A Simplified Approach to Anatomy and Infections of Head & Neck

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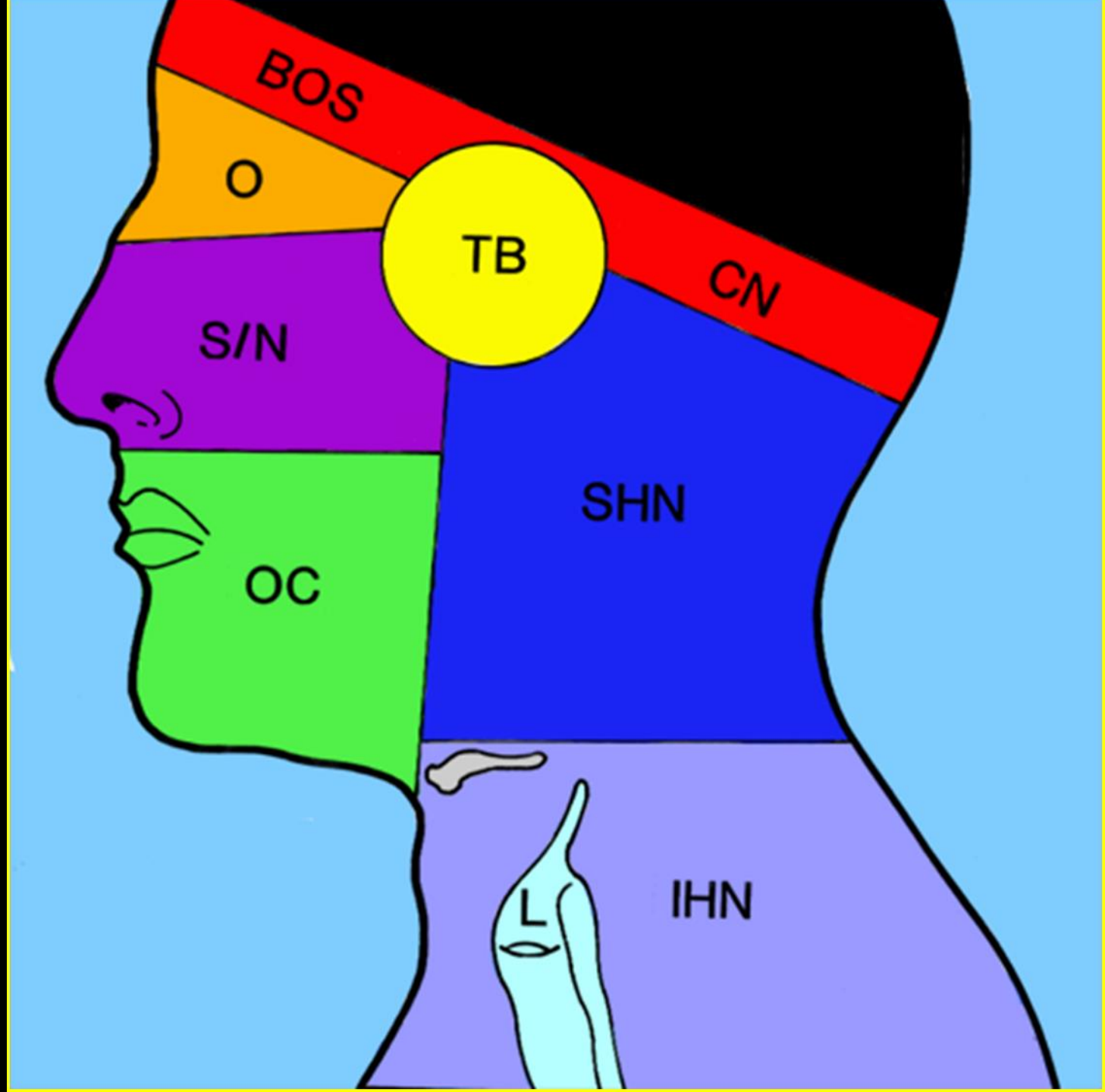
Head and Neck Diseases

- Compromise of vital structures like airway, cervical vessels, orbits, intracranial space, and spinal canal.
- Prolonged inflammatory lesions traversing facial borders.
- Predictable path for extensive spread in para- or retropharyngeal spaces and 'danger spaces'.
- Involvement of vessels, particularly emissary veins and lymphatics, explains disease pattern and spread.

3 Areas to consider

- Suprahyoid Neck
- Infrahyoid Neck
- Oral Cavity



Management of Inflammatory Lesions

- Lesion progression from edematous fat stranding to homogenous phlegmonous mass with enhancement.
- Lesion becomes organized around a central liquefactive cavity, indicating drainage.
- About one in four ring enhancing lesions is not drainable at surgery.
- Dual-phase imaging with a delayed postcontrast scan can increase specificity.

Diagnosis of Acute Infection

- Clinical and laboratory findings at presentation determine diagnosis.
- Imaging primarily determines lesion source and extension, not cause.
- Inflammatory phlegmon or abscess features overlap with aggressive infiltrating/necrotic neoplasm.
- CT, MRI, and positron emission tomography provide suggestive but not definitive information.
- Infection can be a complication of benign or malignant neoplasm or developmental lesions.

Head and Neck Infection Evaluation Technique

- CT and MRI Imaging in Comprehensive Assessment
- CT and MRI are complementary imaging methods for comprehensive assessment.
- MRI is useful for evaluating
  - Intracranial inflammatory spread/abscess formation
  - Differentiation of abscess from other conditions
  - Inflammation and osteomyelitis presence and activity
  - Mastoid extension in middle ear cholesteatoma
  - Facial neuritis and labyrinthitis.

Head and Neck Infection Evaluation Technique

- Diffusion-weighted imaging aids in differential diagnosis and treatment response.
- Dynamic contrast-enhanced MRI perfusion assesses skull base osteomyelitis activity.
- Dual-energy CT reduces metal artifacts, evaluates deep neck abscess, and detects salivary stones.
- Subtraction CT techniques detect progressive bone-destructive changes and reduce dental amalgam artifacts.

Contrast-Enhanced CT in Head and Neck Infections

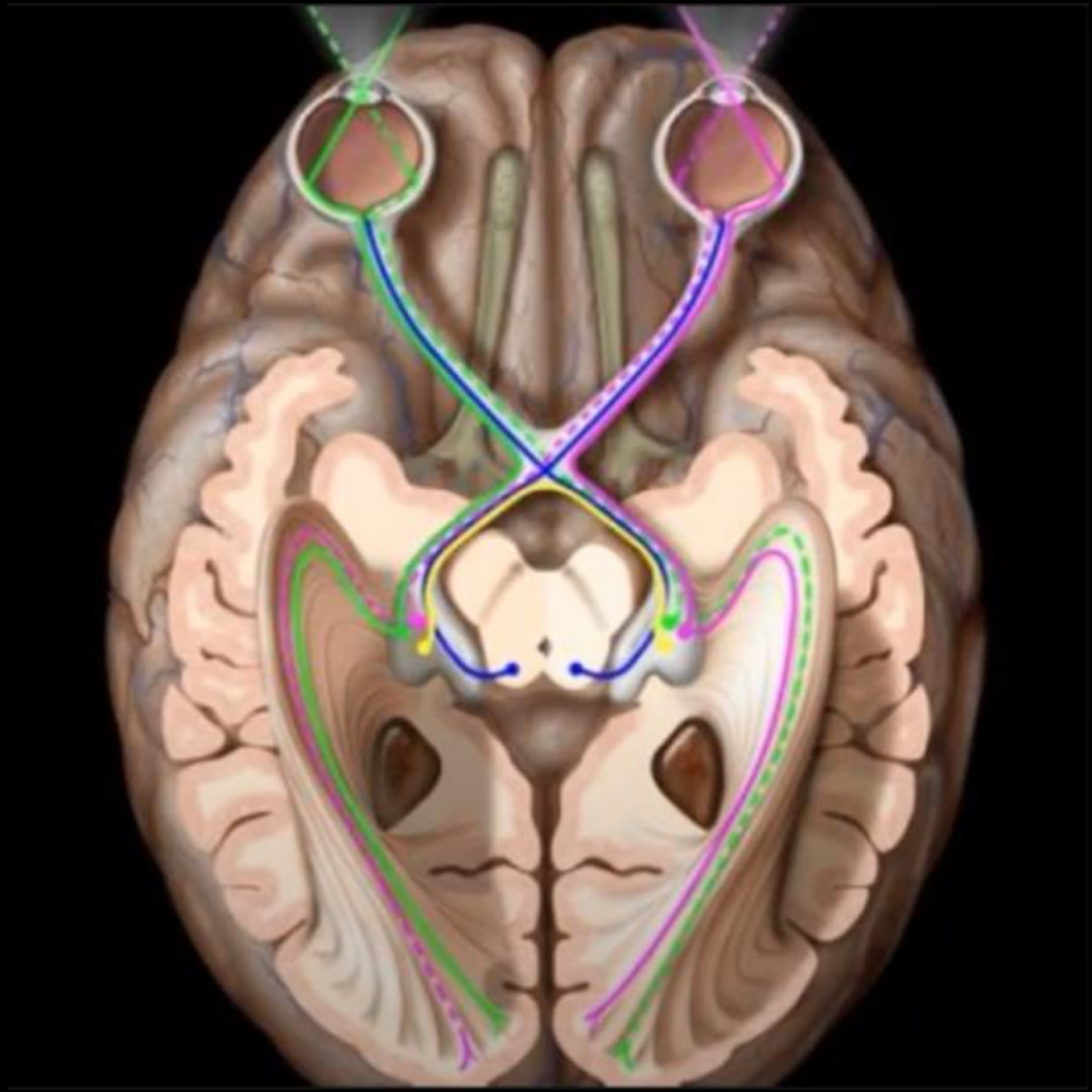
- Standard imaging modality for head and neck infections.
- Offers immediate availability, cost-effectiveness, and rapid data acquisition.
- Minimizes motion artifacts from swallowing and eye movements.
- Identifies infection origin and extension into deep neck spaces.
- Excellent for temporal bone and paranasal sinuses.
- Metal artifacts from dental treatment can degrade image quality and obscure infectious diseases.

ORBITS

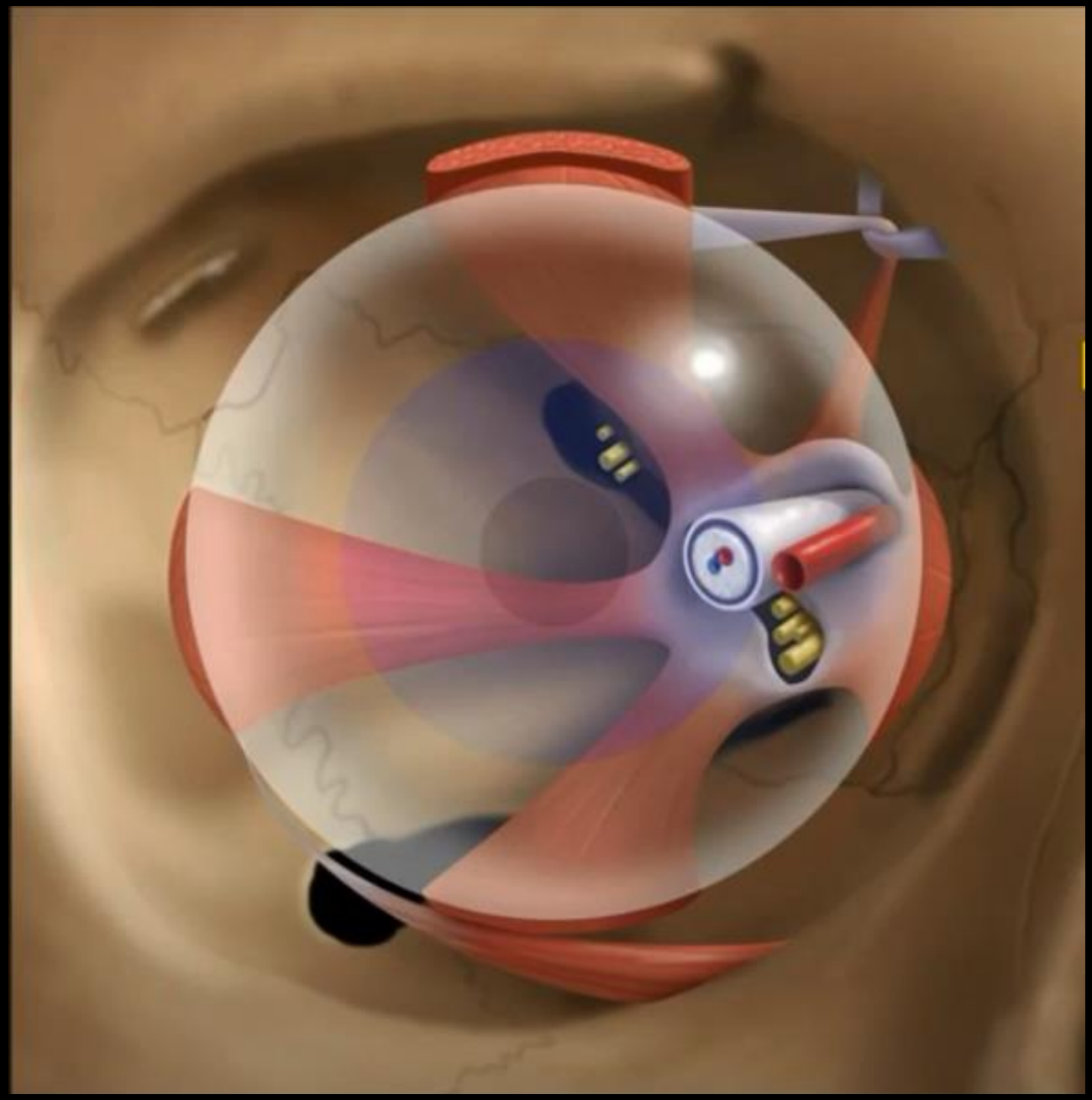
Orbits

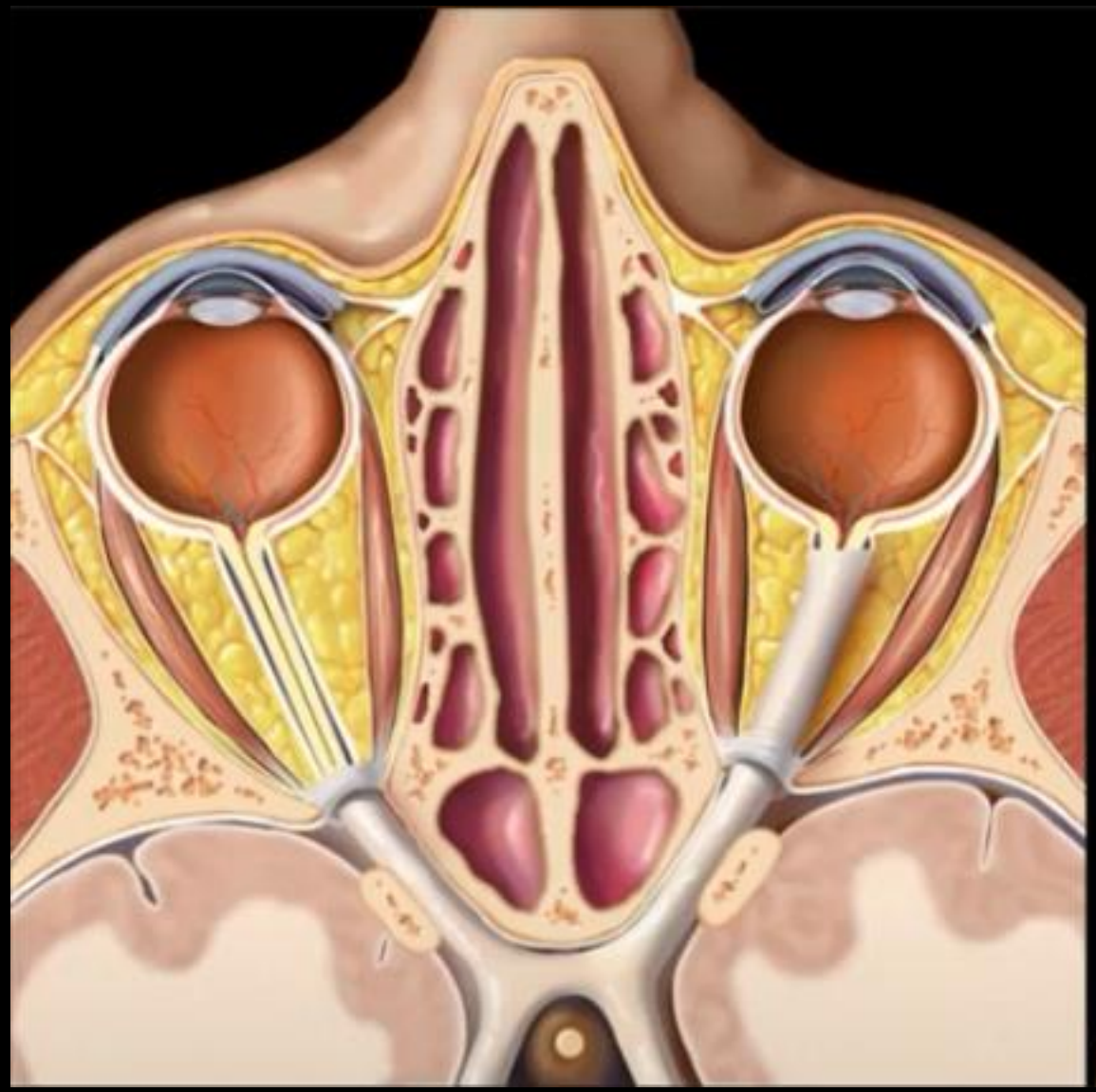
- Orbital infections represent more than half of primary orbital disease processes
- The location of an orbital infection is described with respect to the orbital septum, as either preseptal (periorbital) or postseptal (orbital)

Visual Pathway

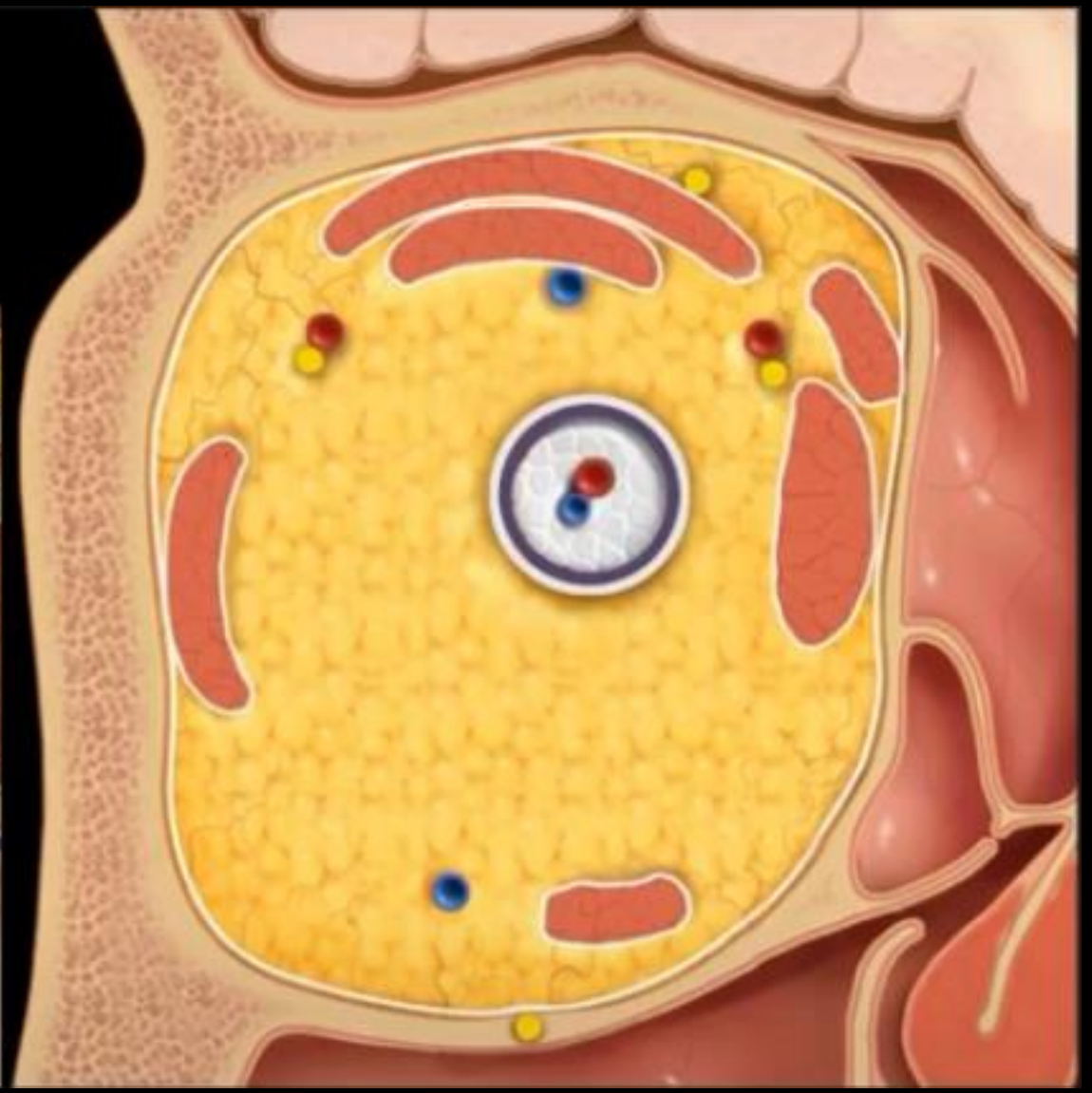


Orbit Anatomy

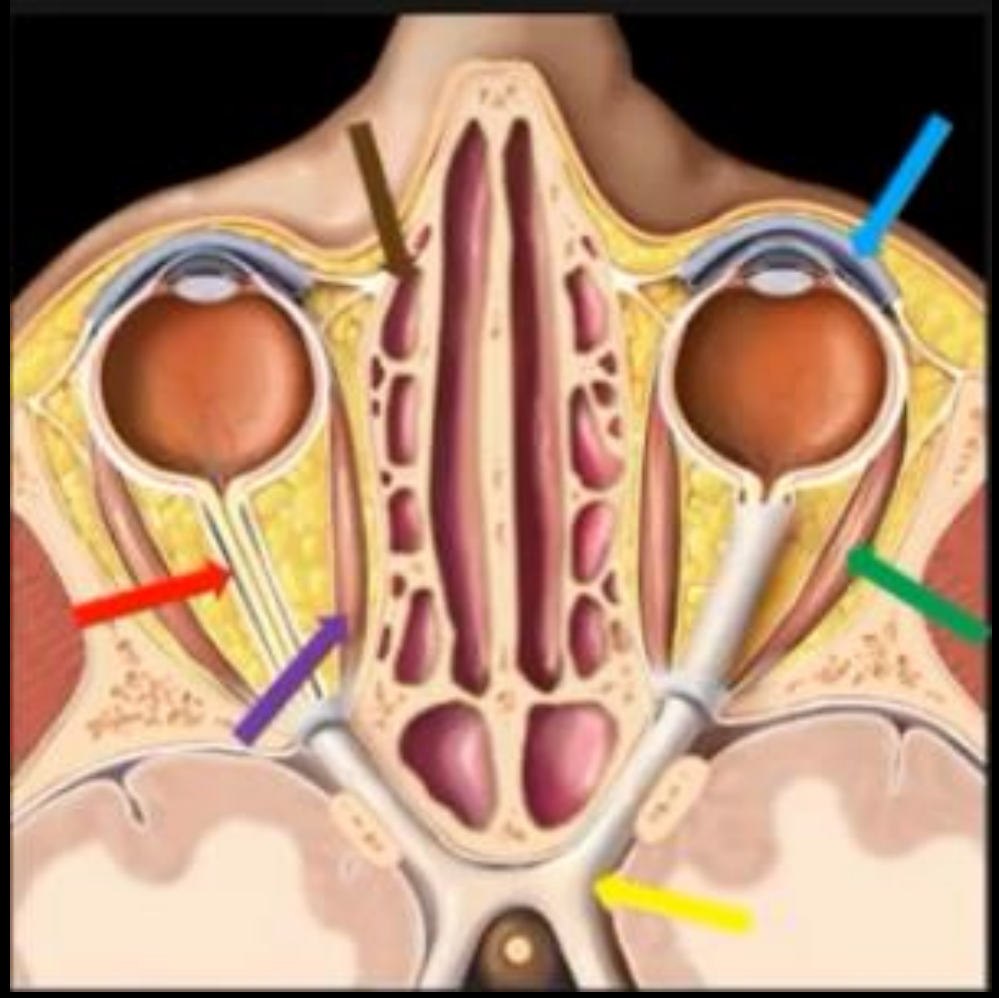




Axial

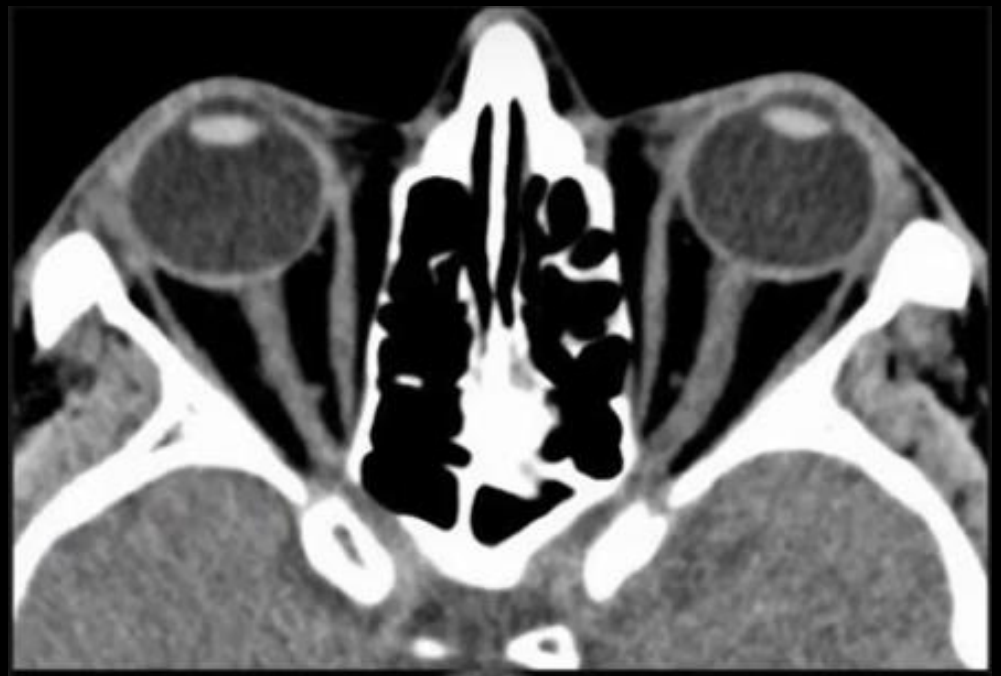


Coronal

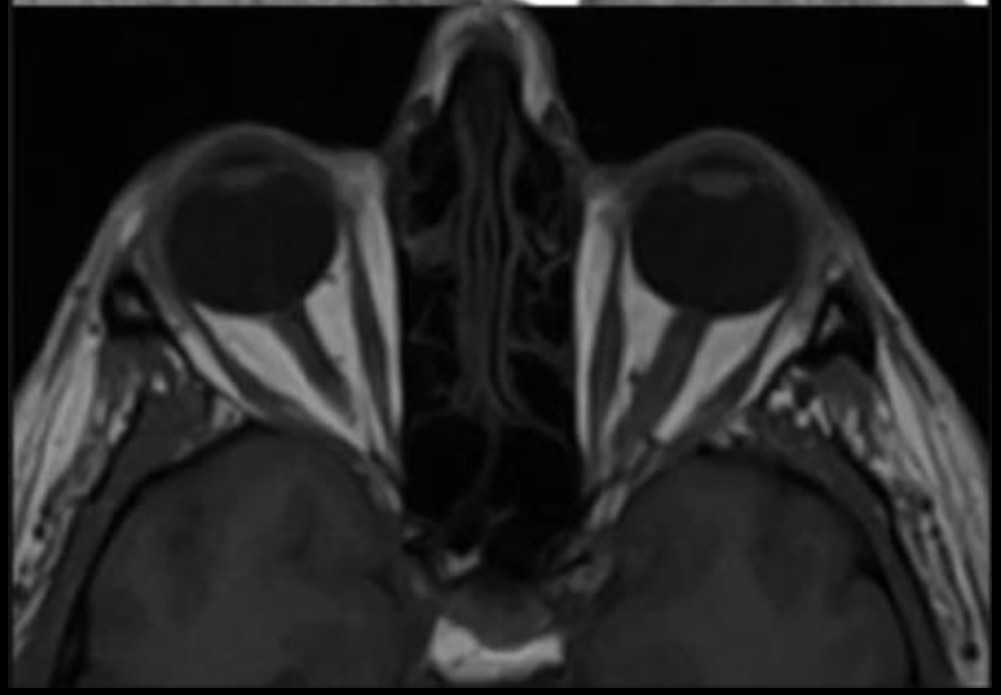


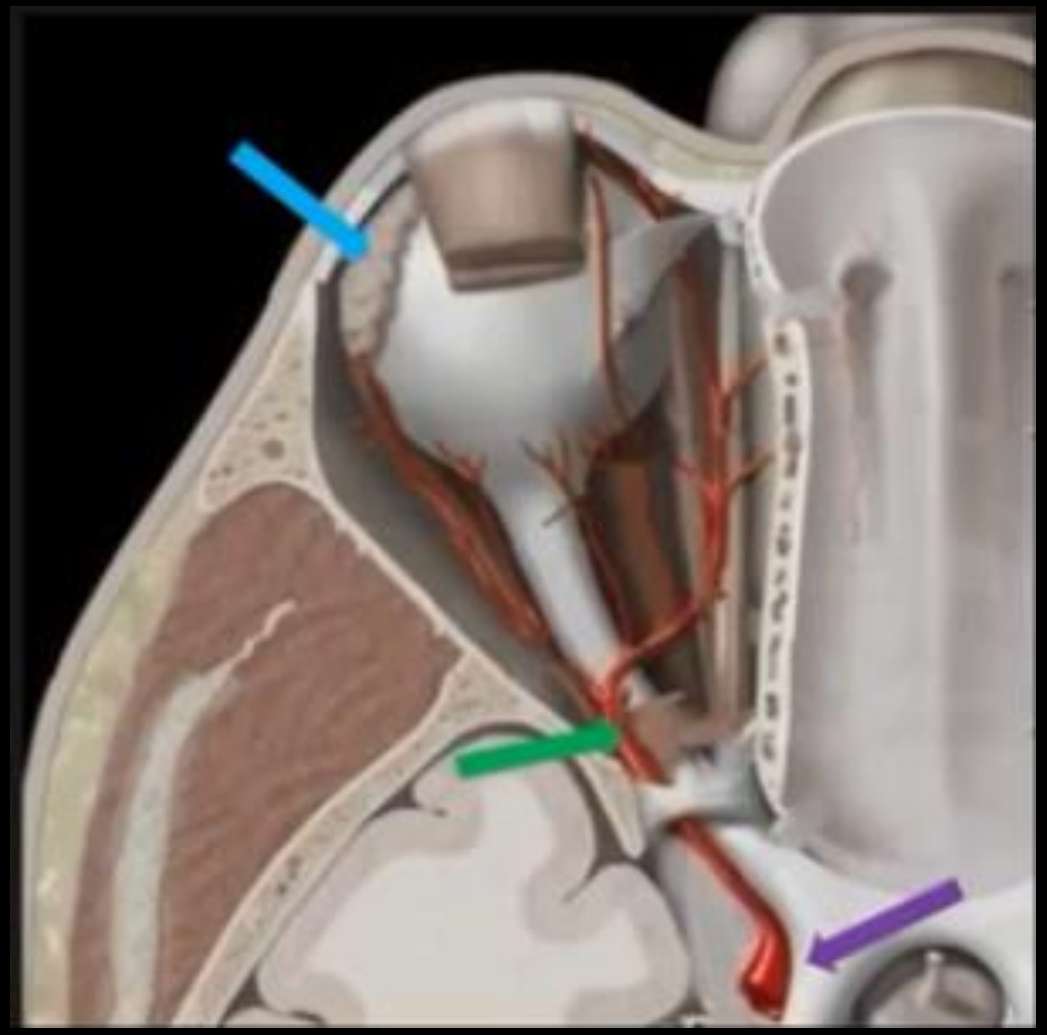
- Globe / Lens
- Lateral Rectus
- Medial Rectus
- Optic Nerve
- Ethmoid Sinus
- Optic Chiasm

CT



MRI

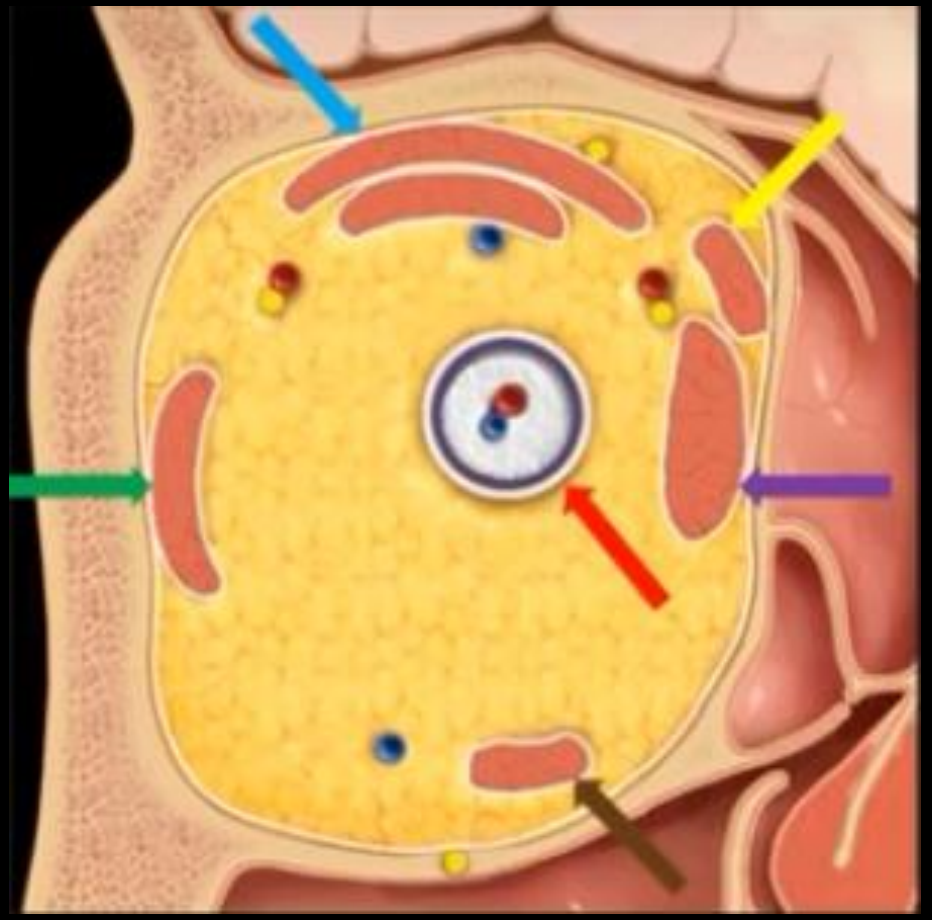




- Lacrimal Gland
- Ophthalmic Art.
- Int. Carotid Art.

Coronal CT

MRI showing lacrimal gland



- Sup. Rectus
- Lateral Rectus
- Inferior Rectus
- Medial Rectus
- Superior Obl.
- Optic Nerve

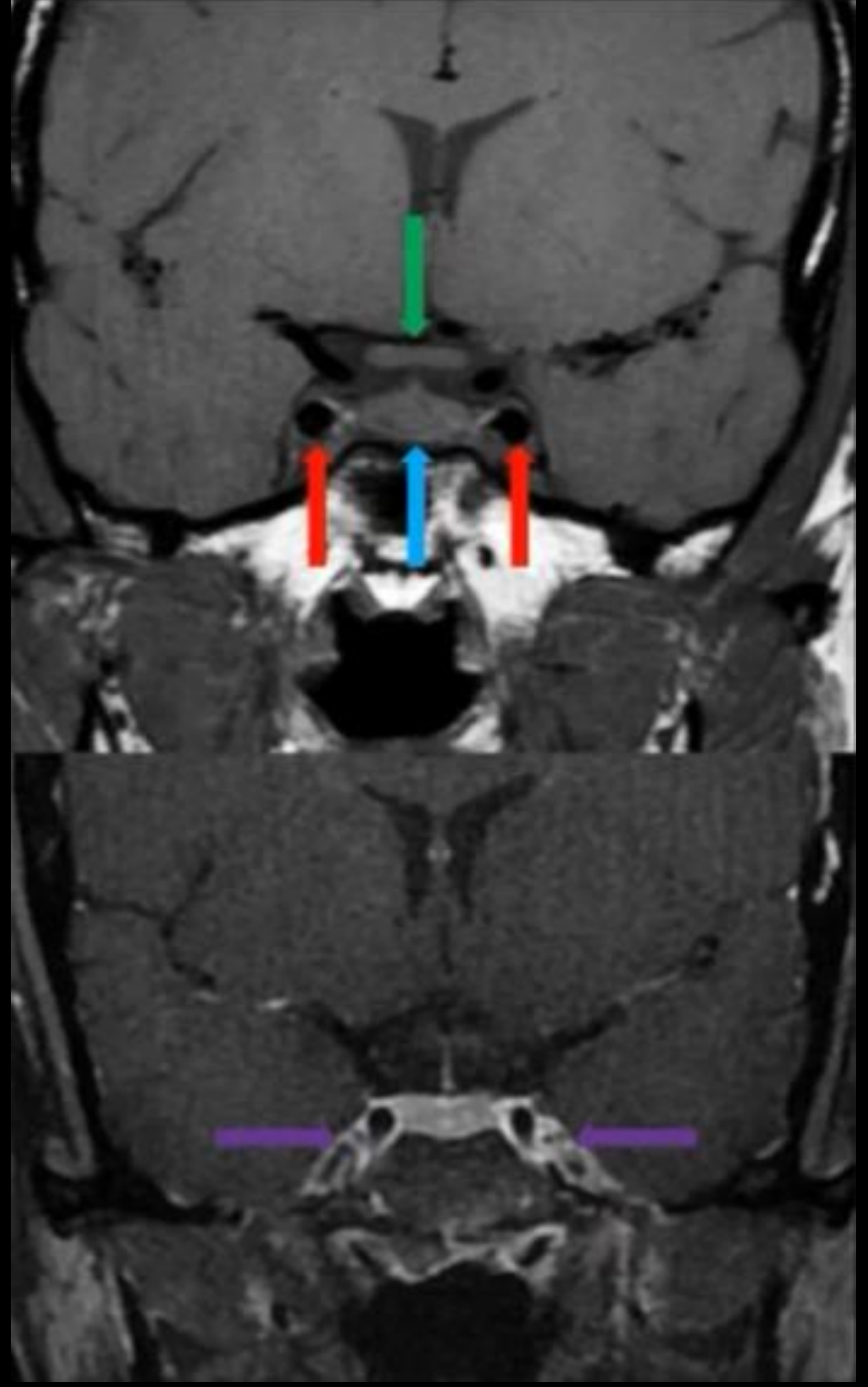
CT

MRI

- Pituitary gland
- Optic Chiasm
- Cavernous Sin.
- Int Carotid Art.
- Cranial Nerves

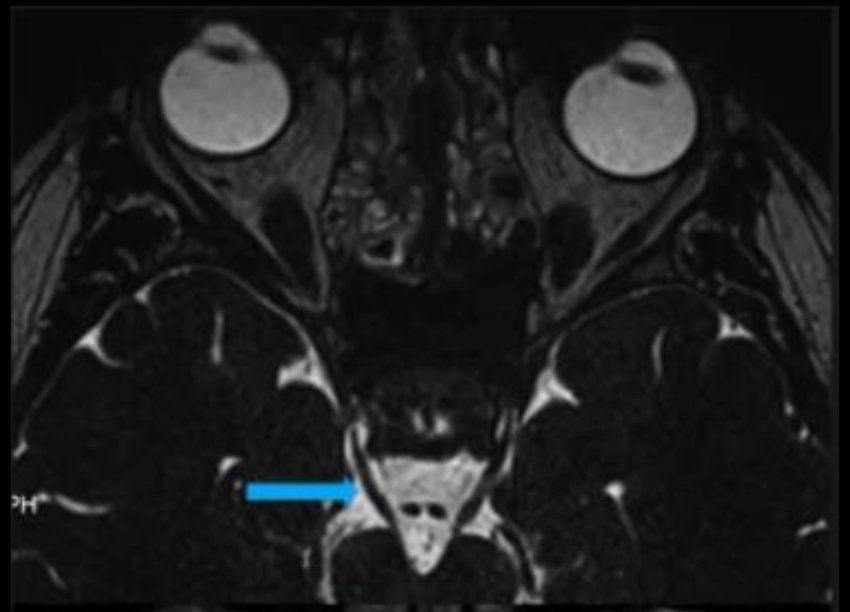
MRI

MRI

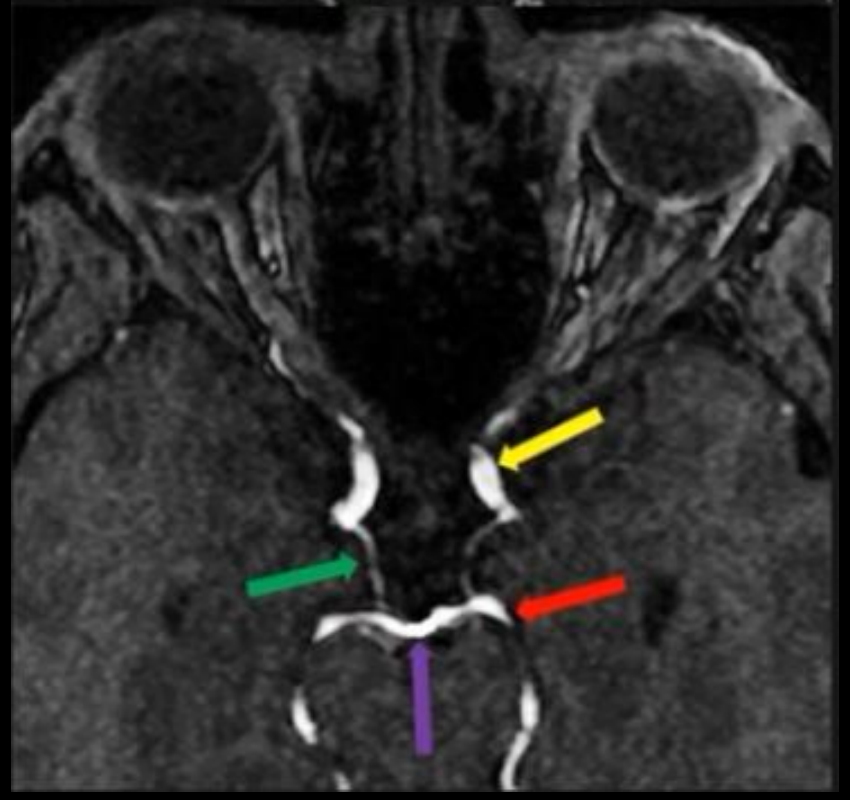


- Oculomotor N
- Int. carotid Art.
- Basilar Art.
- Post Cereb Art.
- Post Com Art.
- Sup Orb Fiss.

MRI



MRI



Orbital Infections

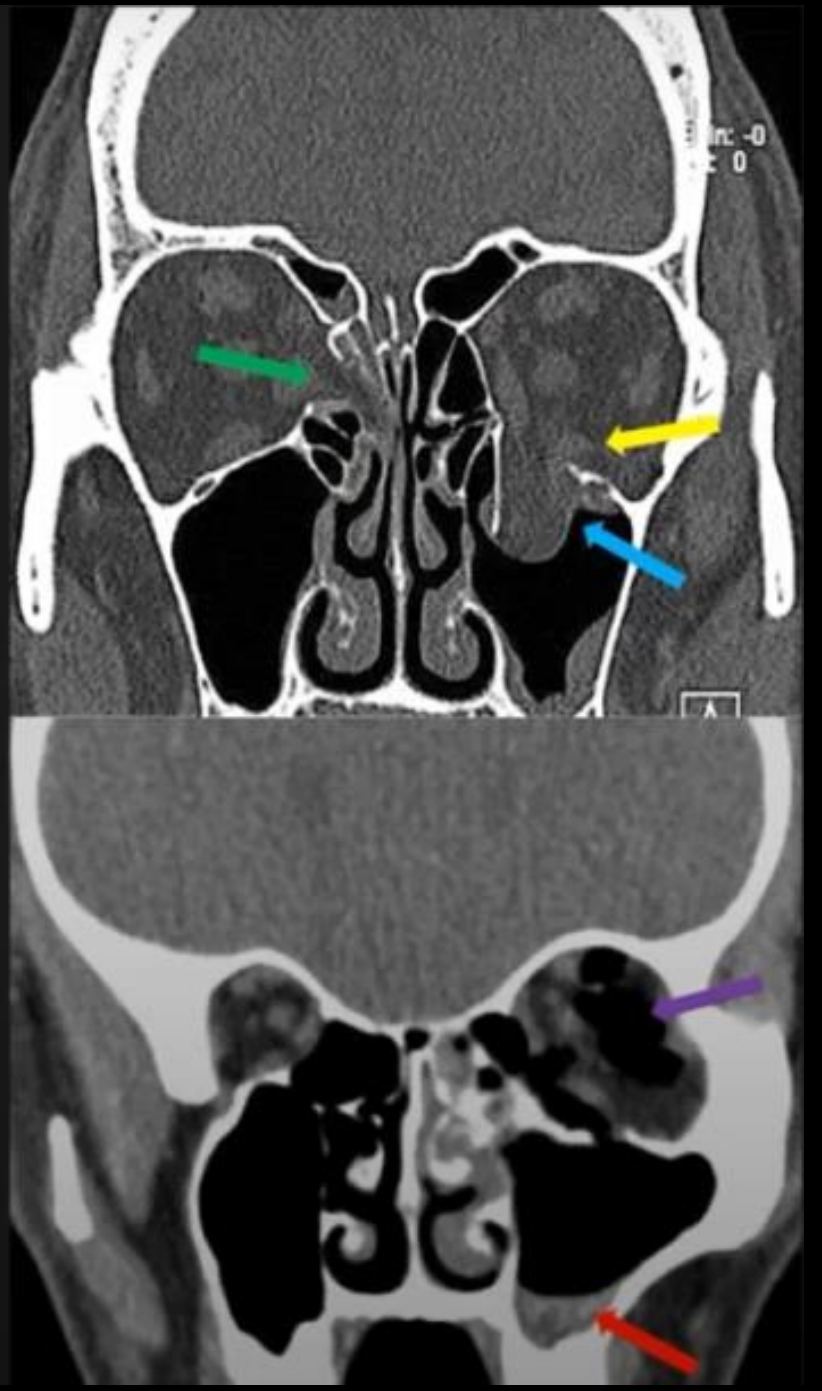
- Orbital infections often linked to rhinosinusitis.
- MRI uses fat-suppressed sequences like STIR and T2WI for orbital cellulitis detection.
- Diffusion restriction in DWI aids in suborbital periosteal abscesses detection.
- Recommended for cases of superior ophthalmic vein or cavernous sinus thrombosis, intracranial abscesses, or meningitis.
- Orbital thrombophlebitis shows high signal intensity on nonenhanced T1-weighted image.

Clinical Issues

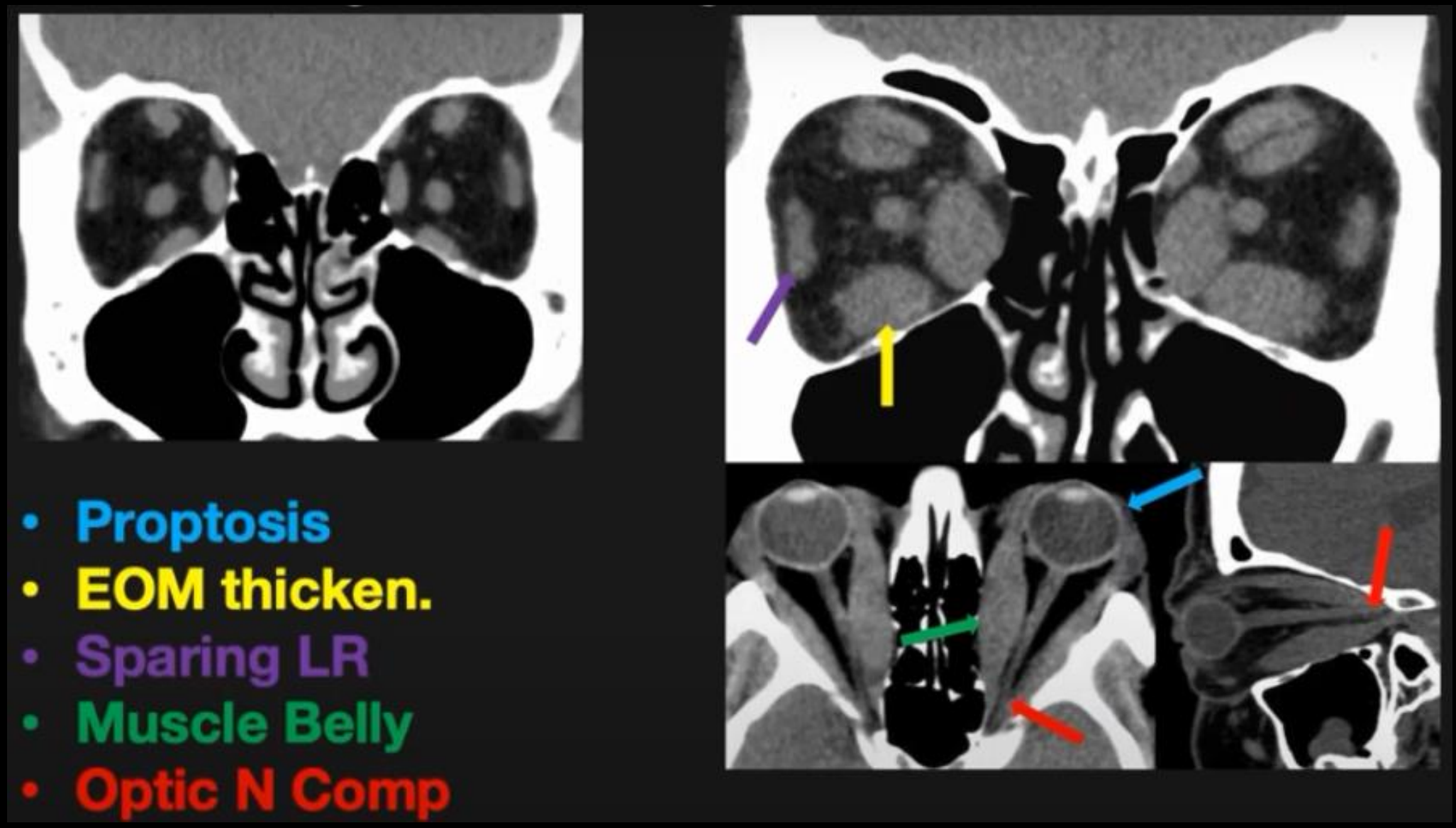
- Trauma
- Proptosis
- Visual Field Defect
- Cranial nerve involvement

Blow out Fracture

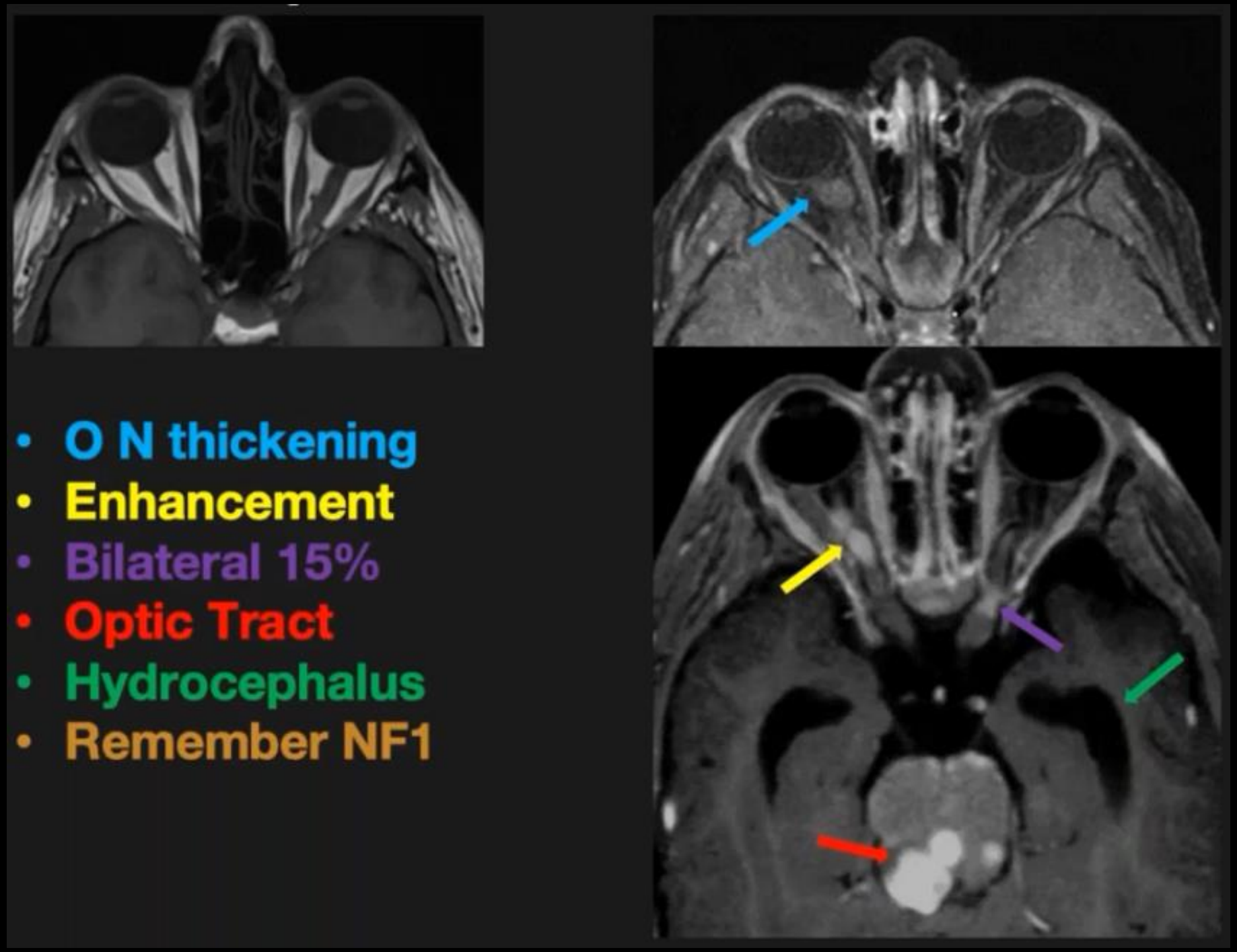
- Soft tissue
- IR entrapment
- Emphysema
- Fluid level
- Other fractures



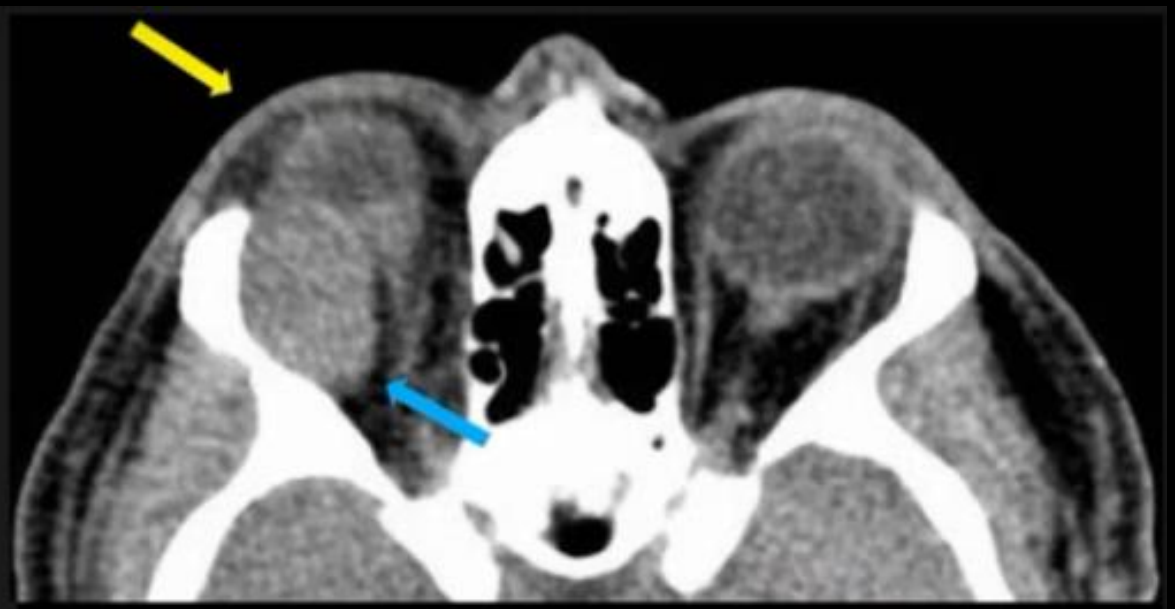
Thyroid Eye Disease



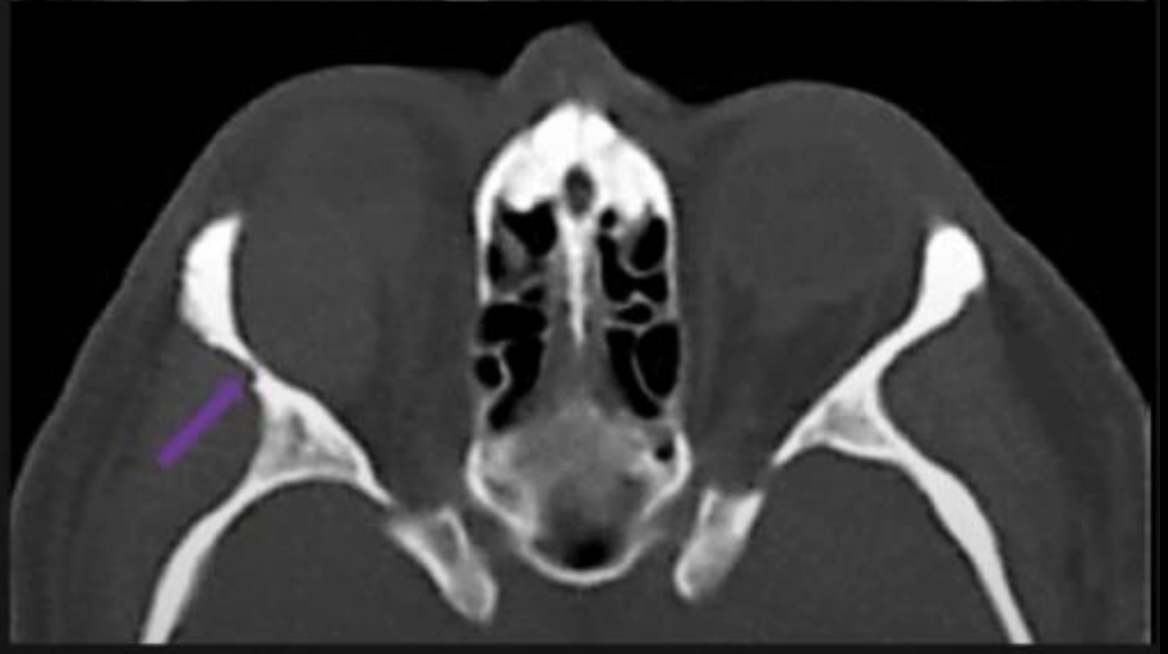
Optic Nerve Glioma



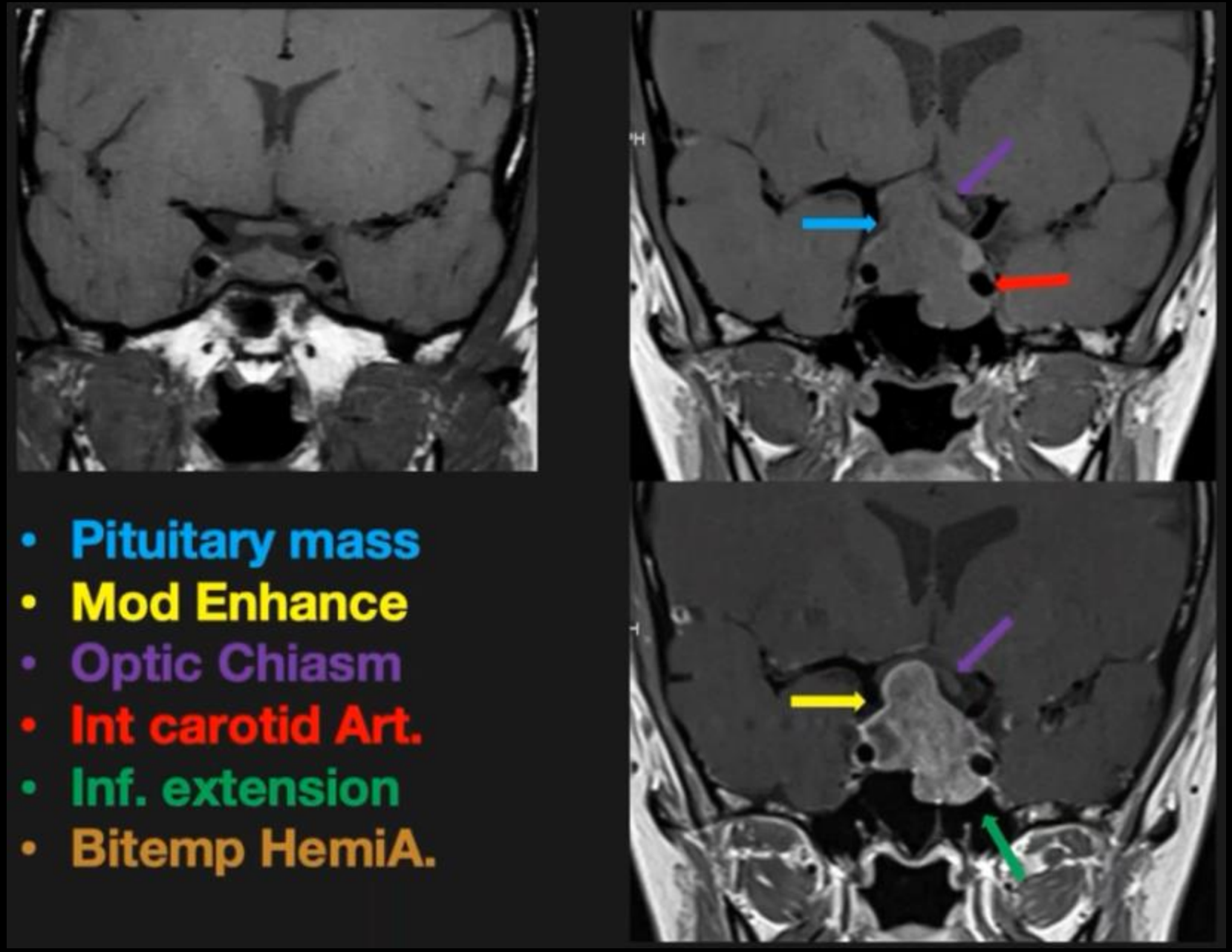
Lacrimal BMT



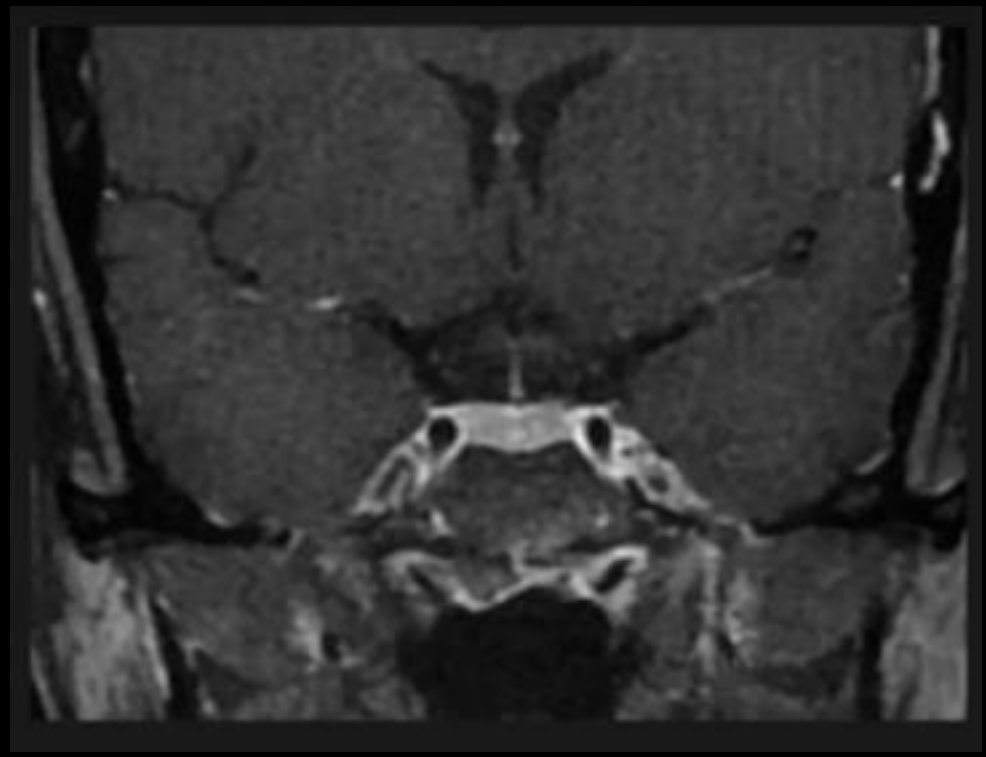
- Sup Lat mass
- Proptosis
- Fossa format.
- Slow growing
- Excision Bx



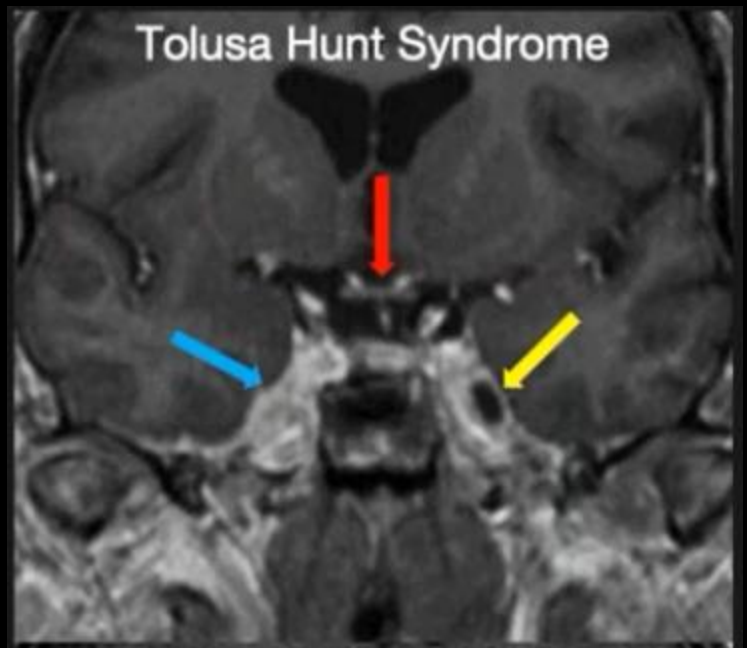
Pituitary Macroadenoma

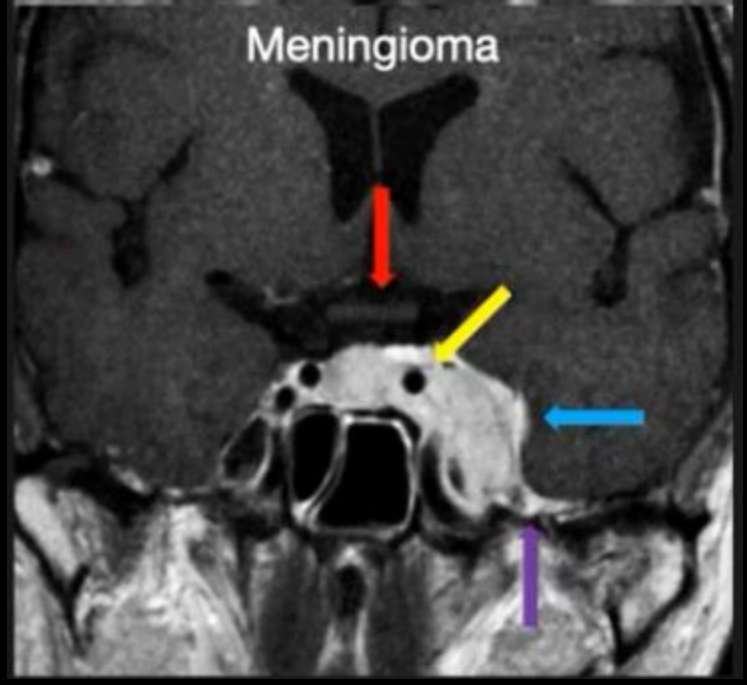


Cavernous Sinus Lesions



- Enhancing lei.
- Int. carotid Art.
- Dural Tail
- Optic Chiasm
- Acute vs Chron

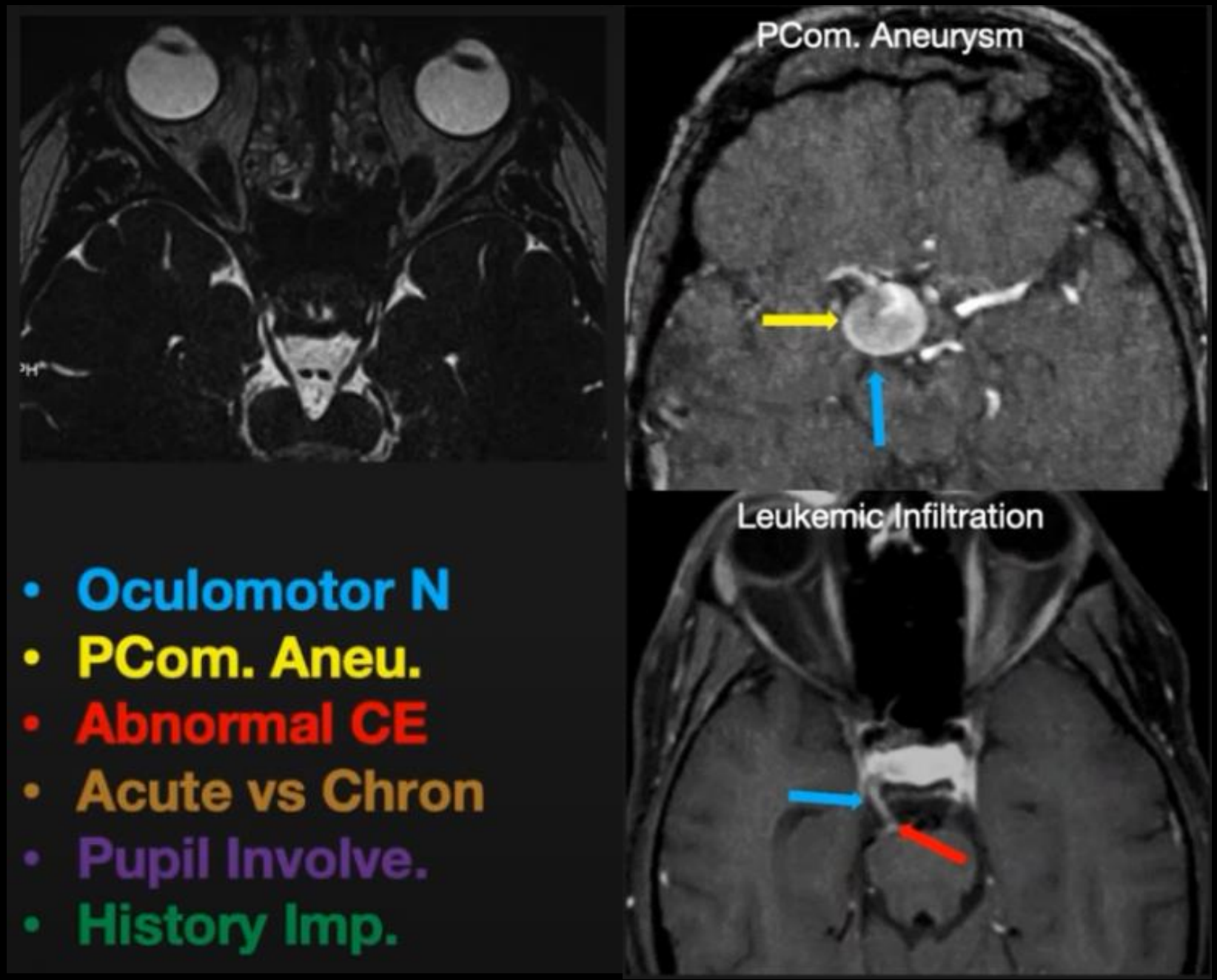




Facial Nerve Palsy

- Common cause of acute peripheral facial nerve dysfunction.
- Etiology attributed to inflammation and edema, often related to viral infection.
- Shows homogeneous enhancement of facial nerve on postcontrast T1WI, especially in segments medial to the geniculate ganglion.
- Has a higher incidence of mastoid fluid retention on MRI than Ramsey-Hunt syndrome.

III Nerve Palsy

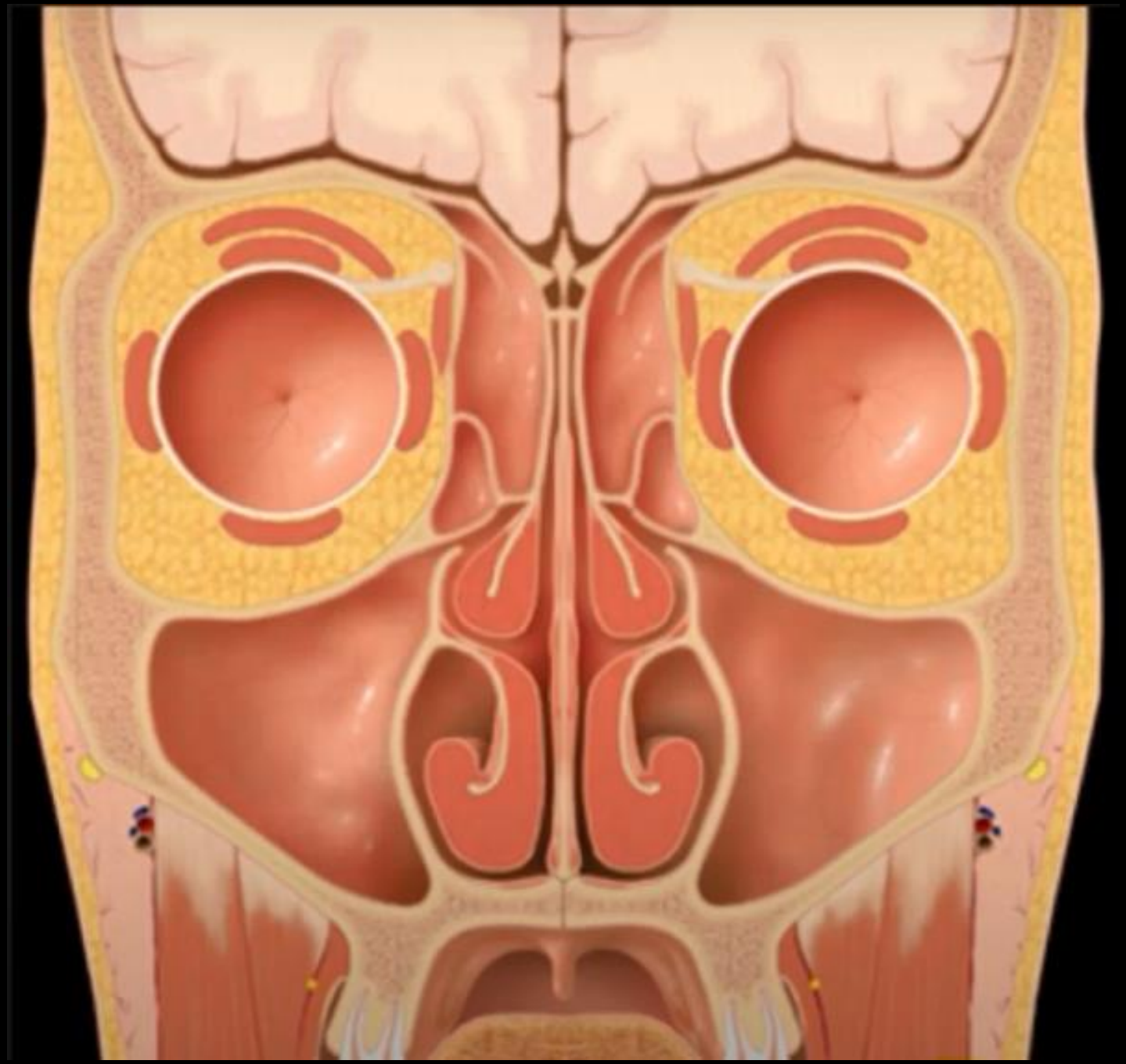


PARANASAL SINUSES

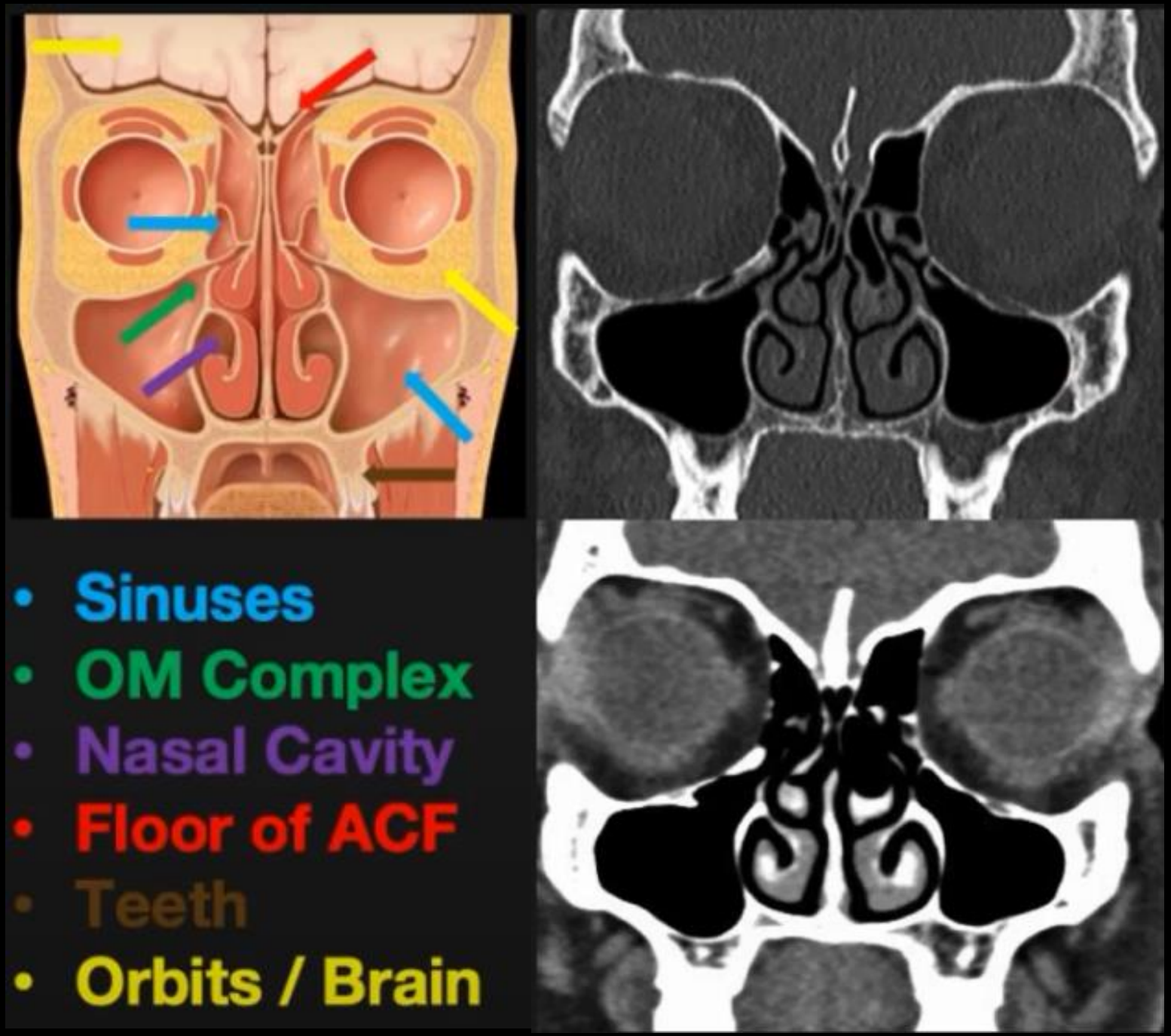
Paranasal Sinus Infections and Complications

- Can lead to complications like
  - Meningitis
  - Epidural
  - Subdural
  - Intracerebral
  - Encephalitis
  - Venous sinus thrombosis.
- • Postcontrast MRI is more effective than contrast-enhanced CT for evaluating intracranial complications

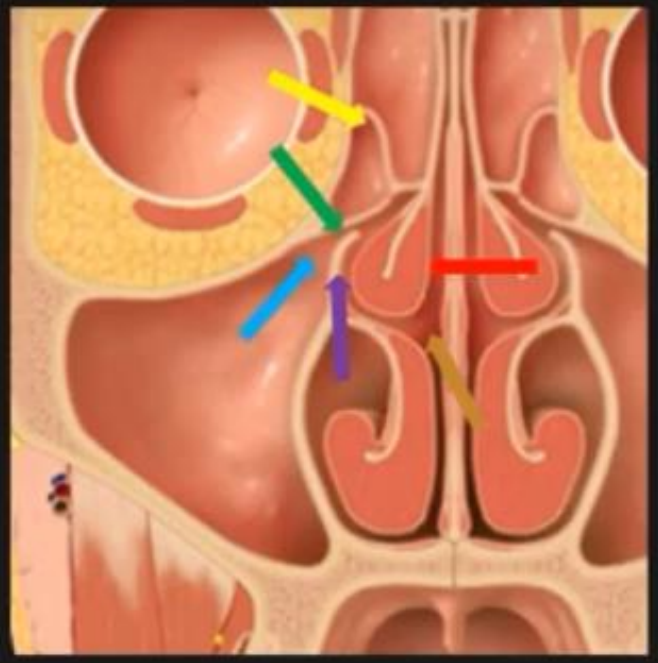
Anatomy



Sinus Overview

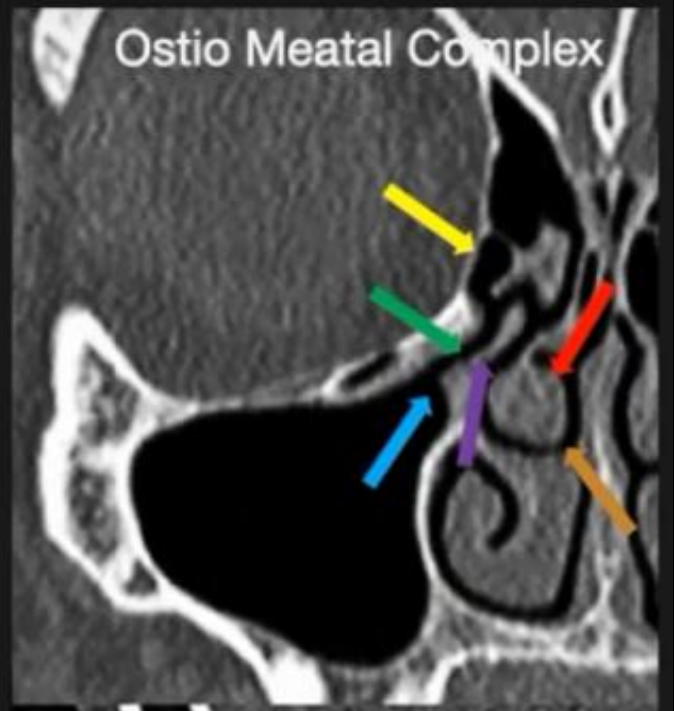


Sinus Drainage

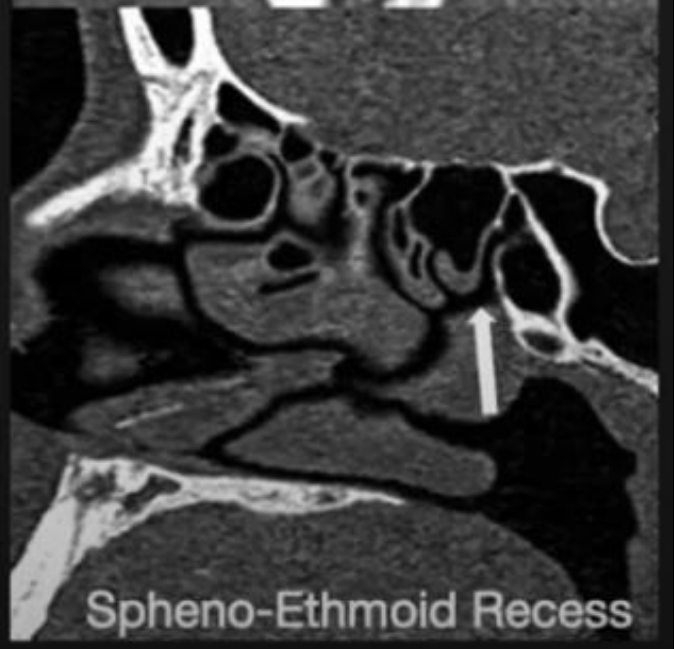


- Ostium
- Infundibulum
- Uncinate Pro.
- Middle Turb.
- Middle Meatus
- Ethmoid Bulla

OMC



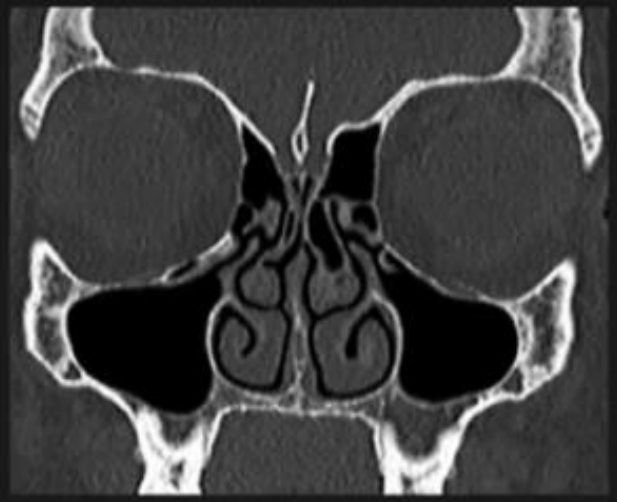
SER

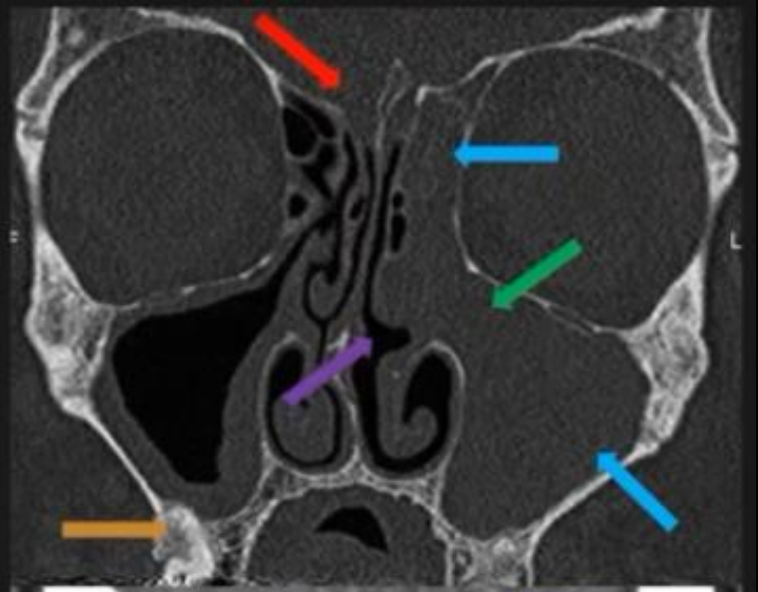


Clinical Issues

- Nasal obstruction
- Post nasal drip
- Headaches
- Facial Pain

Rhino-Sinusitis

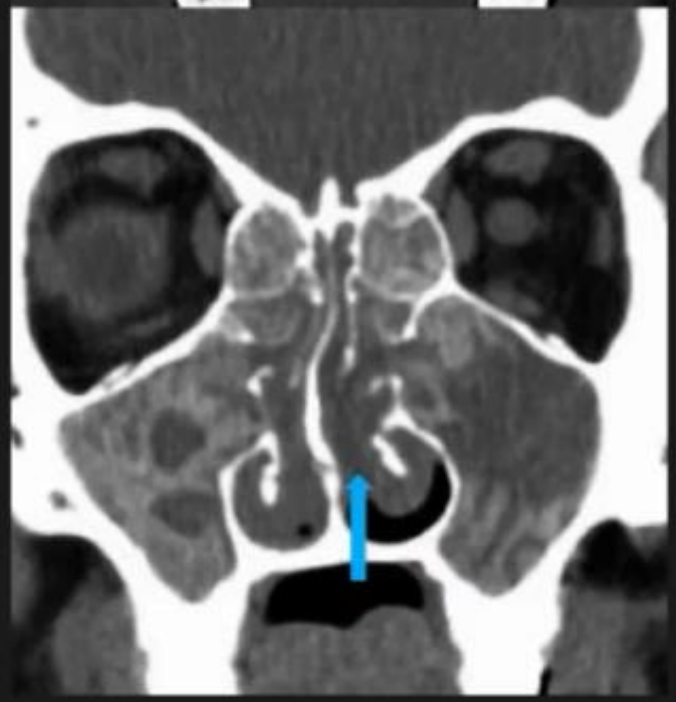




- Opacification
- OM Complex
- Nasal Cavity
- Floor of ACF
- Teeth
- Orbits / Brain

Sinonasal Polyposis

- Nasal Polyps
- OM Complex
- Sinus Opacif.



Non-invasive Fungal Rhinosinusitis

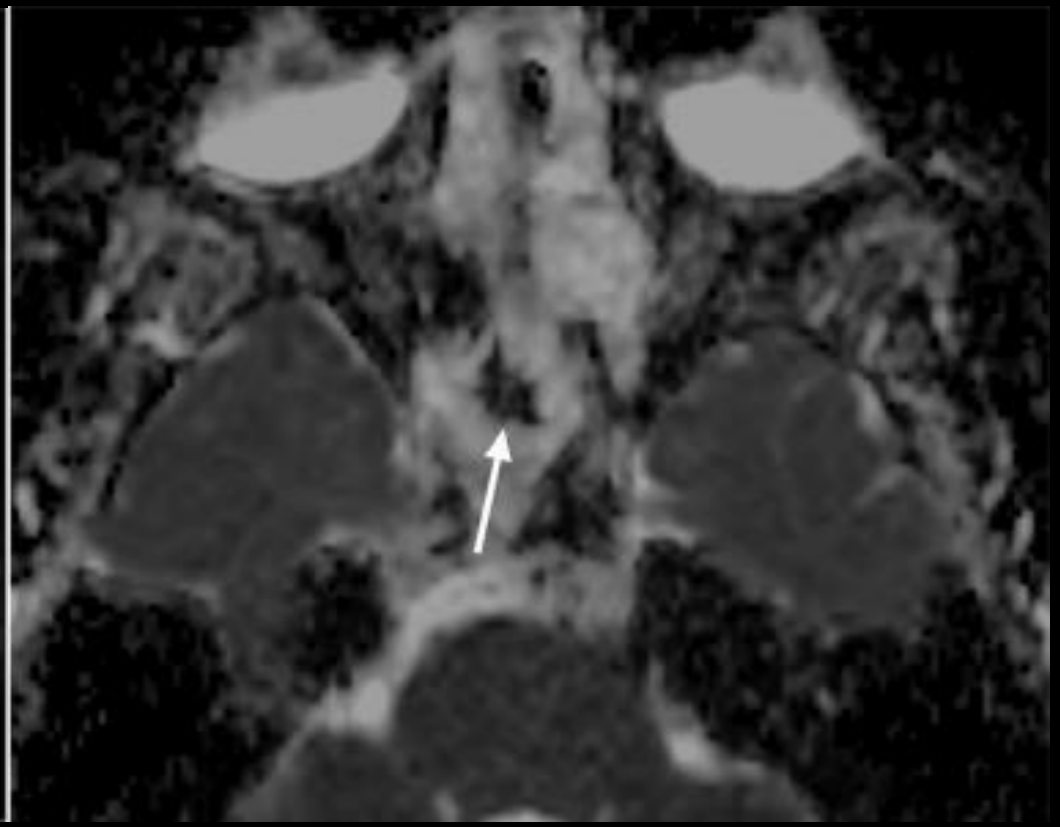
- Includes AFRS and fungal ball formation
- AFRS: Characterized by mucosal thickening and low T2WI signal intensity.
- AFRS and eosinophilic mucin rhinosinusitis share CT findings of characteristic eosinophilic allergic mucin.
- Fungal sinusitis: Lower ADC values from DWI compared to other inflammatory lesions.
- Fungal ball formation suspected when MRI shows low signal intensity on T2WI.

Invasive Fungal Rhinosinusitis

- Classified into acute, chronic, and chronic granulomatous forms.
- Characterized by nasal cavity thickening, sinuses destruction, and bone destruction.
- Diagnostic and evaluation tools for orbital and intracranial spread.
- Causes tissue ischemia, resulting in contrast-enhanced T1WI.
- Chronic sinusitis shows heterogeneous low signal on T2WI, lack of contrast enhancement on postcontrast T1WI.
- Lack of contrast enhancement on MRI is the only independent prognostic factor for disease-specific mortality.

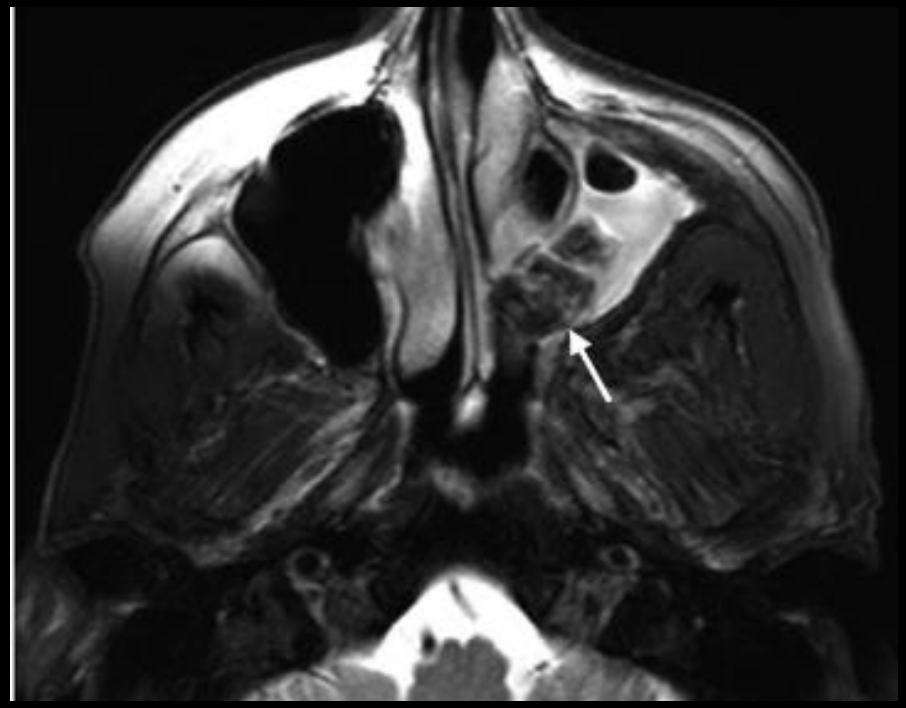
Allergic fungal rhinosinusitis

Fat-suppressed T2WI
a markedly low signal in the right sphenoid sinus (arrow).

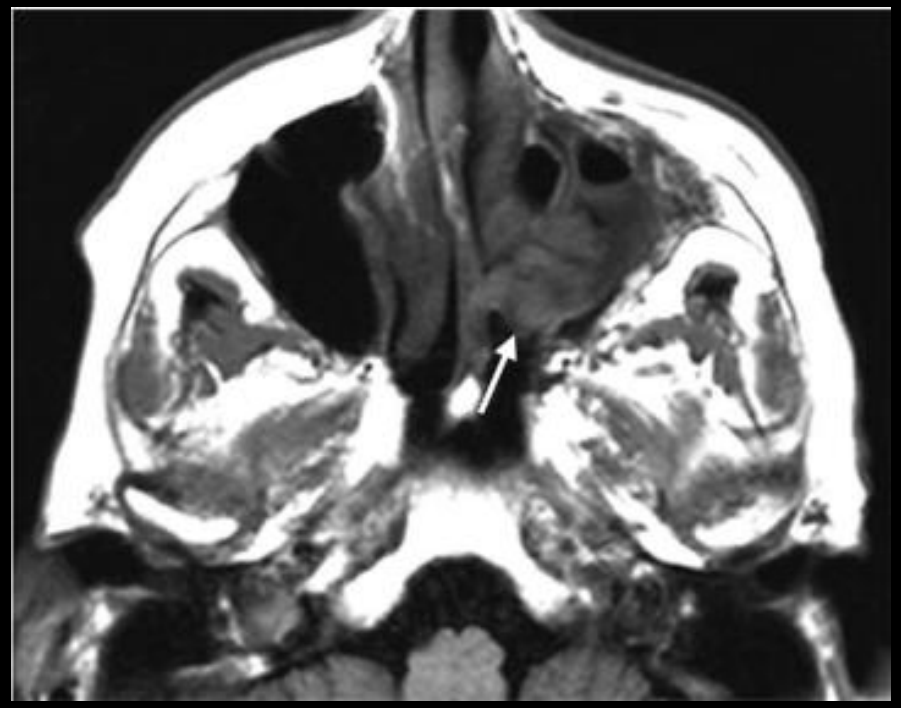


ADC
Value of the lesion was 0.53×10^{-3} mm^2/second

Fungus ball in the maxillary sinus



T2WI
a nodular structure with low signal intensity in the left maxillary sinus (arrow), consistent with a fungal ball



T1WI
the fungal ball with high signal intensity (arrow).

Invasive fungal rhinosinusitis

Contrast Enhanced - T1WI

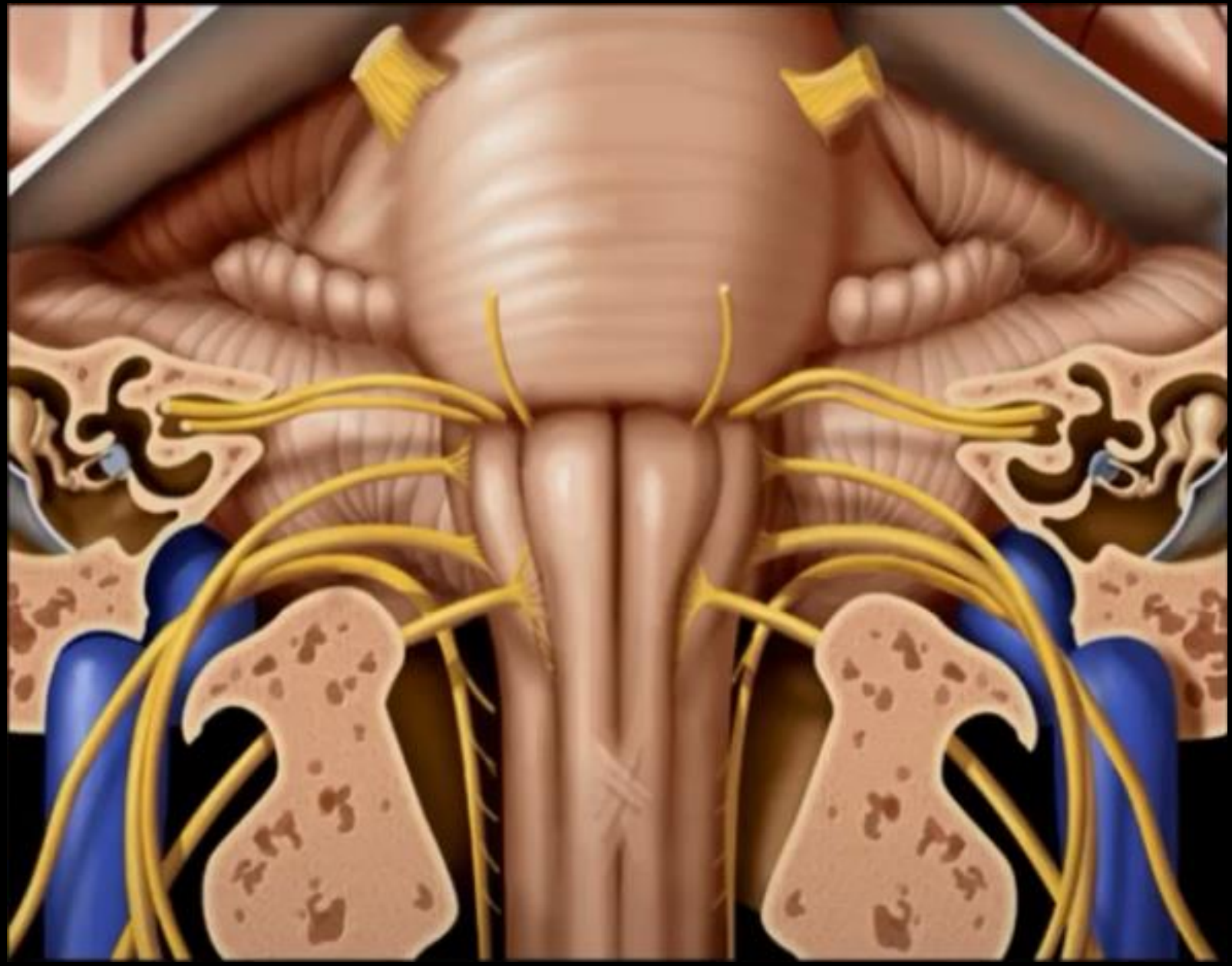
T2WI

a nonenhancing lesion (*) from the right maxillary sinus to the nasal cavity and lack of contrast enhancement of the adjacent right maxillary sinus and nasal mucosa and nasal septum (arrows)

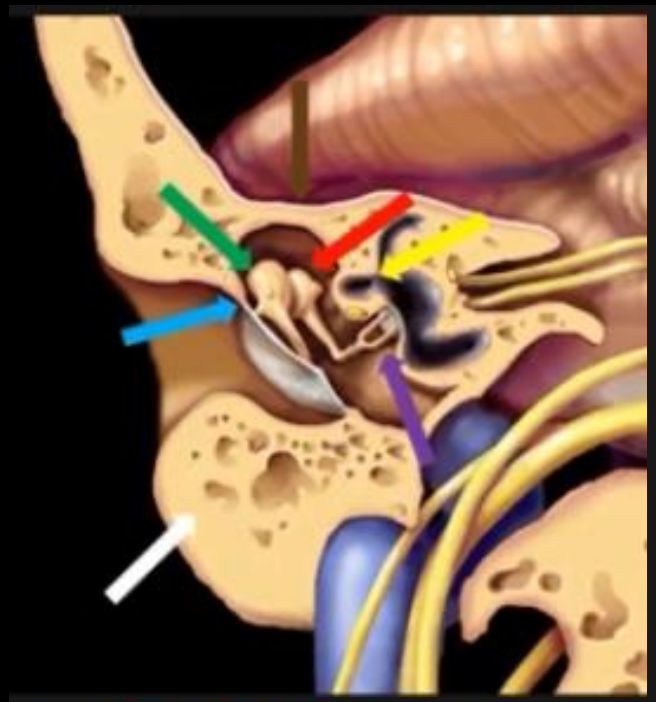
heterogeneous low-signal intensity (arrows) within the lesion.

TEMPORAL BONE

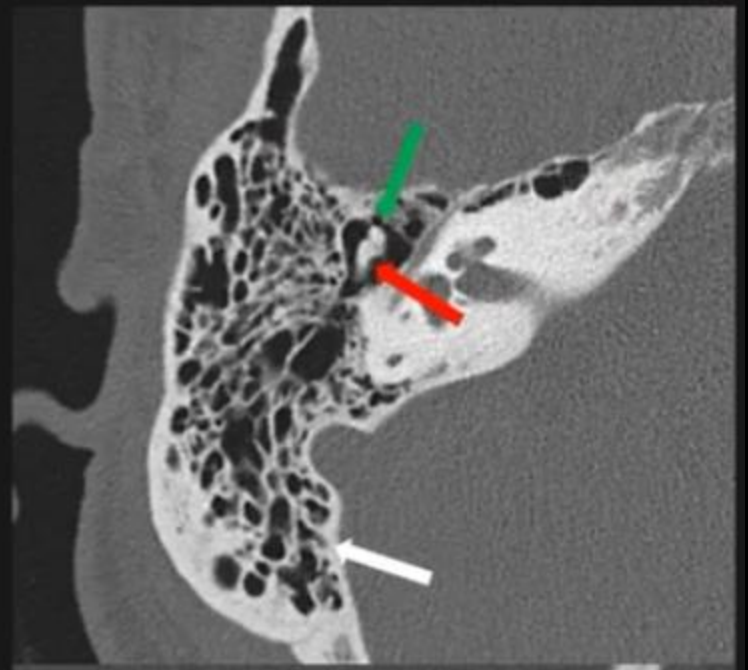
T-Bone Anatomy



Middle Ear Anatomy

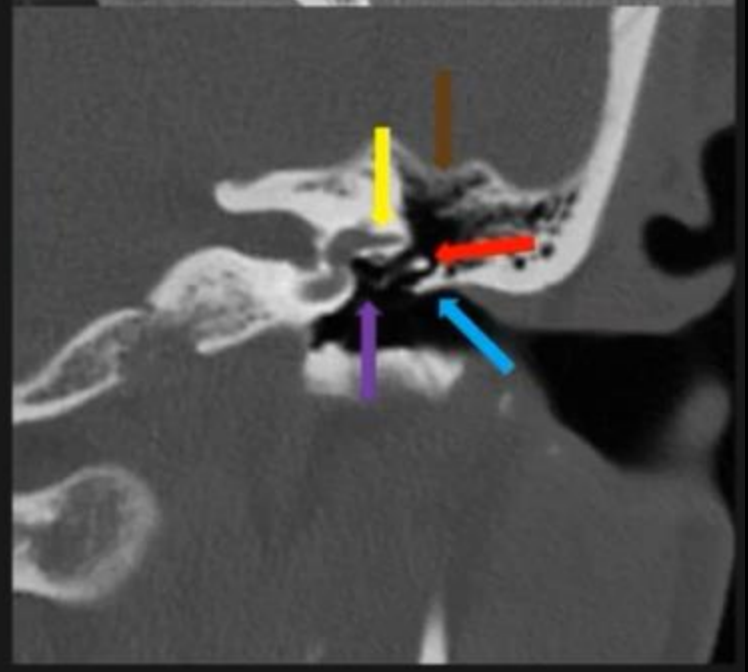


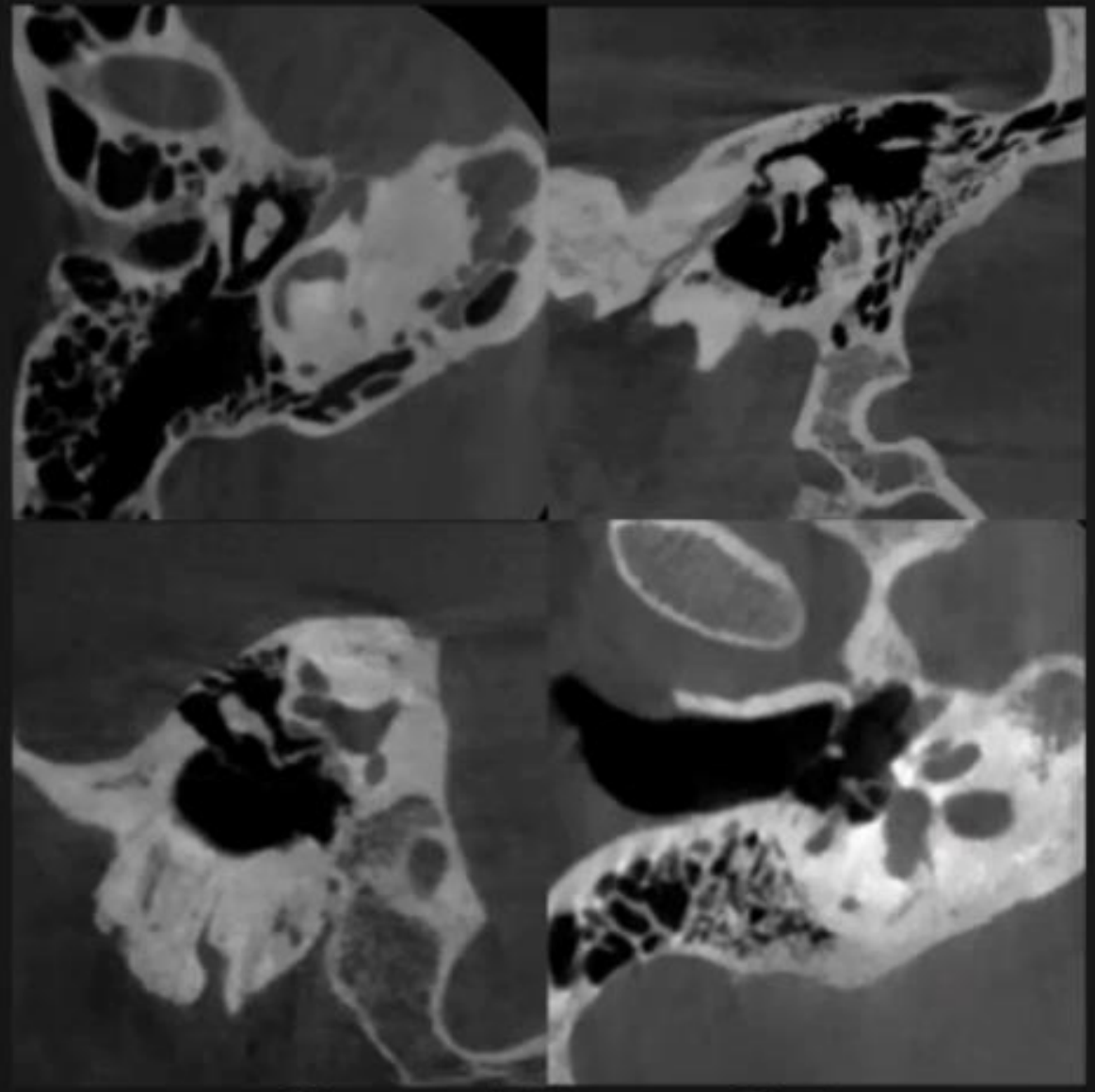
MDCT



- Scutum
- Malleus
- Incus
- Stapes
- Tegmen Tymp.
- Lat. Semi.Can.
- Mastoid

MDCT





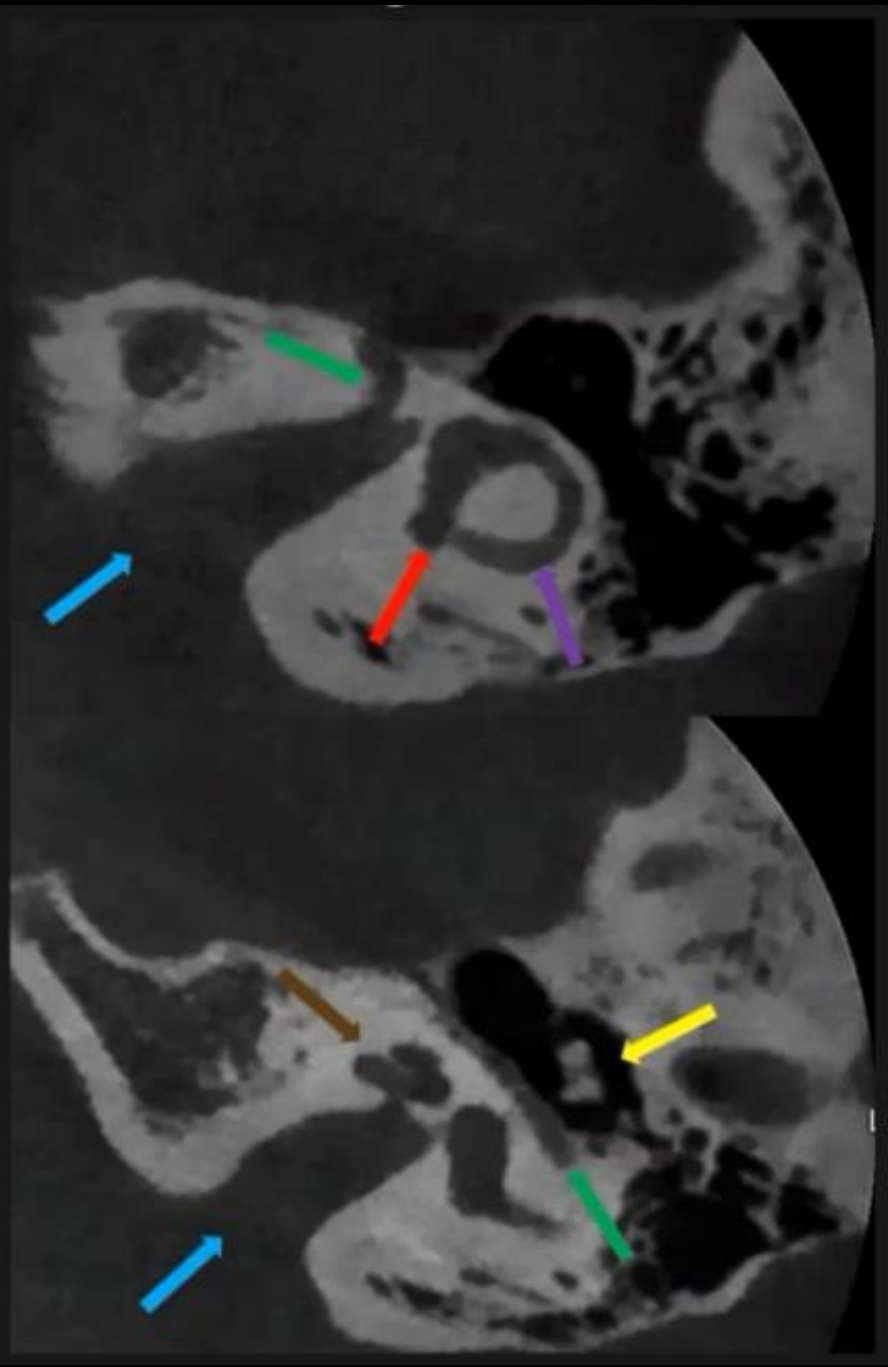
Cone Beam CT

Inner Ear Anatomy

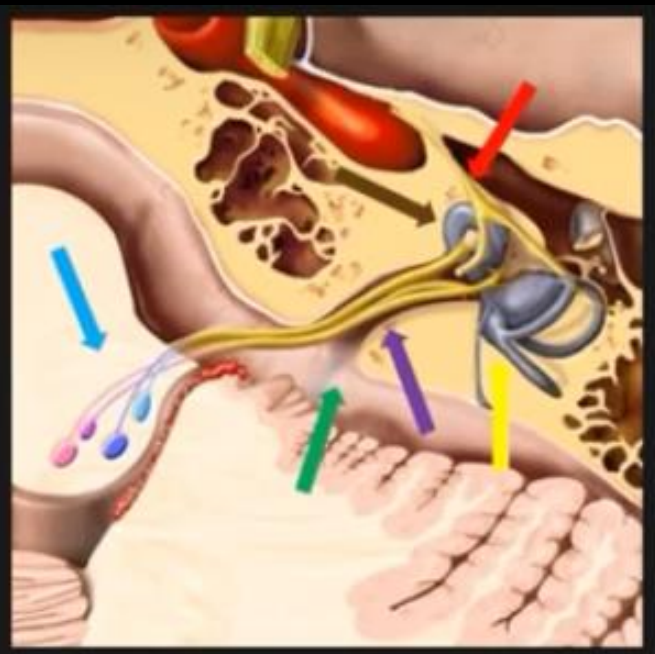
- Int. Aud. Canal
- Facial Canal
- Vestibule
- Lat. SC Canal
- Cochlea
- Ossicles

CBCT

CBCT

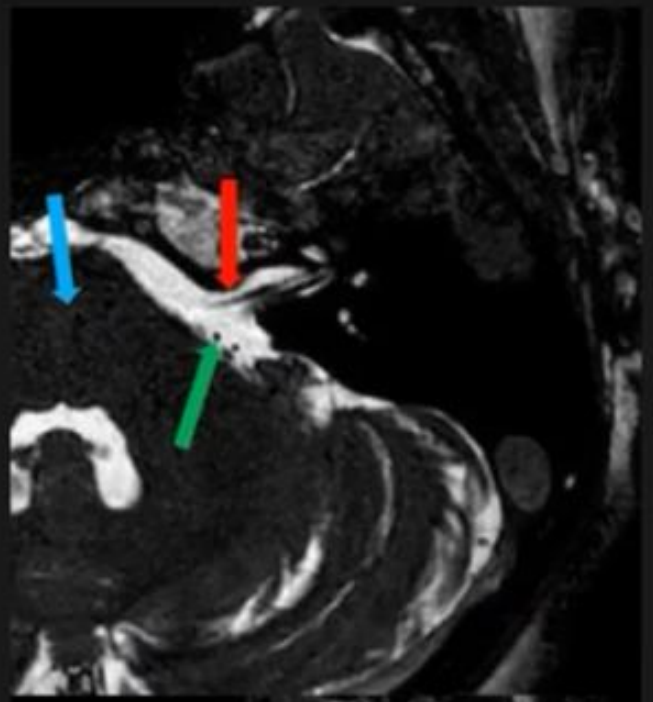


Inner Ear Anatomy-MRI

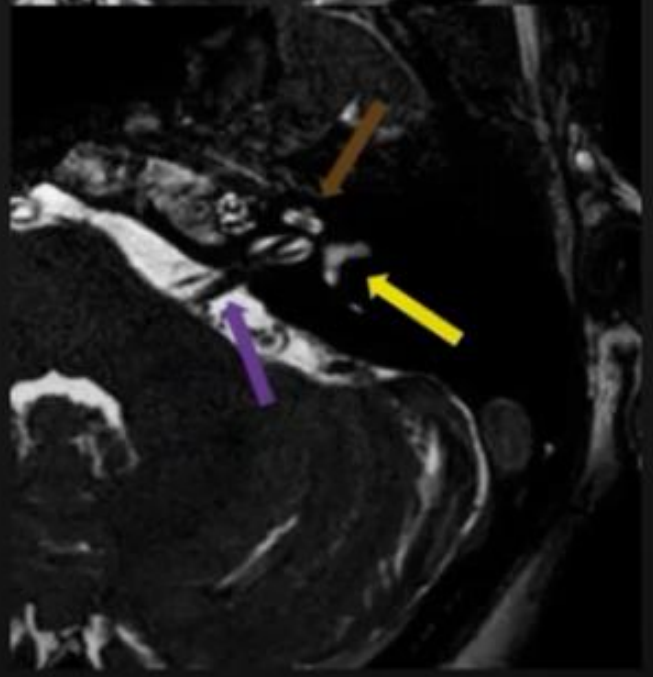


- Pons
- CPA / IAC
- Facial N
- Ves. Coch. N
- Cochlea
- Labyrinth

MRI



MRI



Clinical Issues

- Middle Ear Disease
  - Chronic Otitis Media
  - Cholesteatoma
- Hearing Loss
  - Conductive
  - Mixed
  - Sensori-Neural (Vertigo/Tinnitus)

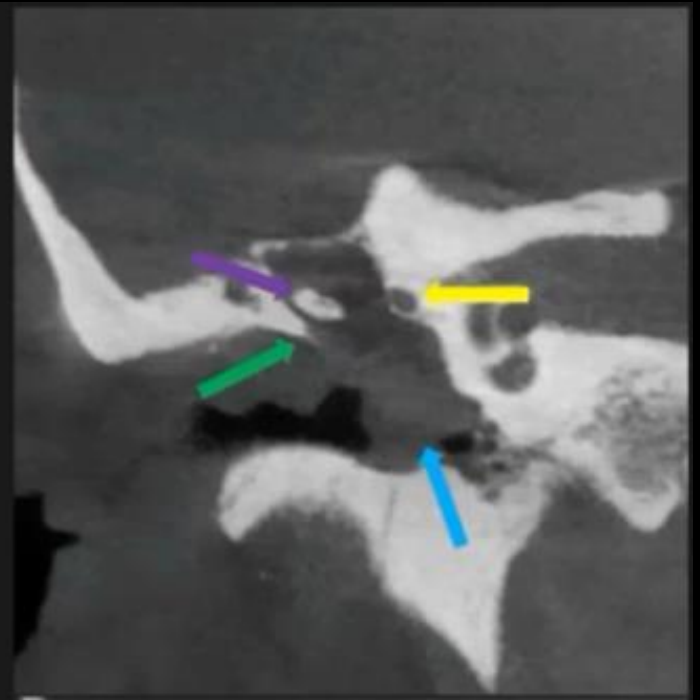
Cholesteatomas

- Cholesteatomas are benign collections of keratinized squamous epithelium in the middle ear.
- Chronic and recurrent otolaryngologic infections and inflammations are associated with cholesteatoma formation.
- Non-echoplanar DWI and temporal subtraction CT images are used for detecting cholesteatoma.
- Fusion imaging of DWI and CT/MRI improves image interpretation of cholesteatoma.

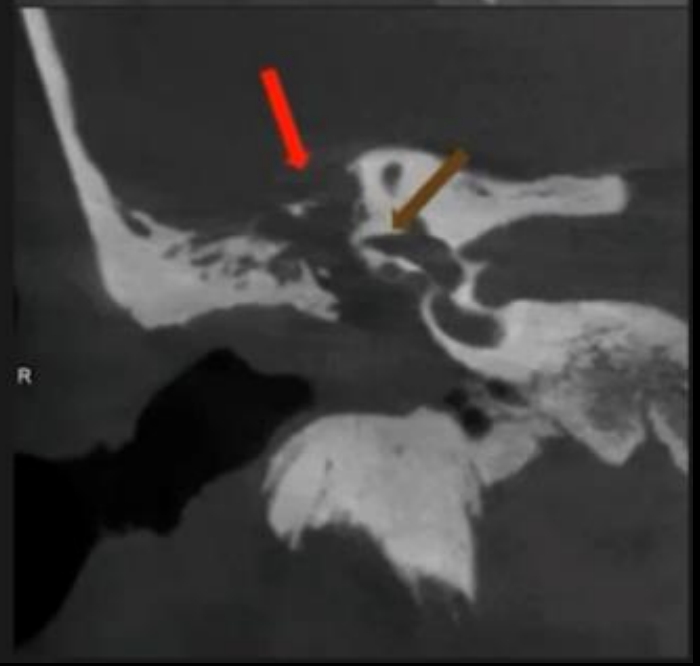
Cholesteatoma

- Opacification
- Scutum
- Oss. Erosion
- Tegmen Deh.
- Lat. SC Canal
- Facial Canal

CBCT

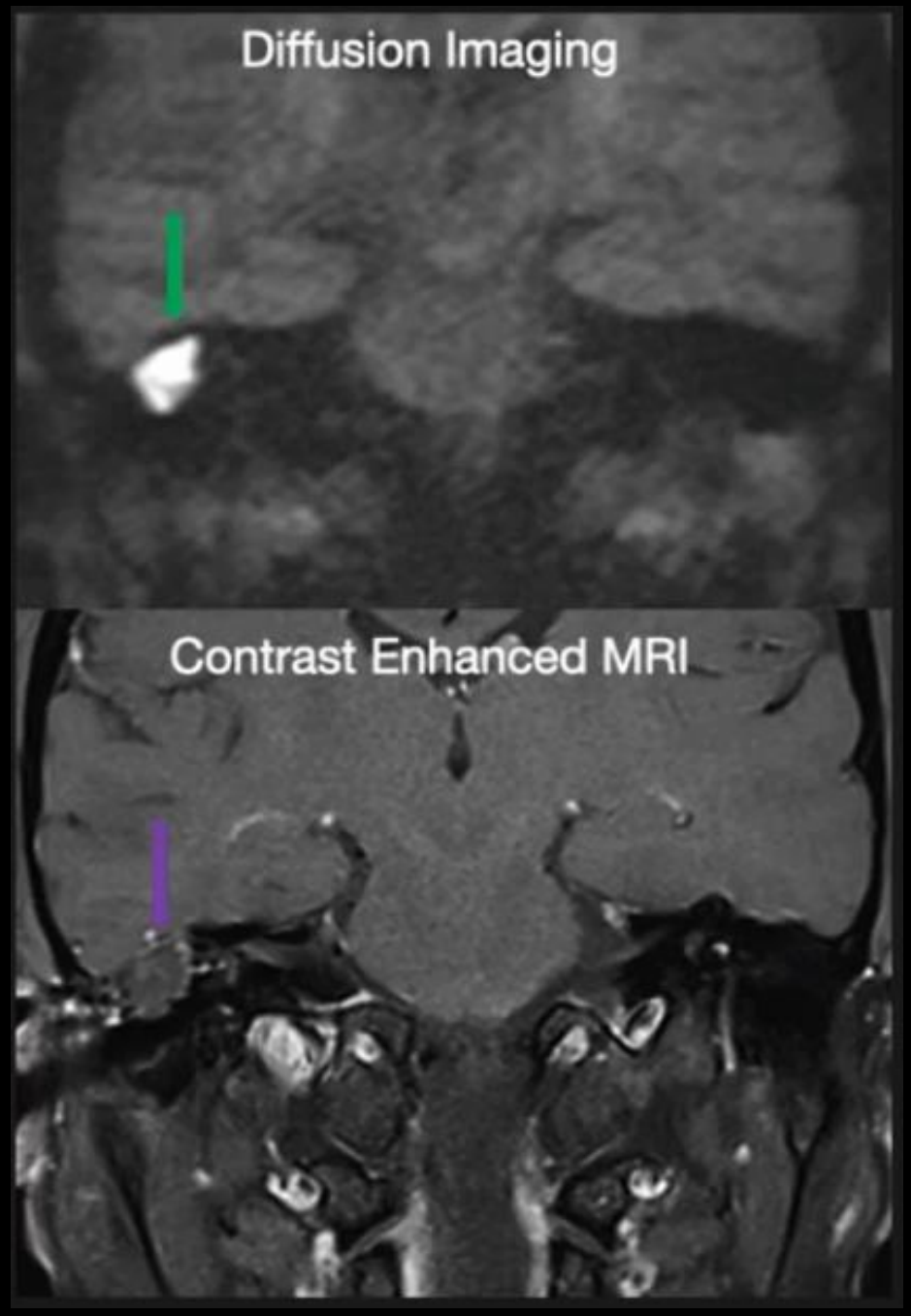


CBCT

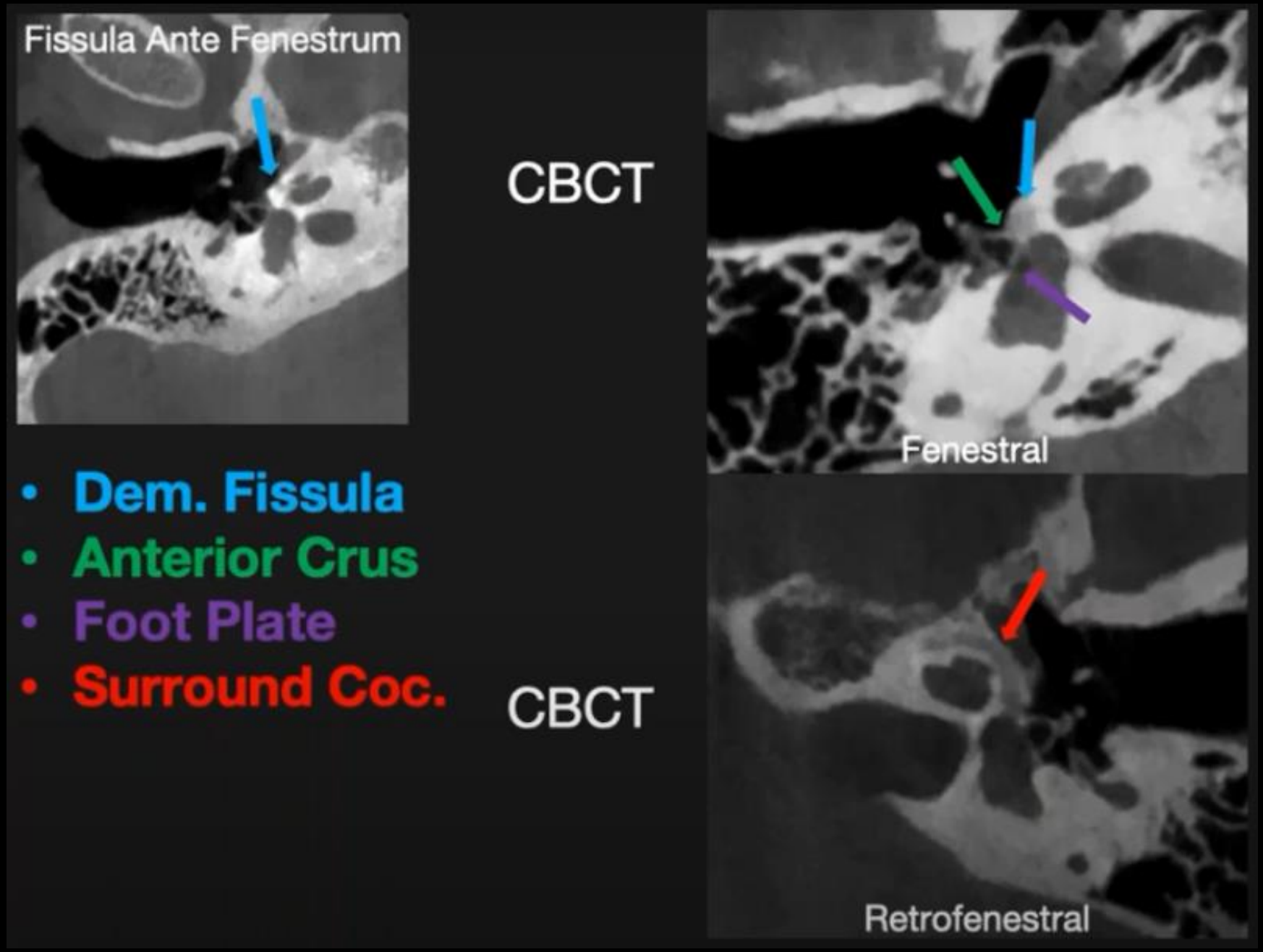


Rec. Cholesteatoma

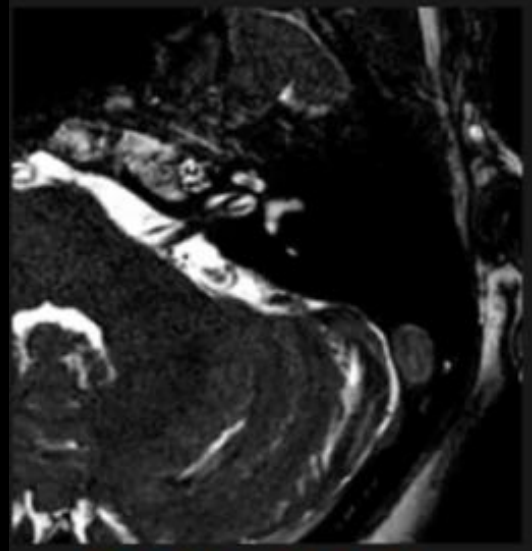
- CT Opacific.
- Res. Diffusion
- No Cont. Enhan



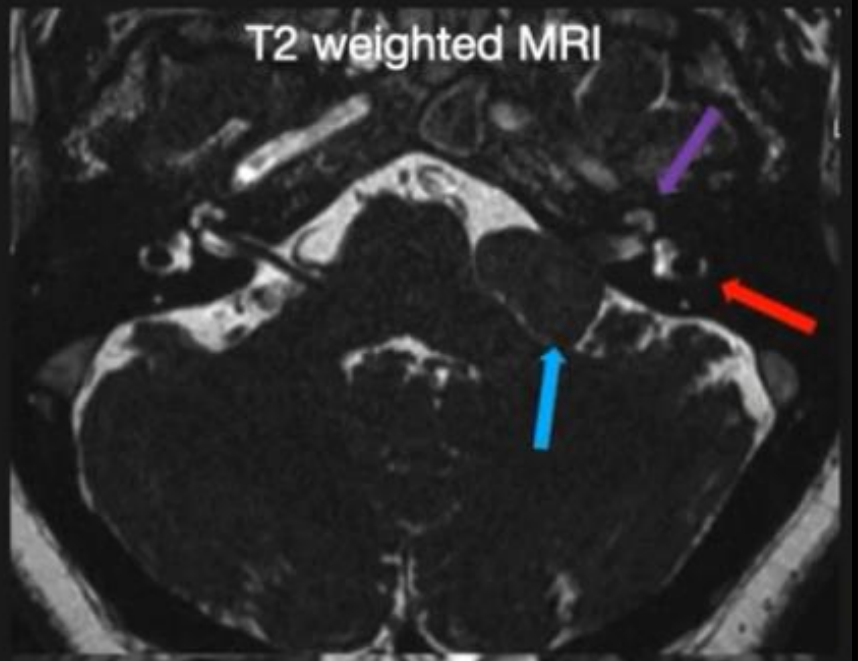
Otosclerosis

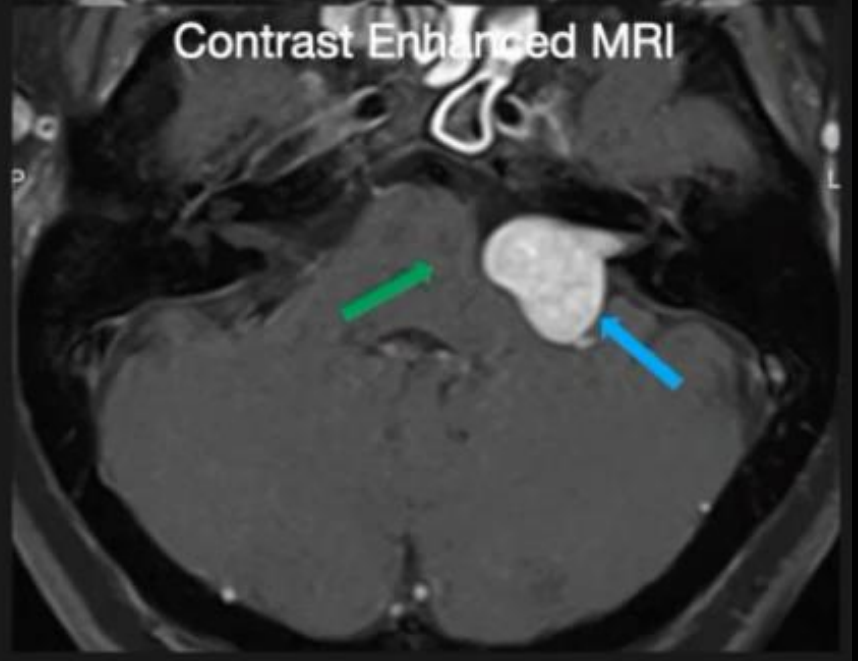


Vestibular Schwannoma



- CPA / IAC mass
- Mass effect
- Cochlea
- Labyrinth



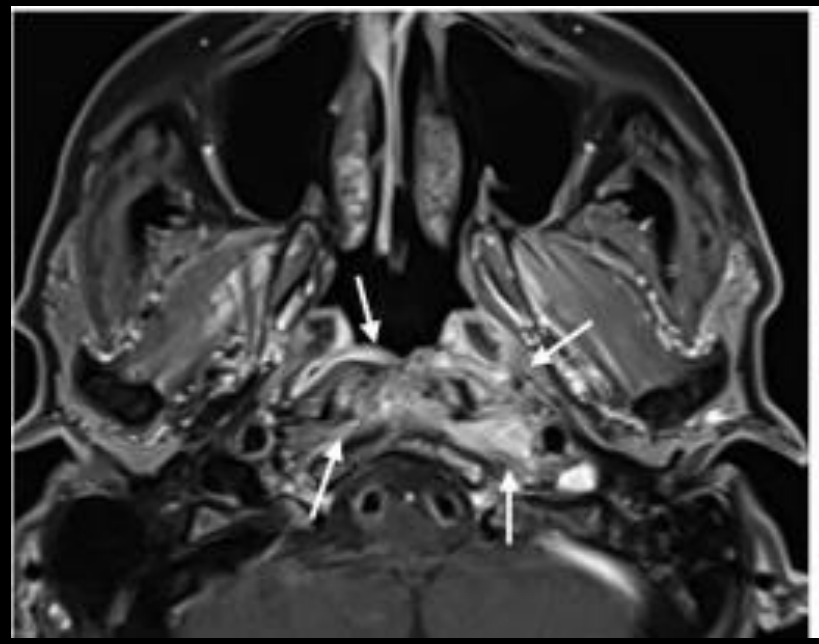


Necrotizing Otitis Externa and Skull Base Osteomyelitis

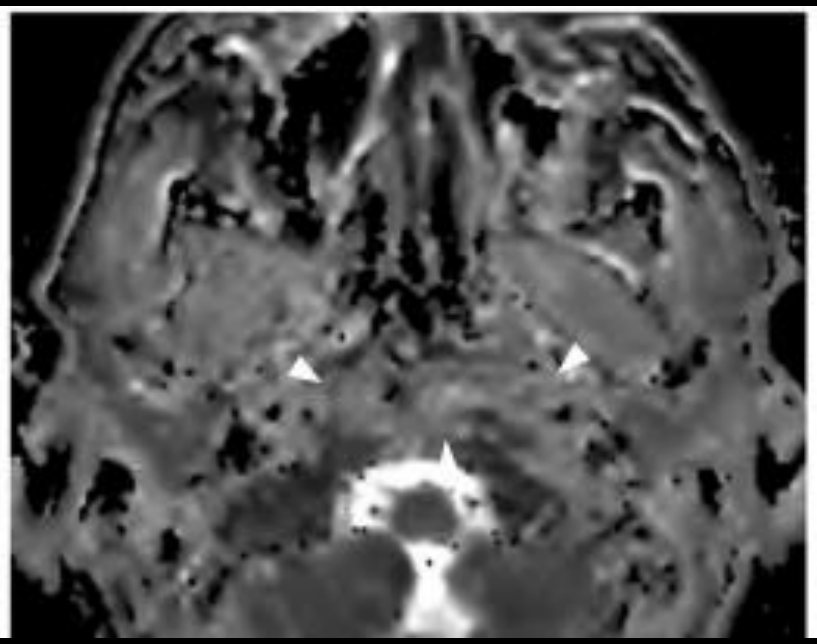
- Necrotizing otitis externa, common in elderly diabetic or immunocompromised patients, caused by Pseudomonas aeruginosa infection.
- Skull base osteomyelitis progresses to skull base osteomyelitis via temporal bone.
- MRI detects changes in skull base bone marrow.
- MR venography and MR angiography useful for suspected venous thrombosis or carotid artery occlusion.
- Advanced MRI techniques like MR bone imaging and bone subtraction iodine CT imaging visualize skull base destruction.

Skull base osteomyelitis

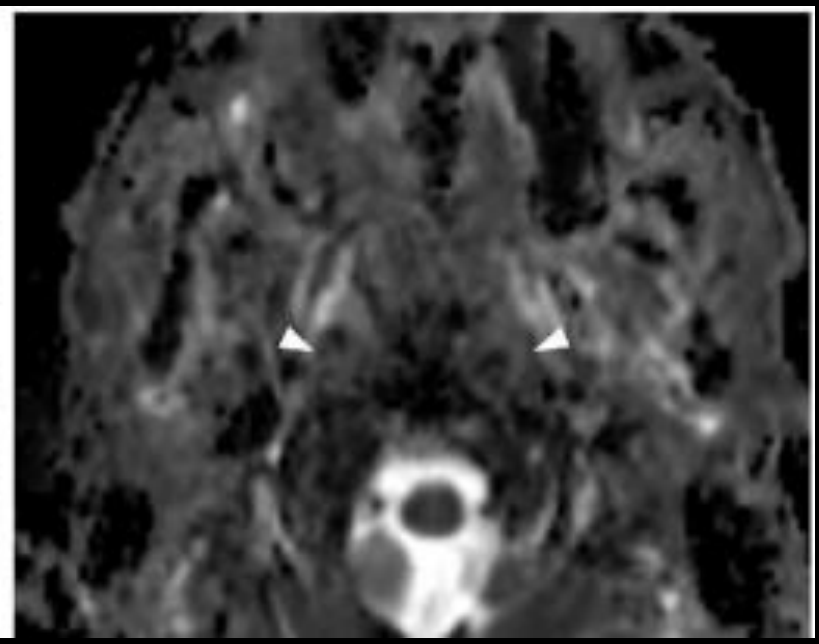
Postcontrast fat supressed - T1WI



ill-defined enhancement (arrows) in the nasopharynx, prevertebral space, and left parapharyngeal space (arrows)



The pretreatment apparent diffusion coefficient (ADC) value is 1.49 × 10–^{3} mm^{2}/second (arrowheads)



The posttreatment apparent diffusion coefficient (ADC) value is 0.94 × 10–^{3} mm^{2}/second (arrowheads)

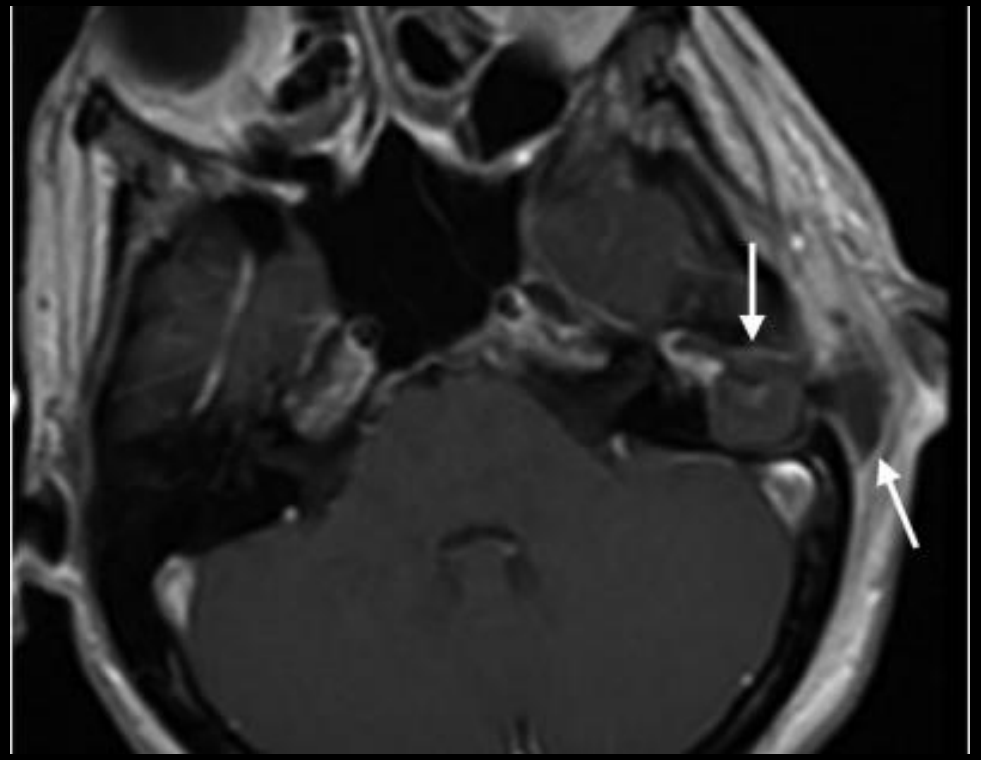
Necrotizing otitis externa & skull base osteomyelitis

Contrast-enhanced fat-suppressed T1WI shows diffuse heterogeneous enhancement (arrows) consistent with inflammation of the bilateral nasopharynx, skull base, and clivus

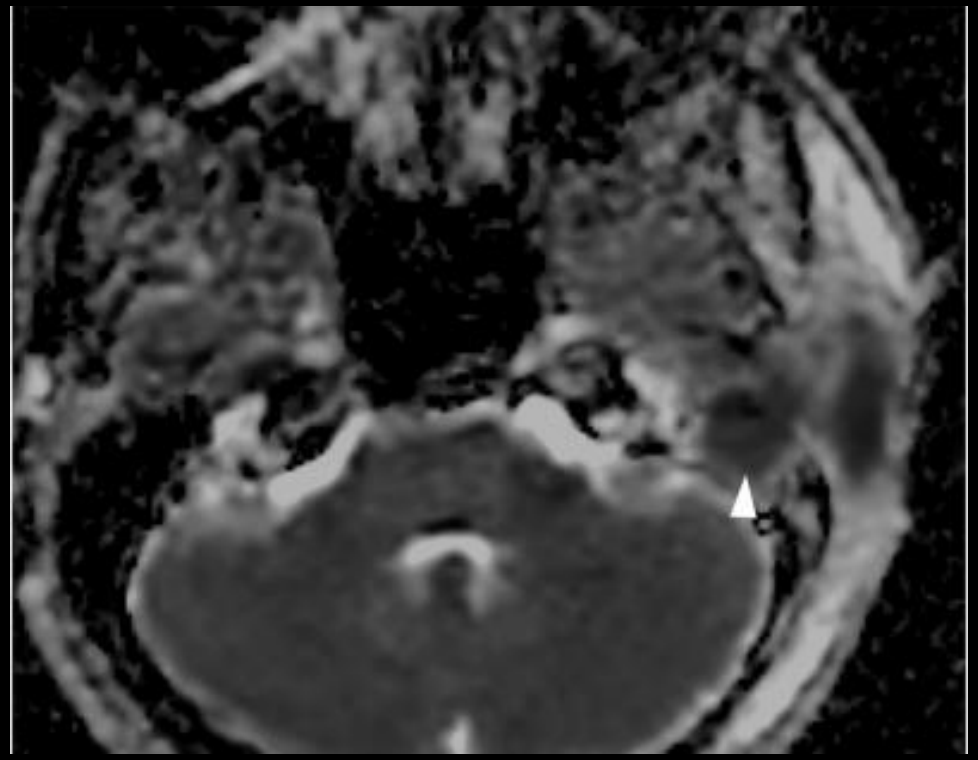
Acute Mastoiditis

- Acute mastoiditis is a common complication of acute otitis media.
- It occurs when a mucoperiosteal infection in a mastoid cell spreads to the bones.
- Common MRI complications include intratemporal abscess (23%), subperiosteal abscess (19%), and labyrinthine involvement (16%).
- Abscesses associated with rim enhancement on contrast-enhanced T1WI and high signal intensity on DWI.
- ADC values greater than 1.2×10^{-3} mm^2/second have a negative predictive value of 92%.

Complicated Coalescent Mastoiditis



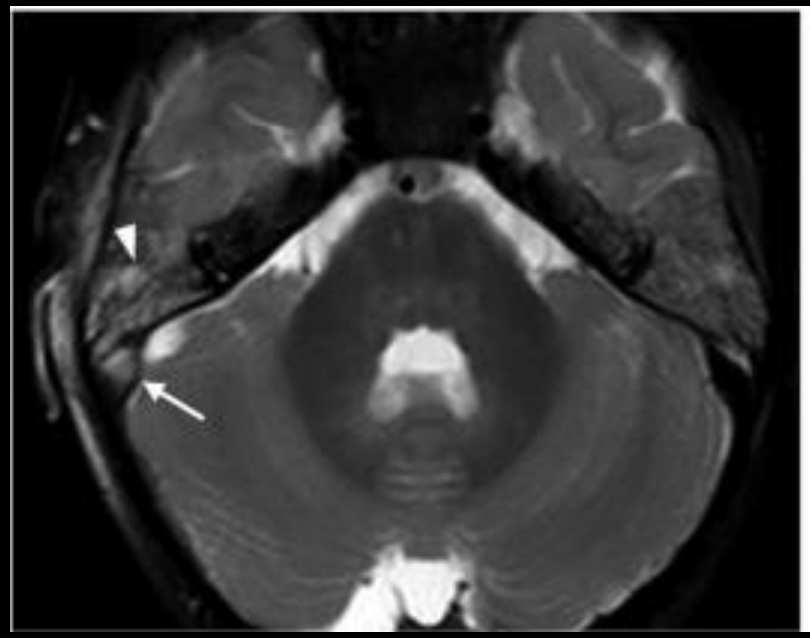
Post-contrast T1WI
a hypoenhancing region from the left mastoid to the adjacent subcutaneous area with an enhancing rim (arrows), consistent with coalescent mastoiditis associated with subcutaneous and subperiosteal abscesses



ADC
value (arrowhead) was 0.49 × 10^{-3} mm^2/second

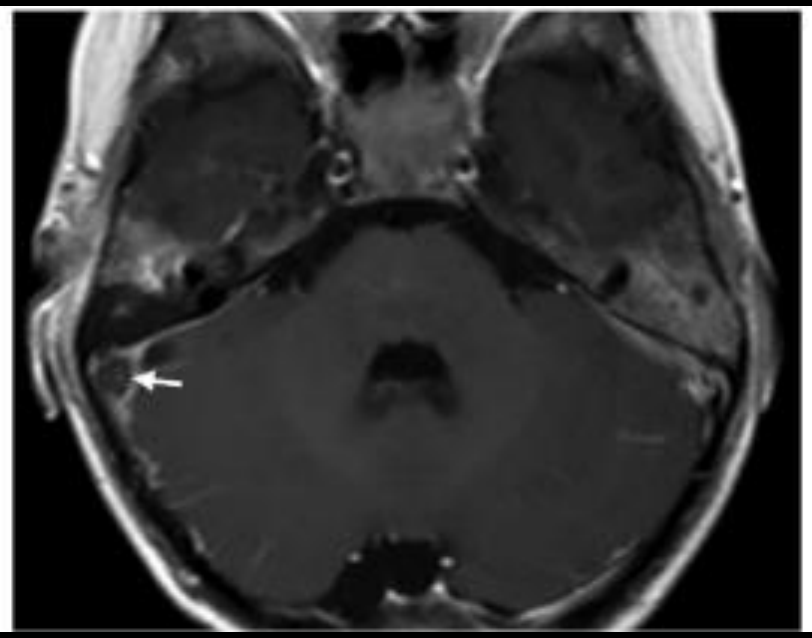
Sigmoid sinus thrombosis associated with coalescent mastoiditis

Fat supressed T2WI



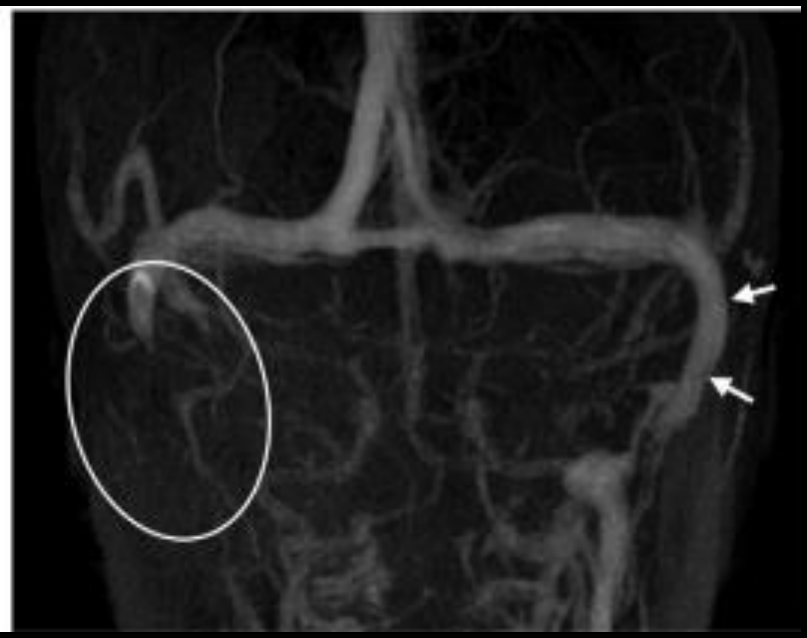
high signal intensity in the right mastoid (arrowhead), consistent with coalescent mastoiditis, and the right sigmoid sinus with high signal intensity (arrow), indicating the loss of the flow void

Contrast enhanced T1WI



enhancement defect (arrow) in the right sigmoid sinus

MR Venography



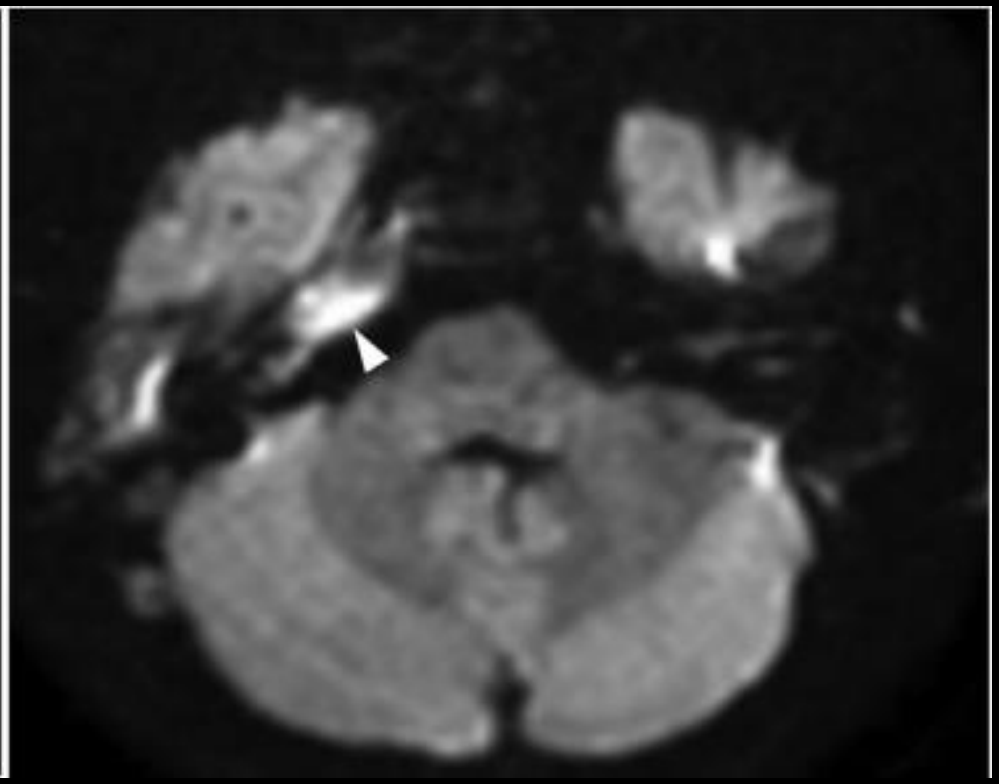
the right sigmoid sinus is absent (within circle) and the left sigmoid sinus (arrows)

Petrous Apicitis

- Caused by medial spread of infection to pneumatized petrous apex from acute otorhinolaryngitis.
- MRI shows high signal intensity on STIR/fat-suppressed T2WI and enhancement on postcontrast T1WI in early stages.
- DWI detects small abscesses within the inflamed region.
- MRI assesses abscess formation in intracranial and nasopharyngeal regions and infection spread to surrounding structures.

Petrous Apicitis

Fat-suppressed T2WI
high signal intensity in the right petrous apex (arrow), consistent with petrous apicitis

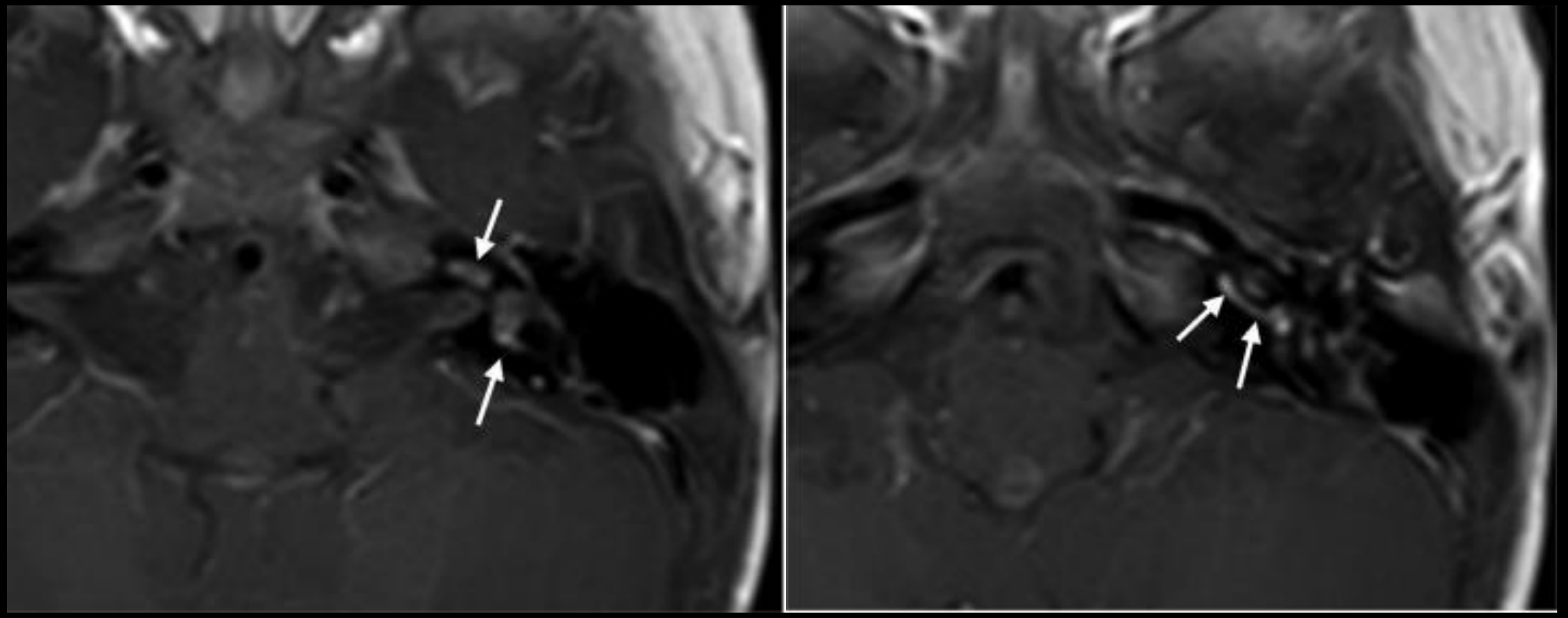


DWI
localized high signal intensity in the right petrous apex (arrowhead), indicating the presence of an abscess

Labyrinthitis and Ramsey Hunt Syndrome

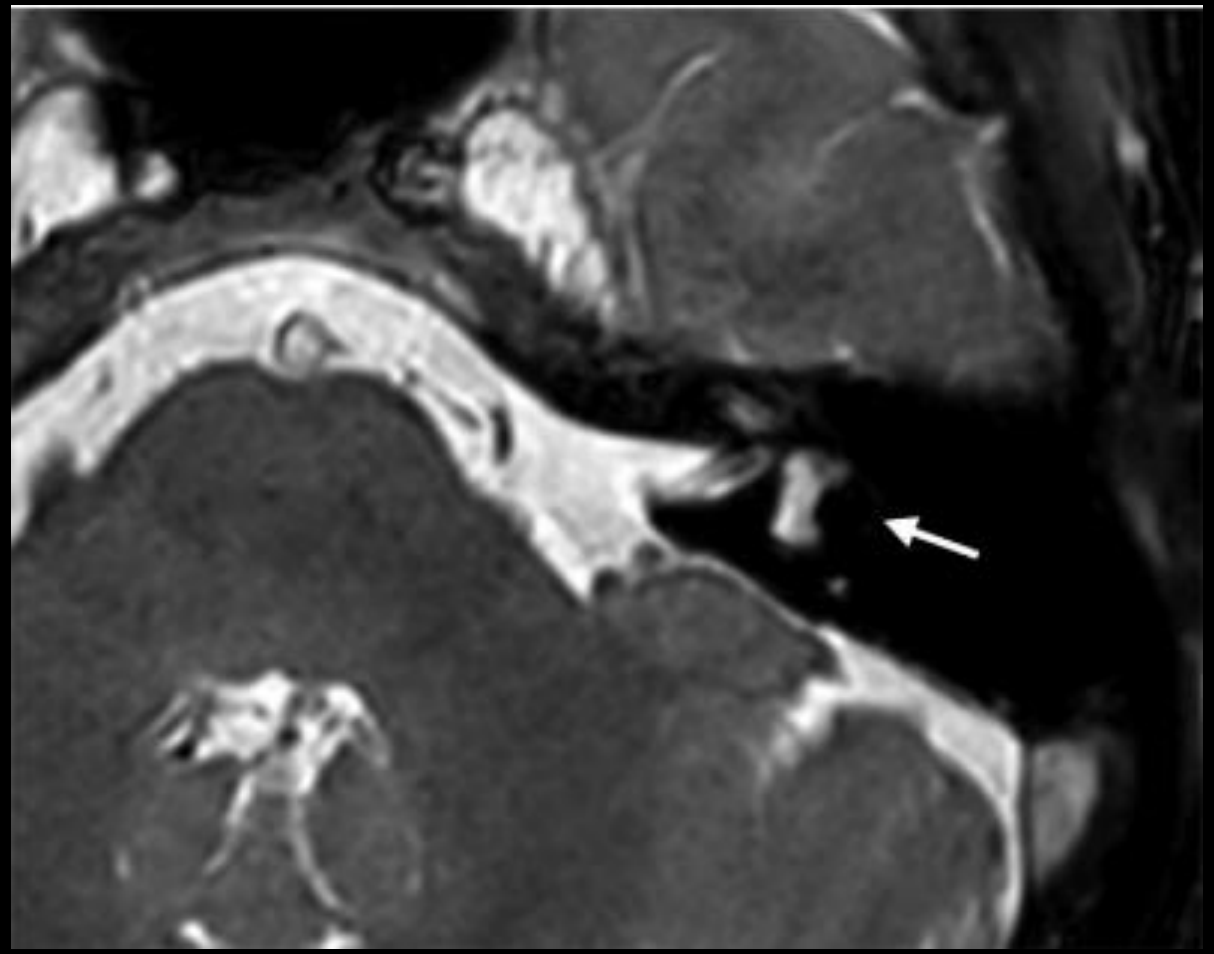
- Labyrinthitis: Inner ear inflammation and infection caused by viral or bacterial infections.
- Imaging shows enhancement of membranous labyrinth on high-resolution T1WI.
- Ramsey Hunt Syndrome: Involves both facial nerve and membranous labyrinth.
- High-resolution T2WI shows decreased or absent signal, with MRI more sensitive in identifying fibrotic stage.

Left Labyrinthitis



Postcontrast T1WI
enhancement (arrows) in the left inner ear, including the cochlea and vestibule, consistent with labyrinthitis.

Left Labyrinthitis Ossificans



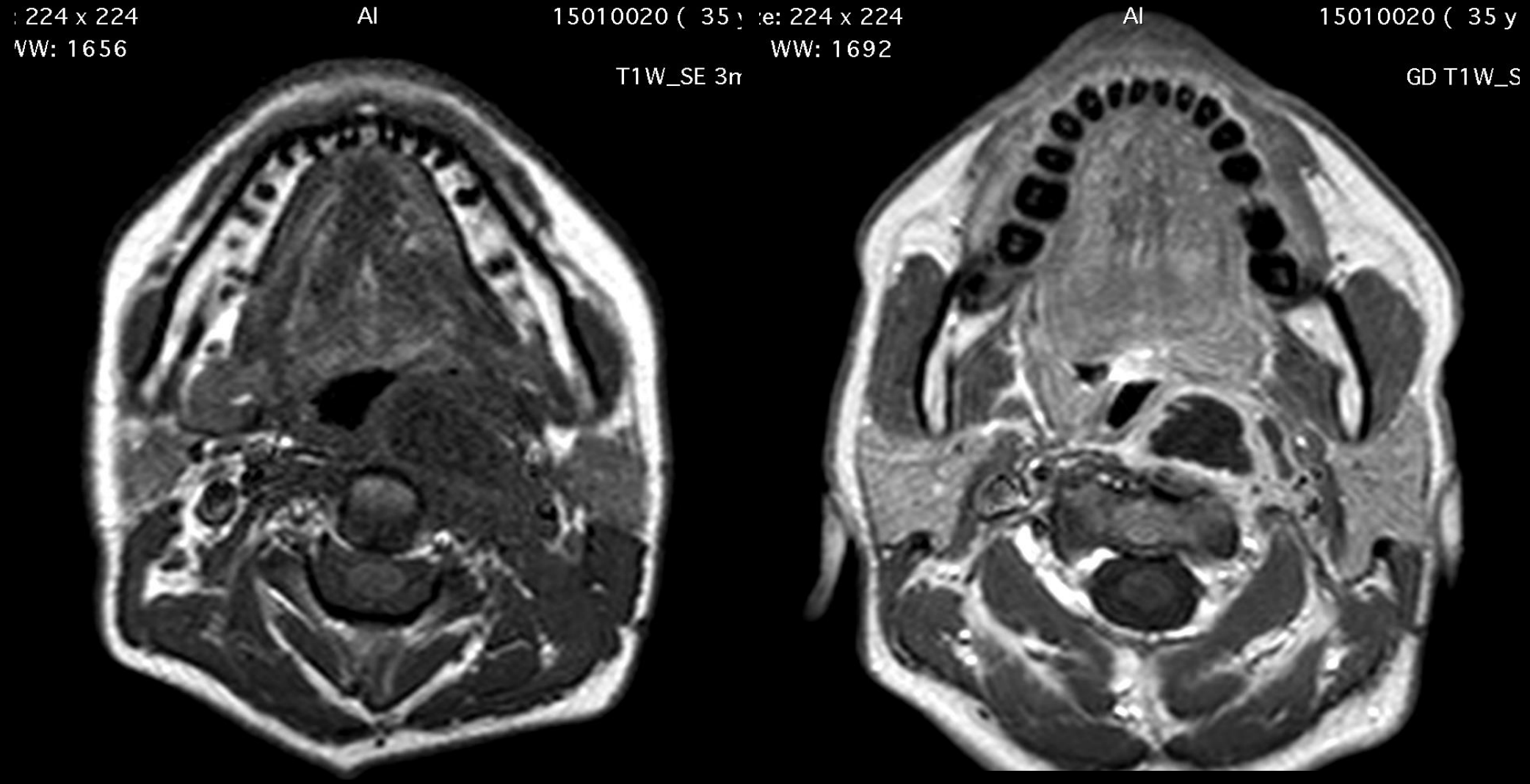
Three-dimensional heavily T2WI
decreased signal intensity in the left lateral semicircular canal (arrow), consistent with left labyrinthitis ossificans.

PHARYNX

Peritonsillar Abscess

- Results from uncomplicated acute tonsillitis.
- Postcontrast T1WI shows localized fluid collection.
- DWI shows internal diffusion restriction.
- In emergencies, MRI provides accurate assessment of abscess formation and deep neck spread.

Peritonsillar Abscess

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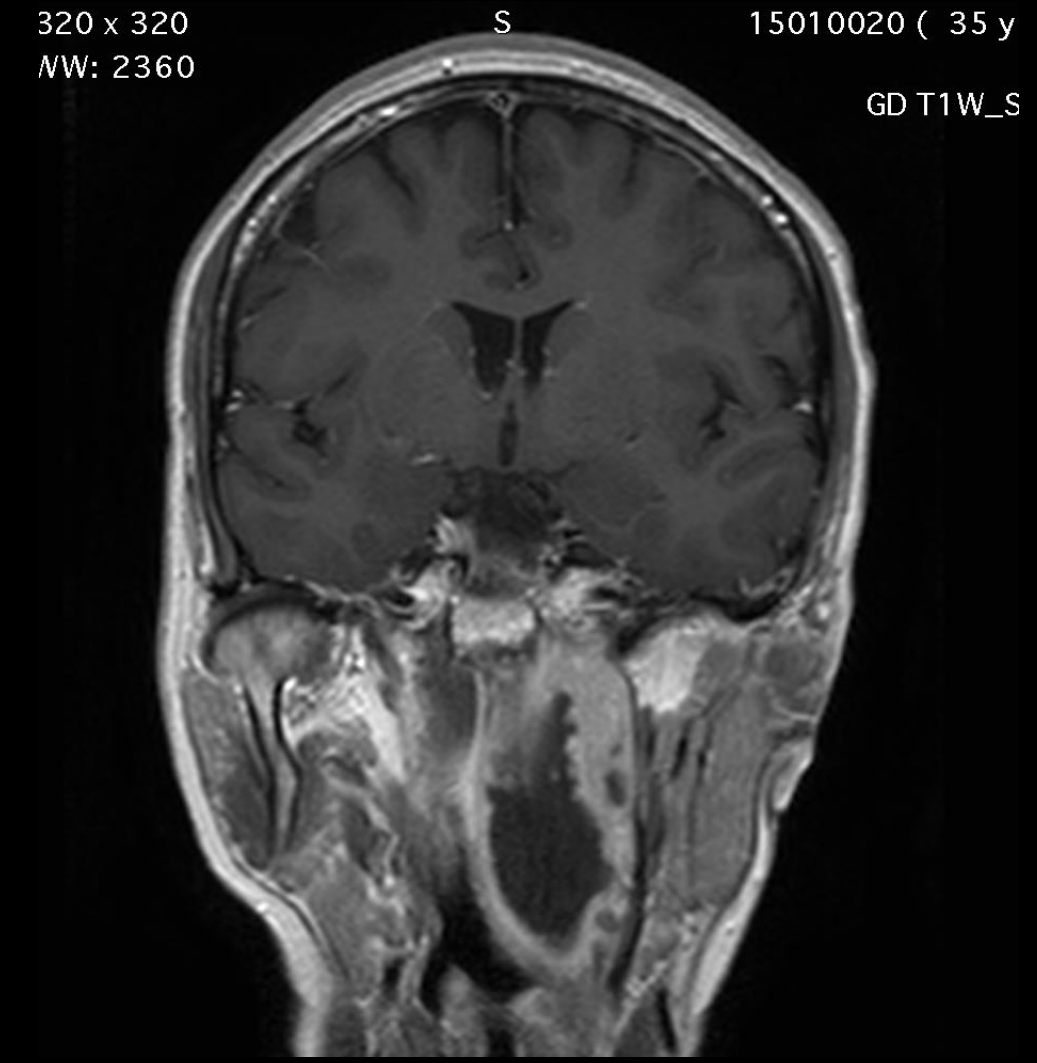
S
15010020 (35 y ,
WW: 2114
T2W_TSE (

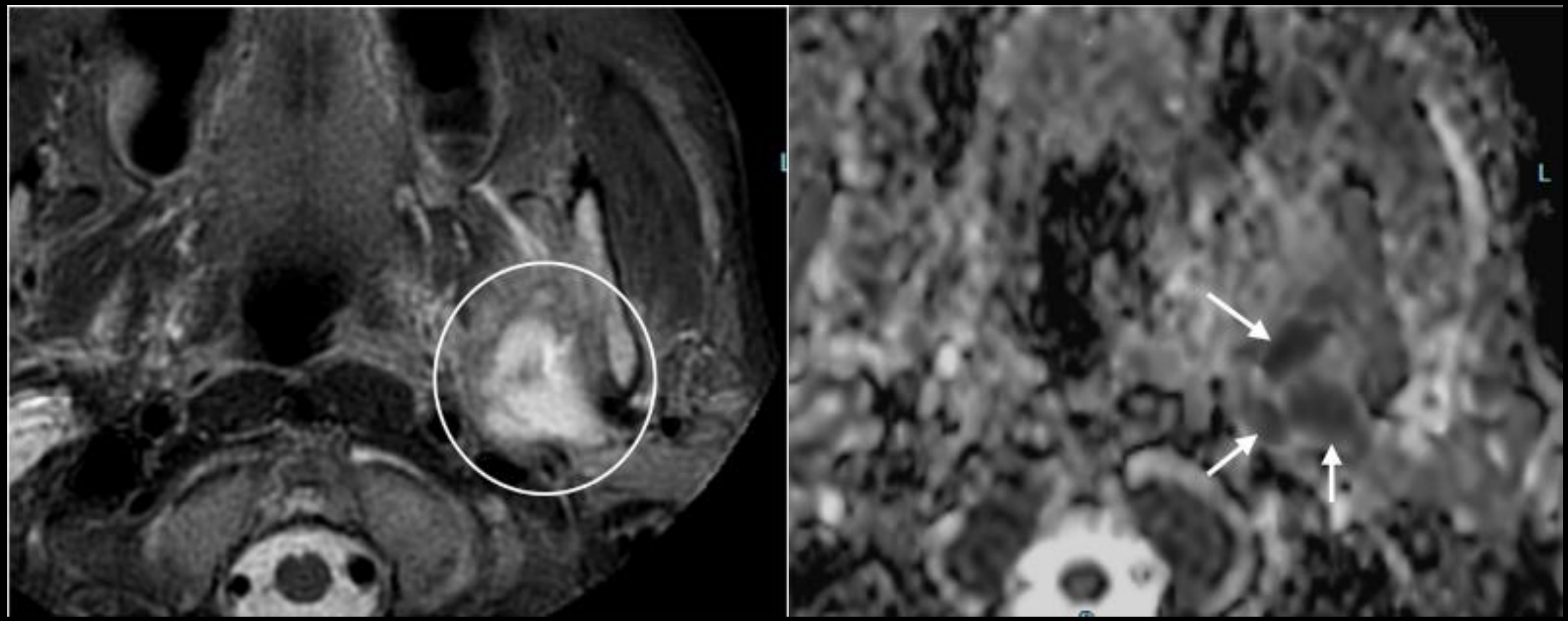

320 x 320
S
15010020 (35 y
WW: 2360
GD T1W_S

DEEP NECK

Deep Neck Infection

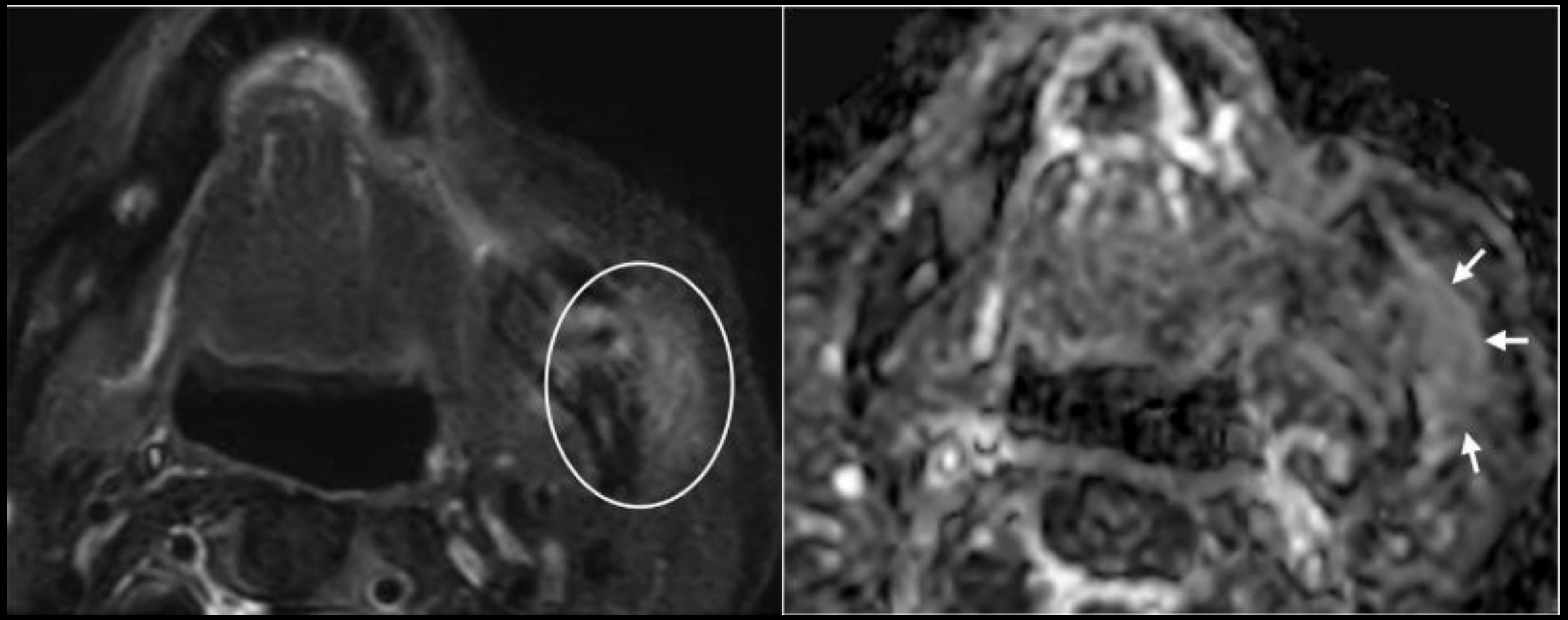
- Found in sublingual, parapharyngeal, perivertebral, masticator, and parotid spaces.
- Crucial for diagnosing cellulitis and abscess.
- MRI superior to CT for visualizing lesions, assessing extension, and identifying infection origin.
- MRI has high diagnostic accuracy of.96 for abscesses.
- DWI and contrast-enhanced MRI equivalent in detecting abscesses.
- MR venography and DWI can detect internal jugular vein thrombophlebitis.
- Low-keV virtual monochromatic image and iodine mapping from dual-energy CT useful for deep neck abscess evaluation.

Masticator Space Abscess



Short tau inversion recovery shows high signal intensities (within circle) in left masticator space with the low mean apparent diffusion coefficient of 0.51 × 10−3 mm2/second (arrows), indicating diffusion restriction.

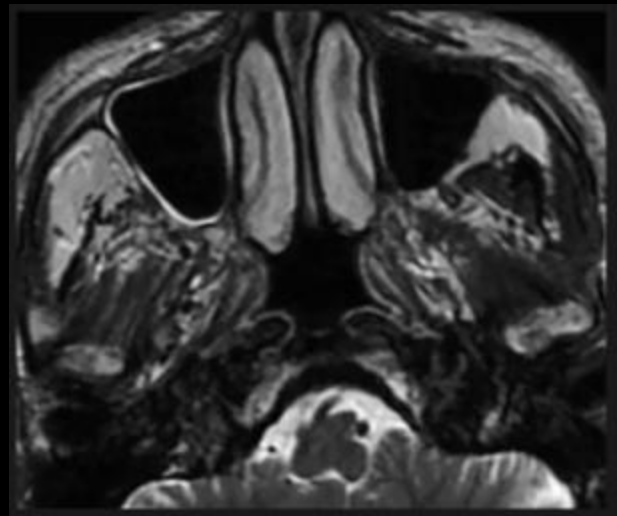
Masticator space cellulitis



Short tau inversion recovery shows high signal intensities (within circle) in left masticator space with the high mean apparent diffusion coefficient of 1.52 × 10−3 mm2/second (arrows)

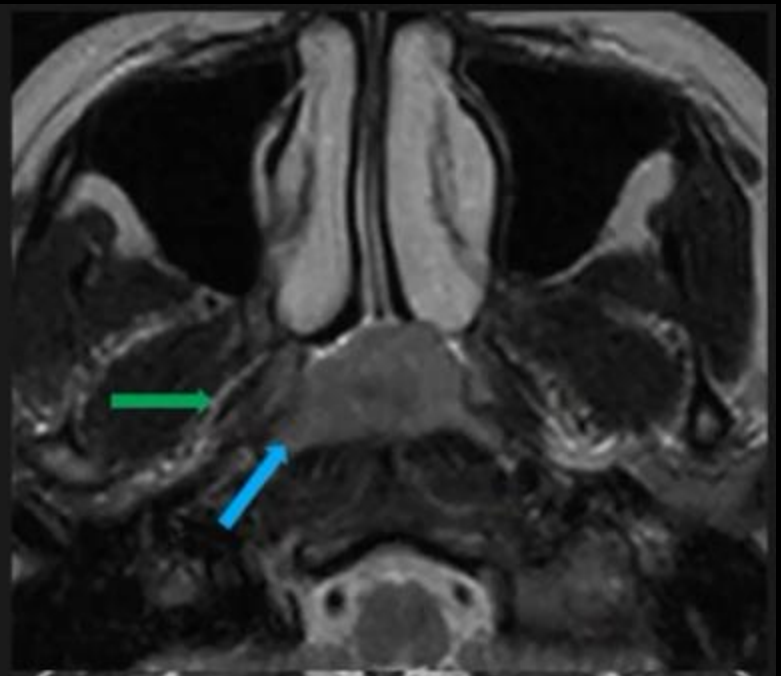
Imaging In Head And Neck Cancer

Nasopharyngeal Ca

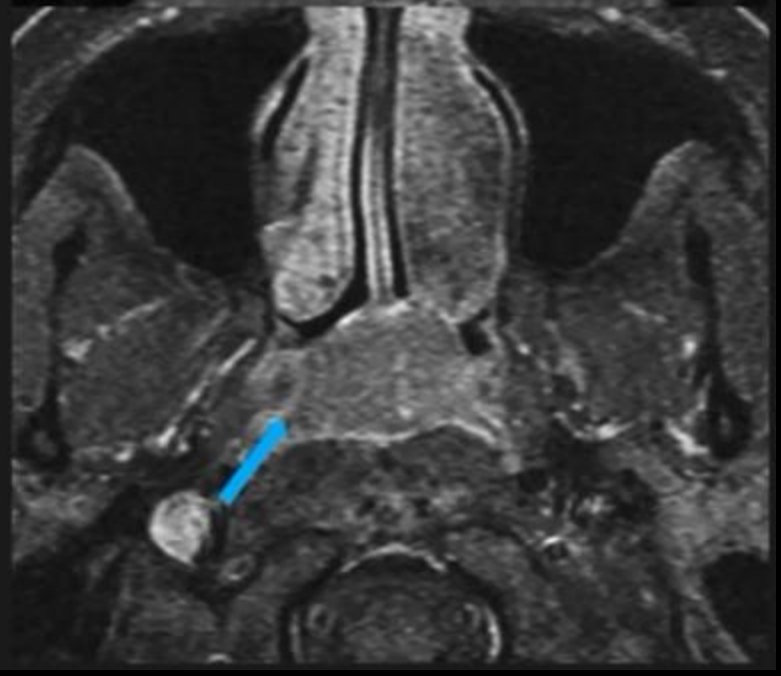


MRI

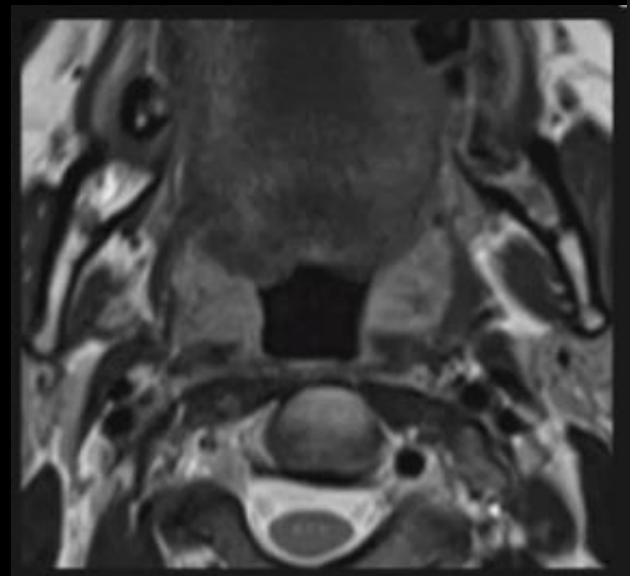
- NP Mass
- Lateral Ext
- Skull Base Inv.
- Inferior Ext
- Nodal Disease
- Distant Mets



MRI



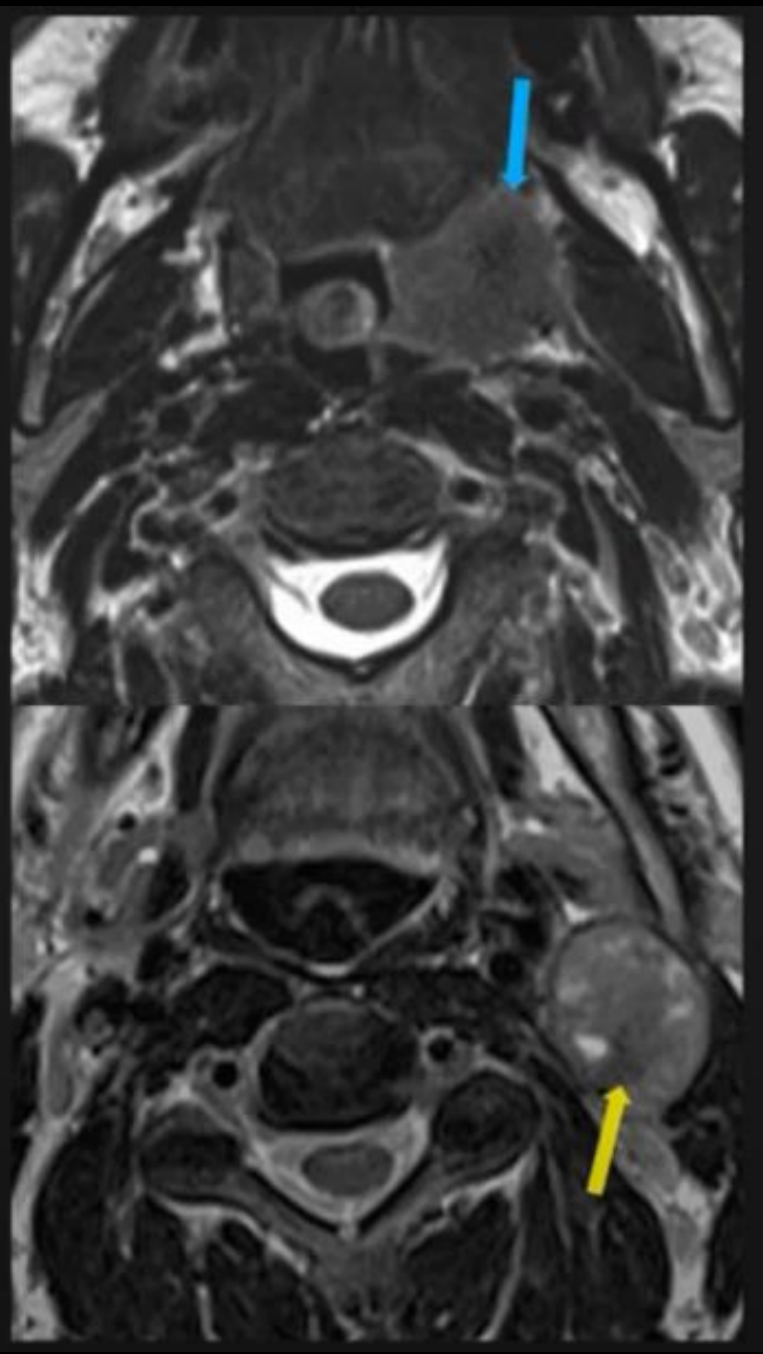
Oropharyngeal Ca



- Left OP Mass
- Lateral Ext
- Superior Ext
- Inferior Ext
- Nodal Disease
- Distant Mets

MRI

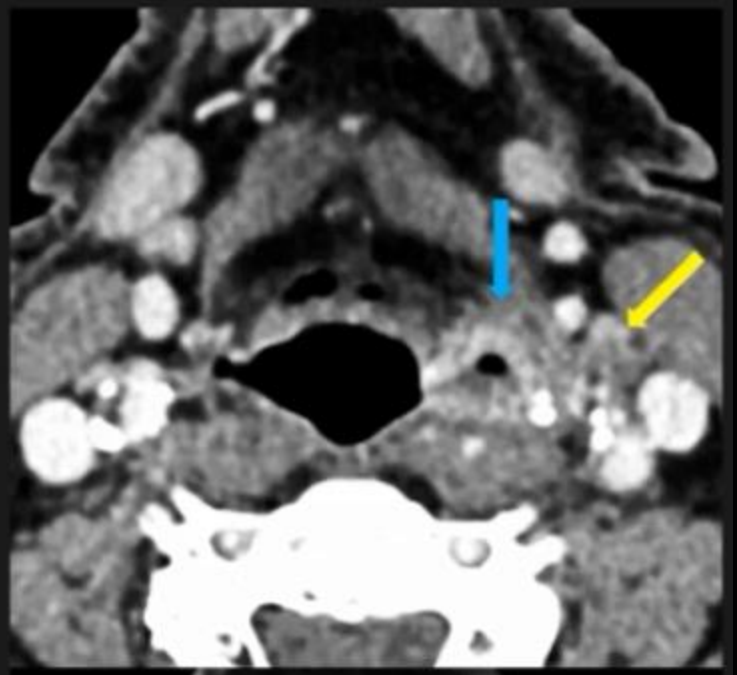
MRI



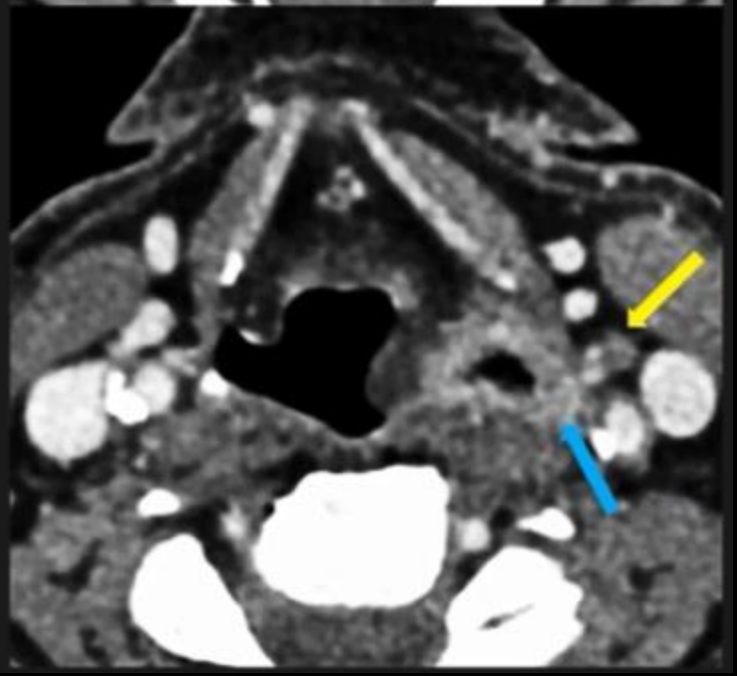
Hypopharyngeal Ca

- Left HP Mass
- Nodal Disease
- Distant Mets

CT



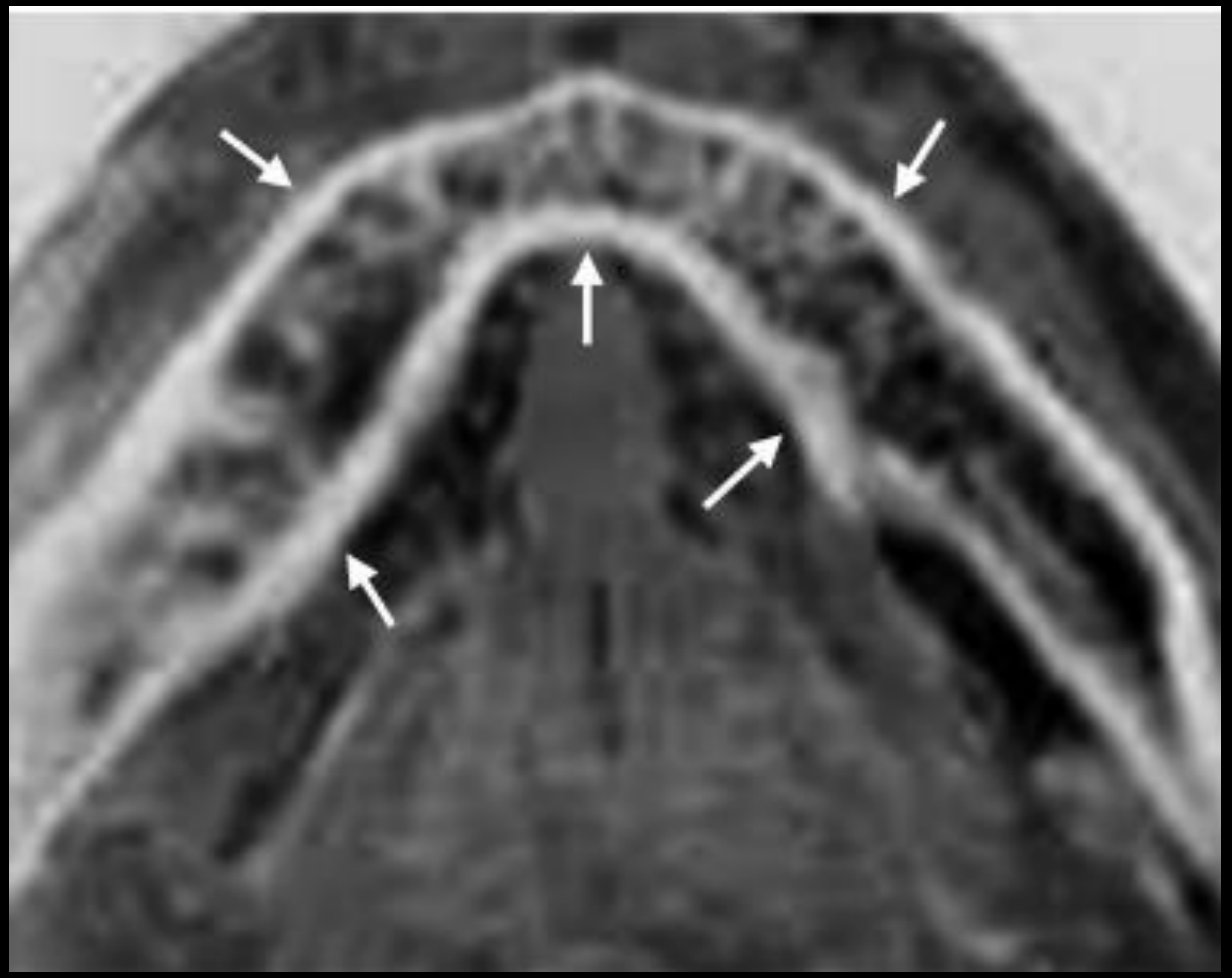
CT



ORAL CAVITY

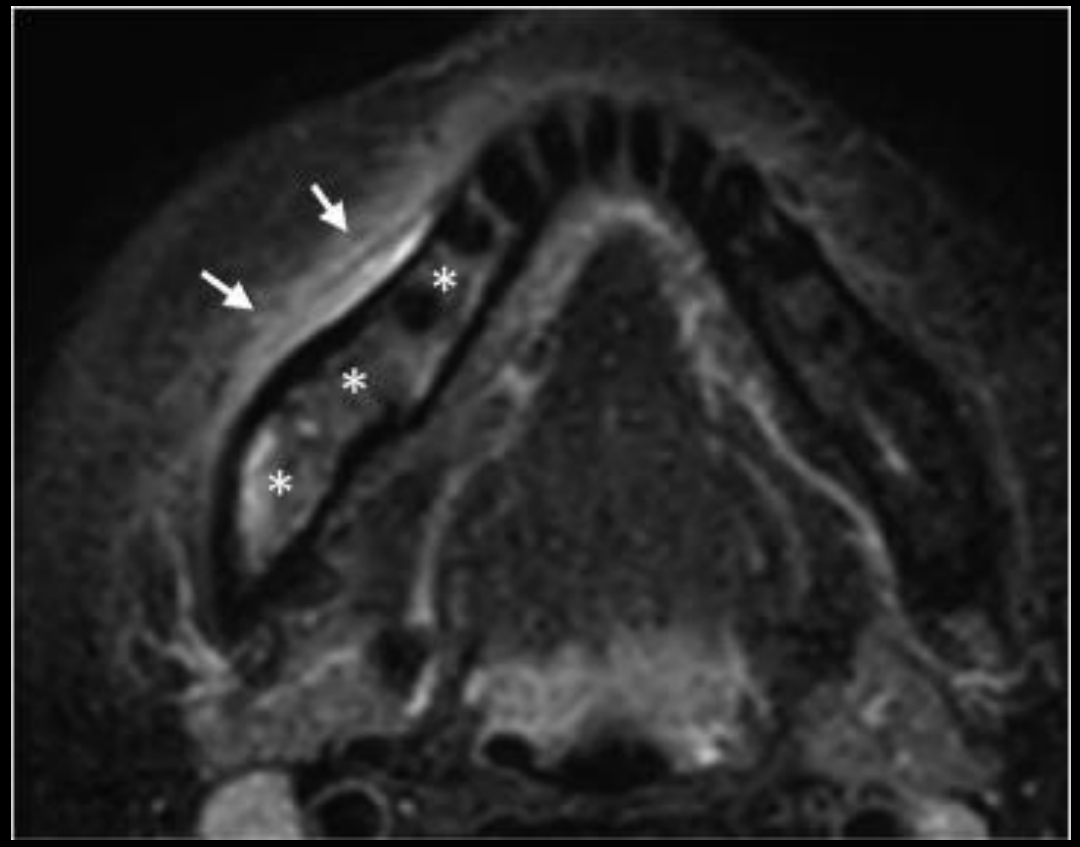
Odontogenic Inflammation

- Odontogenic infections are common inflammatory diseases in the head and neck.
- Acute and chronic osteomyelitis of the jaw show different signal intensities on T1WI and T2WI.
- STIR detects and assesses soft tissue inflammation.
- DWI's ADC value aids in assessing mandibular osteomyelitis.
- Low ADC value of odontogenic abscesses distinguishes them from other maxillofacial diseases.
- MR bone imaging enhances morphologic evaluation of jaw osteomyelitis.
- Dynamic maneuvers improve imaging of oral infections and abscesses.

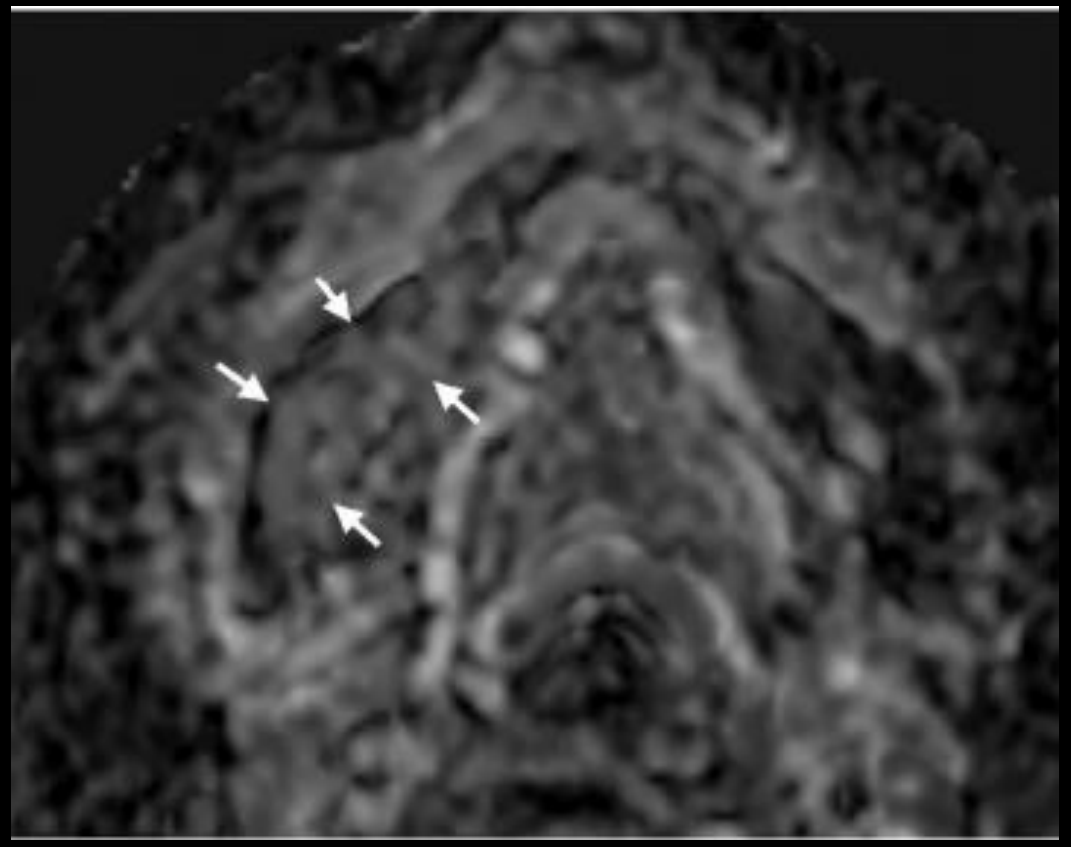


MR bone imaging at the level of the mandible clearly shows the bony cortex and trabecula of the jaw (arrows).

Mandibular Osteomyelitis



high signal intensity (*) of the right mandible with edematous high signal intensity in the surrounding soft tissues (arrows)



The mean apparent diffusion coefficient value of the lesion is elevated at 1.31 × 10−3 mm^2/second (arrows)

Dental Filling & CT Artifacts

- Dental fillings cause severe beam-hardening artifacts on CT, complicating evaluation.
- MRI is superior for oral cavity lesions with fewer artifacts.
- Artifact reduction methods include bite blocks and tilting CT gantry.
- New technologies like metal artifact reduction (MAR) algorithm and high-energy virtual monochromatic imaging improve intraoral CT evaluation.
- Subtraction iodine imaging reduces intraoral metal artifacts by subtracting artifacts.

Inflammatory spread to the masticator space from right mandibular osteomyelitis

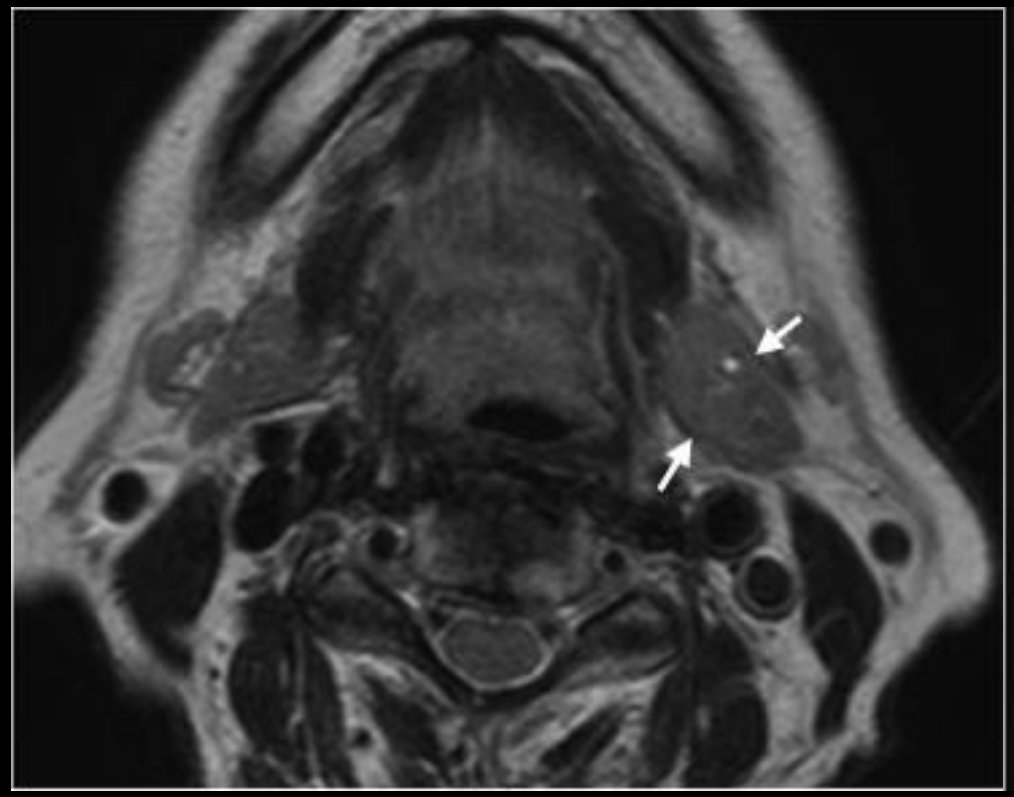
ARTIFACTS

SALIVARY GLANDS

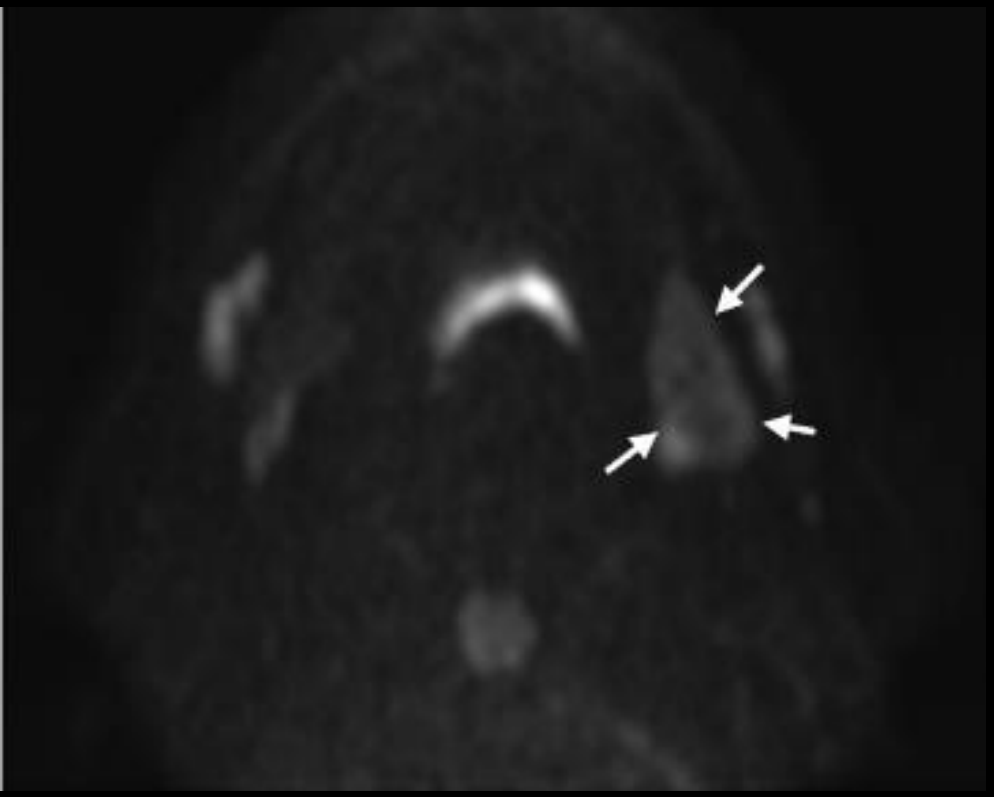
Overview

- Infections can be acute, recurrent, or chronic, linked to obstructive mechanisms like salivary stones.
- Etiology can be bacterial or viral.
- MRI shows gland enlargement on T2WI and STIR.
- DWI can detect early-stage or small abscess formation in acute bacterial sialadenitis.
- Early pathologic changes in Sjögren’s syndrome can increase ADC values.
- Virtual unenhanced images from dual-energy CT may be an alternative for sialolithiasis detection.

Submandibular Sialadentis

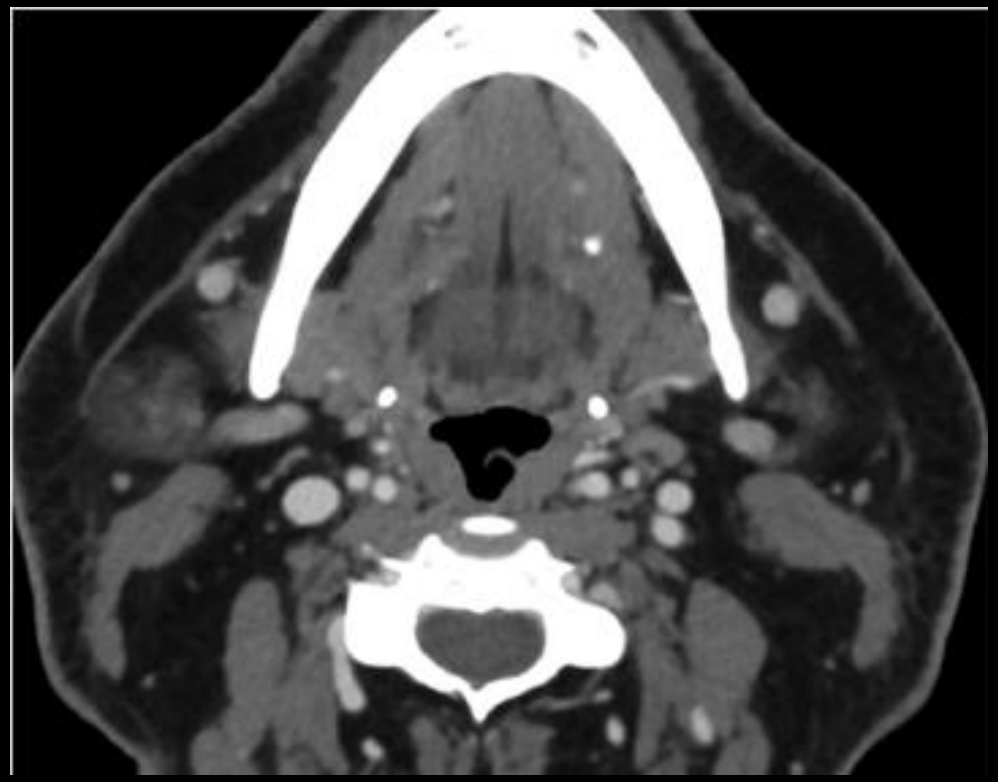


T2WI
no internal abnormal signal intensity in the slightly swollen left submandibular gland (arrows)



DWI
high signal intensity (arrows) in the left submandibular gland indicating submandibular adenitis

Virtual monochromatic imaging



more easily depicts a salivary stone (arrow) of the left submandibular duct

derived from contrast-enhanced dual-energy CT