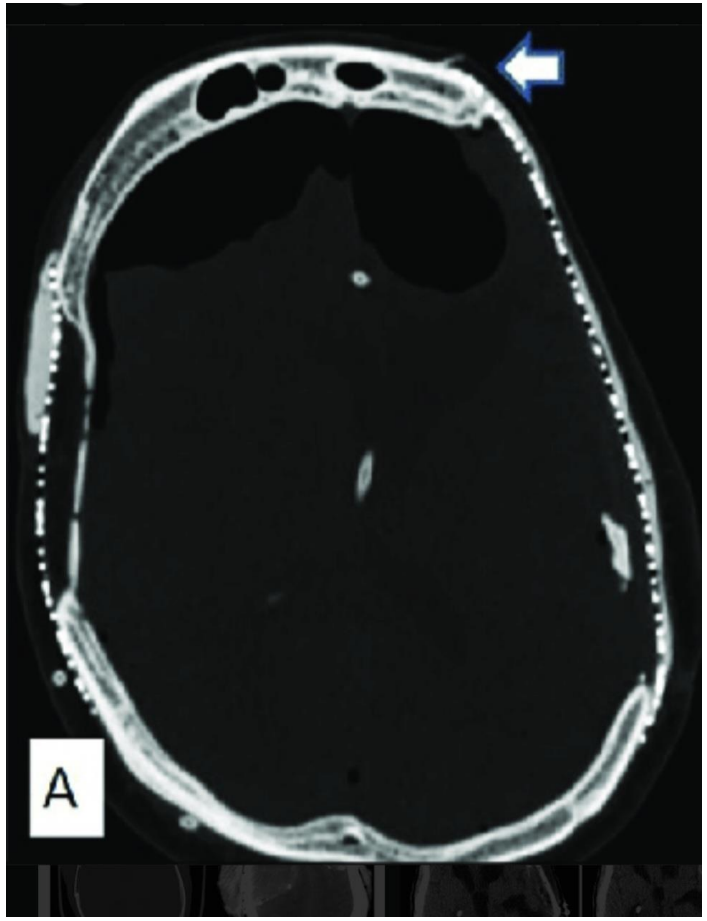
CT Brain – FB (Bullet)

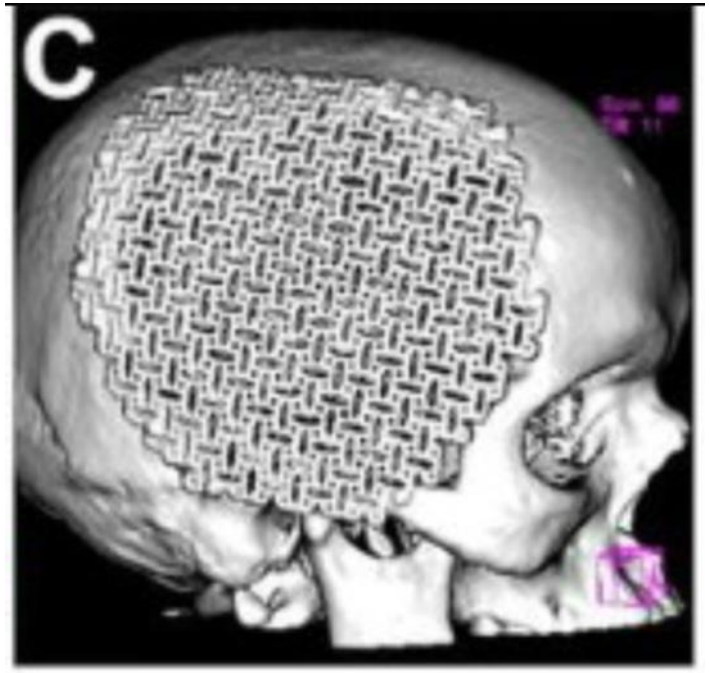


CT Brain – Pneumocephalus



CT Brain – Mesh Cranioplasty





CT Cervical Spine – ‘ABCs’ Interpretation

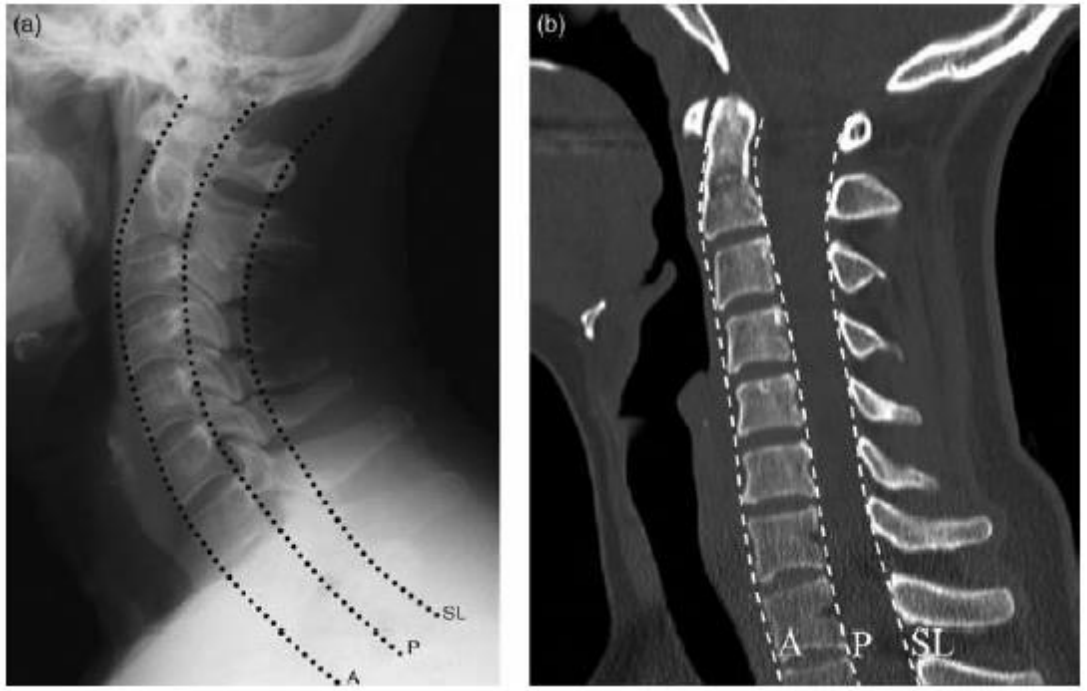
A. Alignment

B. Bone
   - Check for loss of vertebral height or retro-pulsion of a fracture fragment into the spinal canal

C. Cartilage
   - Widening of the intervertebral spaces, or interspinous distances, may indicate an unstable dislocation

S. Soft Tissues
   - Retropharyngeal soft tissue (less than 7 mm, anterior to C2–C4 (half a vertebral body width at this level) and less than 22 mm below C5 (one vertebral body width).

CT Cervical Spine – ‘ABCs’ Interpretation



Alignment:

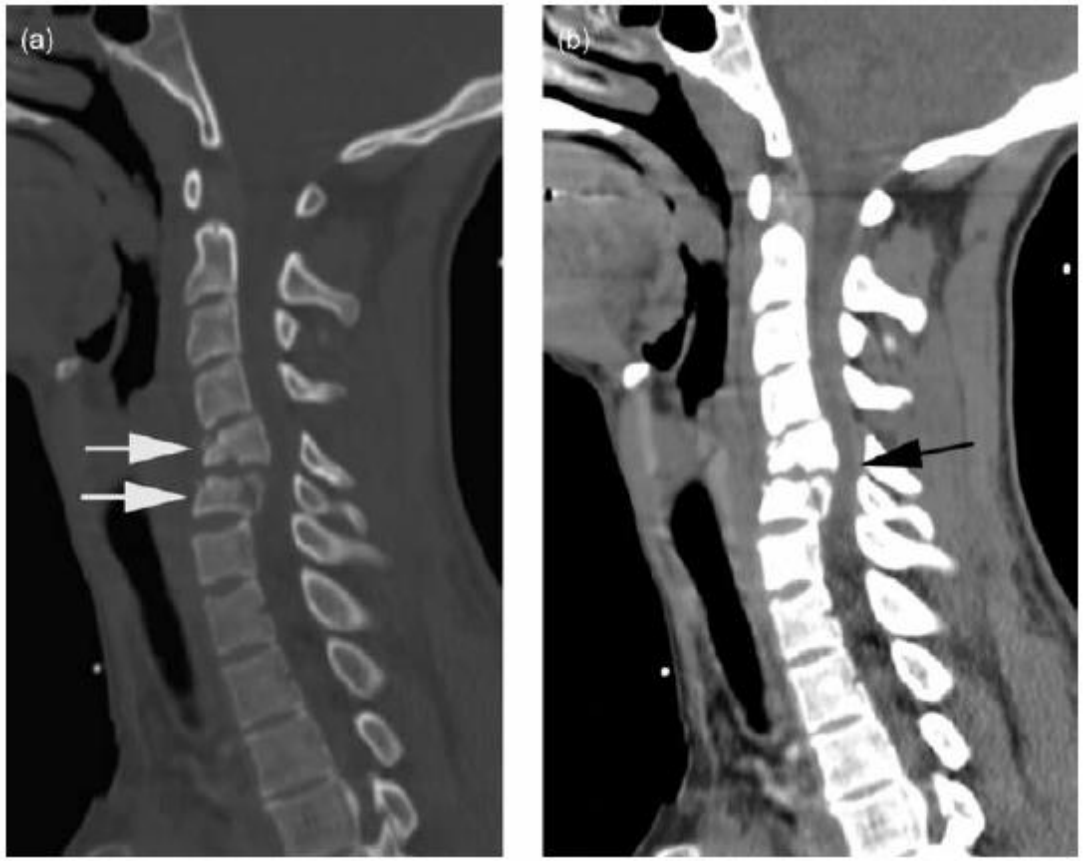
Normal lateral radiography and normal mid-sagittal CT cervical spine with three lines:

Anterior vertebral (A)

Posterior vertebral (P)
Spinolaminar (SL)

➢showing normal alignment

CT Cervical Spine – Fractures



Sagittal CT images in (a) bone and (b) soft-tissue windows demonstrating loss of height of the C5 and C6 vertebral bodies, with retro-pulsion into the spinal canal. Note the compression of the spinal cord demonstrated on soft-tissue windows

CT Cervical Spine – Fractures



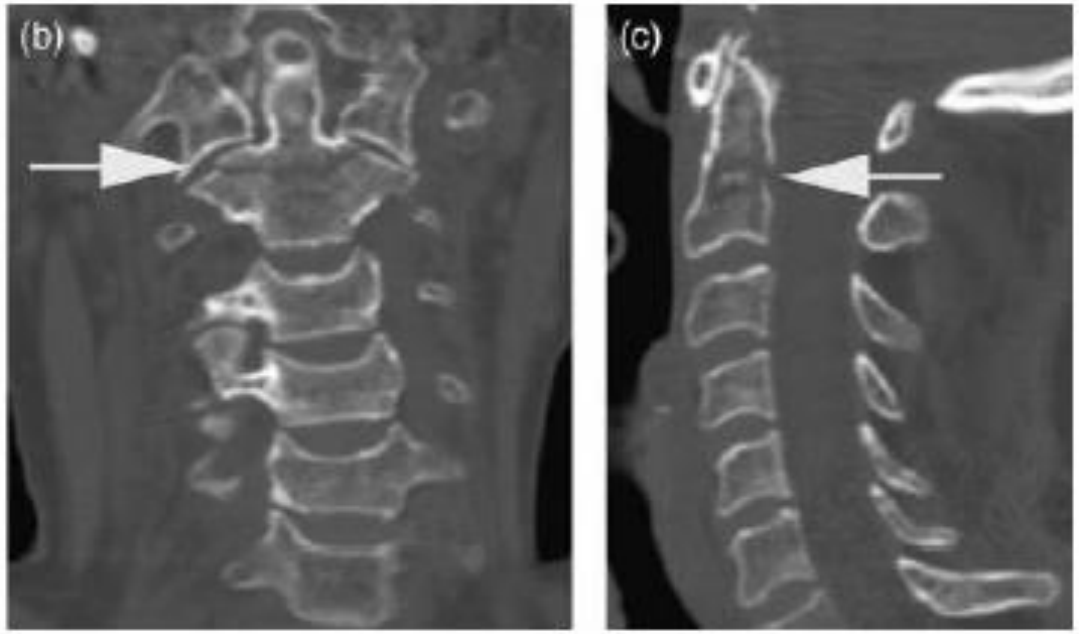
Sagittal CT image demonstrating fracture of the antero-inferior corner of the C2 vertebral body in keeping with flexion teardrop fracture

CT Cervical Spine – Fractures



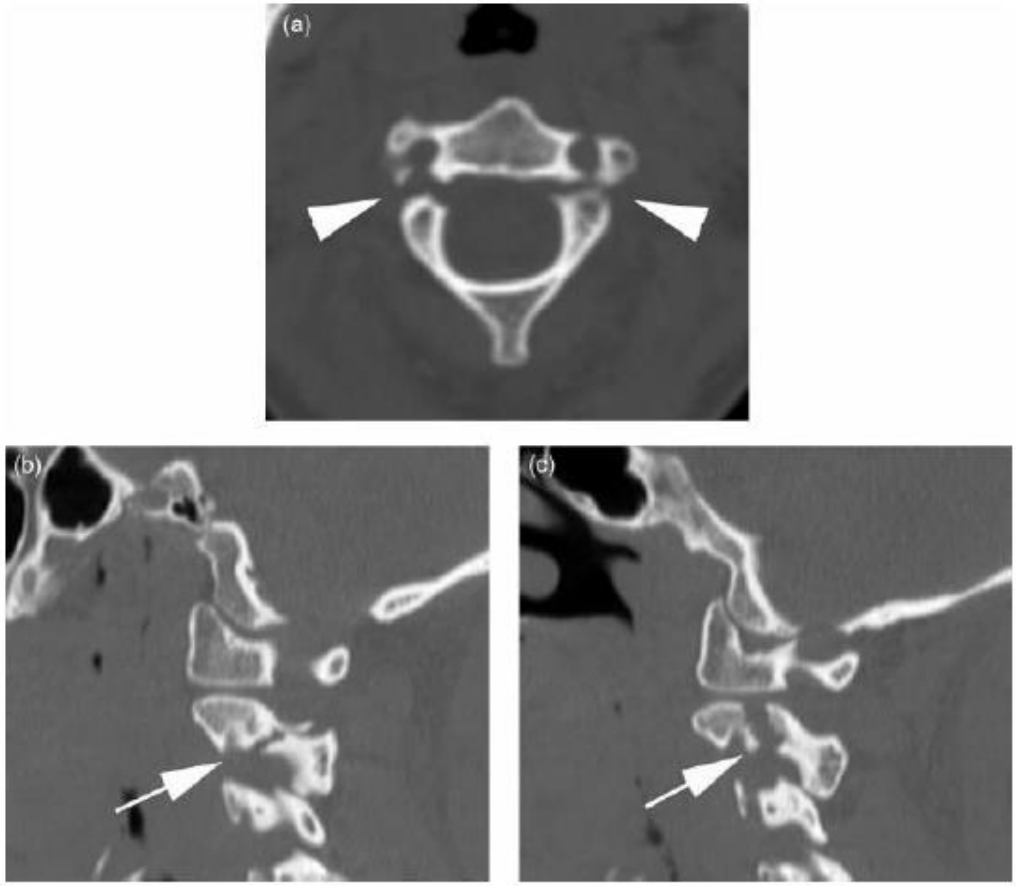
Sagittal CT images demonstrating type 2 odontoid fracture

CT Cervical Spine – Fractures



Coronal & sagittal CT images demonstrating type 3 odontoid fracture

CT Cervical Spine – Fractures

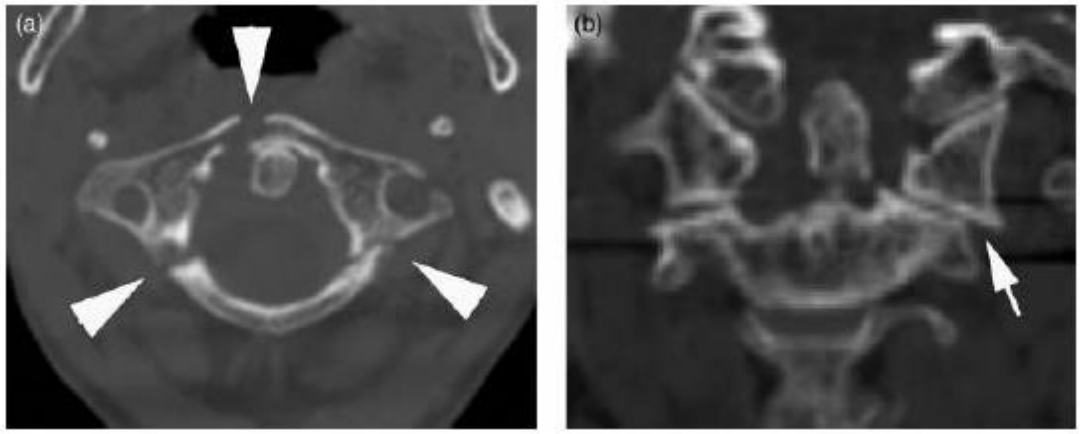


<u>Hangman's fracture</u>:

Fractures through the pedicles of C2 bilaterally

Hyperextension mechanism of injury

CT Cervical Spine – Fractures



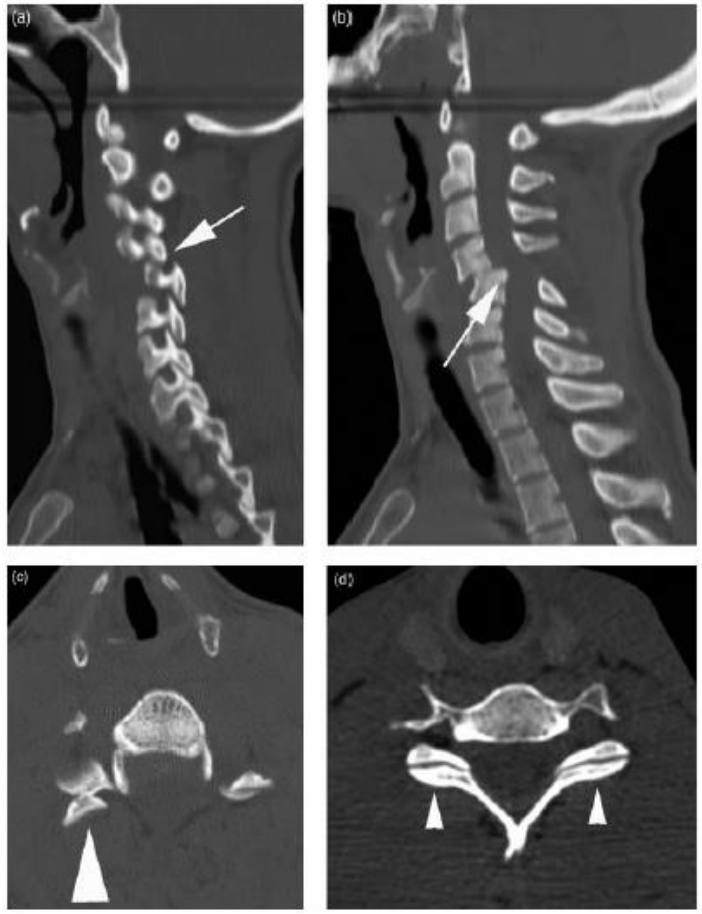
<u>Jefferson fracture</u>: (axial load)

Fractures affecting the anterior and posterior arches of C1

Coronal CT image demonstrating lateral displacement of the C1 lateral mass

There is also a concurrent fracture of the odontoid peg.

CT Cervical Spine – Fractures



Unilateral jumped (locked) facet at Rt C4-5

Note:

Loss of anterior and posterior vertebral alignment & posterior displacement of C5 into the spinal canal

Reverse hamburger sign, in facet dislocation

CT Thoracic Spine – Fractures



Th12 burst fracture

CT Lumbar Spine – Fractures



L2 Compression fracture

Axial load with flexion

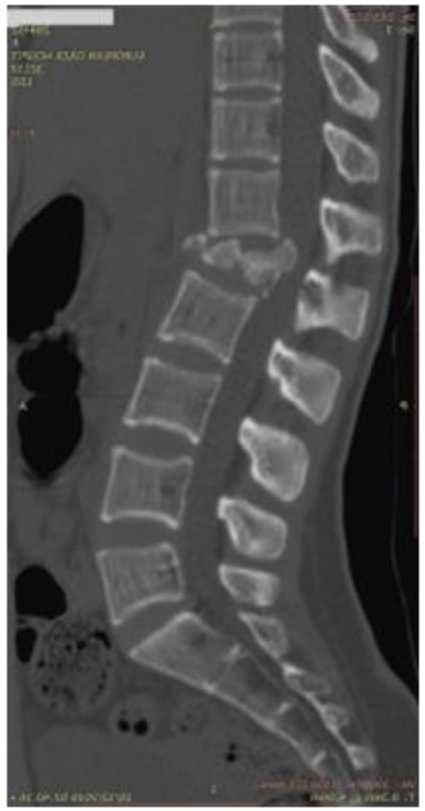
CT Spine – Fractures



Chance fracture or Seatbelt fracture

Flexion mechanism

CT Lumbar Spine – Fractures

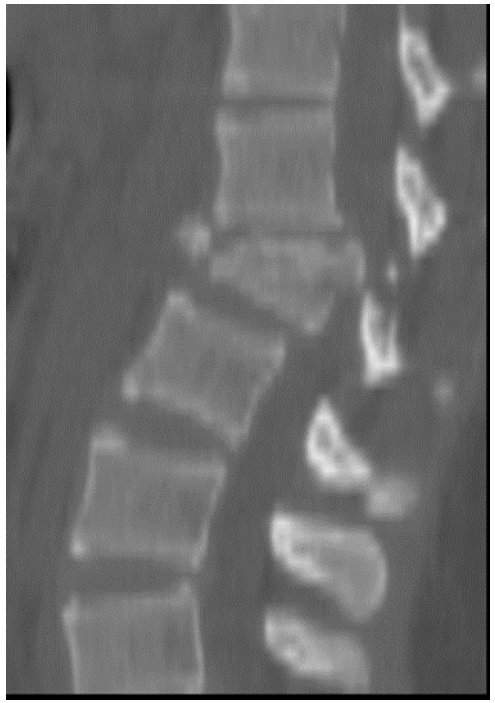




L1 burst fracture (CT)

Pedicle screws fixation Th12-L2

CT Lumbar Spine – Fractures



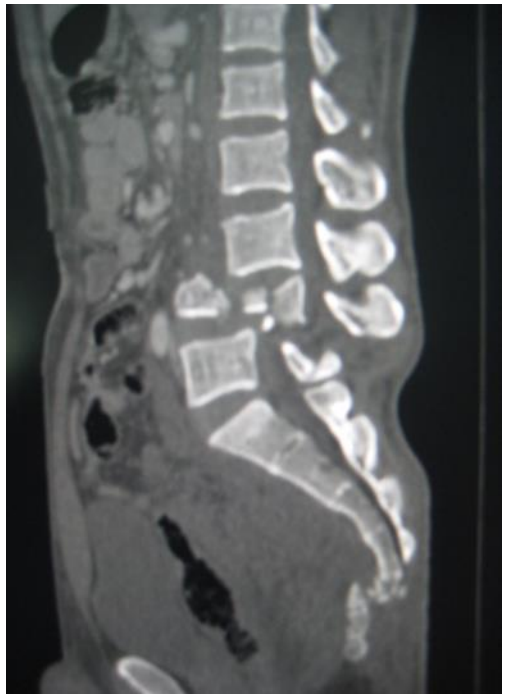


L2 burst fracture

Pedicle screws fixation

Th12-L1-L3-L4

CT Lumbar Spine – Fractures

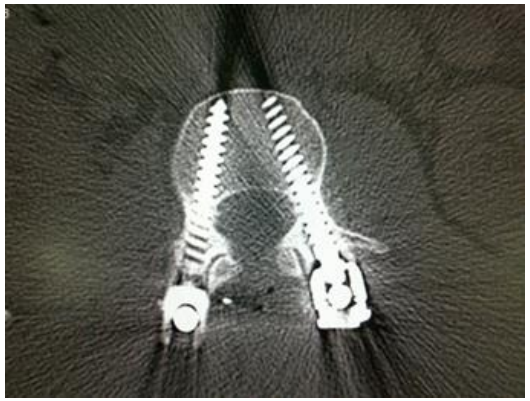




L4 fracture dislocation

Pedicle screws fixation L3-L5

CT Lumbar Spine – Fracture Fixation





Pedicle screw fixation

Ideal position

Thanks



Any Questions?