Head and Neck Imaging

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Anatomy Course
Johns Hopkins School of Medicine

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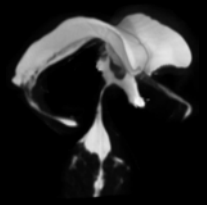
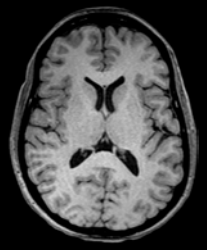
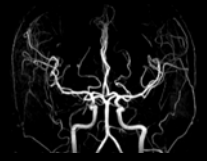
Objectives





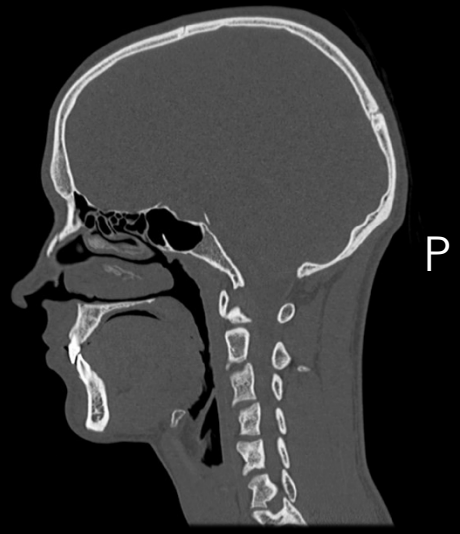


- Introduce cross sectional imaging of head and neck
  - Computed tomography (CT)
- Review head and neck anatomy
  - Major anatomical landmarks on imaging
    - Bone
    - Ventricles
    - Brain
    - Vessels

Cross Sectional Views

Sagittal

Superior



Inferior

Coronal

Superior

Inferior

Axial

Anterior

Posterior

Introduction to CT: Rules of Light and Dark

- Bright = high density
  - Bone

Axial

Introduction to CT: Rules of Light and Dark

- Bright = high density
  - Bone

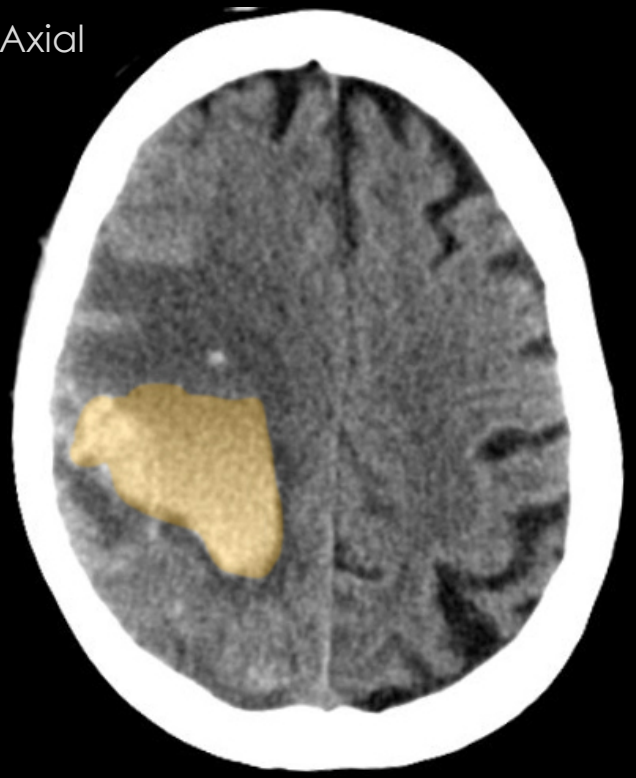
Calvarium appears bright (Bone)

Introduction to CT: Rules of Light and Dark

- Bright = high density
  - Bone
  - Blood

Introduction to CT: Rules of Light and Dark

- Bright = high density
  - Bone
  - Blood



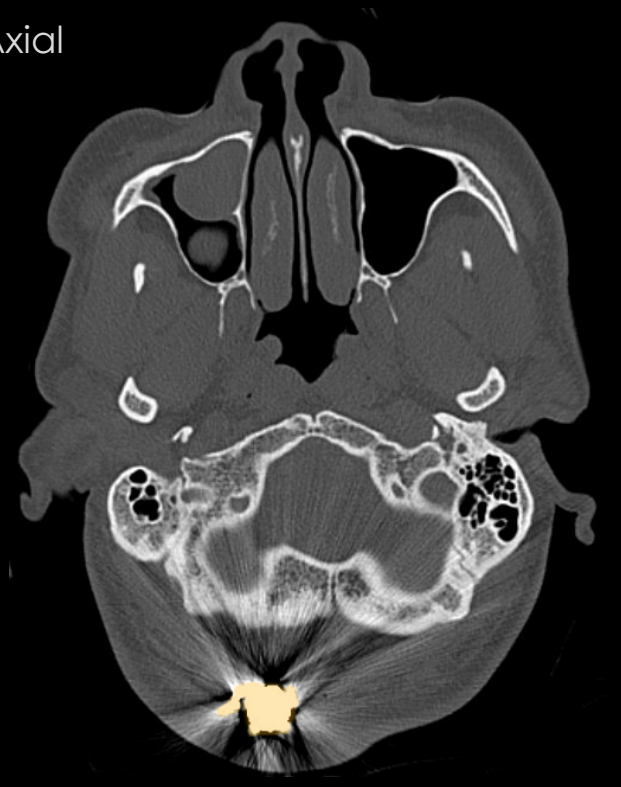
Parenchymal Hemorrhage (Blood)

Introduction to CT: Rules of Light and Dark

- Bright = high density
  - Bone
  - Blood
  - Bullets (hardware)

Introduction to CT: Rules of Light and Dark

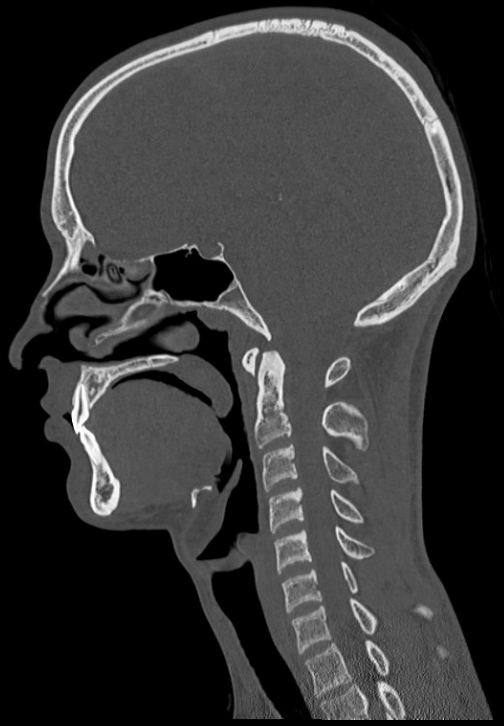
- Bright = high density
  - Bone
  - Blood
  - Bullets (hardware)
- Dark = low density
  - Air
  - Water (fluids)
- Gray = in between
  - Soft tissue



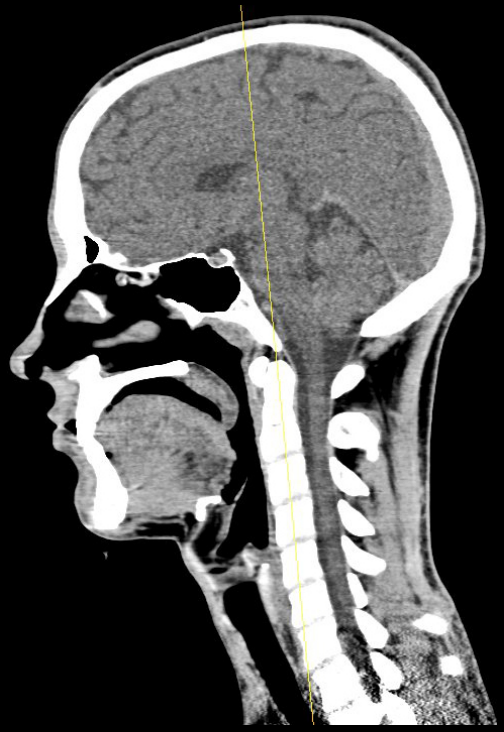
Bullet – note artifact from metal

Introduction to CT: Windowing

- Image brightness/contrast adjusted to accentuate particular structures



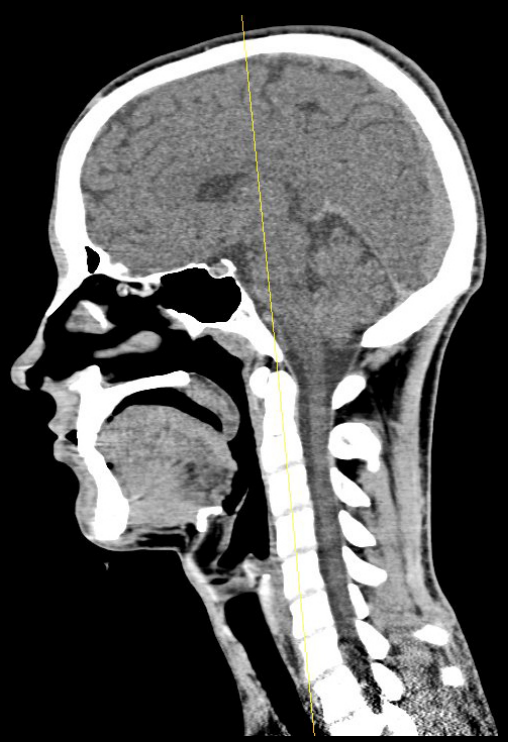
Bone Window



Brain Window

Introduction to CT: Contrast

- Intravenous contrast makes vessels bright



Non-contrast

Contrast

Neck Imaging

- Cervical vertebrae
  - Cross sectional anatomy
- Vasculature
  - Carotid arteries
  - Vertebral arteries

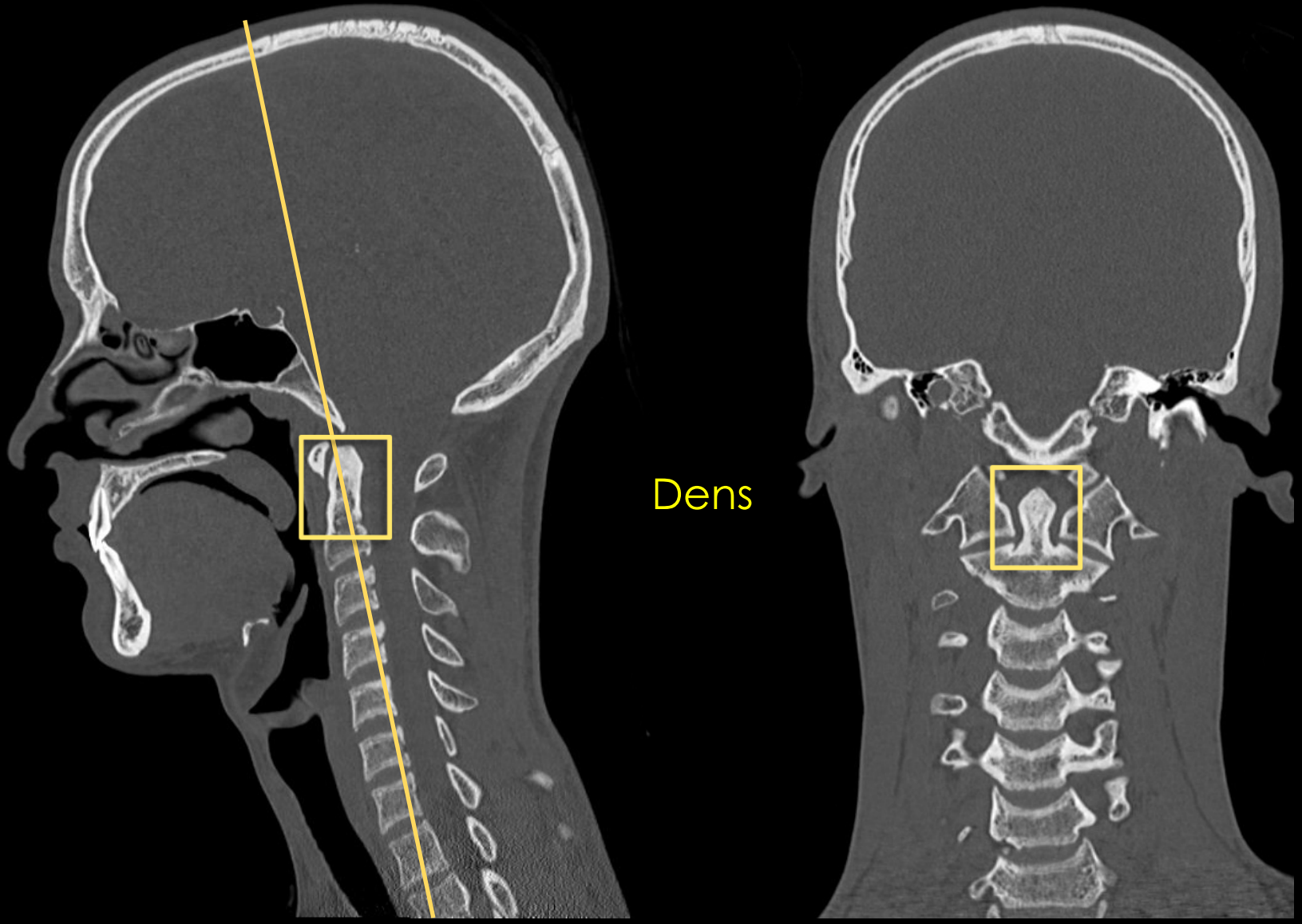
Cervical Vertebrae

Sagittal (bone window)

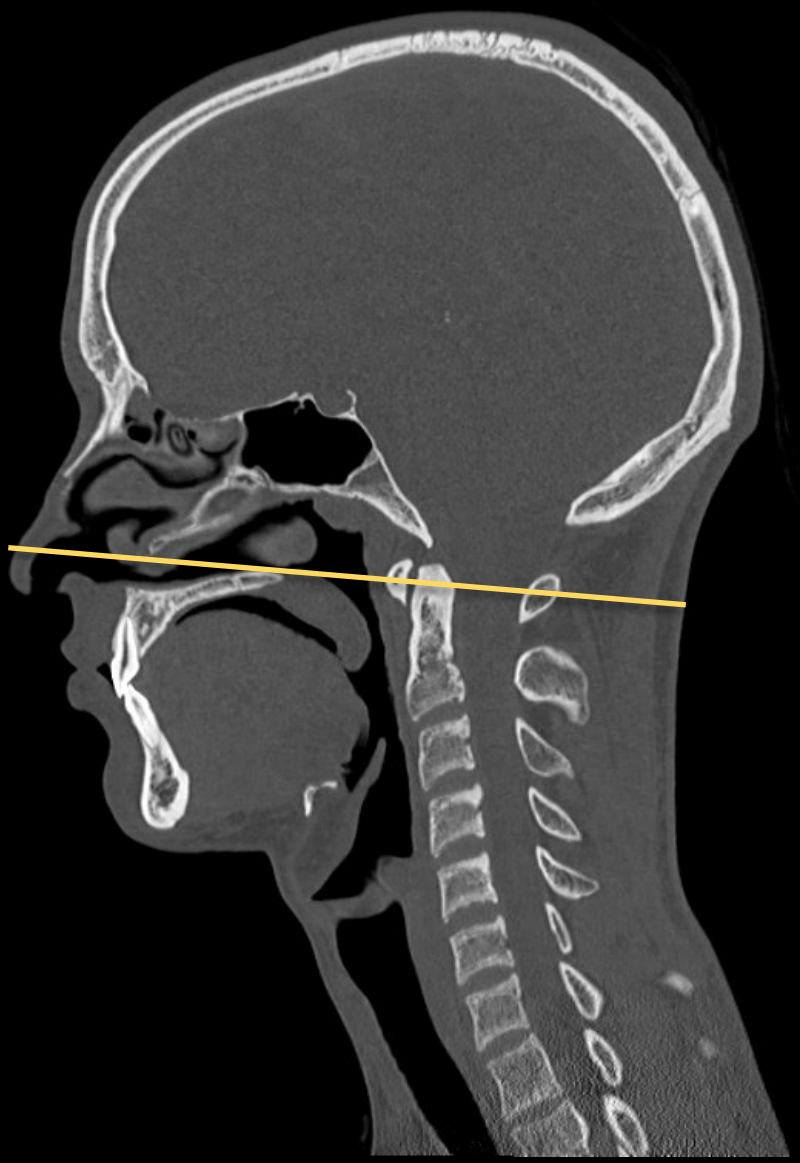
Cervical Vertebrae

Sagittal (bone window)

- Articulation allows head movement
  - C1 - atlas
  - C2 – axis
- Protects vital neural and vascular structures
  - Cervical spinal cord
  - Vertebral arteries
- Damage can result in significant morbidity

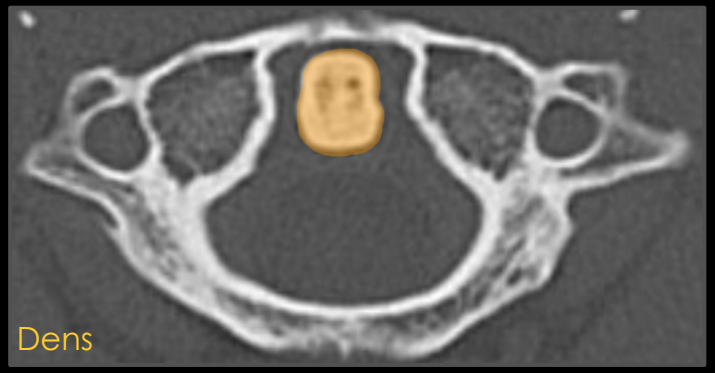

Dens
Sagittal
Coronal

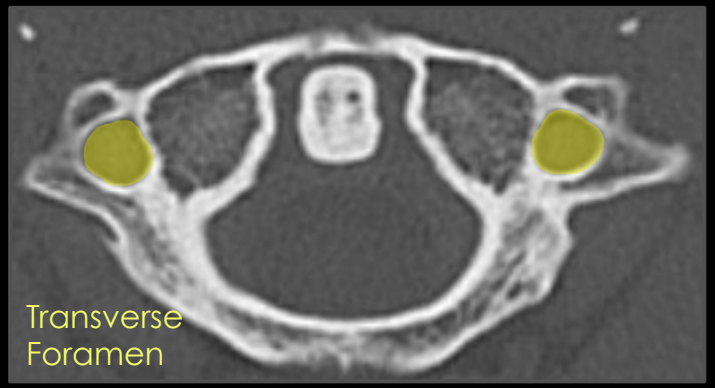
Which cervical vertebral level is this axial section?

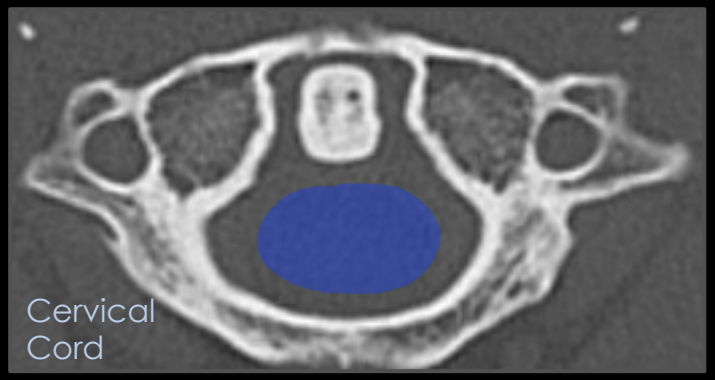


Sagittal

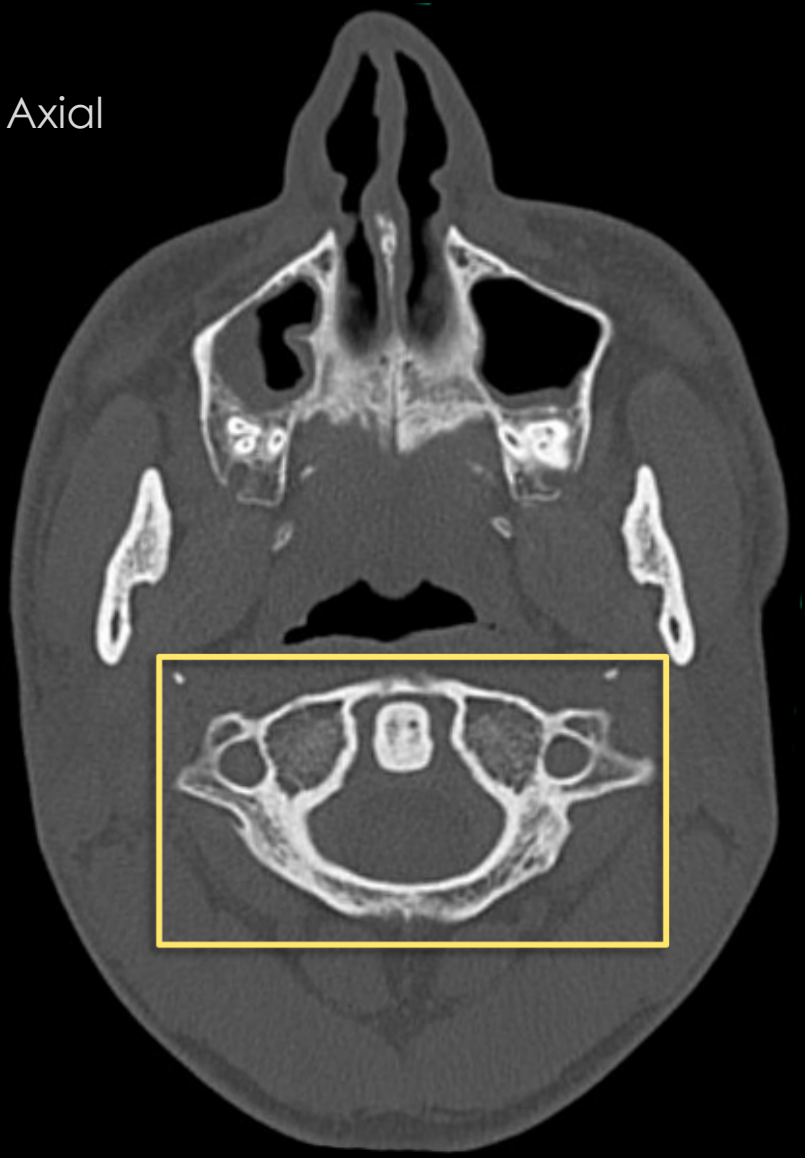
Axial







Axial



Level of Atlas

Neck Imaging

- Cervical vertebrae
  - Cross sectional anatomy
- Vasculature
  - Carotid arteries
  - Vertebral arteries

Cervical Vessels

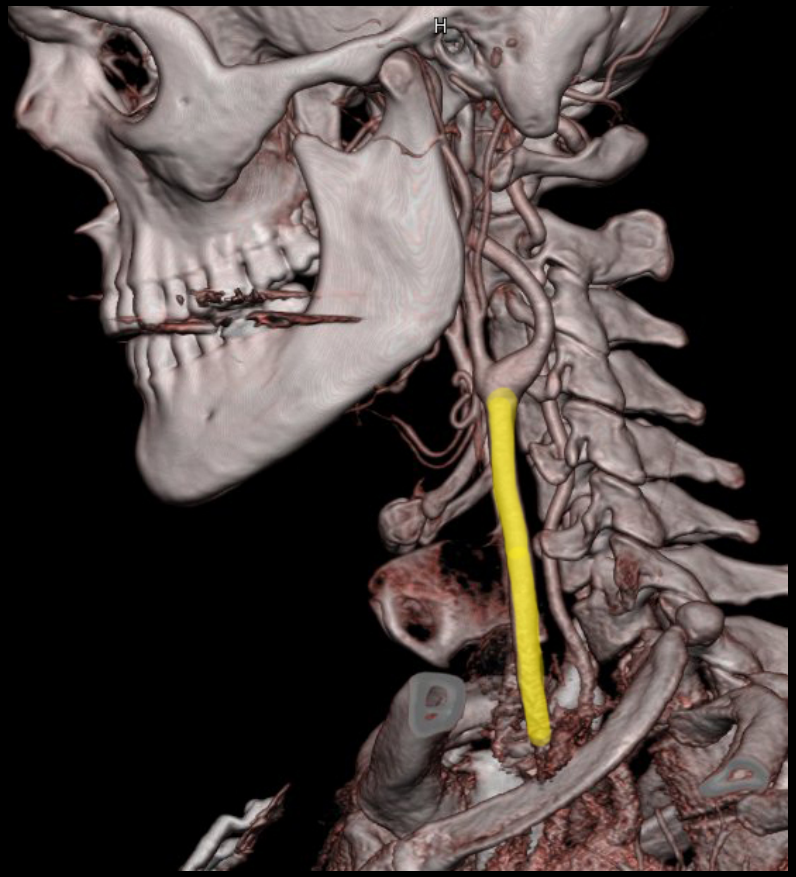
- Large vessels of the neck deliver blood supply to the brain
- Anterior and posterior circulations
  - Anterior: Carotid arteries
  - Posterior: Vertebral arteries
- Disrupted flow can result in significant morbidity

Vasculature: Carotid Arteries

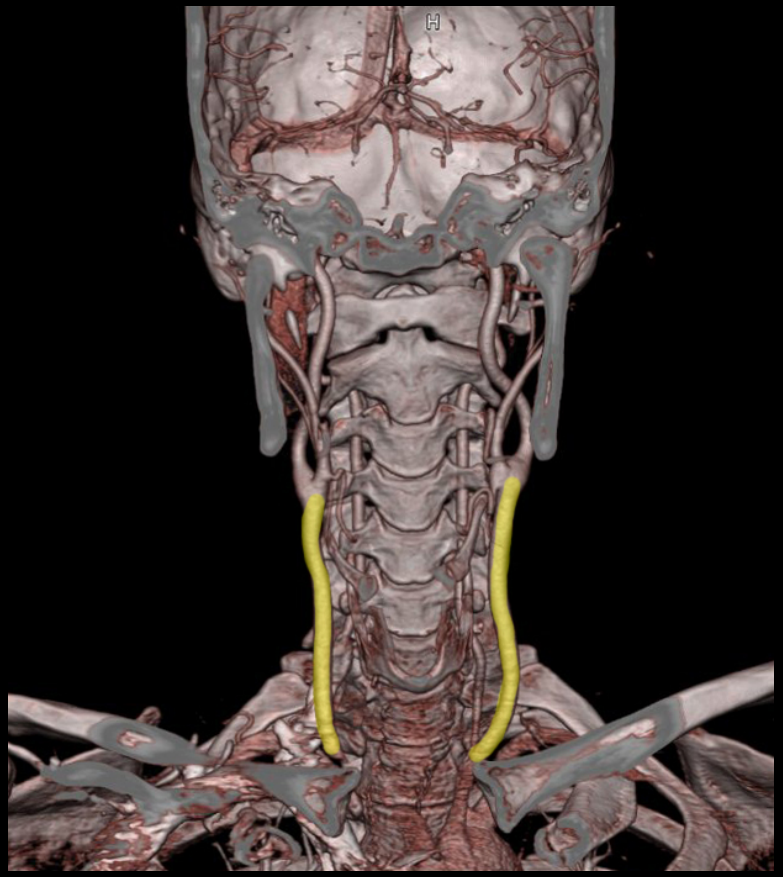
Sagittal

Coronal

Vasculature:
Common Carotid Arteries

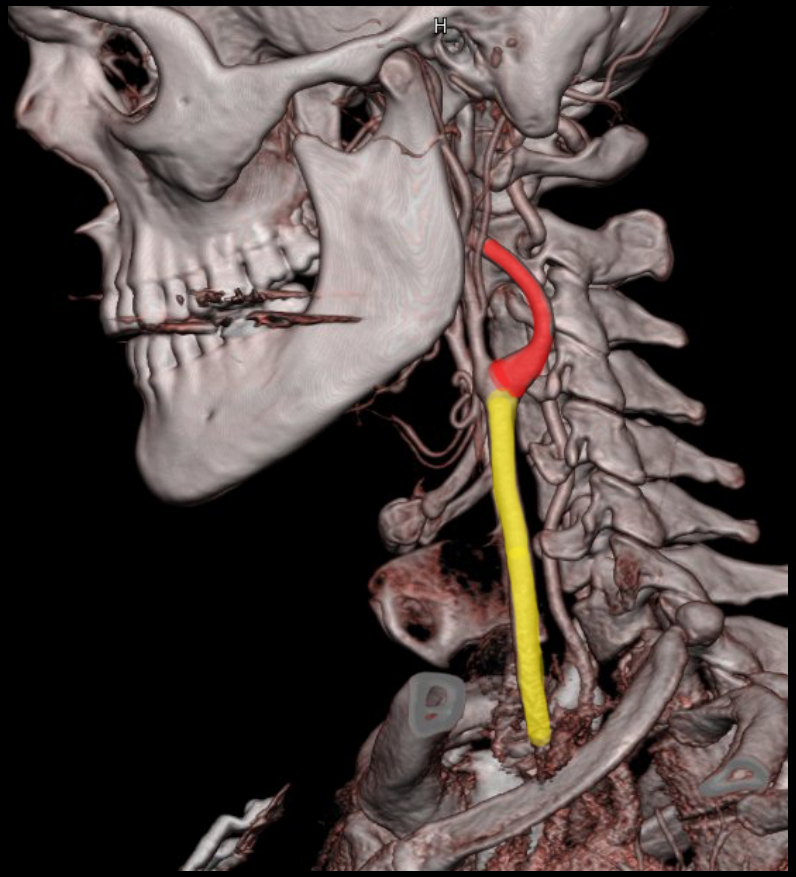


Sagittal

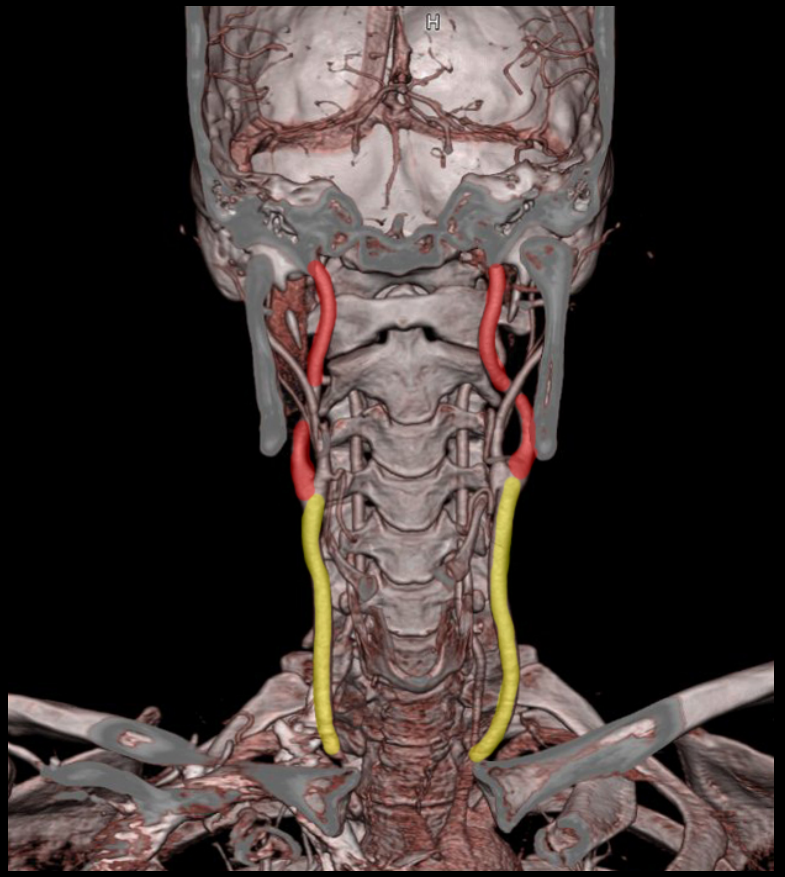


Coronal

Vasculature:
Internal Carotid Arteries

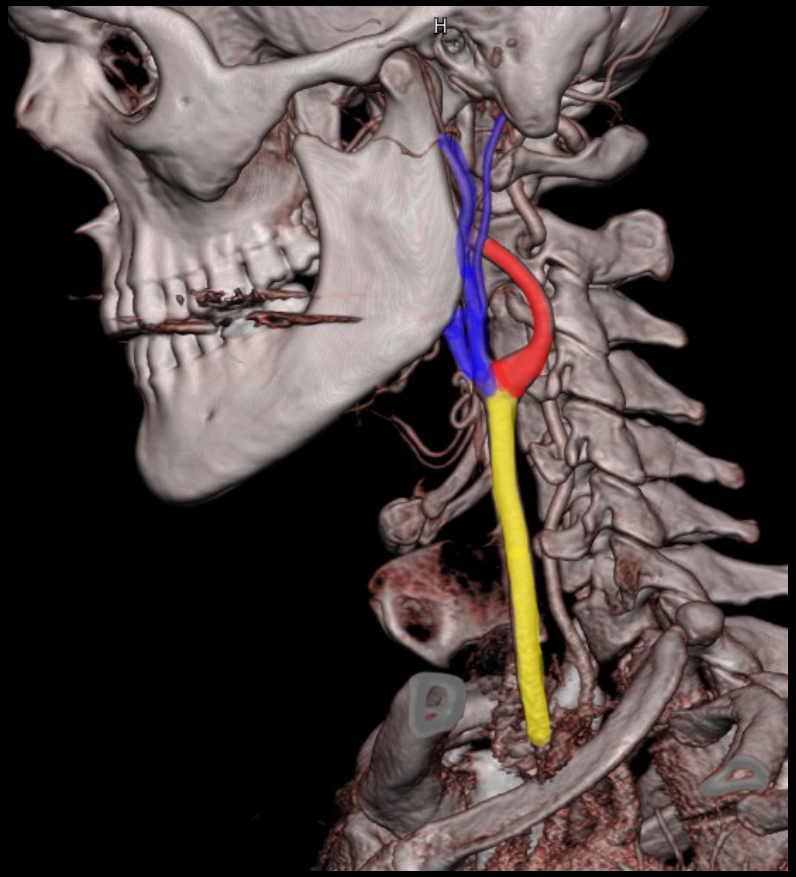


Sagittal

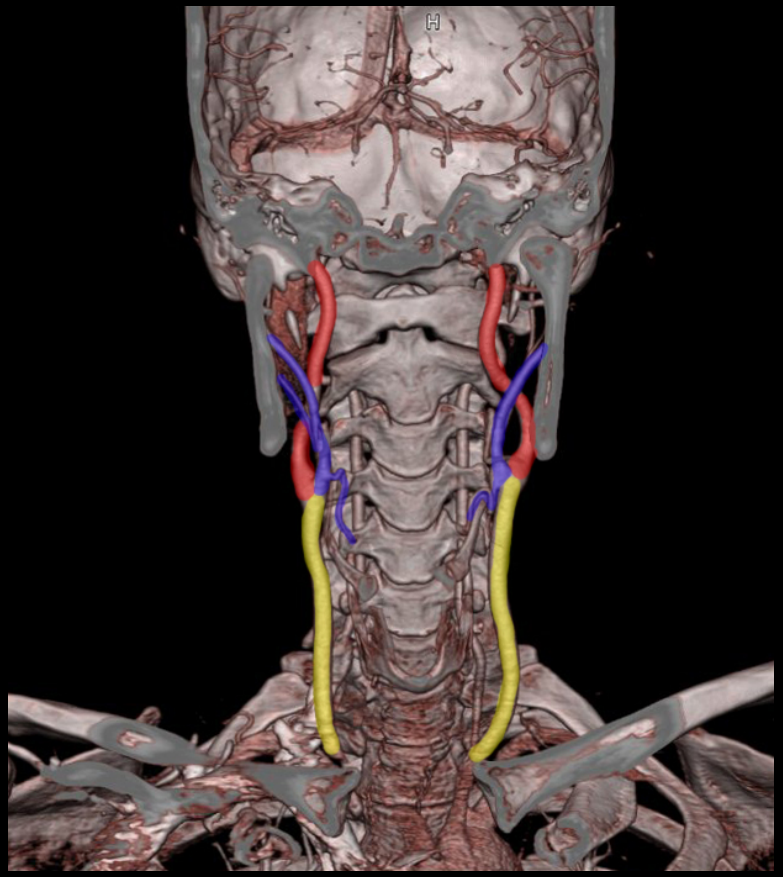


Coronal

Vasculature:
External Carotid Arteries



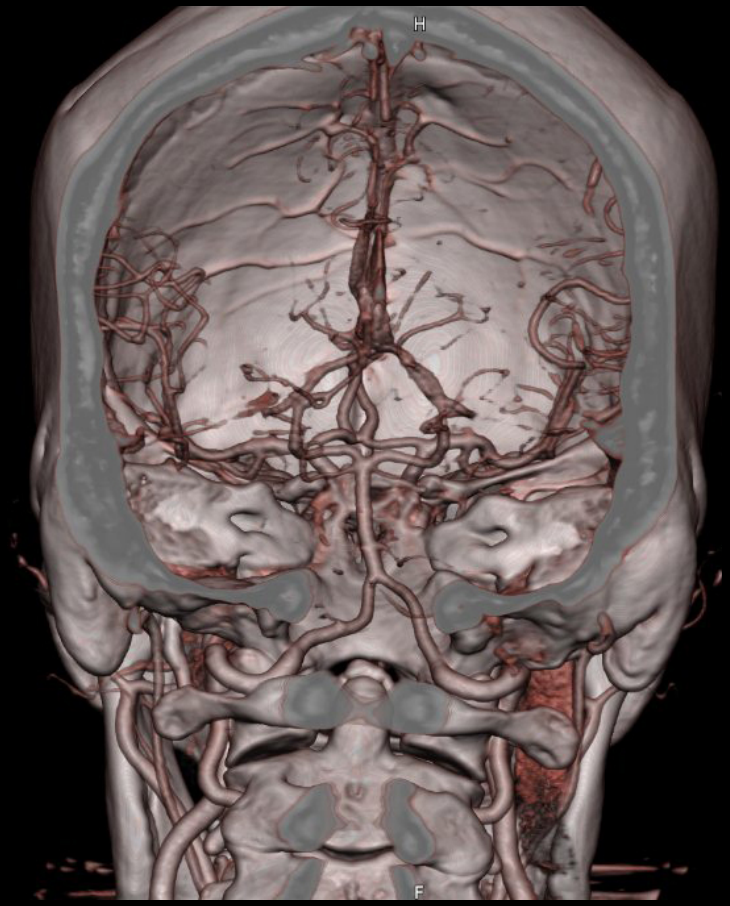
Sagittal



Coronal

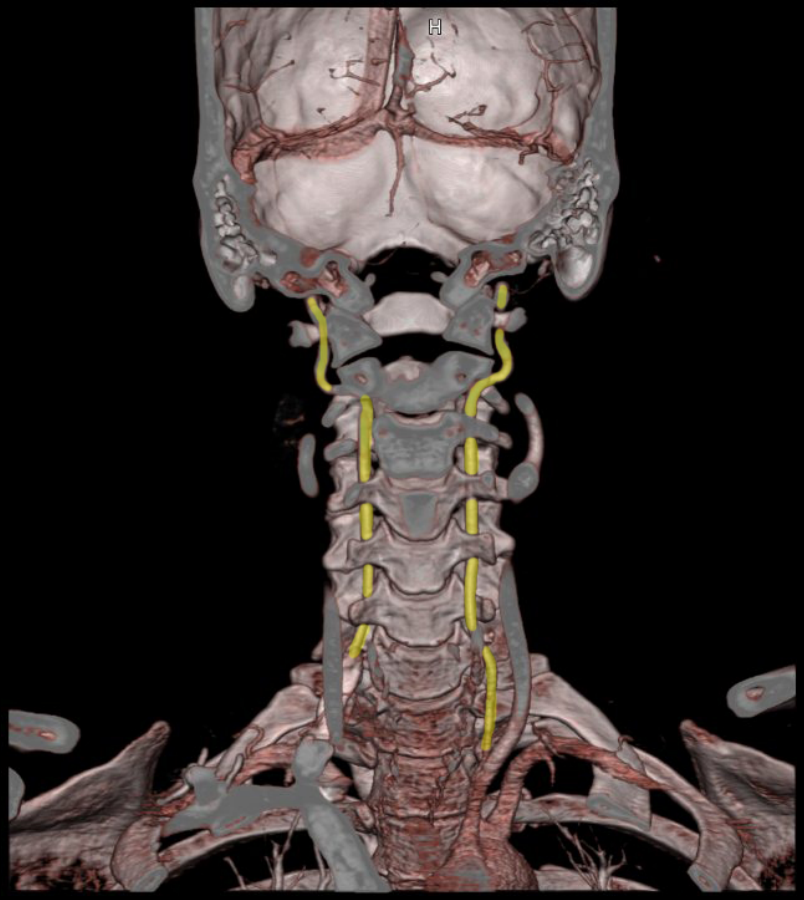
Vasculature: Vertebral Arteries

Vertebral Arteries (coronal)

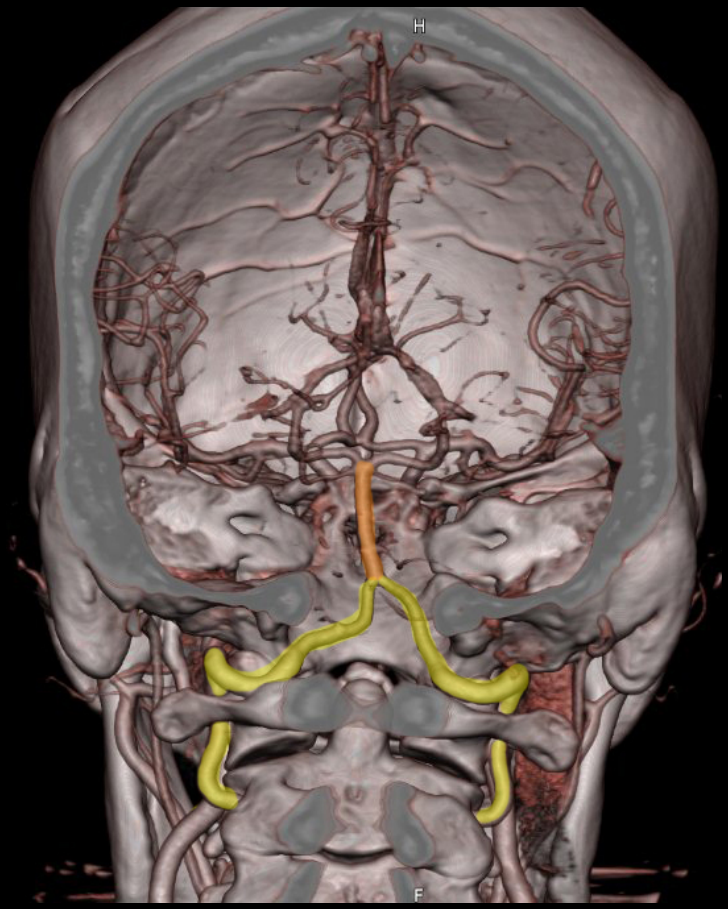


Vertebrobasilar arteries (coronal)

Vasculature:
Vertebral Arteries



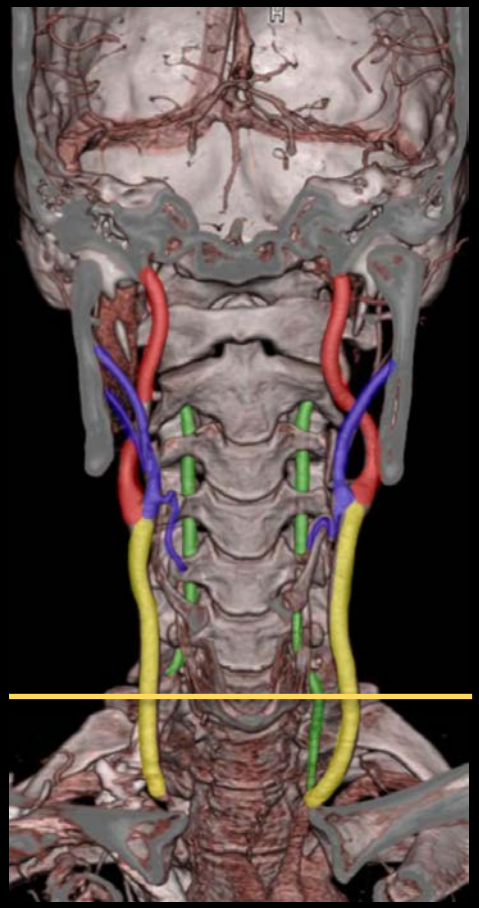
Vertebral Arteries (coronal)



Vertebrobasilar arteries (coronal)

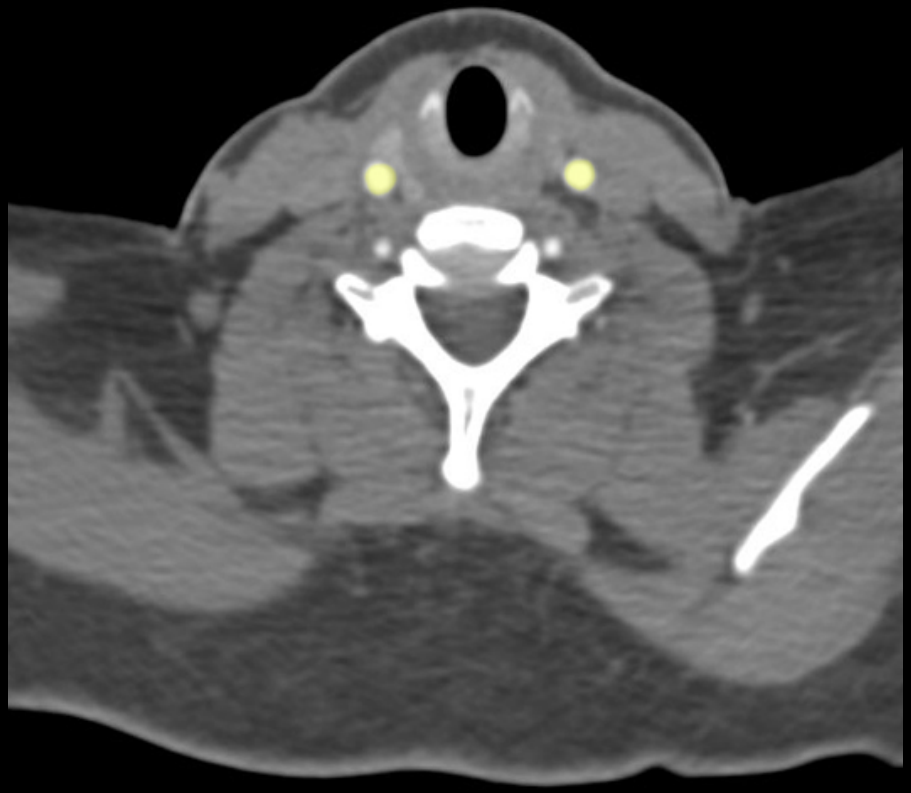
Vasculature: Axial Images

Axial

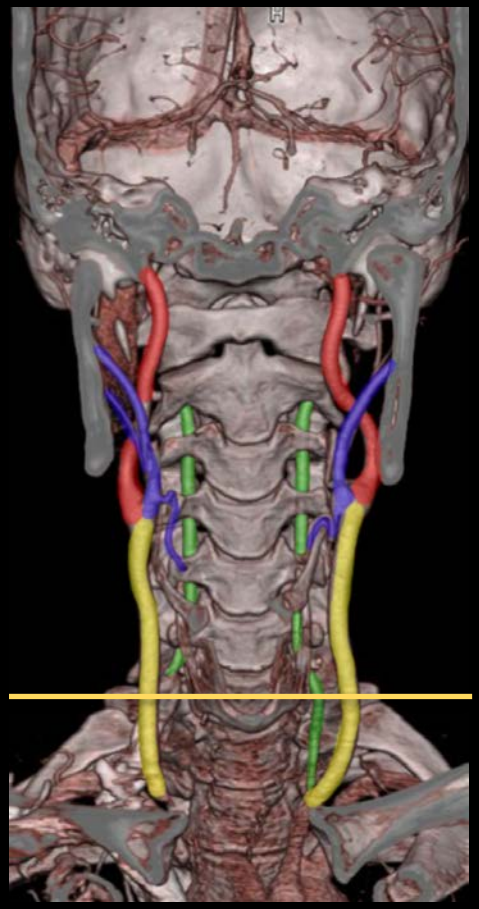


Coronal

Vasculature:
Axial Images



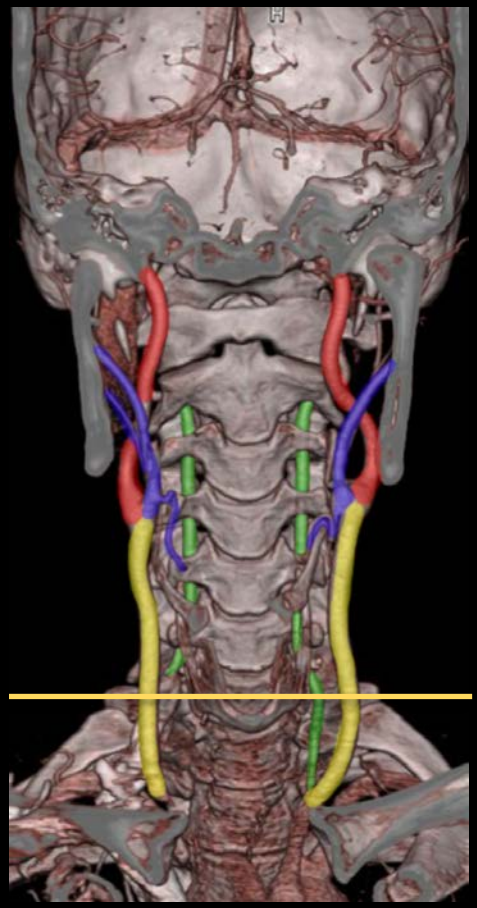
Common Carotid Arteries



Below carotid bifurcation

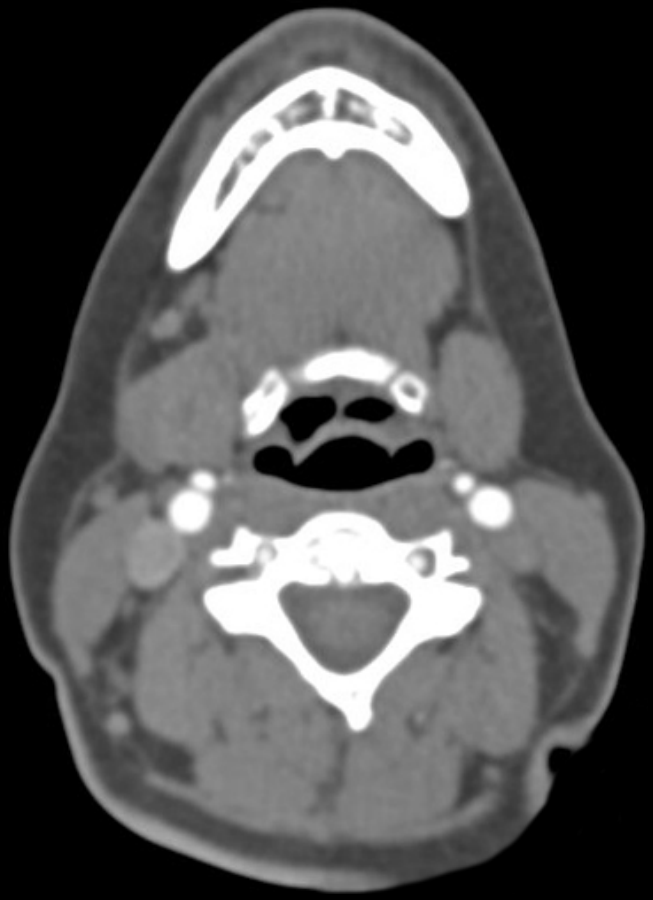
Vasculature:
Axial Images

Vertebral Arteries

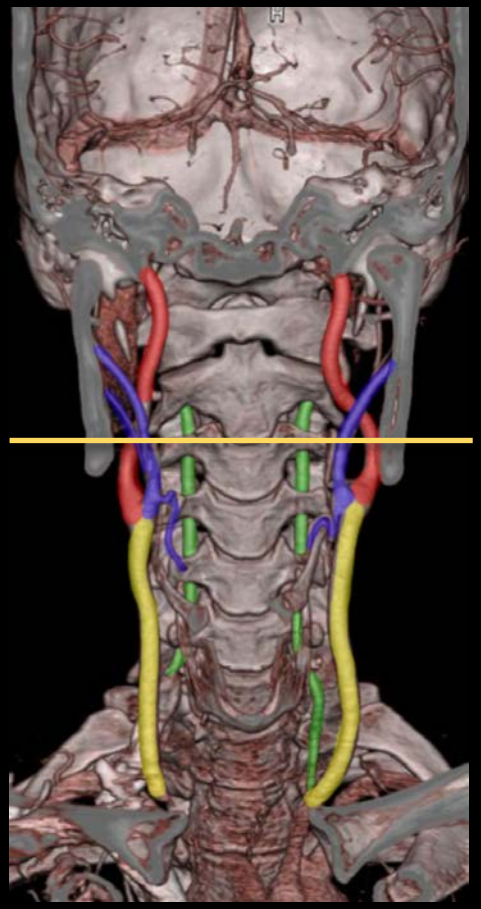


Below carotid bifurcation

Vasculature: Axial Images

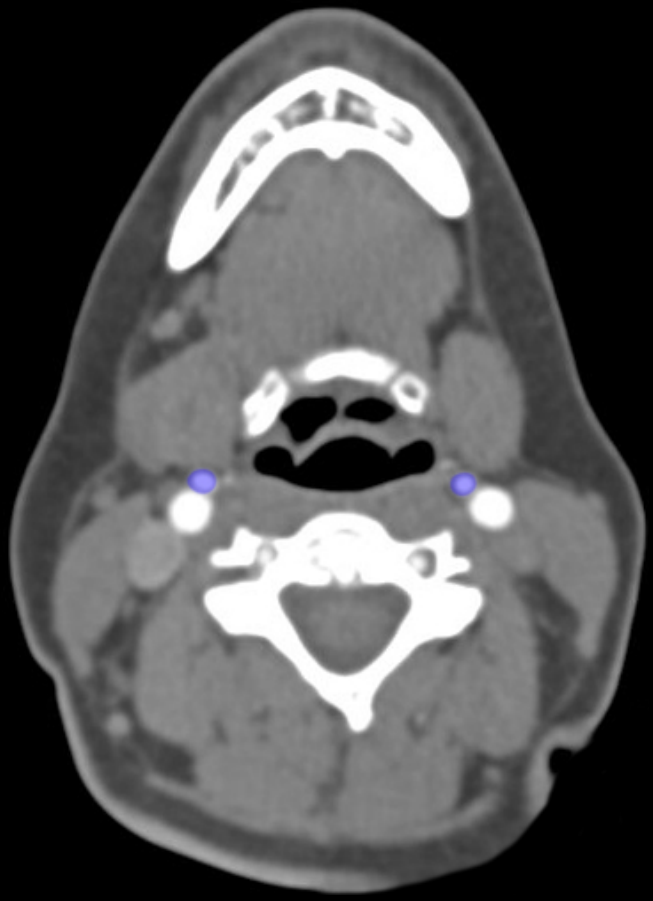


Axial

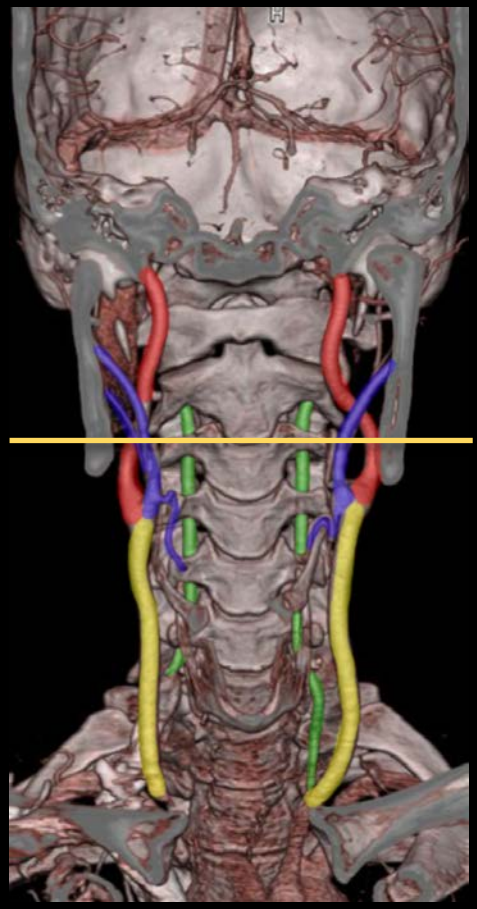


Above carotid bifurcation

Vasculature: Axial Images

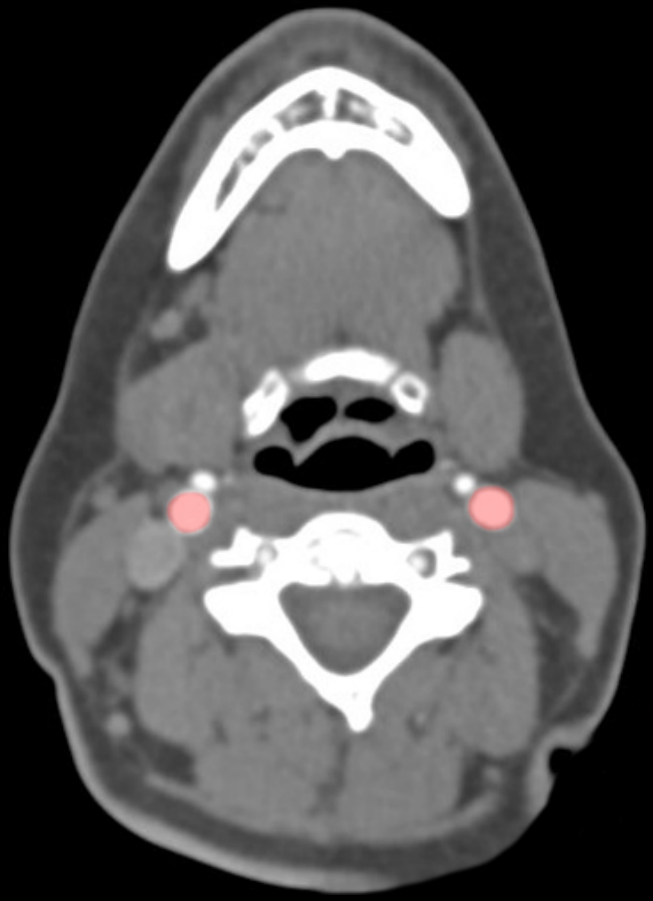


External carotid arteries

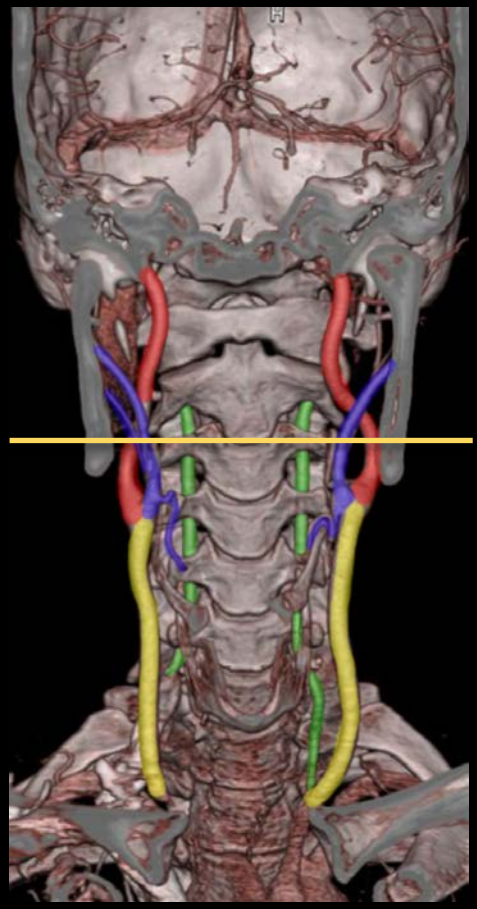


Above carotid bifurcation

Vasculature:
Axial Images

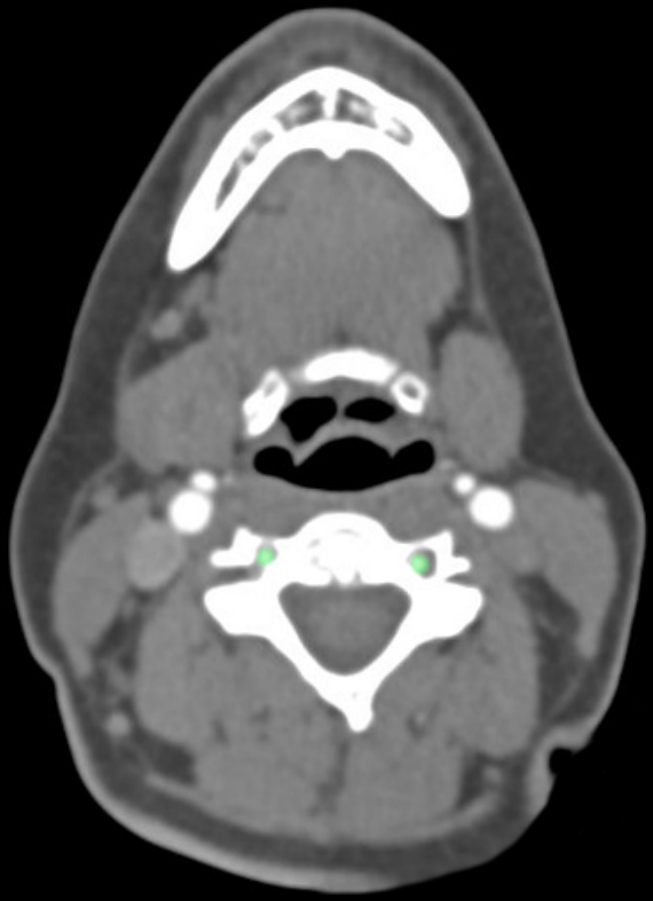


Internal carotid arteries

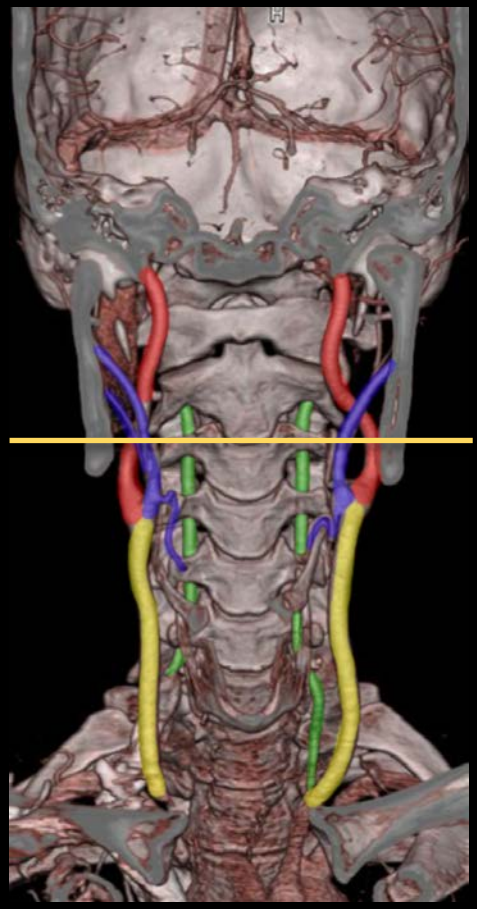


Above carotid bifurcation

Vasculature: Axial Images



Vertebral arteries

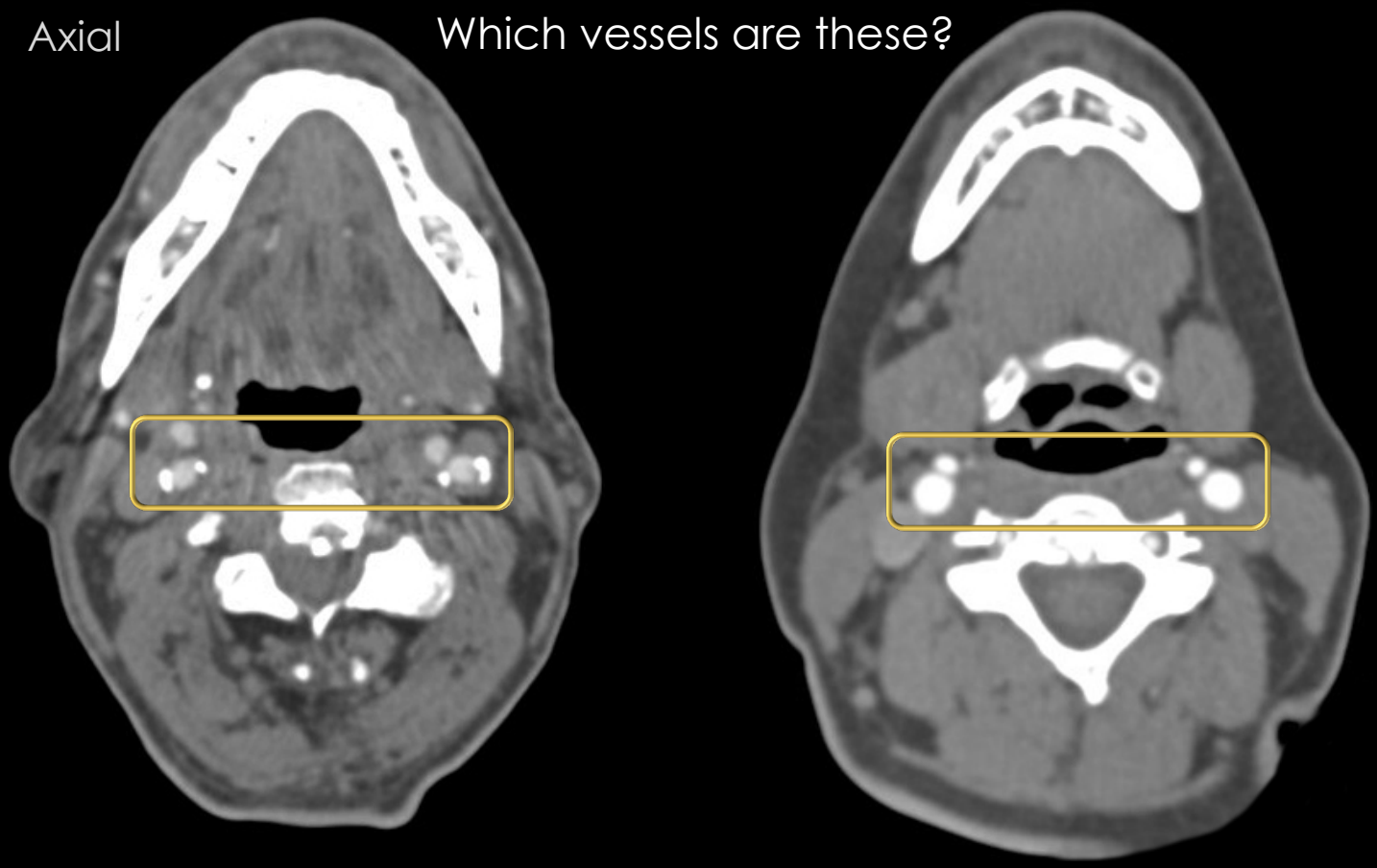


Above carotid bifurcation

Case:
Arterial Abnormality

Axial

Which vessels are these?

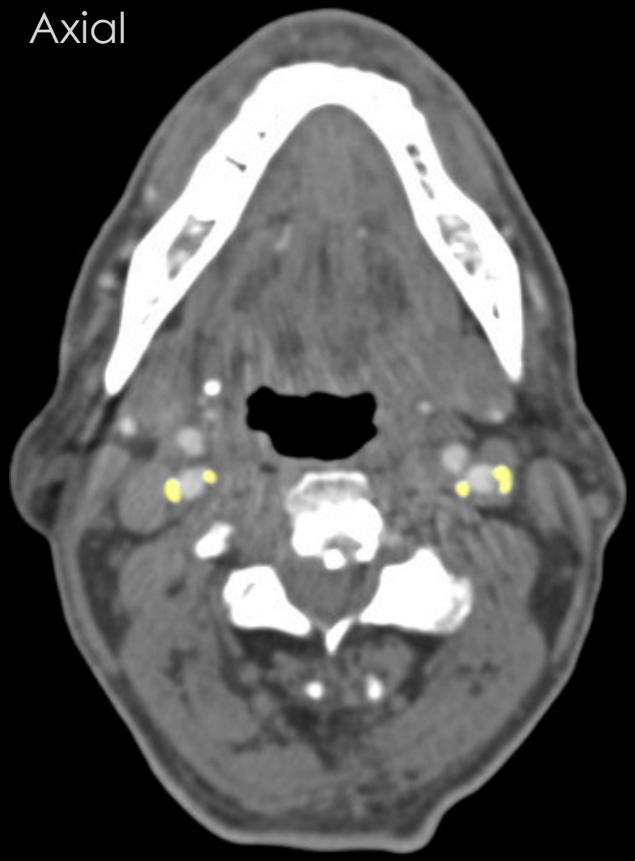


Abnormal

Normal

Case:
Carotid Arteries

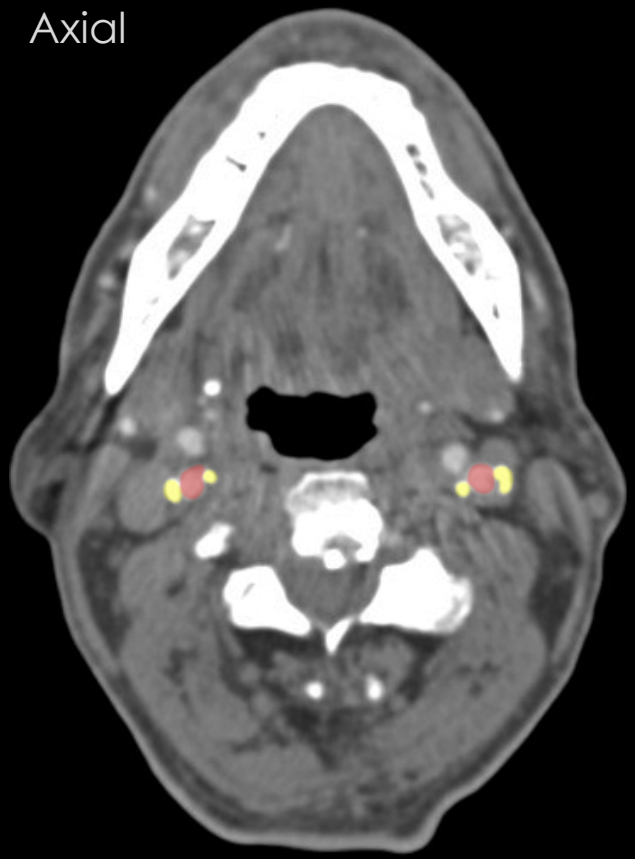
Axial



Calcifications in
atherosclerotic plaques

Case:
Carotid Arteries

Axial



- Which vessels are affected by atherosclerosis
  - A. Vertebral arteries
  - B. Common carotid arteries
  - C. External carotid arteries
  - D. Internal carotid arteries

- Internal POSTERIOR to external carotid artery above bifurcation

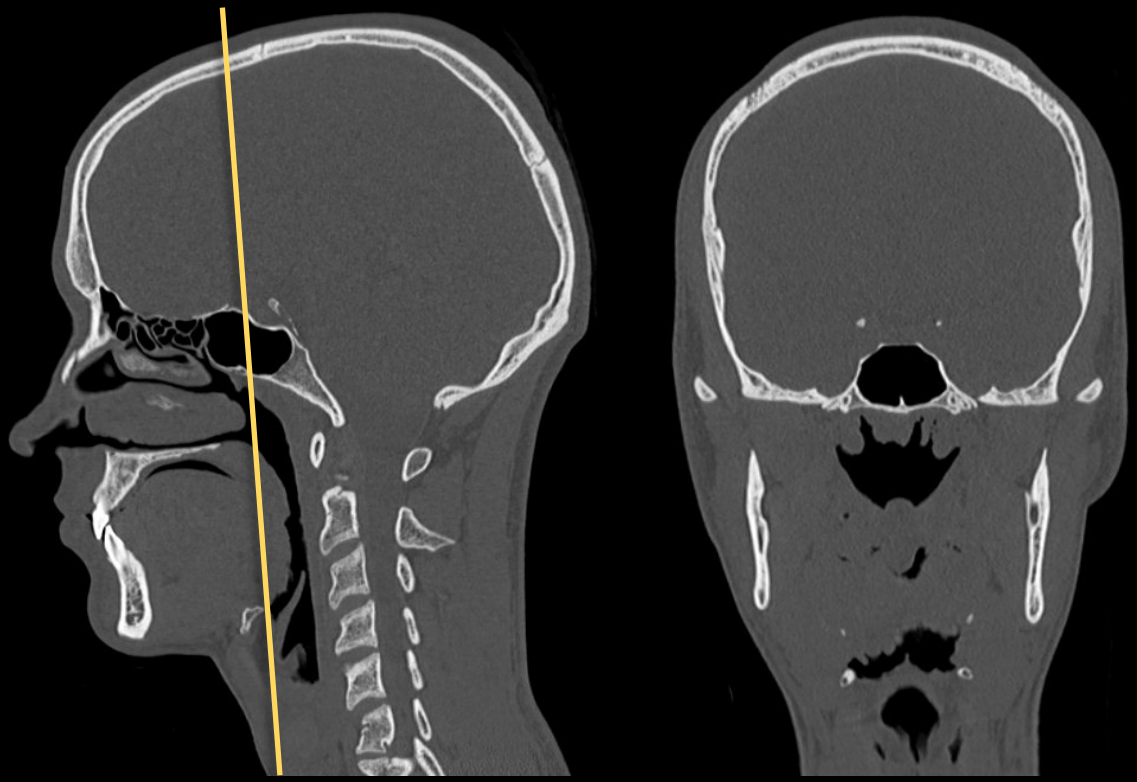
Head Imaging

- Paranasal Sinuses
  - Bony walls and contents
- Ventricles
  - Normal vs. Enlarged
- Parenchyma
  - Basic anatomy and midline shift
- Vasculature
  - Hemorrhage types

Paranasal Sinuses

- Paired air-filled spaces around nasal cavity
  - Frontal, ethmoid, sphenoid, maxillary
- "Normal" varies
  - Development occurs prenatally and after birth
  - Shape and size of sinuses can differ between people
- Things to look for:
  - Are the bony walls intact?
  - Is there anything in the sinus (air will appear black)?

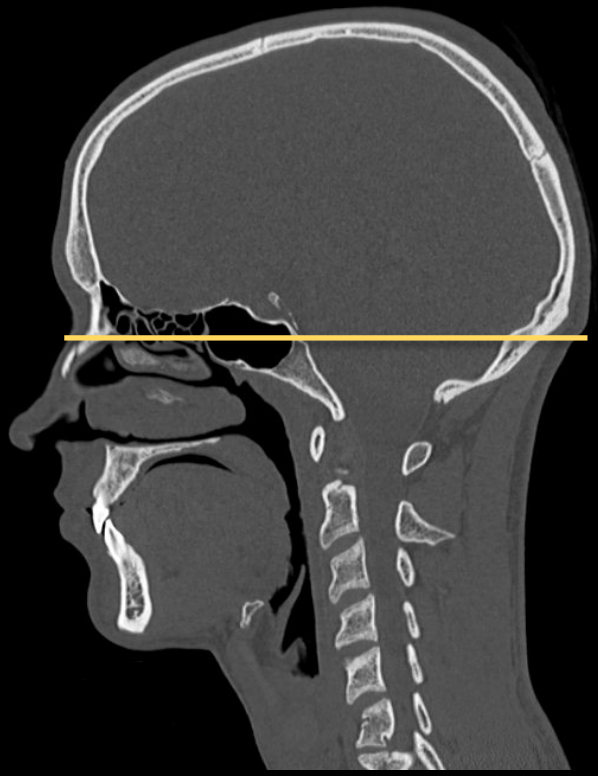
SINUSES: SPHENOID



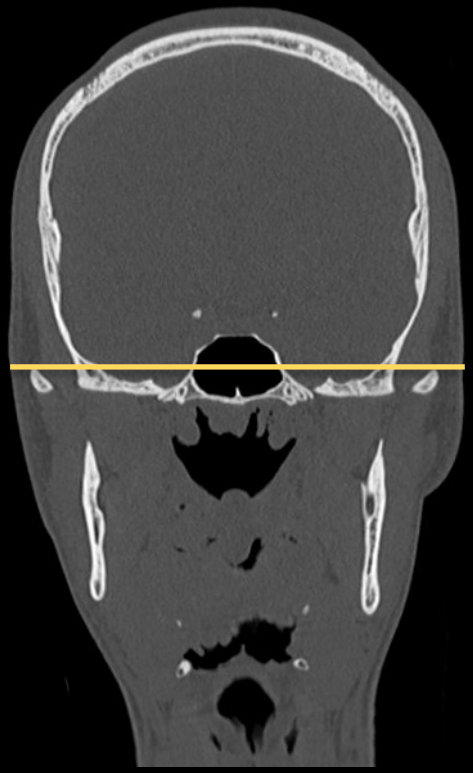
Sagittal

Coronal

SINUSES:
SPHENOID



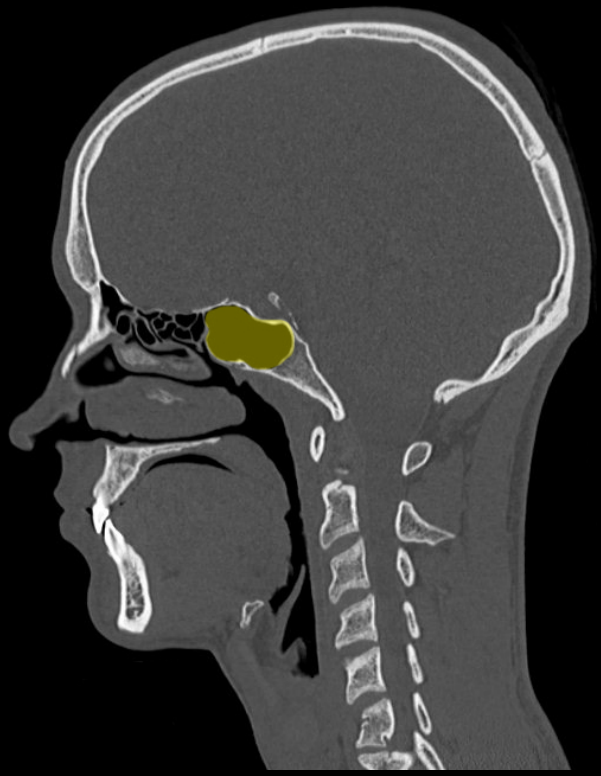
Sagittal



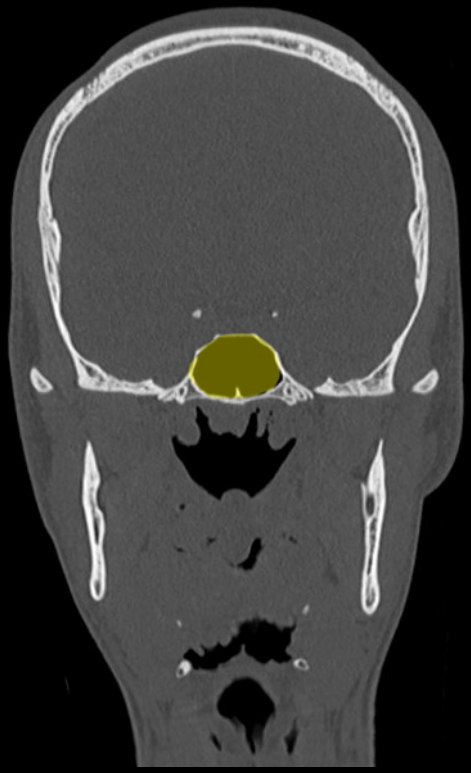
Coronal

Axial

Sinuses: Sphenoid



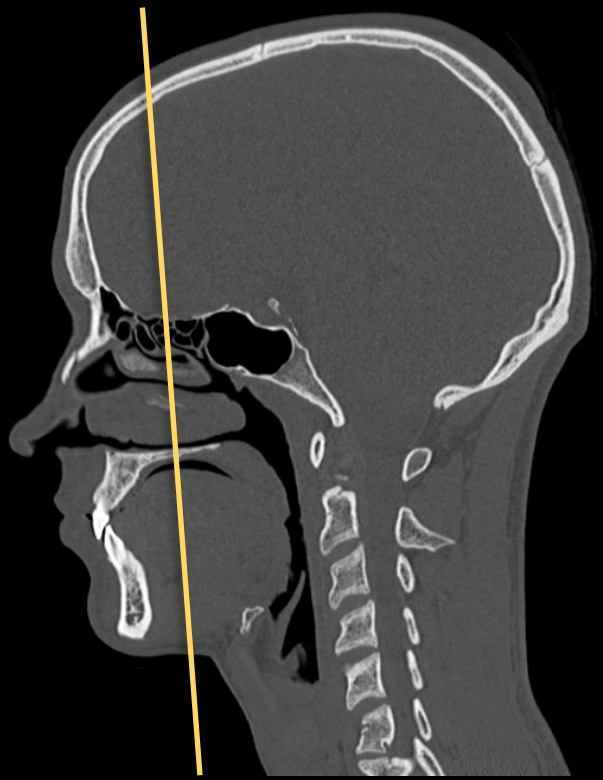
Sagittal



Coronal

Axial

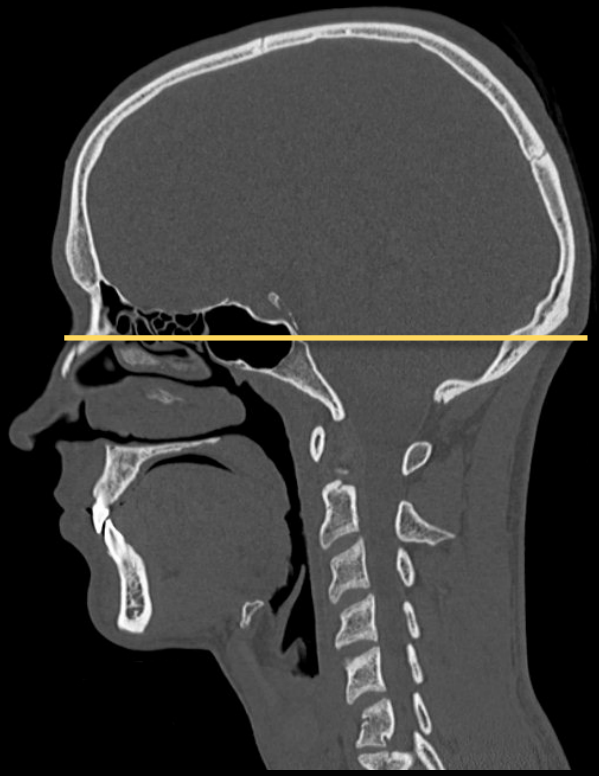
Sinuses: Ethmoid



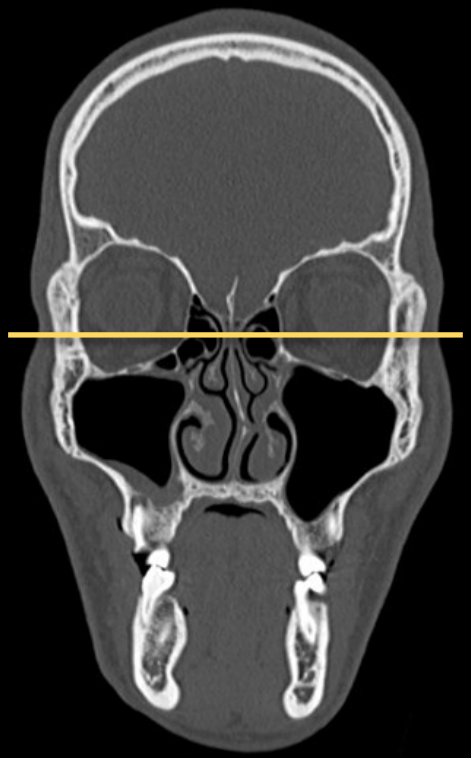
Sagittal

Coronal

Sinuses: Ethmoid



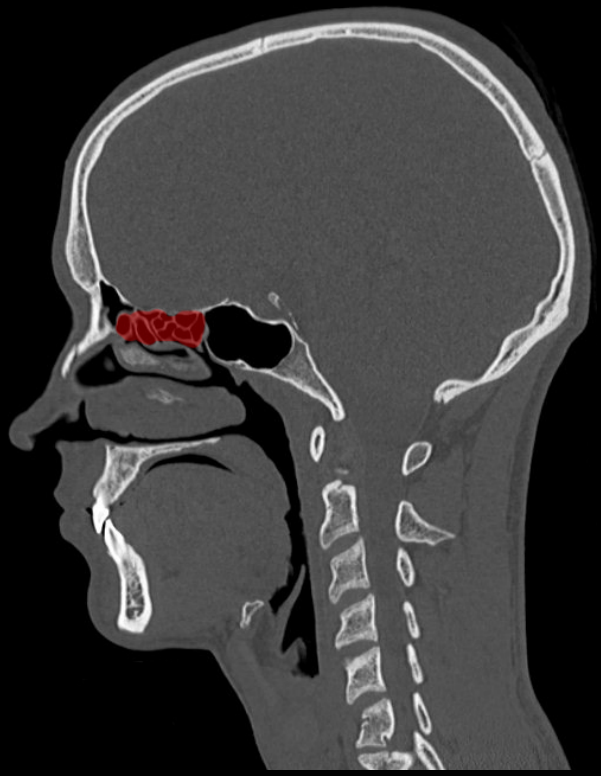
Sagittal



Coronal

Axial

Sinuses: Ethmoid

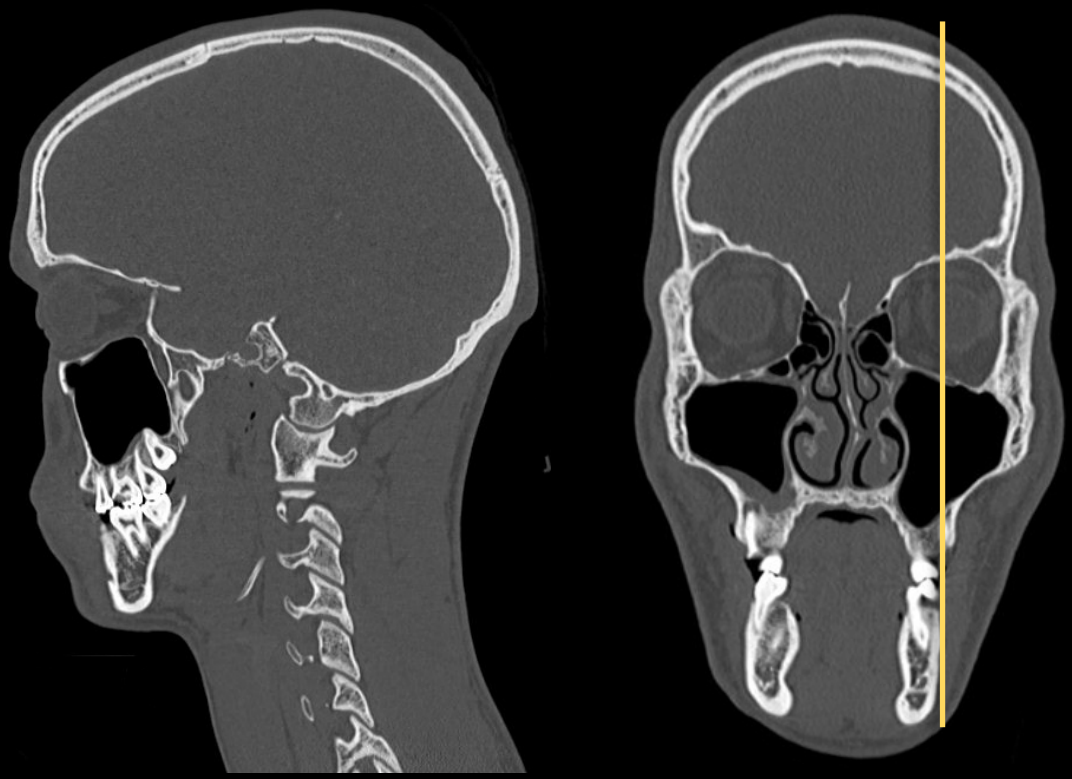


Sagittal

Coronal

Axial

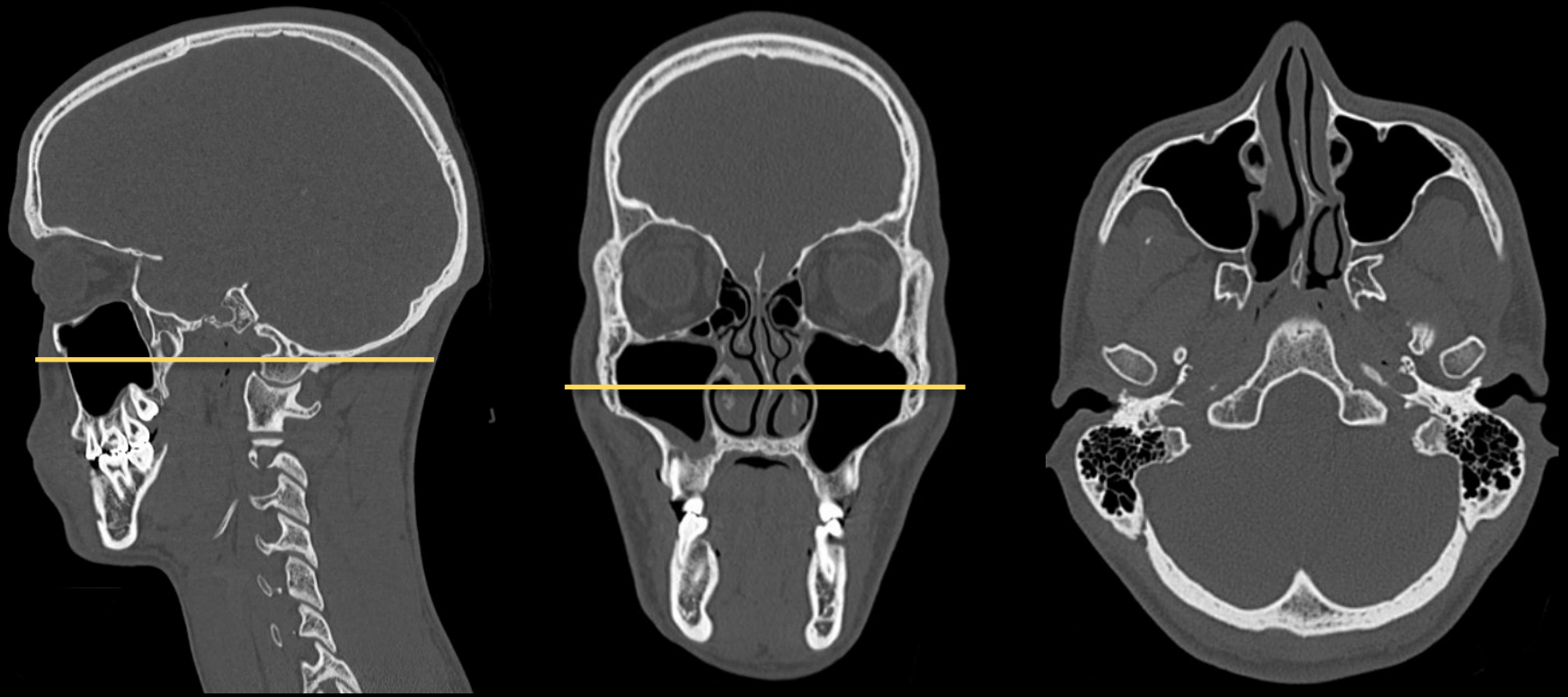
SINUSES:
MAXILLARY



Sagittal

Coronal

SINUSES:
MAXILLARY

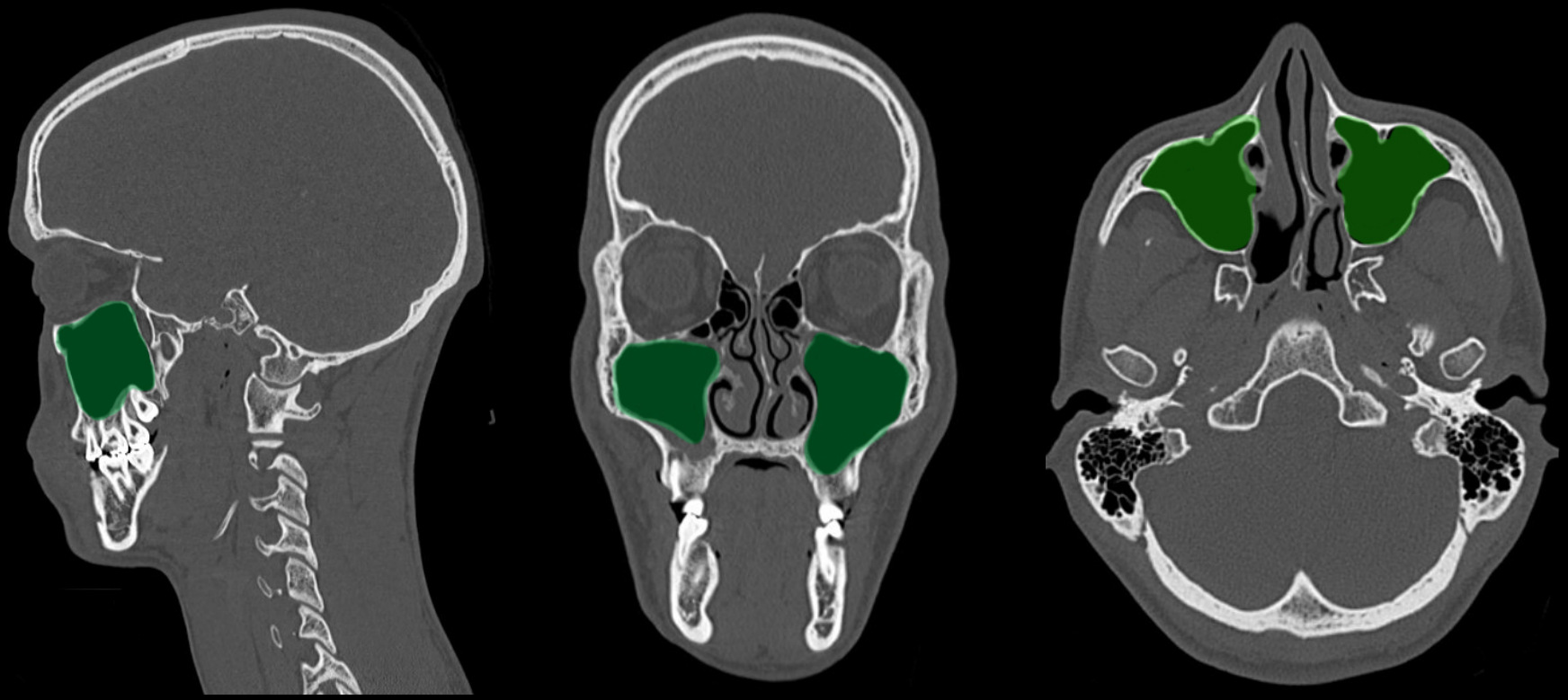


Sagittal

Coronal

Axial

SINUSES:
MAXILLARY

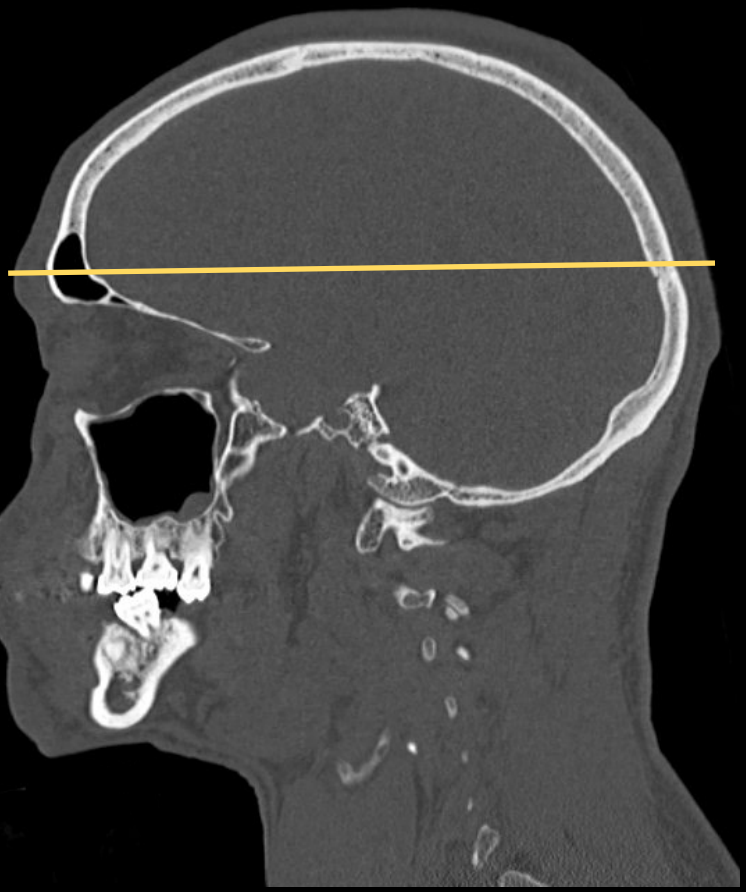


Sagittal

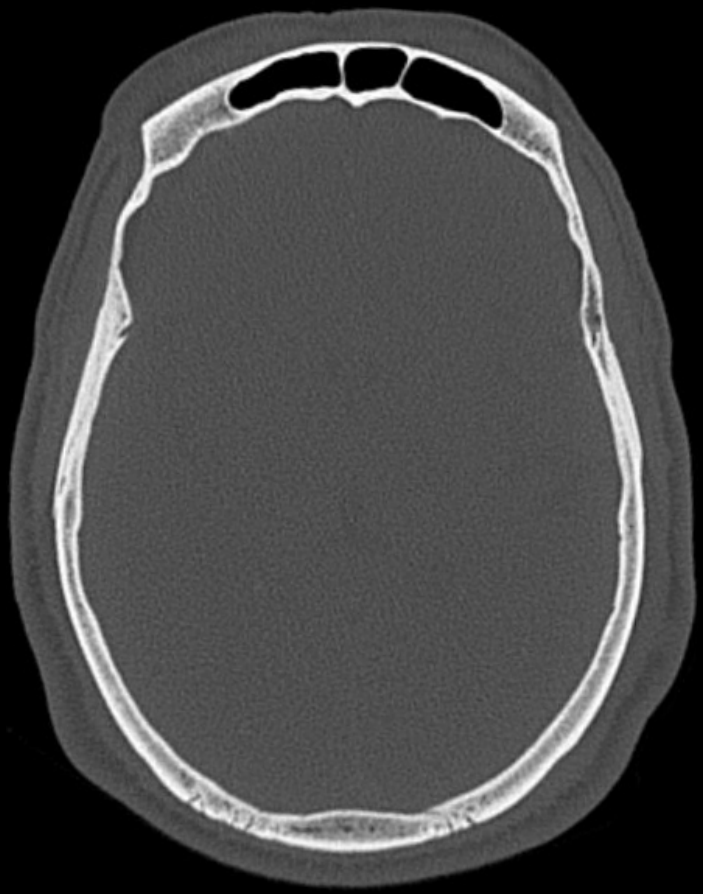
Coronal

Axial

SINUSES: FRONTAL

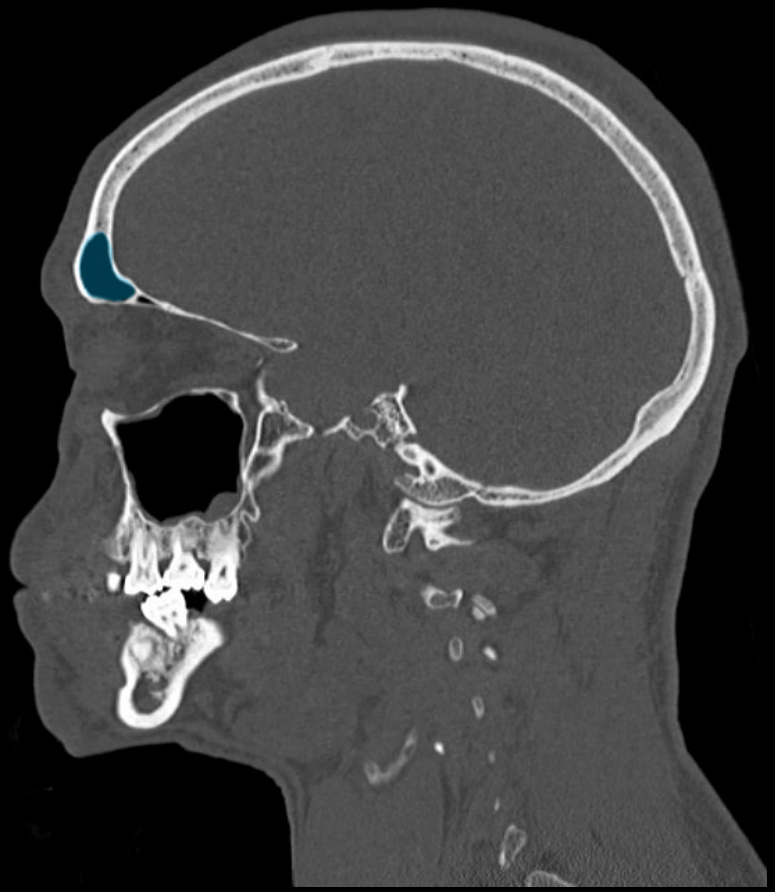


Sagittal

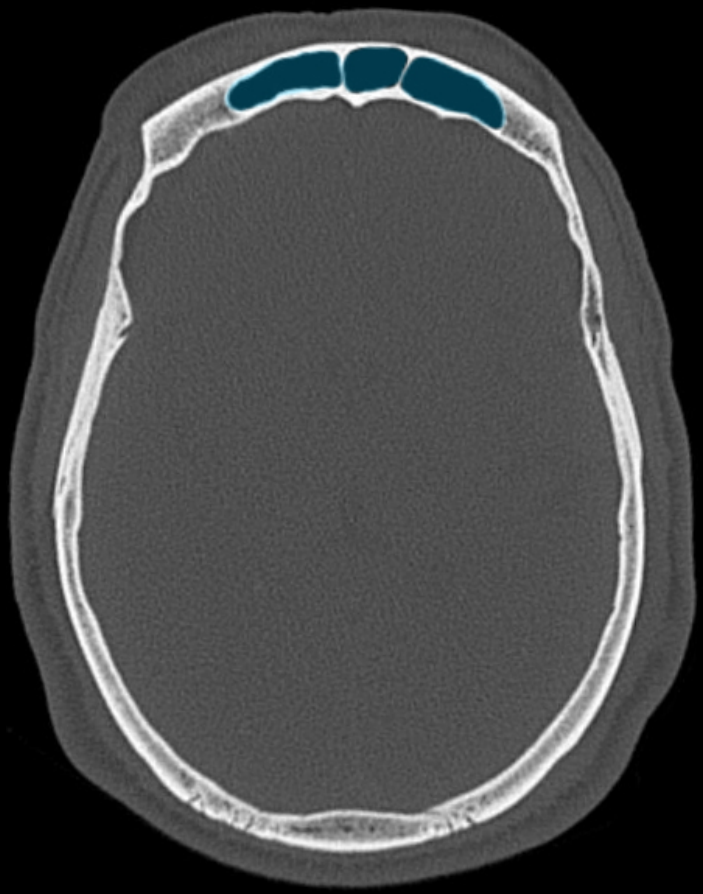


Axial

SINUSES: FRONTAL



Sagittal



Axial

Case:
Sinus Abnormality

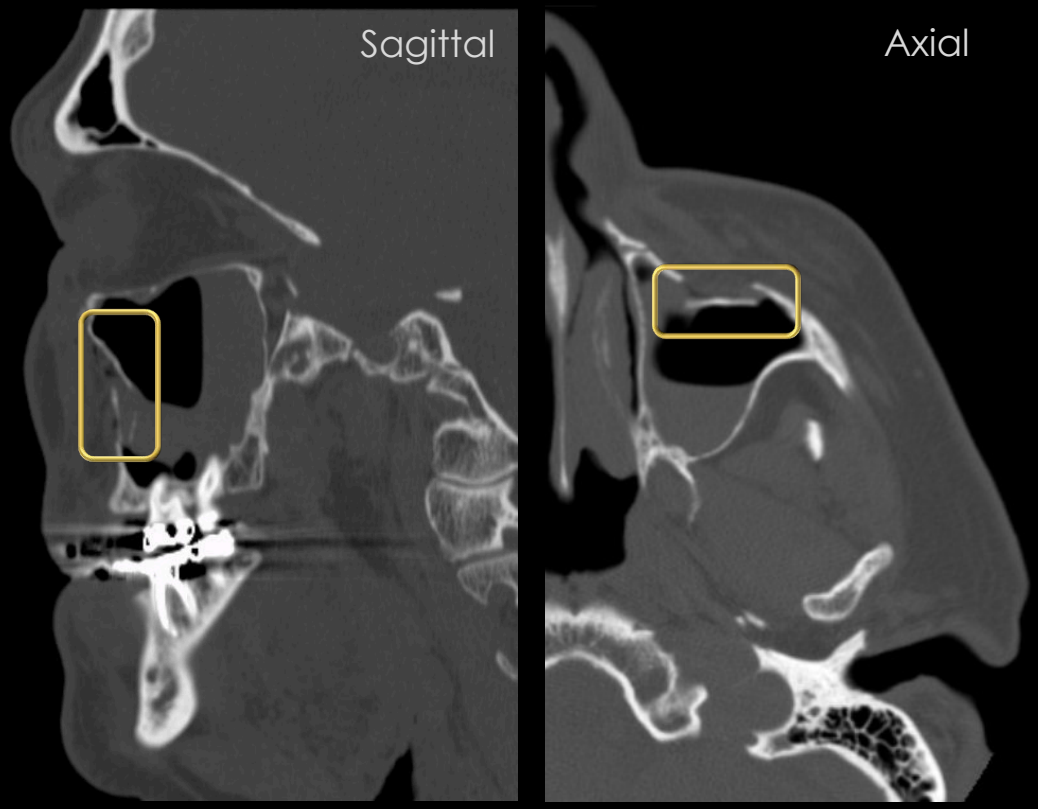
- Which sinuses do we see on this axial image?
  - A. Frontal
  - B. Ethmoid
  - C. Maxillary
  - D. Sphenoid

Case:
Sinus Abnormality

Left Maxillary Sinus

Right Maxillary Sinus
(Normal)

Case:
Facial Fracture



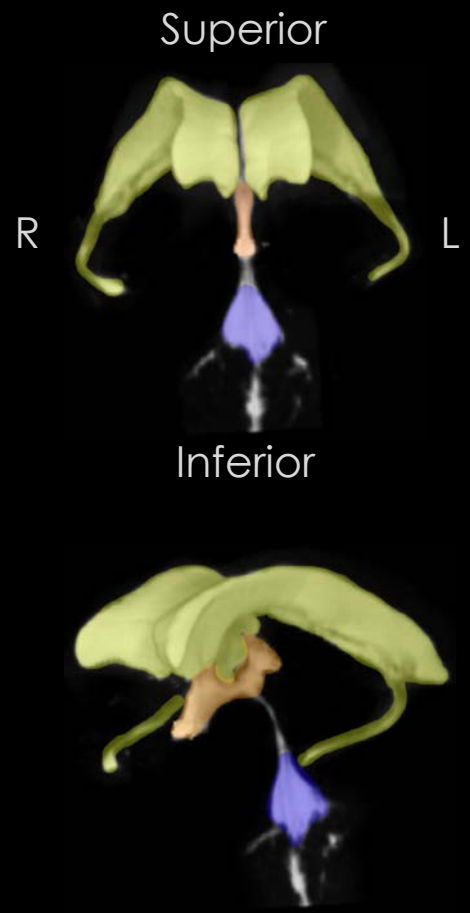
- What is the likely cause of the abnormality?
  - A. Neoplastic
  - B. Trauma
  - C. Infection
  - D. Endocrine

Fracture in anterior wall of left maxillary sinus

Head Imaging

- Paranasal Sinuses
  - Bony walls and contents
- Ventricles
  - Normal vs. Enlarged
- Parenchyma
  - Basic anatomy and midline shift
- Vasculature
  - Hemorrhage types

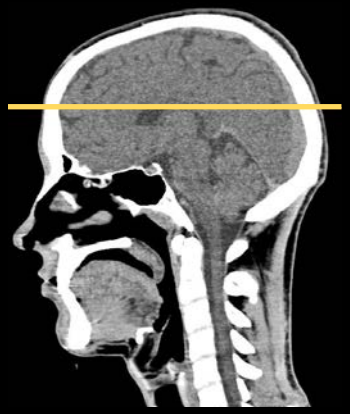
Cerebral Ventricles



- Anatomy
  - Lateral ventricles (paired)
  - Third ventricle
  - Fourth ventricle
- Cerebrospinal fluid
  - Produced in choroid plexus (lateral + third ventricles)
- Approach on axial images
  - Ventricles midline and symmetric?
  - Ventricles normal size?
  - Abnormal ventricle contents?

Ventricles symmetric?

Sagittal



Axial

VENTRICLES SYMMETRIC?

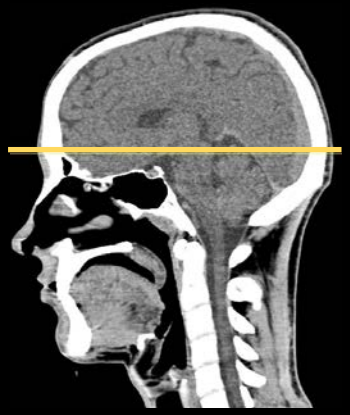
Sagittal

Axial

Lateral ventricles symmetric

Ventricles in midline?

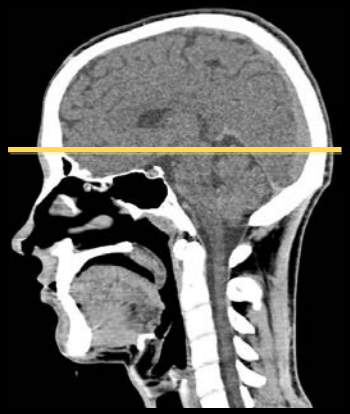
Sagittal



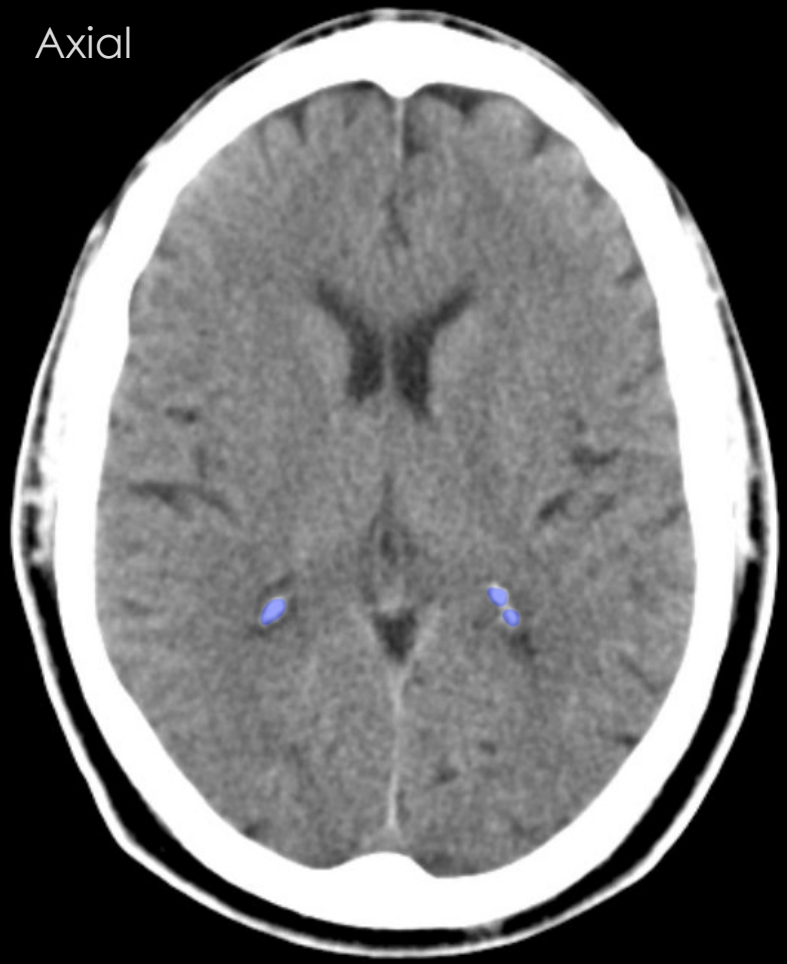
Axial

Ventricles in midline?

Sagittal



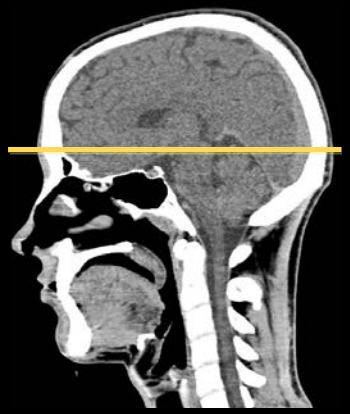
Axial



Choroid plexus (lateral ventricles)
bright from calcium

Ventricles in midline?

Sagittal



Axial

Ventricles equidistant from midline

Normal ventricular size?

Axial

Normal

Axial

Enlarged (Hydrocephalus)

Abnormal ventricle Contents?

Axial

Normal CSF (dark)

Axial

Blood in ventricles

Axial

Normal CSF (dark)

Axial

Intraventricular Catheter (helps reduce pressure by draining CSF)

Intraventricular blood (bright)

Head Imaging

- Paranasal Sinuses
  - Bony walls and contents
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Brain Parenchyma

- Basic anatomy
  - Cerebral hemispheres divided by falx cerebri

Brain Parenchyma

- Basic anatomy
  - Cerebral hemispheres divided by falx cerebri

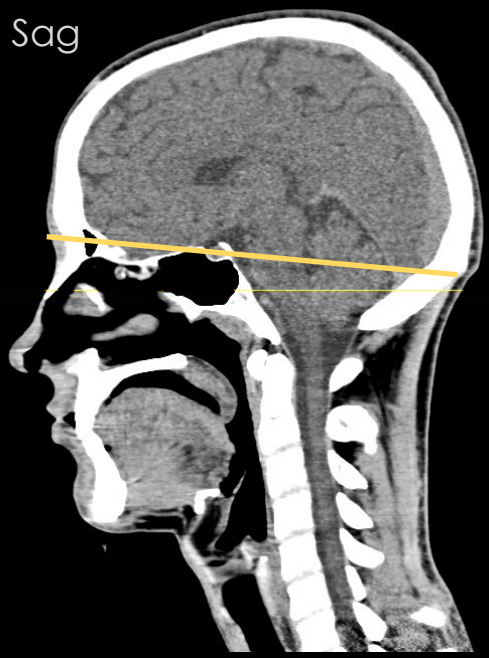
Falx cerebri is dural fold separating left and right hemispheres

Brain Parenchyma

- Basic anatomy
  - Cerebral hemispheres divided by falx cerebri
  - Cerebral cortex superior to brainstem and cerebellum

Ax

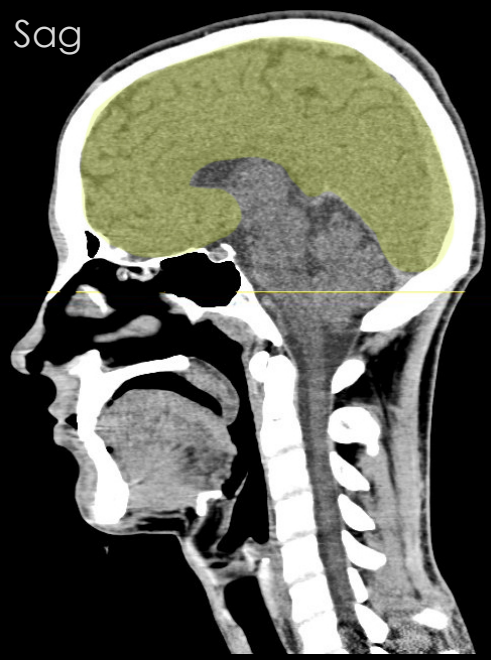
Sag



Brain Parenchyma

- Basic anatomy
  - Cerebral hemispheres divided by falx cerebri
  - Brainstem and cerebellum inferior to cerebral cortex

Cerebrum (temporal lobes)



Cerebrum

Brain Parenchyma

- Basic anatomy
  - Cerebral hemispheres divided by falx cerebri
  - Brainstem and cerebellum inferior to cerebral cortex

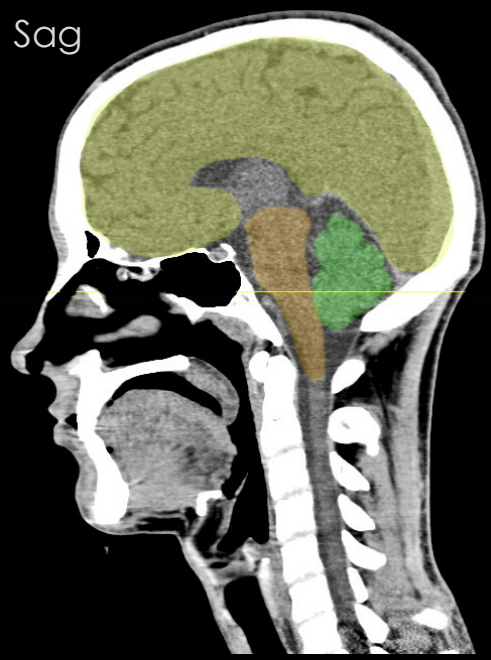
Brainstem

Brainstem

Brain Parenchyma

- Basic anatomy
  - Cerebral hemispheres divided by falx cerebri
  - Brainstem and cerebellum inferior to cerebral cortex

Cerebellum



Cerebellum

Brain Parenchyma

- Normal changes with age
  - Brain mass decreases
  - Surrounding CSF spaces appear larger (enlarged sulci, ventricles)

20-years-old

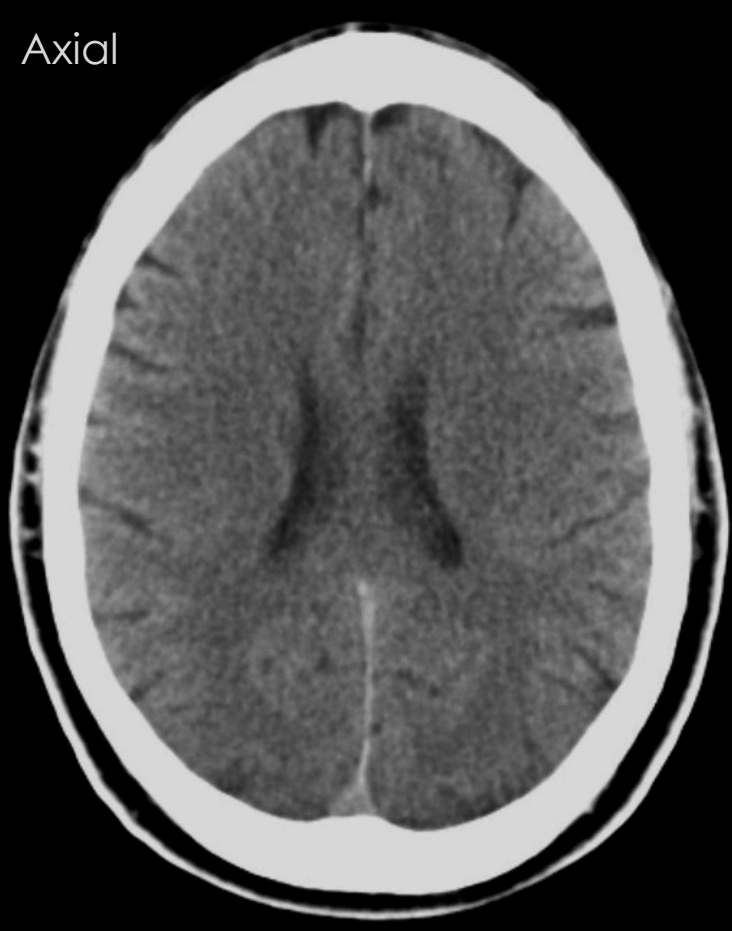
80-years-old

Brain Parenchyma

- Elements to consider on imaging:
  - Symmetry?
  - Falx cerebri in midline?
  - Abnormal mass (variable brightness) or edema (darker)?
  - Hemorrhage (bright)?

Case:
Brain Abnormality

Abnormal



Normal

Case:
Brain Abnormality

- What abnormalities are present?
  - A. Compression of left lateral ventricle
  - B. Intraventricular hemorrhage
  - C. Midline shift
  - D. A and C

Case:
Brain Abnormality

- What abnormalities are present?
  - A. Compression of left lateral ventricle
  - B. Intraventricular hemorrhage
  - C. Midline shift
  - D. A and C

Case:
Intracranial Abnormality

- What is the cause of the mass effect?
  - A. Trauma
  - B. Hemorrhage
  - C. Congenital
  - D. Tumor

Case:
Intracranial Abnormality

- What is the cause of the mass effect?
  - A. Trauma
  - B. Hemorrhage
  - C. Congenital
  - D. Tumor

Large mass in left frontal lobe

Case:
Intracranial Abnormality

- What is the cause of the mass effect?
  - A. Trauma
  - B. Hemorrhage
  - C. Congenital
  - D. Tumor

Significant edema related to mass

Case:
Intracranial Abnormality

- What is the cause of the mass effect?
  - A. Trauma
  - B. Hemorrhage
  - C. Congenital
  - D. Tumor

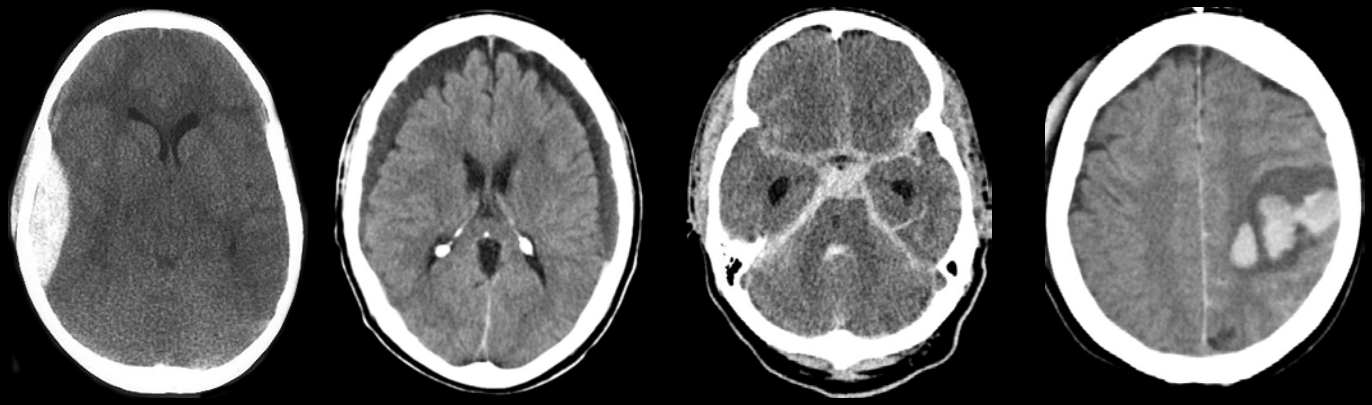
Significant edema related to mass

Head Imaging

- Paranasal Sinuses
  - Bony walls and contents
- Ventricles
  - Size and symmetry
- Parenchyma
  - Basic anatomy and midline shift
- Vasculature
  - Hemorrhage

Intracranial Bleeding

- Common use of non-contrast head CT
  - NEW blood appears BRIGHT (acute bleed)
  - OLD blood can be DARK (old bleed)
- Different locations

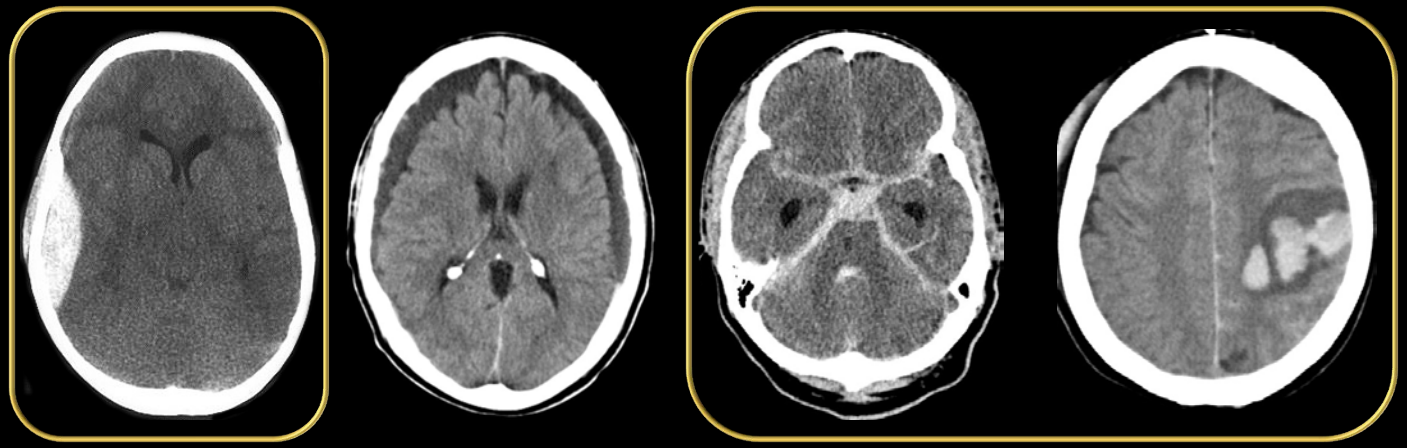


Epidural | Subdural | Subarachnoid | Parenchymal

Outside brain parenchyma

Intracranial Bleeding

- Common use of non-contrast head CT
  - NEW blood appears BRIGHT (acute bleed)
  - OLD blood can be DARK (old bleed)
- Different locations

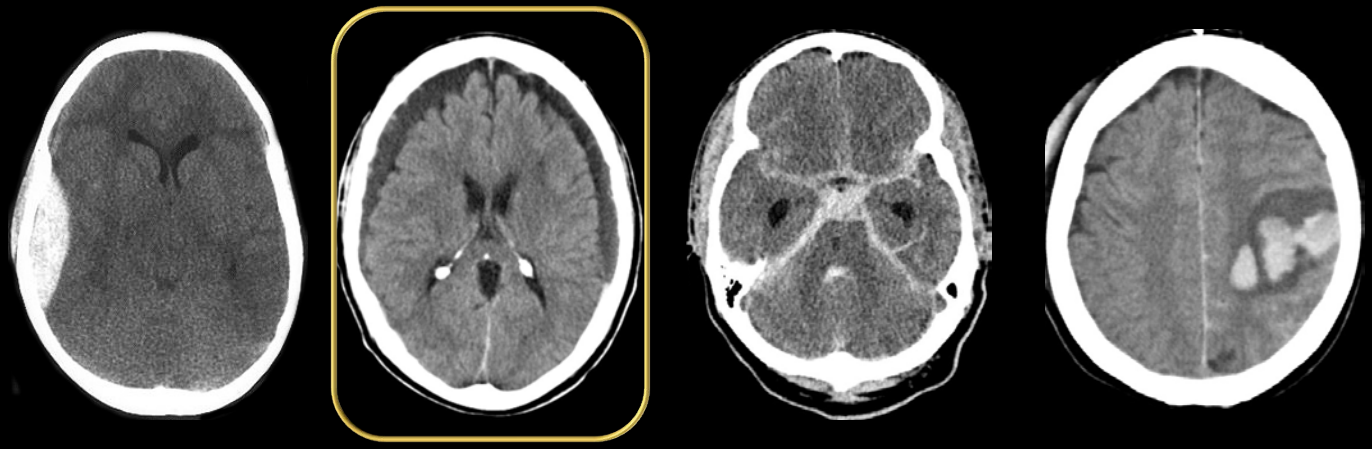


Epidural Subdural Subarachnoid Parenchymal

ARTERIAL hemorrhage

Intracranial Bleeding

- Common use of non-contrast head CT
  - NEW blood appears BRIGHT (acute bleed)
  - OLD blood can be DARK (old bleed)
- Different locations



Epidural | Subdural | Subarachnoid | Parenchymal

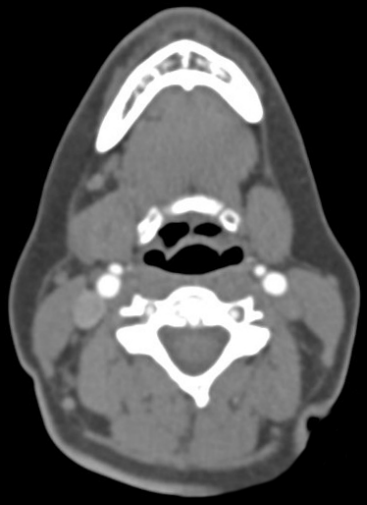
VENOUS hemorrhage

Summary

- Rules of CT
  - High density = Bright (Bone, blood, bullets)
  - Low density = Dark (Air, CSF, edema)
- Normal anatomic landmarks on cross-sectional imaging

Bone

Brain/Ventricles



Vessels

Thanks

- Questions?
  - James.chen@jhmi.edu
- Good luck on the rest of anatomy!