



# Sinonasal Imaging

Mahmud Mossa-Basha, MD

University of Washington

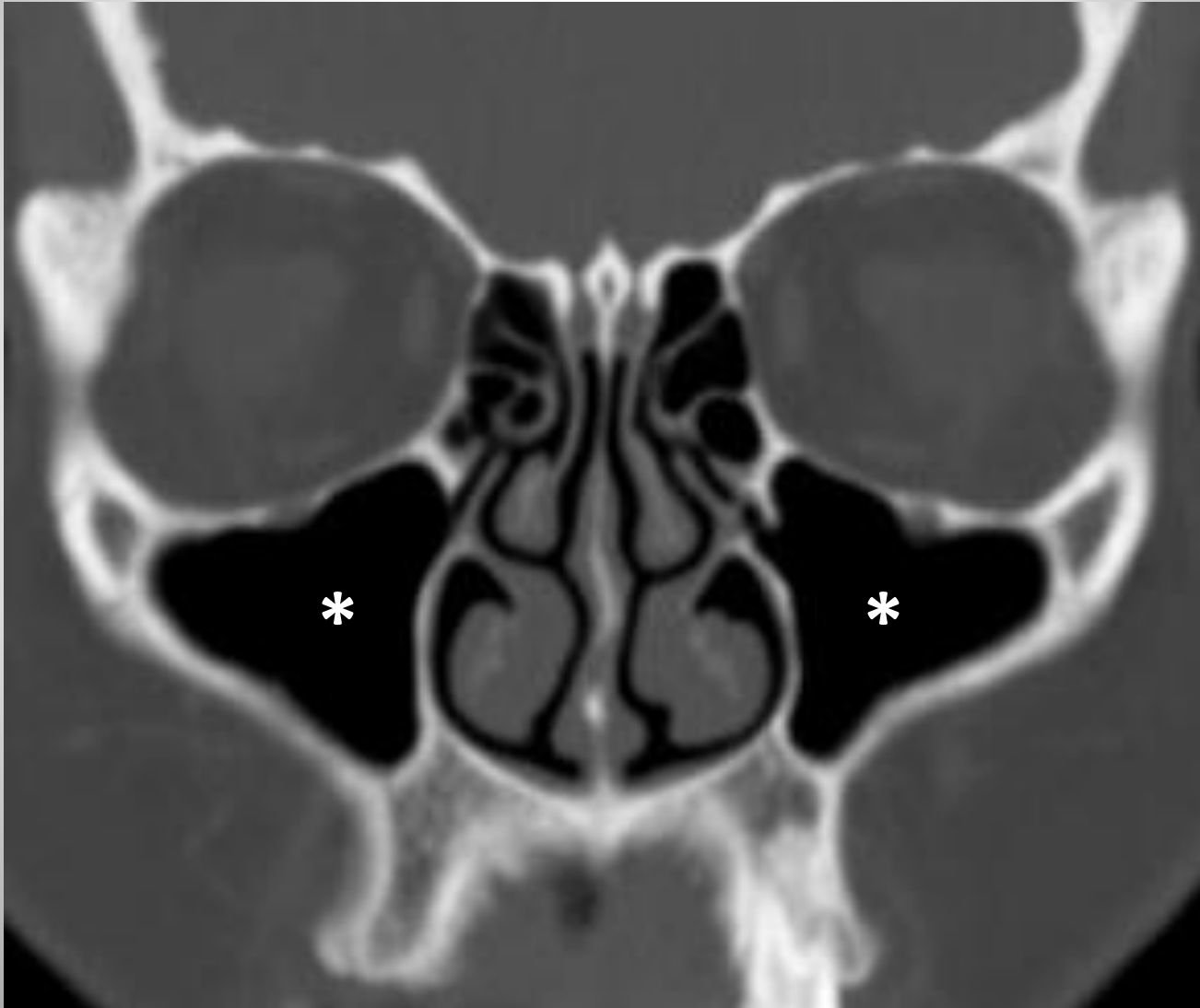
Department of Radiology



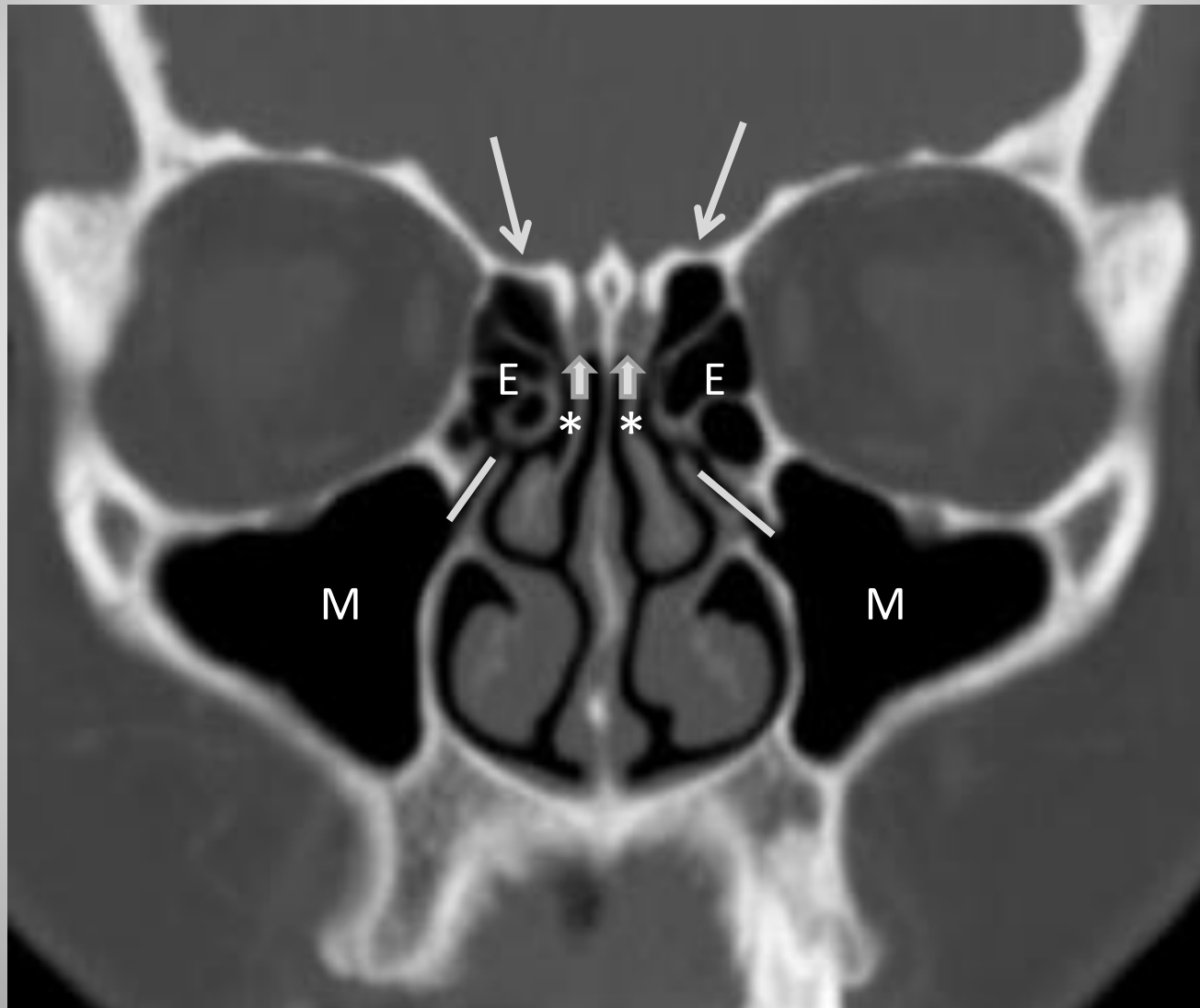
# Sinonasal Imaging

- Outline
  - Sinonasal anatomy
  - Inflammatory diseases of the paranasal sinuses
    - Acute
    - Chronic
    - Fungal infections
  - Sinonasal masses

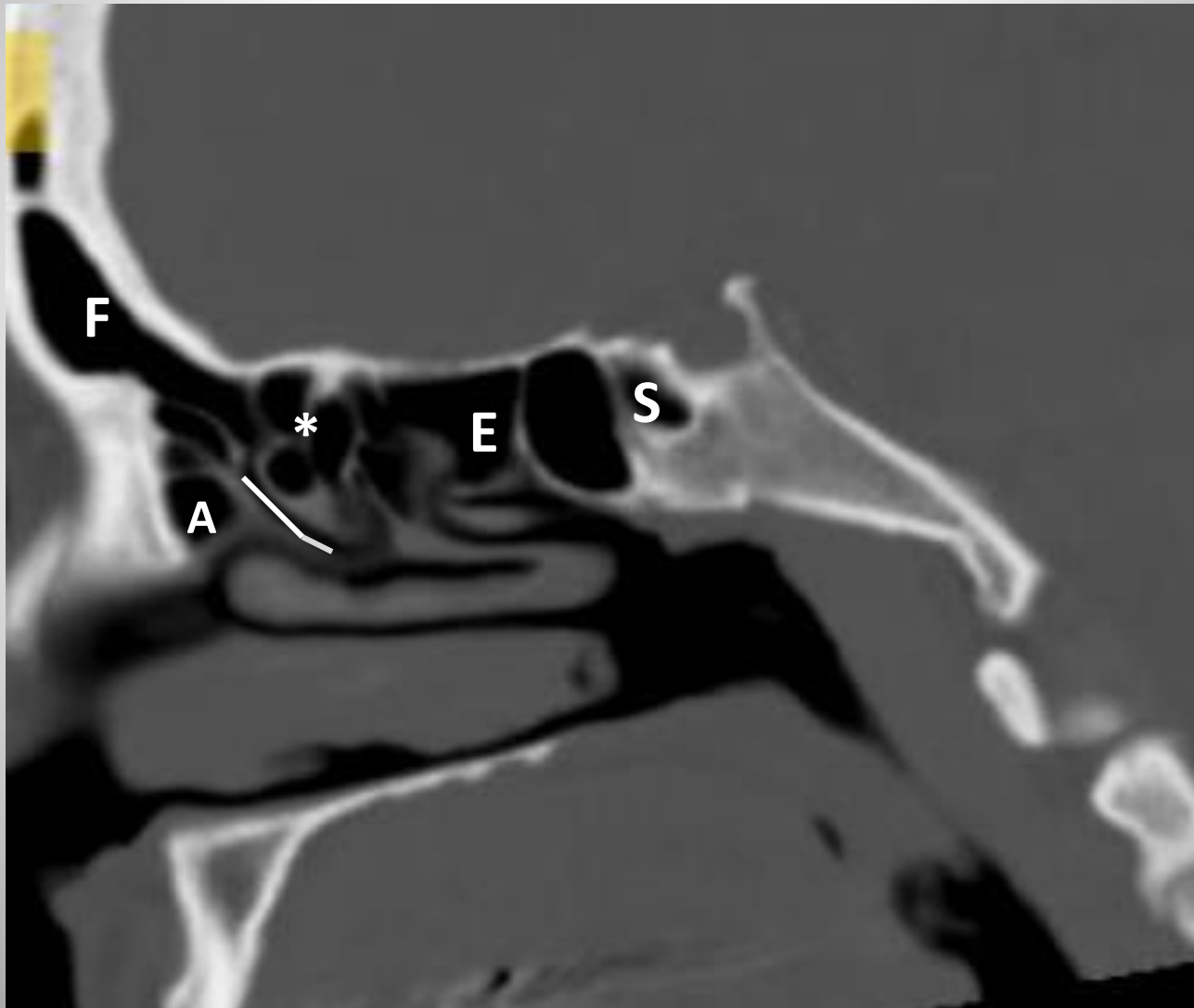
# Sinonasal Anatomy



# Sinonasal Anatomy



# Sinonasal Anatomy



# Imaging of Sinonasal Inflammatory Disease



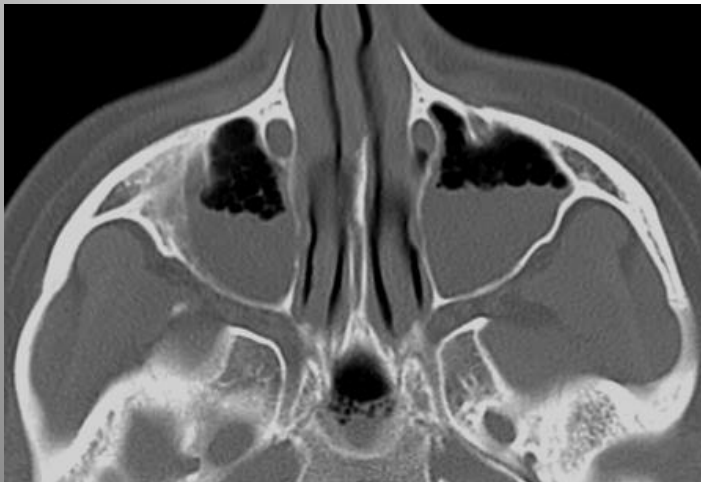
- CT imaging modality of choice
  - Improved bony detail
  - Higher spatial resolution
  - Roadmap for functional endoscopic sinus surgery
    - Identify ostial occlusions
    - Surgical hazards
- MRI valuable when concern for extrasinus spread

# Functional Endoscopic Sinus Surgery

- Mucociliary motion directs secretions towards native ostia
- **Goal of FESS:** widen native drainage pathways and preserve mucociliary function

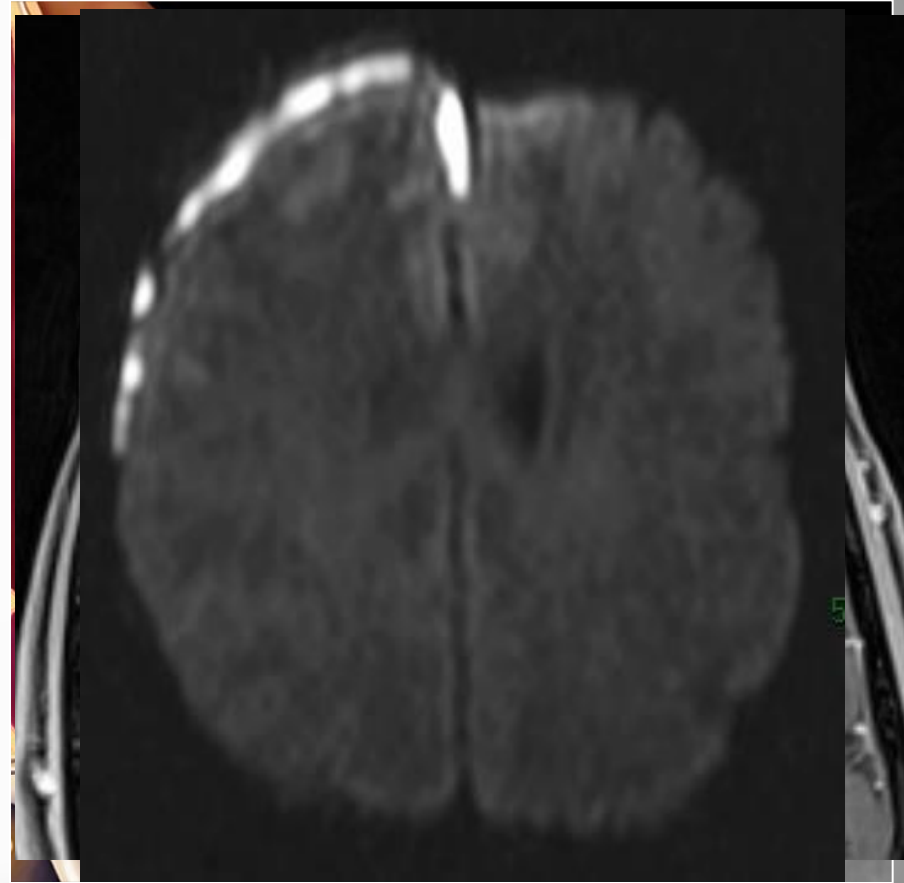
# Acute Rhinosinusitis

- There are **NO** pathognomonic imaging findings
- Air-fluid levels, frothy secretions are supportive but **not specific**
- Mucosal thickening may be sole manifestation
- “In the appropriate clinical setting, these findings may represent acute sinusitis”



# Acute Sinusitis Complications

- Ethmoid- orbit
- Frontal- anterior cranial fossa, scalp
- Maxillary- premaxillary, retroantral, orbit

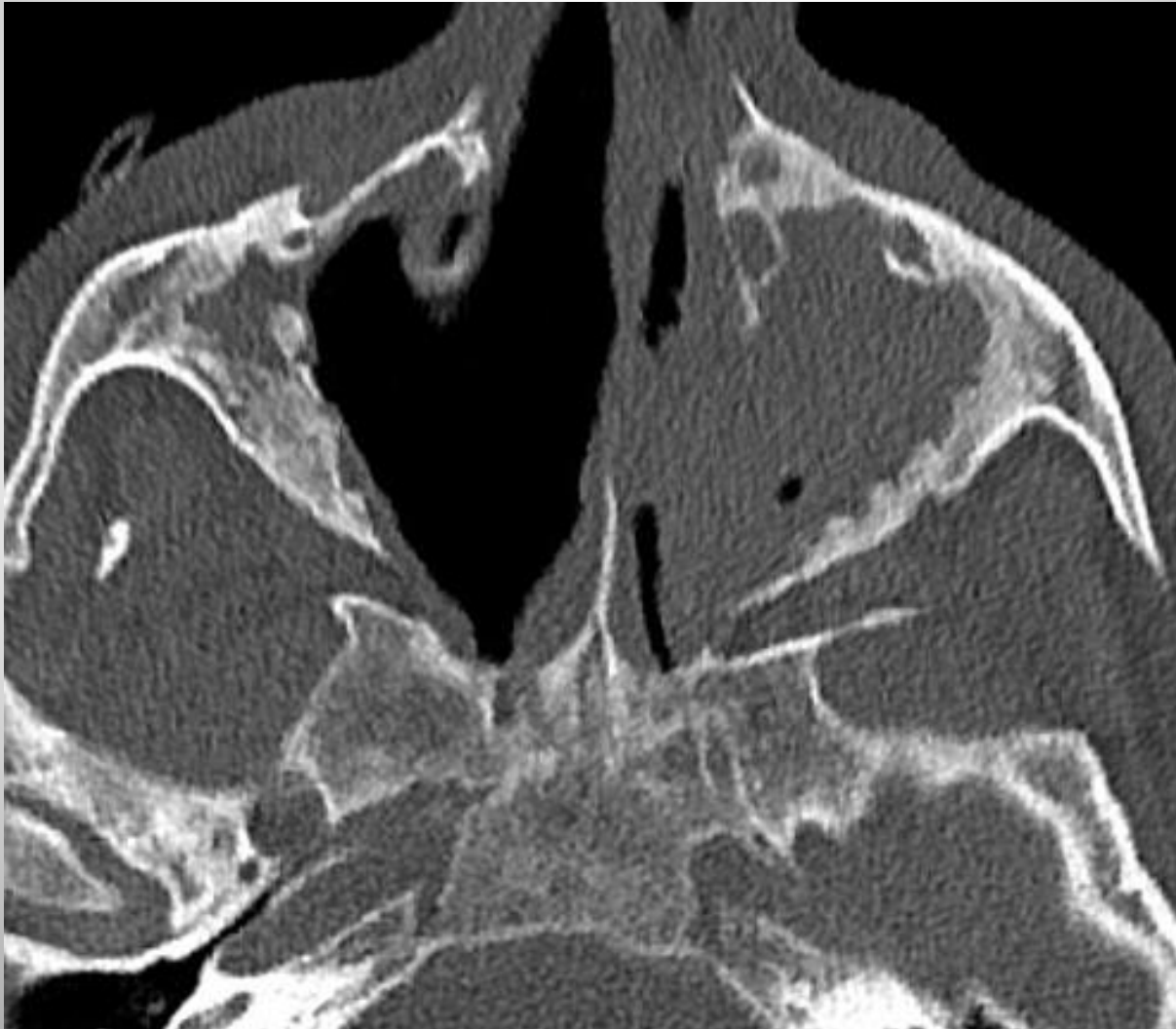




# Chronic Rhinosinusitis

- Symptoms > 12 weeks
- Clinical symptoms overlap with other entities
  - Mimics: polyps, masses, sarcoid, Wegener
  - Our role is to exclude other mimics
- Imaging findings  $\neq$  Clinical symptoms
  - 27-42% asymptomatic  $\rightarrow$  CT findings
    - Findings: Mucosal edema vs. sinus secretions
  - Imaging severity  $\neq$  symptom severity

# Chronic Rhinosinusitis



# Chronic Rhinosinusitis

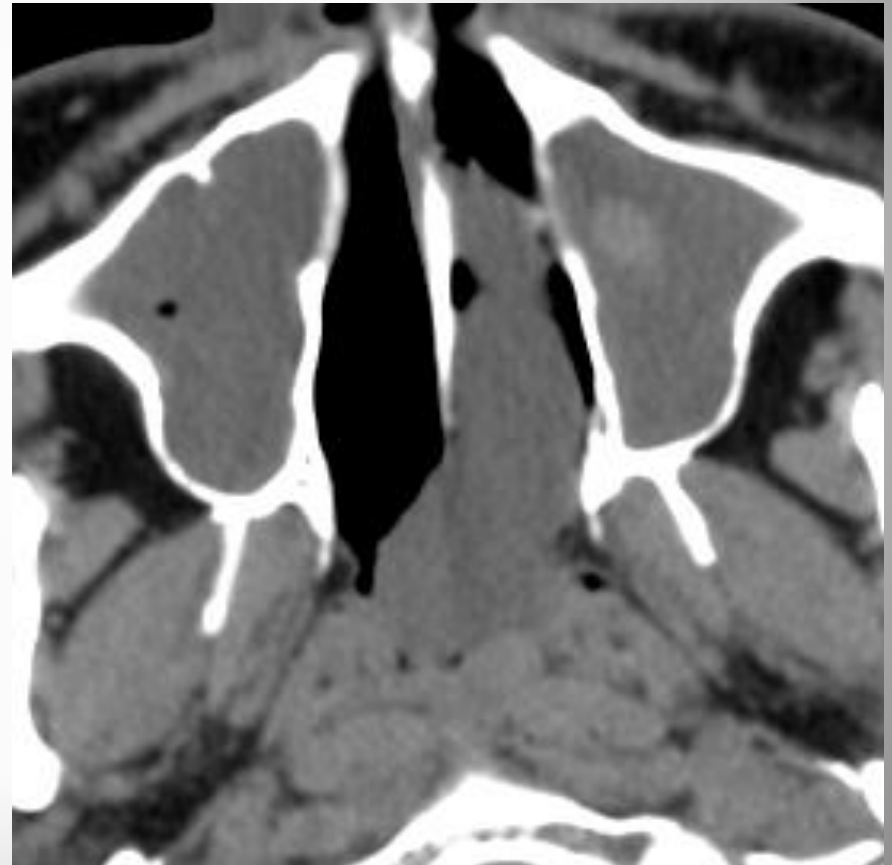
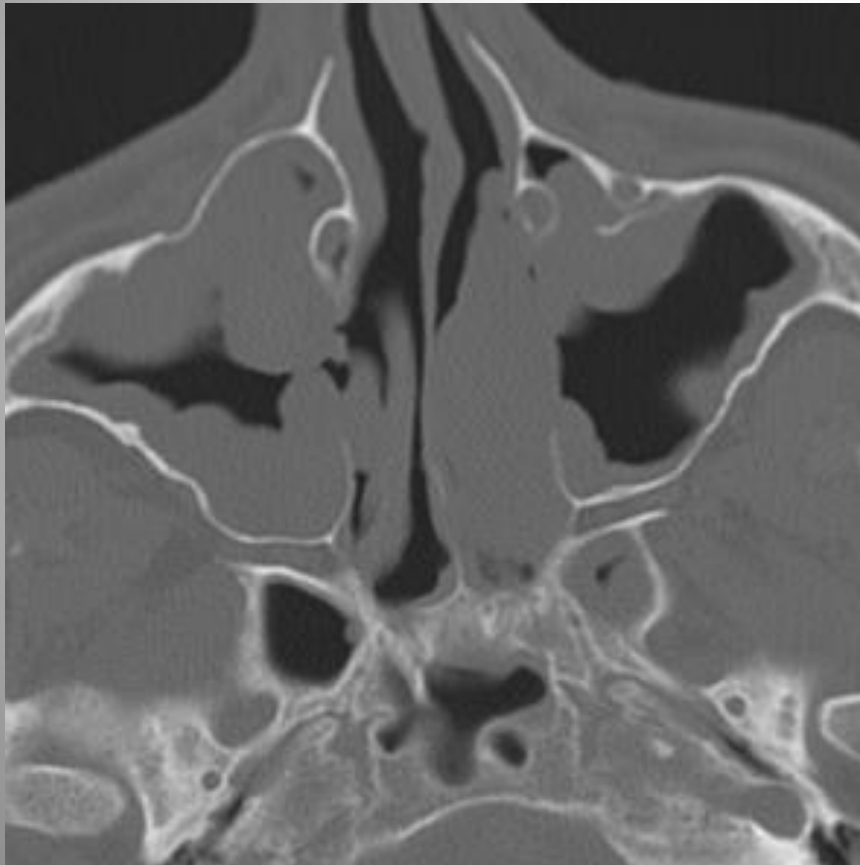




# Sinonasal Polyps

- Secondary to chronic inflammation/infection
- Thickening and protrusion of mucosa
  - Infolding of mucosa
- Can be difficult to differentiate from mucous retention cysts
  - Polyps enhance

# Sinonasal Polyposis

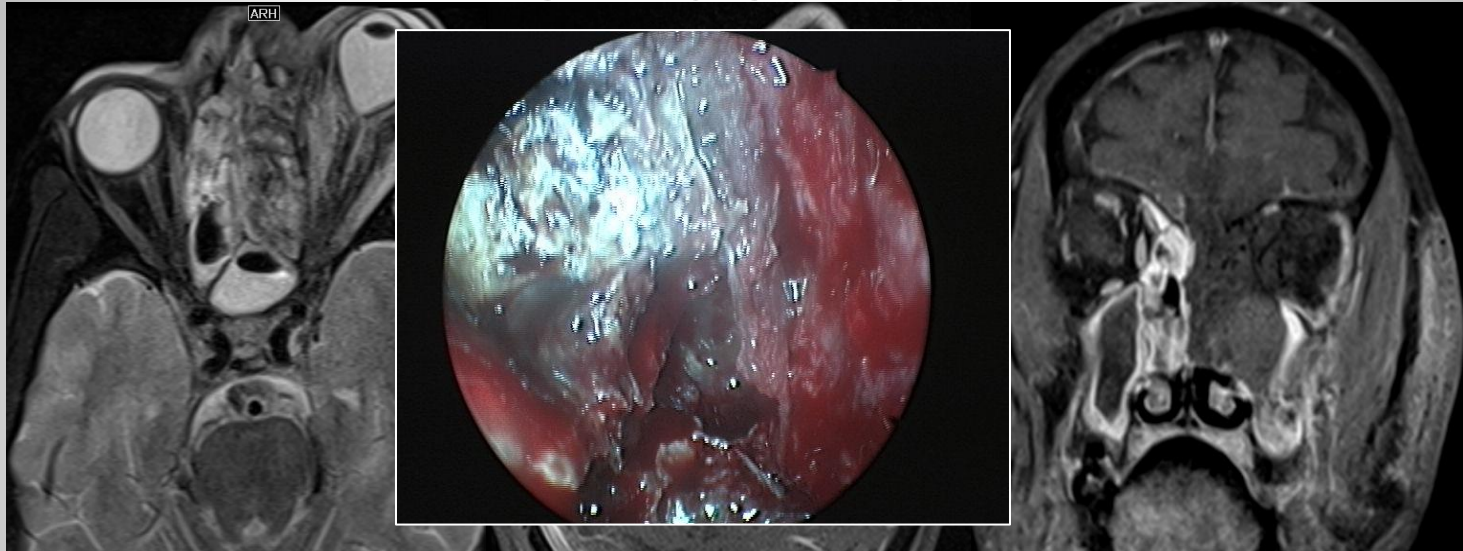




# Fungal Rhinosinusitis

- Invasive
  - Acute Invasive
  - Chronic Invasive
  - Chronic Invasive Granulomatous
- Non-Invasive
  - Allergic Fungal
  - Fungus Ball

# Acute Invasive Fungal Sinusitis



- Immunocompromised pts (diabetes, neutropenia)
- Angioinvasion with necrosis → absent enhancement
- Fungal hyphae result in low T2 signal



# Chronic Invasive Fungal Sinusitis

- Slowly progressive fungal infection
- Greater than 12 weeks in duration
- Immunocompetent
  - Also occurs in steroid patients, DM and AIDS
- Present with chronic sinusitis and focal neurological deficit

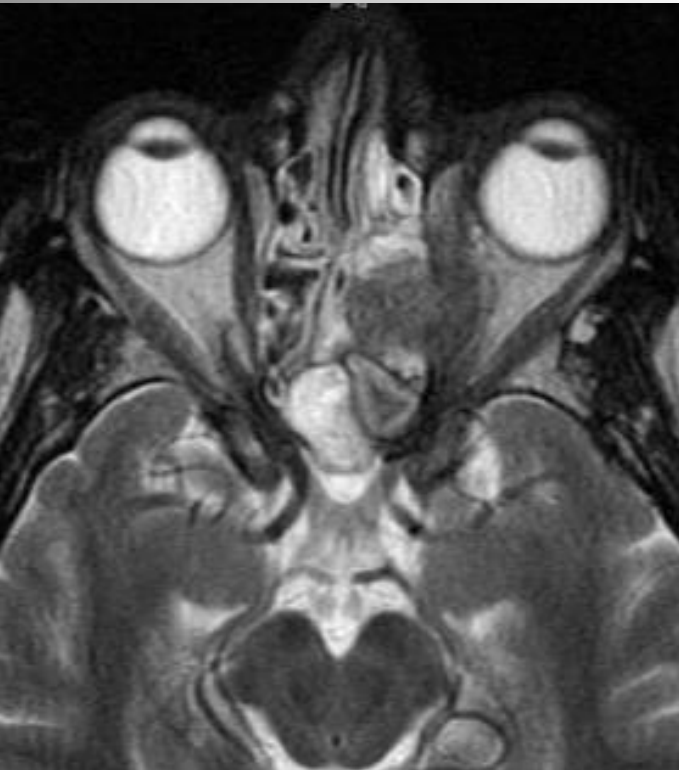


# Chronic Invasive Fungal Sinusitis

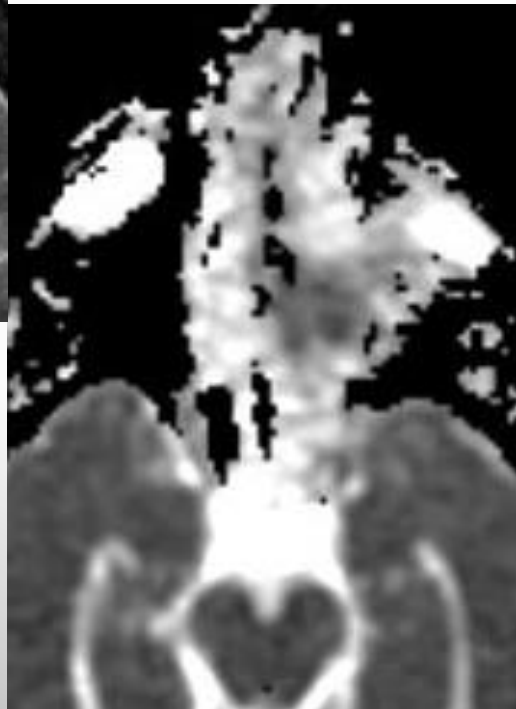




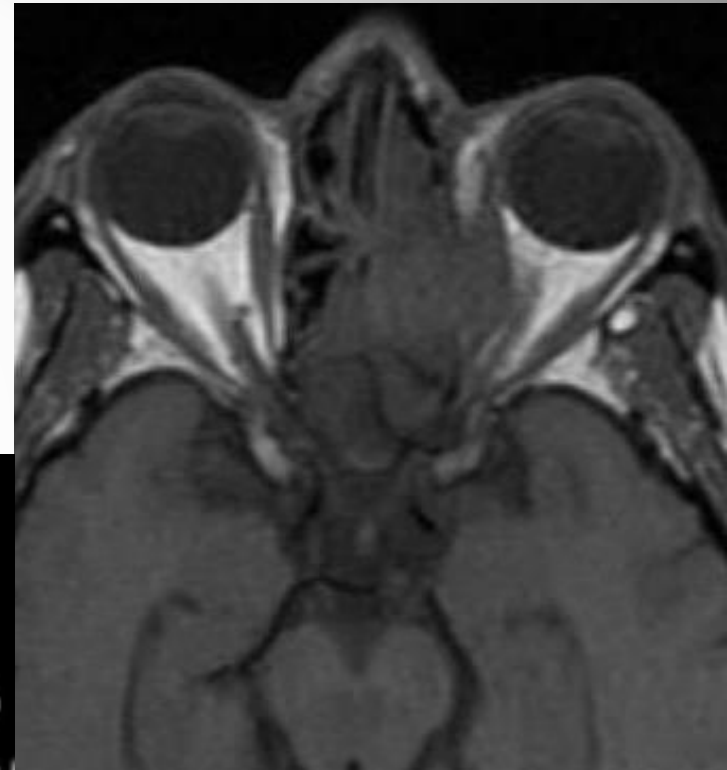
# Chronic Invasive Fungal Sinusitis



T2

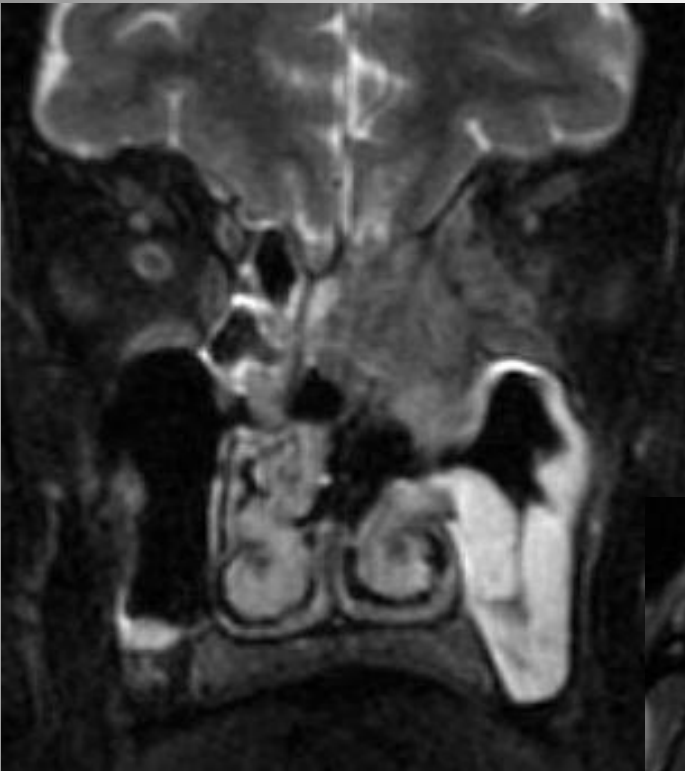


ADC

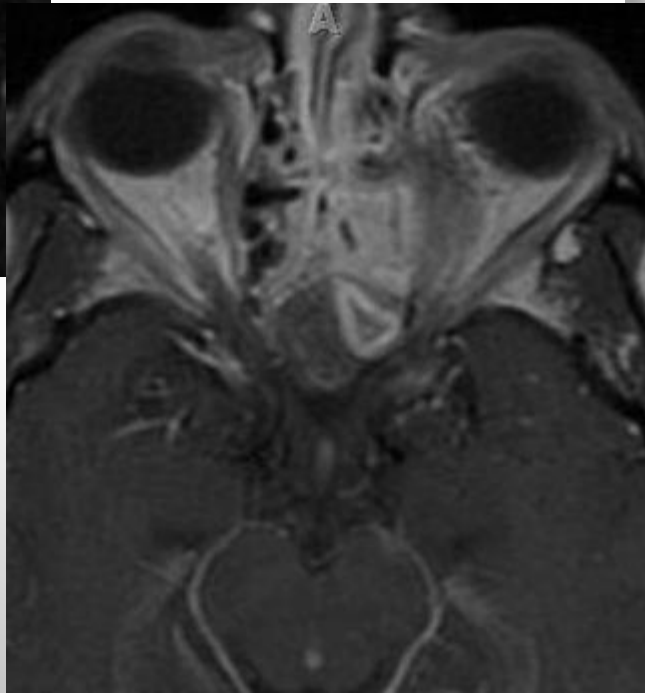


T1

# Chronic Invasive Fungal Rhinosinusitis



STIR

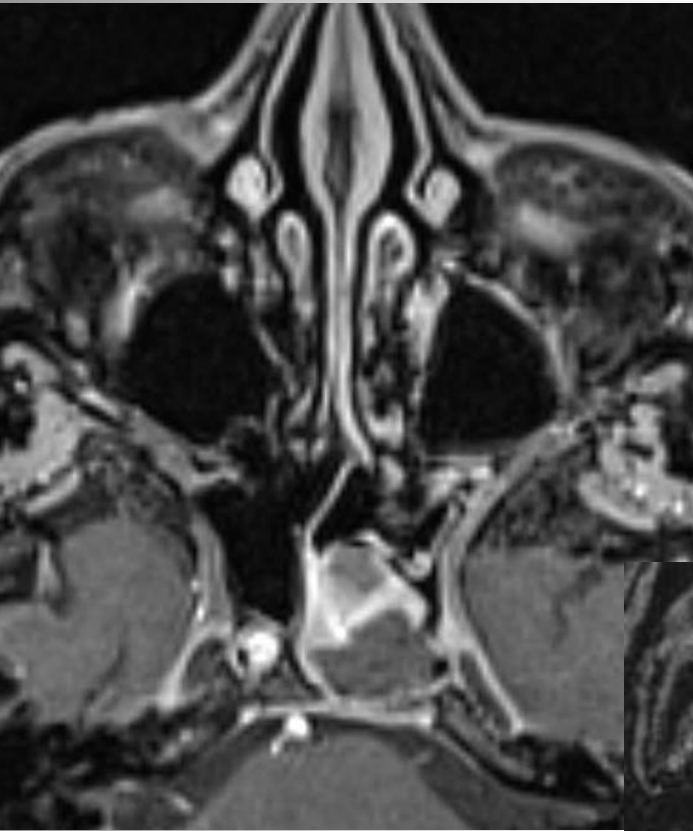


T1 post



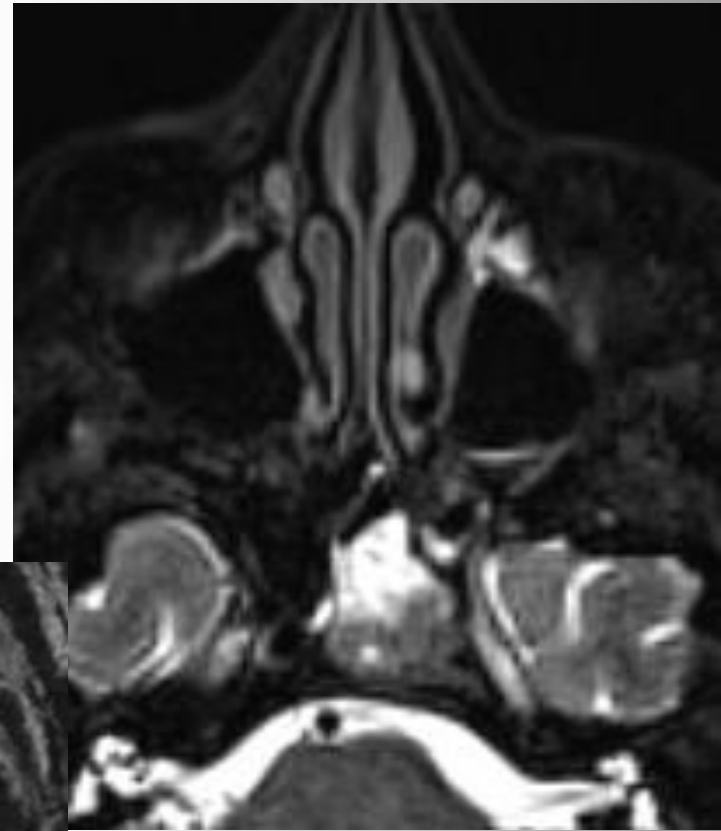
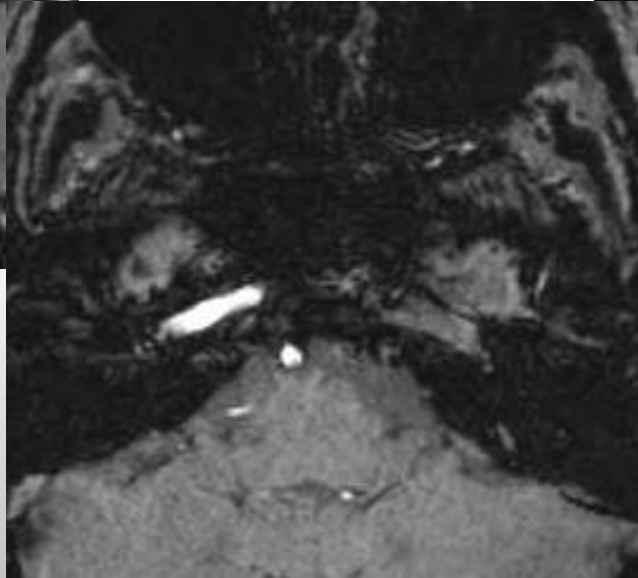
T1 post

# Chronic Invasive Fungal



T1 post FS

SWI



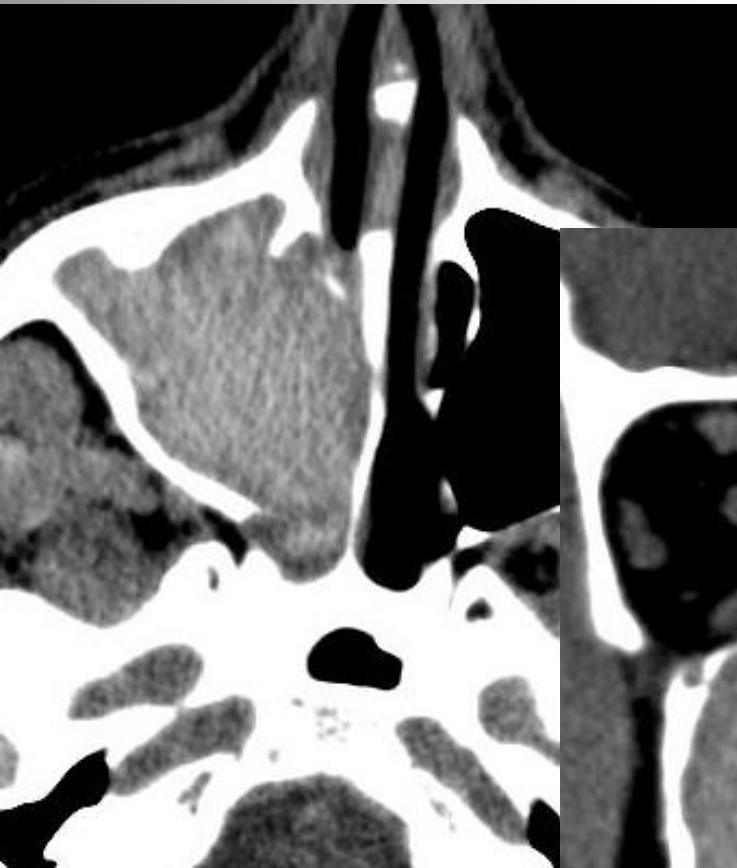
T2 FS



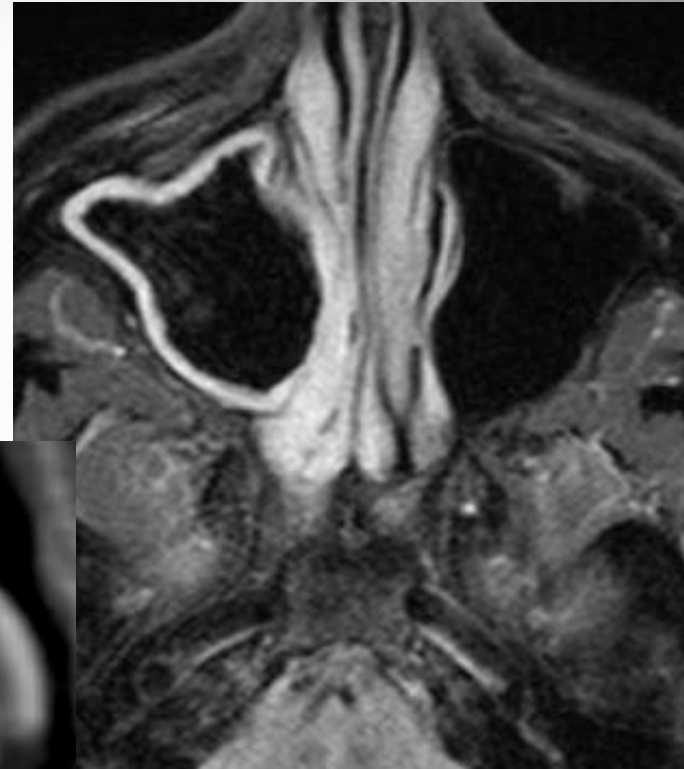
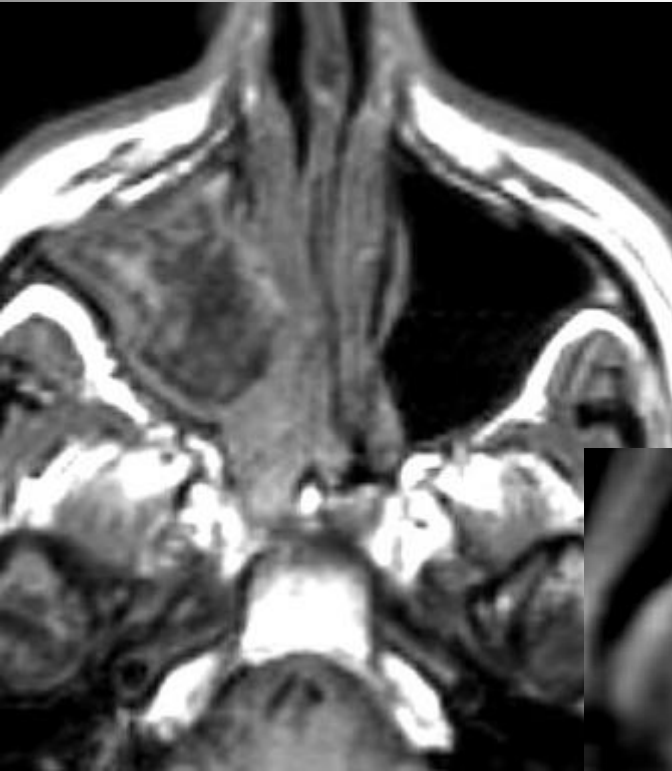
# Allergic Fungal Rhinosinusitis

- Most common fungal disease
- Young, immunocompetent, atopic host
- Fungal allergens lead to immune mediated response

# Allergic Fungal Rhinosinusitis



# Allergic Fungal Rhinosinusitis

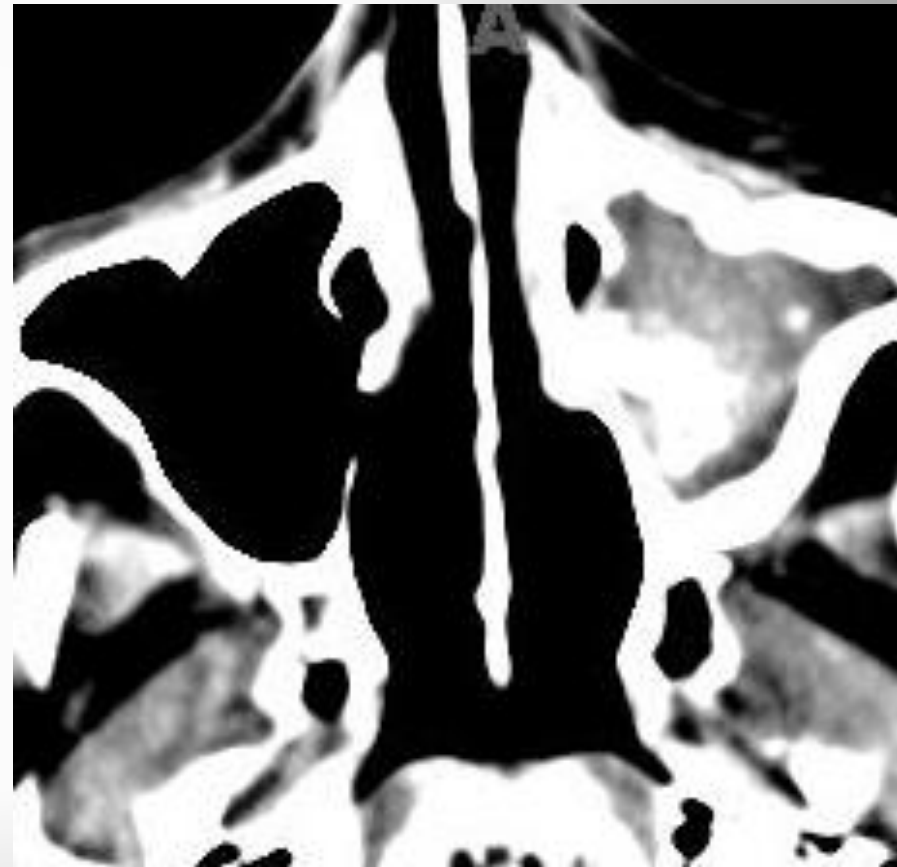
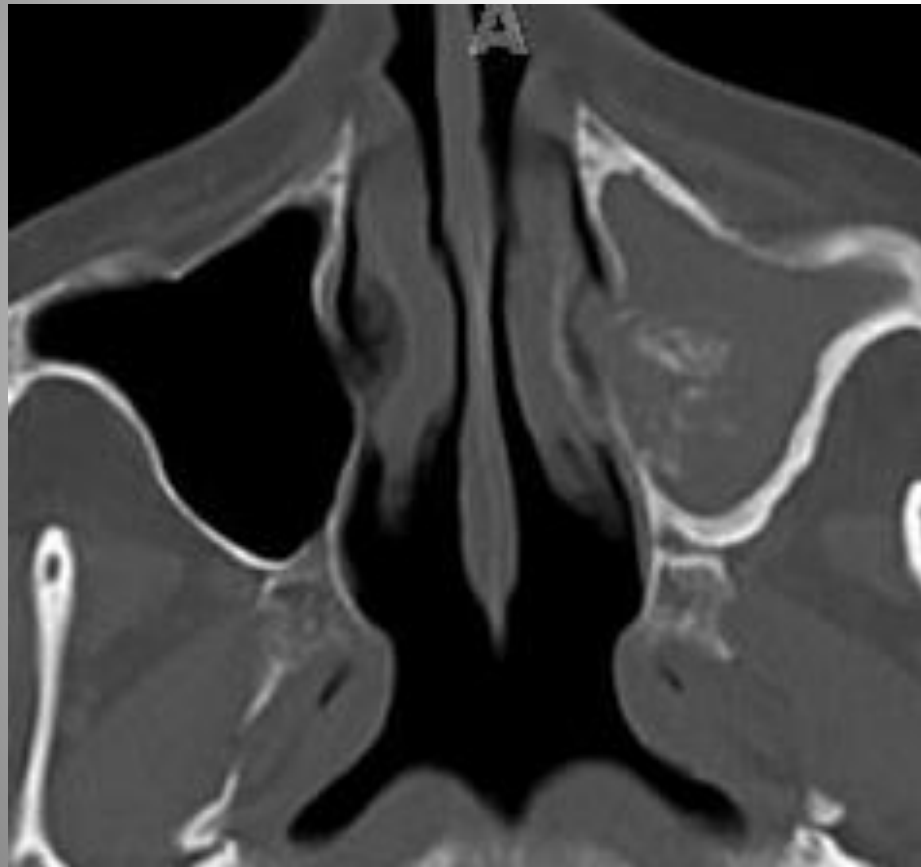




# Fungus Ball

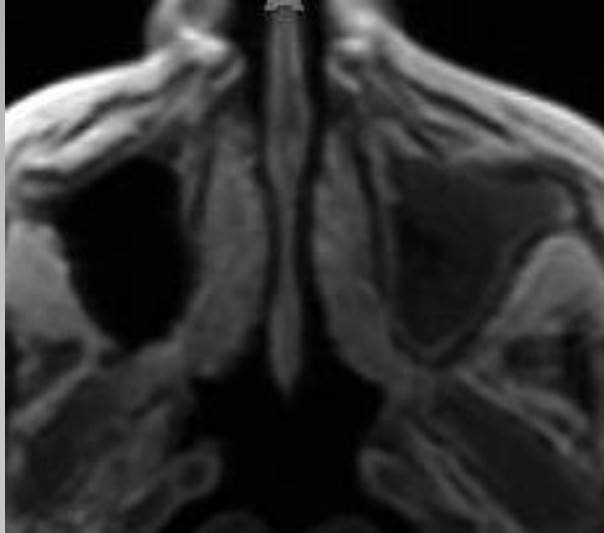
- Conglomeration of fungal hyphae within a sinus
  - Chronic sinusitis
- Elderly and immunocompetent
  - Asymptomatic or mild symptoms

# Fungus Ball

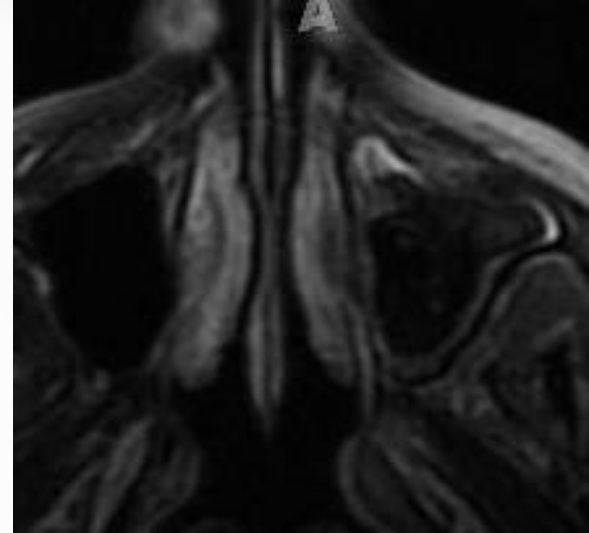


# Fungus Ball

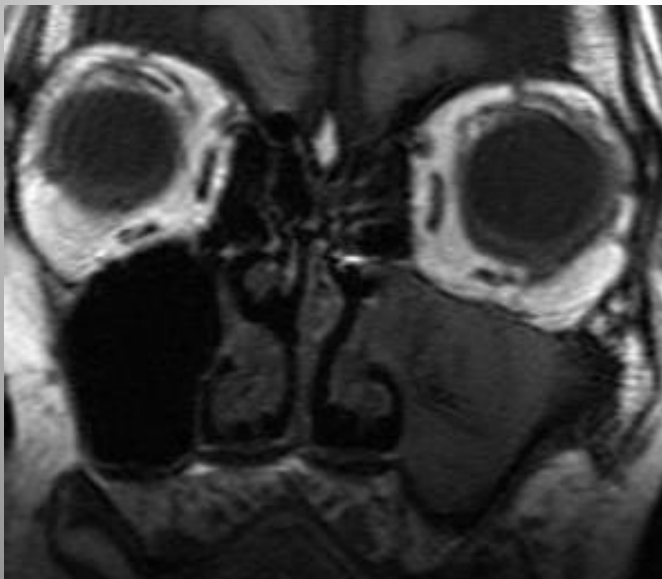
T1



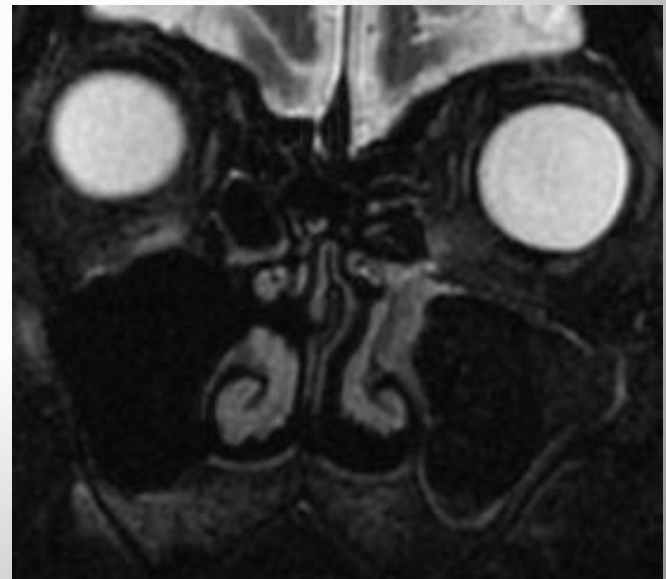
T2



T1



T2





# Sinonasal Masses

- CT and MRI provide complementary information for evaluating sinonasal masses
- CT
  - Evaluation of osseous detail and erosion
  - Surgical roadmap
- MRI
  - Evaluation of extrasinus extension
  - Differentiation between sinus secretions and masses
  - Better delineation of the tumor extent
  - Early marrow edema/involvement at the skull base



# Extracranial Spread

- Anterior and middle cranial fossa
- Central skull base
- Cavernous sinuses
- Orbits
- Pterygopalatine fossa
- Palate



# Sinonasal Masses

- Sinonasal polyps most common sinus mass
- Malignancy relatively uncommon
  - 3-4% of all head and neck cancers
  - 80% squamous cell carcinoma, 5-15% adenoid cystic, 5-10% adenocarcinoma, 5% esthesioneuroblastoma
  - Melanoma, other minor salivary gland tumors, sinonasal undifferentiated carcinoma (SNUC) rare
- Detected at advanced stage



# Imaging

- Significant overlap in imaging characteristics of sinonasal malignancies
  - Usually requires biopsy for diagnosis
  - Radiologists
    - Delineate tumor extent and structures involved
      - Perineural and lymphatic spread
        - » Retropharyngeal lymph nodes
      - Dural and intracranial invasion
      - Soft tissue involvement

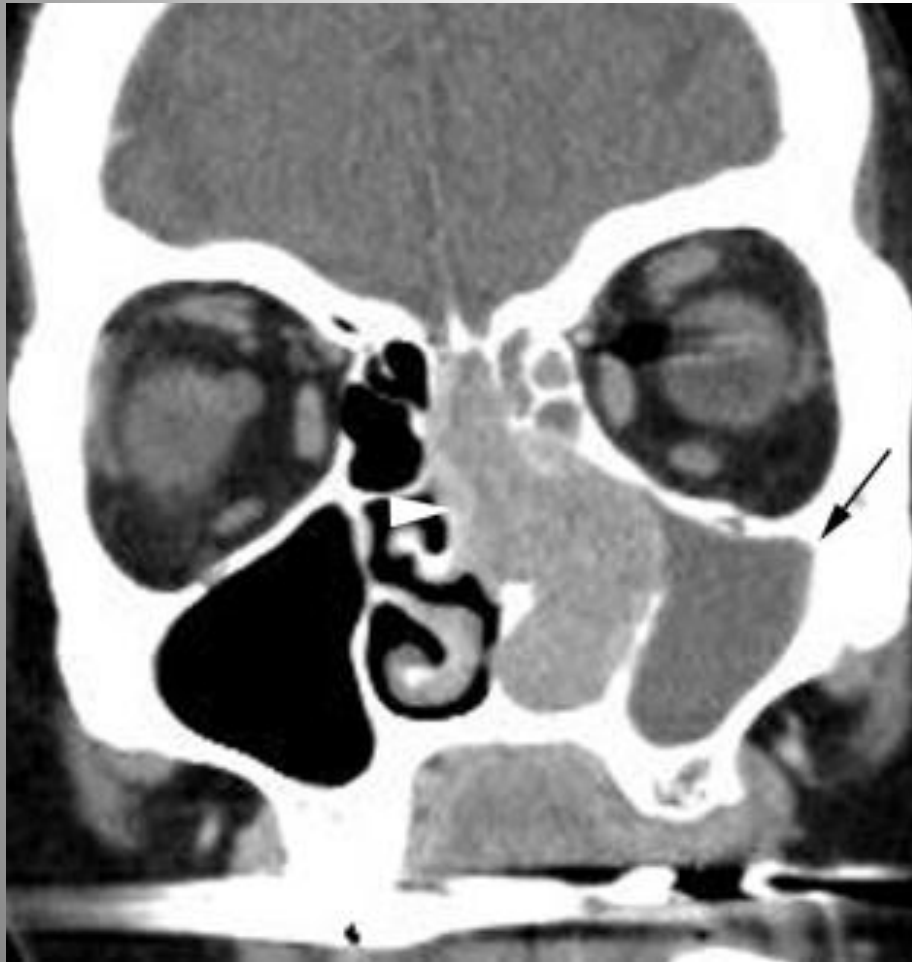
# Can we at least tell Malignant from Benign??

1. Multiplicity
2. Margins
  - well-demarcated
  - invasive
3. Bone changes
  - remodeling
  - destruction



**Solitary invasive mass with bone destruction=malignant (usually!)**

# CT Findings of Sinonasal Malignancy

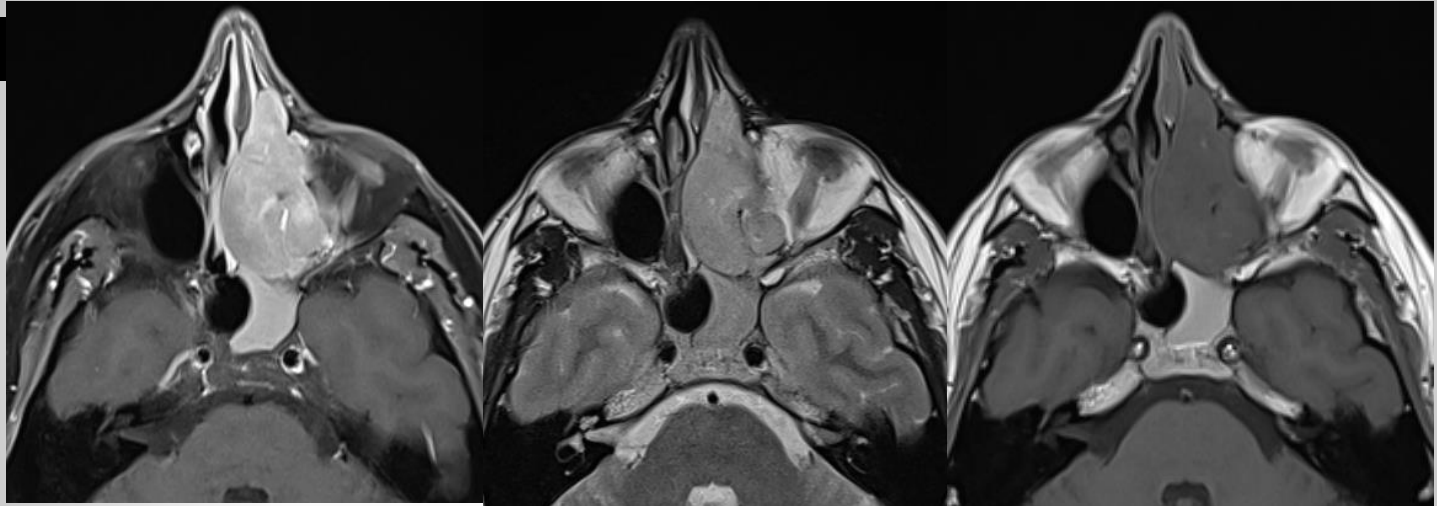




# MR Findings

- Intermediate to low T1 and T2 signal
  - Central heterogeneity
- Avid, heterogeneous enhancement
- Diffusion restriction

# **Ethmoid adenocarcinoma with sphenoid mucocele**



**Use ALL sequences to help map tumor v.  
inflammatory disease**

# Adenocarcinoma

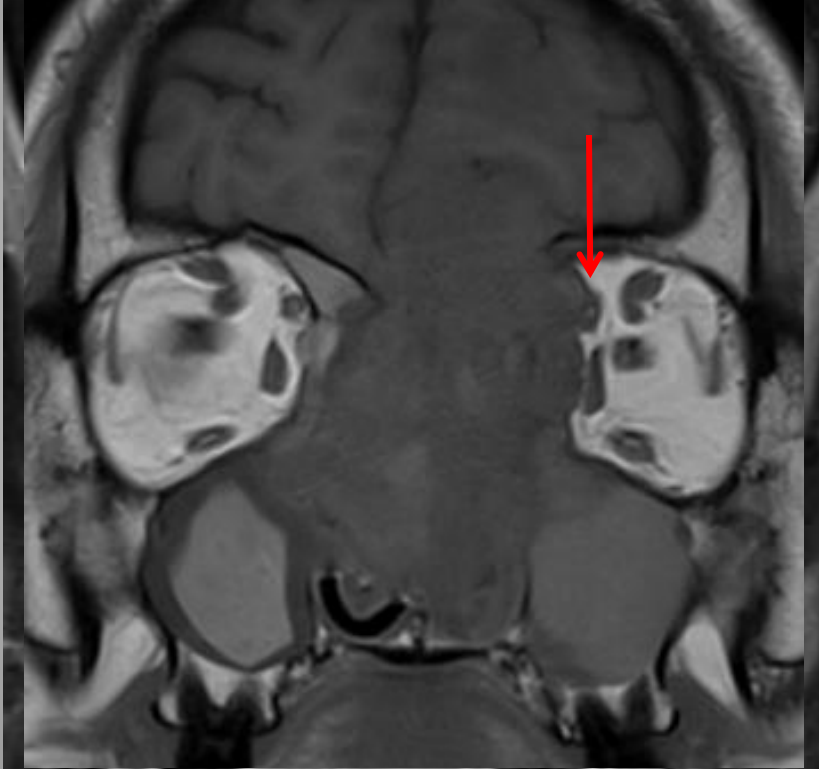




# Dural Invasion

- Thin linear enhancement likely reactive
- Indications of dural involvement
  - Nodular, focal dural enhancement
  - Discontinuous band of enhancement
  - Loss of hypointense zone b/w tumor and dura
  - Dural thickening greater than 2 mm
  - Pial enhancement

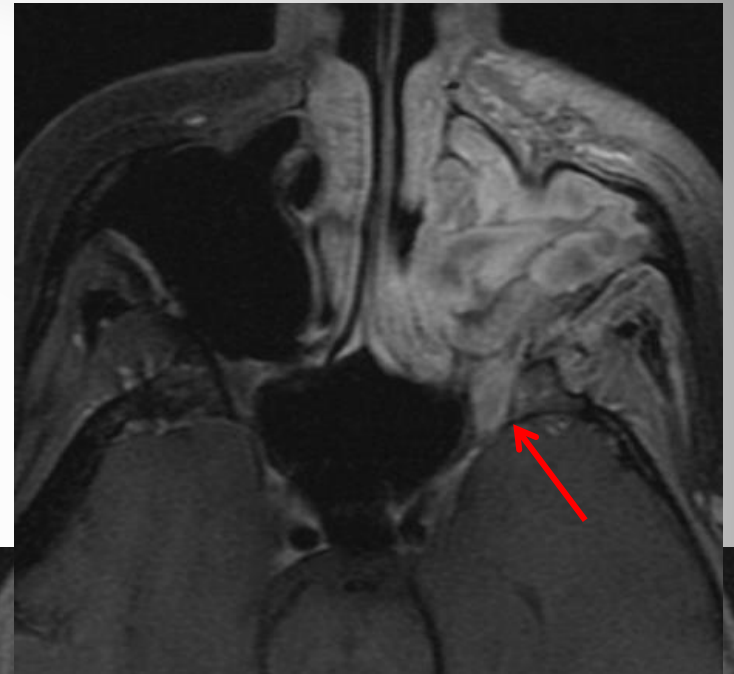
# Orbital Invasion



- Orbital wall invasion  $\neq$  enucleation
- If intact fat plane between tumor and EOM, globe may be saved
- If tumor invades the muscle cone, enucleation required for surgical cure

# Perineural Tumor Spread

- Most commonly branches of trigeminal n. (V2)
- SCC, ACC, melanoma, lymphoma
- Thickening/enhancement of nerves
- Widening of foramina
- Assess cavernous sinuses

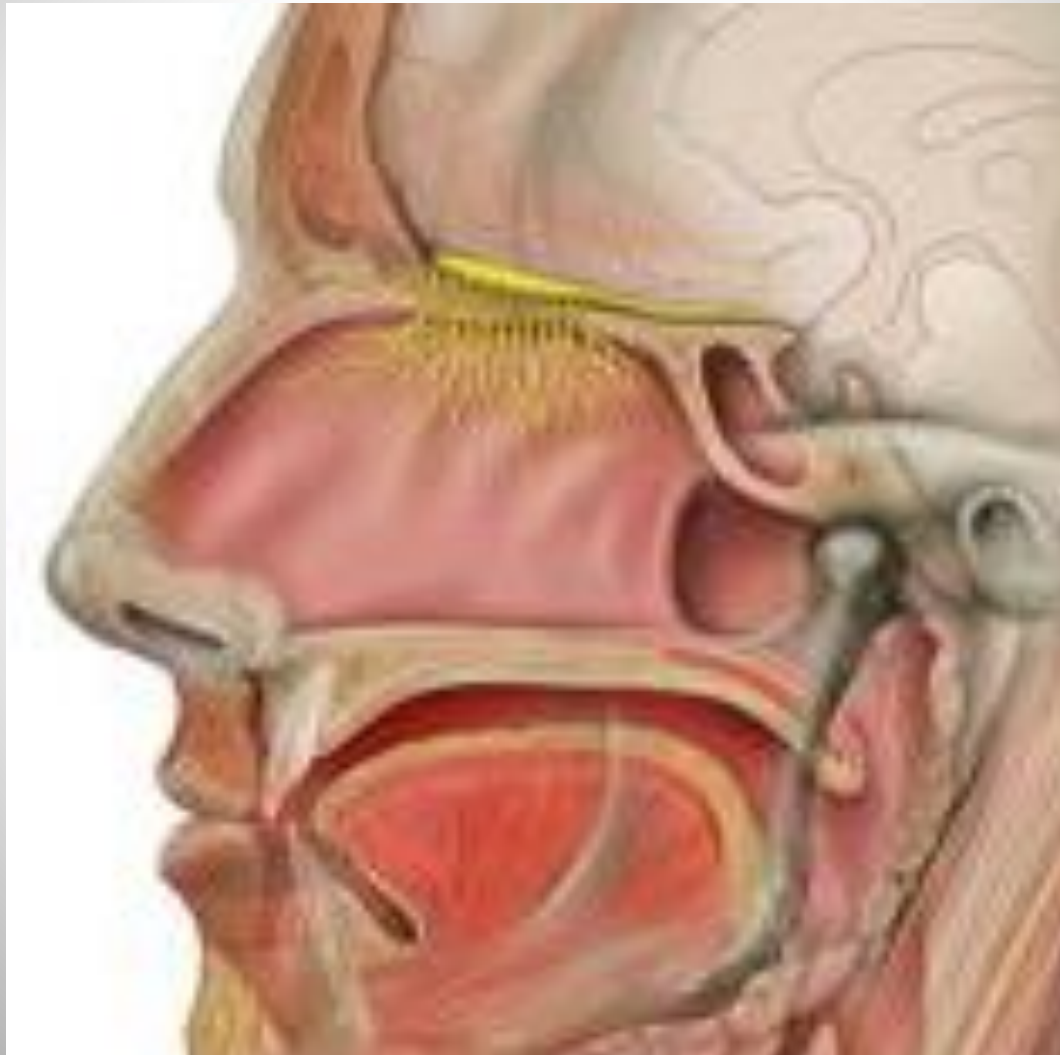




# Distinguishing Characteristics

- Esthesioneuroblastoma
  - Intracranial cyst
    - Specific but not sensitive
- Melanoma
  - Intrinsic T1 shortening
- Inverted papilloma
  - Cerebriform pattern
  - Hyperstosis at osseous attachment site in lateral nasal cavity
- Lymphoma
  - Can extend between compartments without destroying bone
  - Molds to surrounding structures

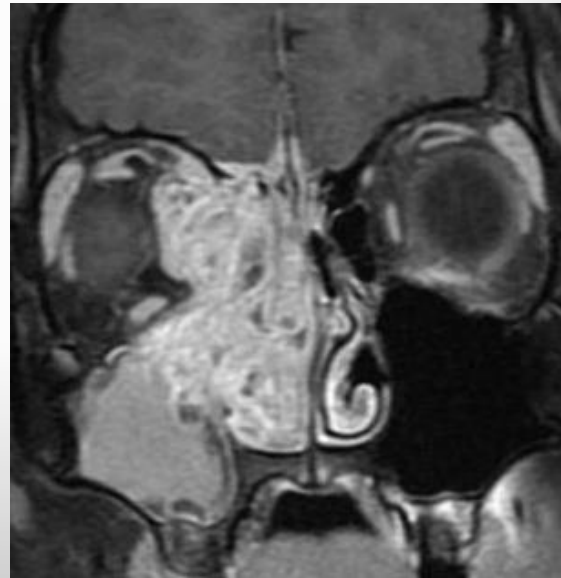
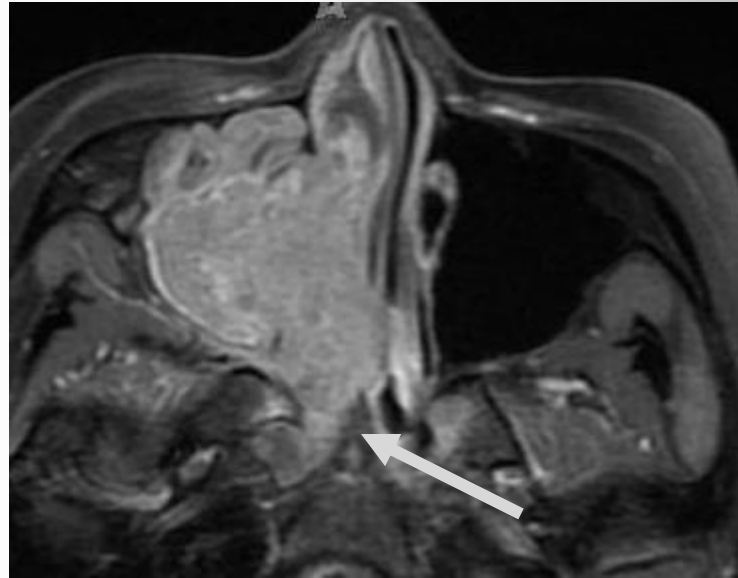
# Esthesioneuroblastoma



# Esthesioneuroblastoma



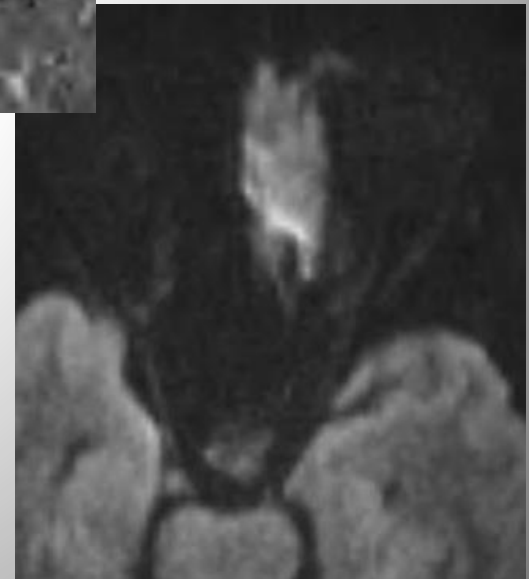
# Esthesioneuroblastoma



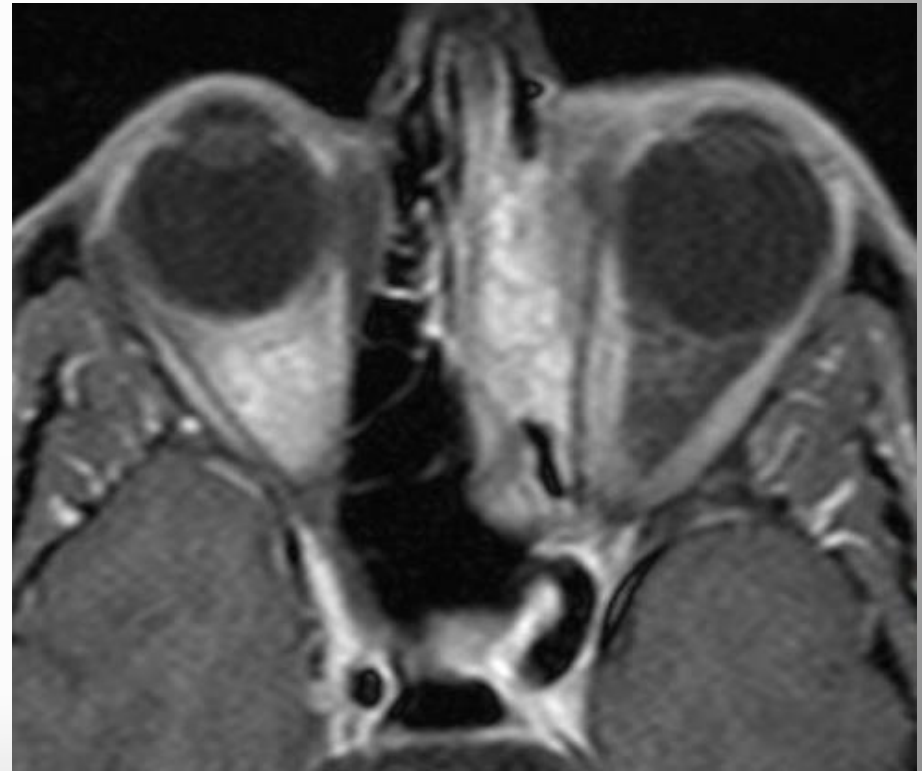
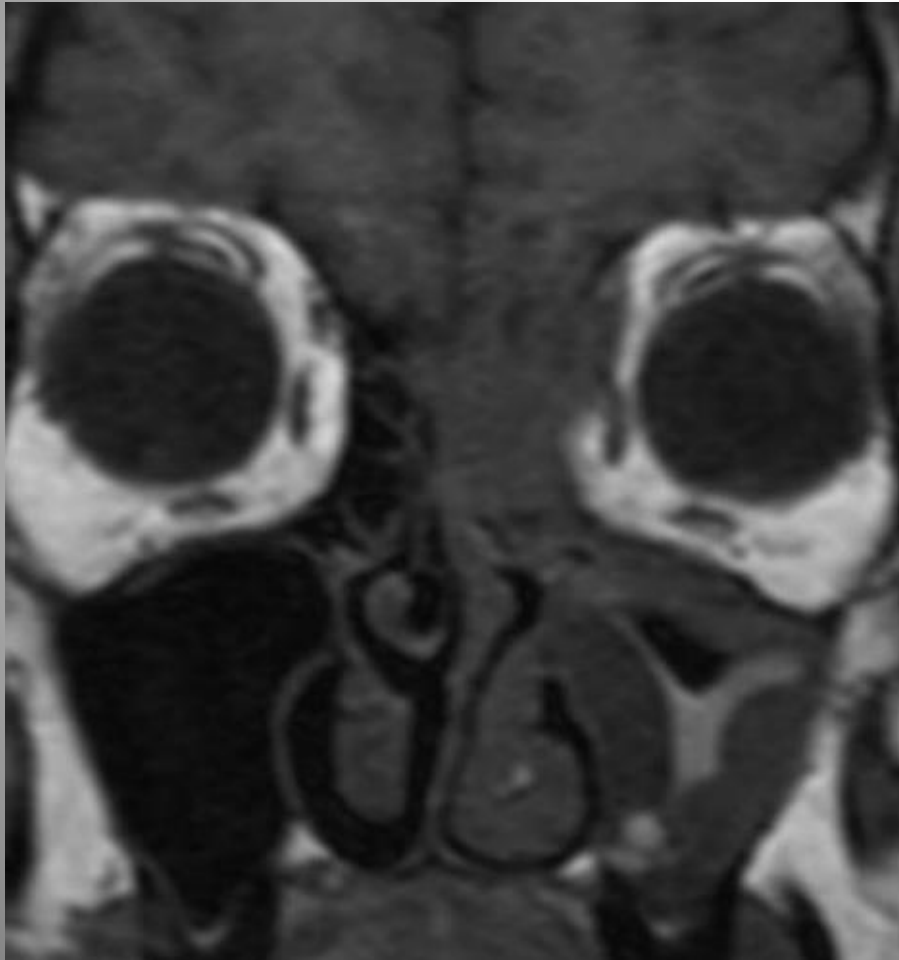
# Esthesioneuroblastoma



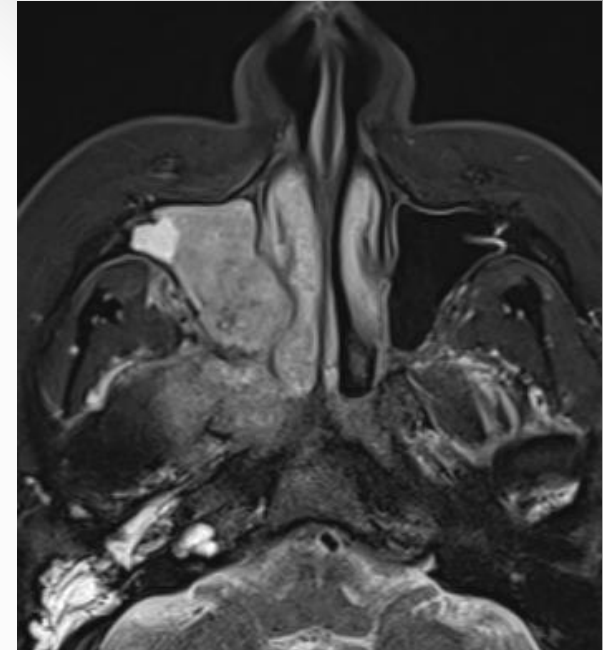
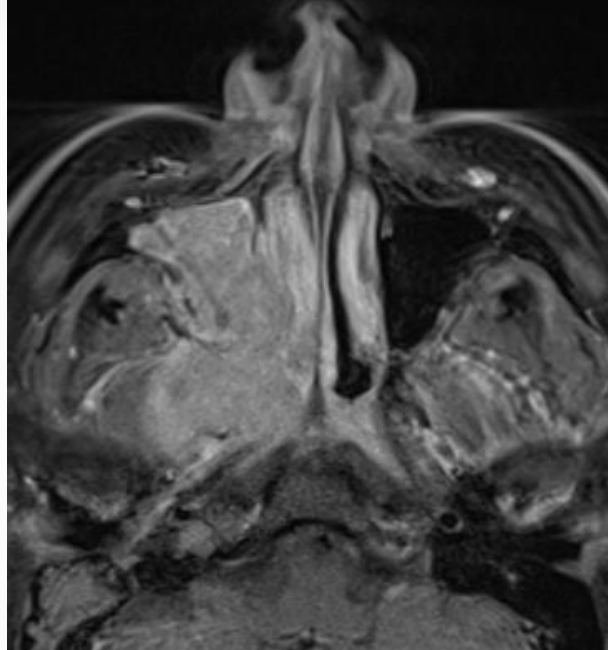
# Sinonasal Lymphoma



# Sinonasal Lymphoma

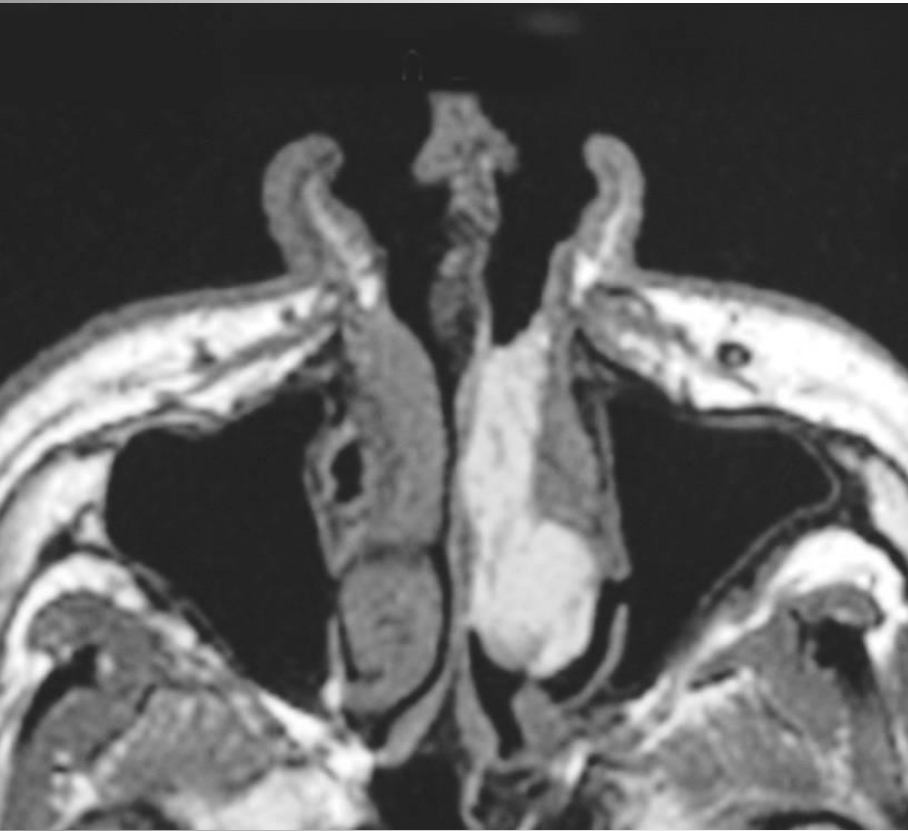


# Squamous Cell Carcinoma



- Most common SN tumor
- Epistaxis, facial pain, nonspecific sinus complaints
- Mean 5-year survival 35%
- Poor prognostic indicators
  - Orbital invasion
  - Pterygopalatine fossa extension
  - Cervical lymph node metastases

# Sinonasal Melanoma



# Inverted Papilloma



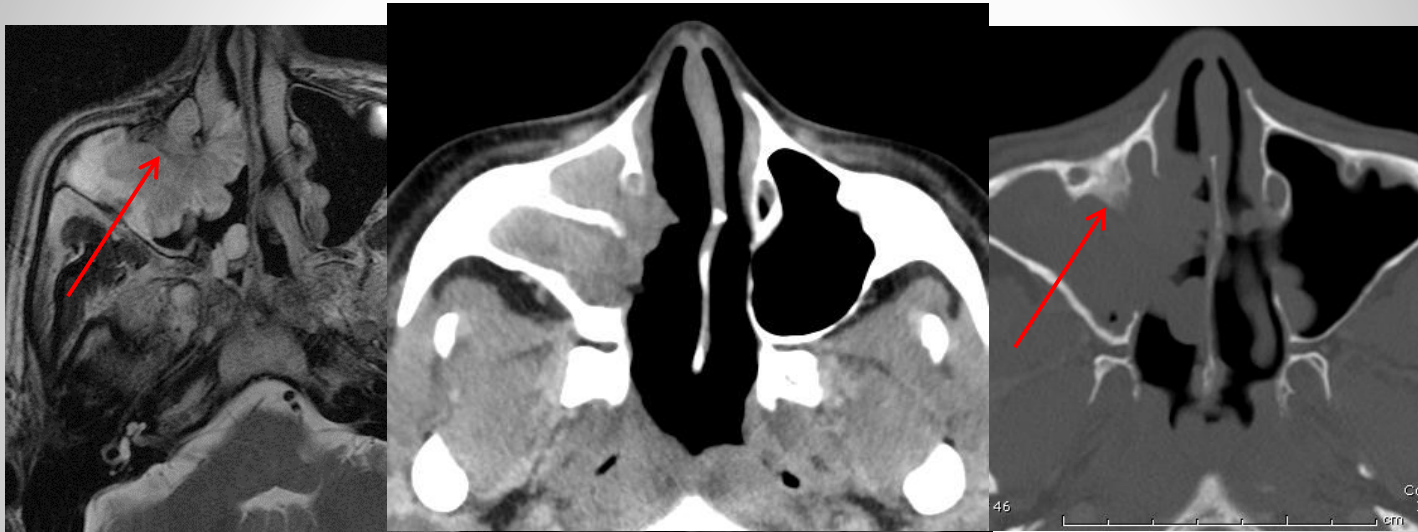
# Inverted Papilloma



# Cerebriform Pattern

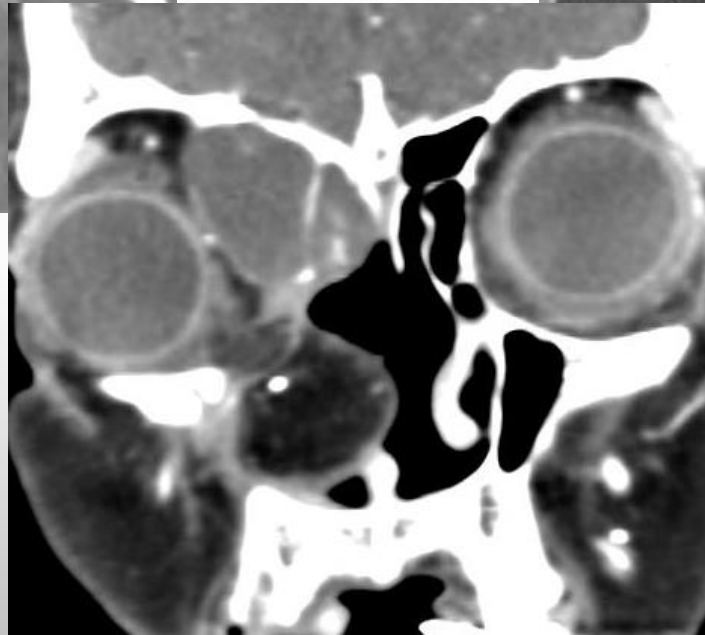


# Recurrent Inverted Papilloma



Osseous strut indicates site of origin,  
which must be resected

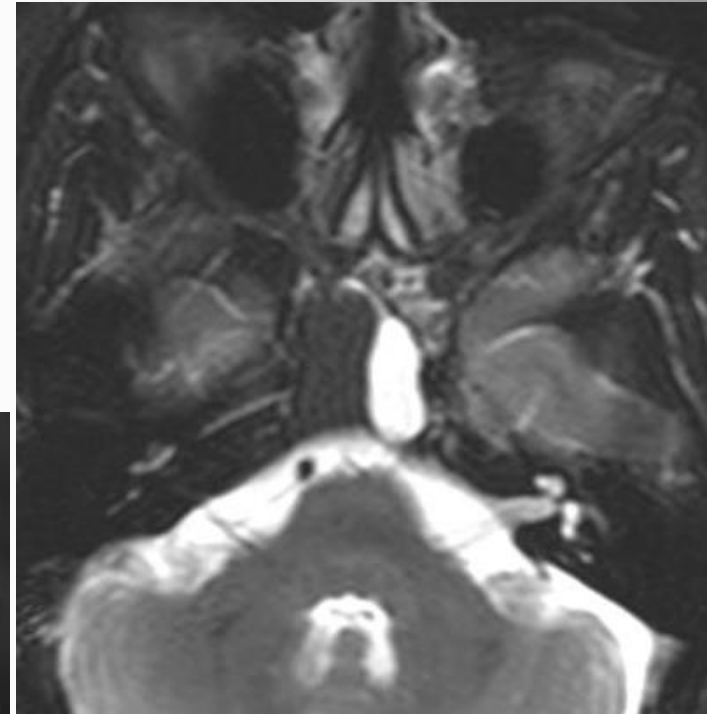
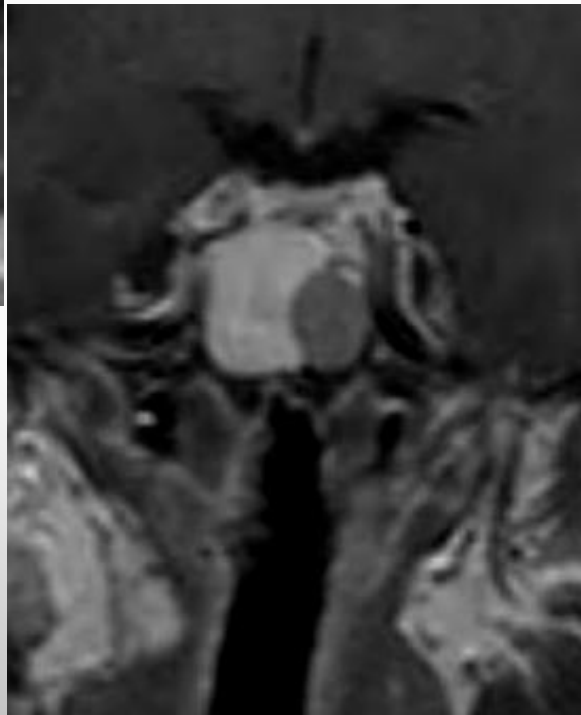
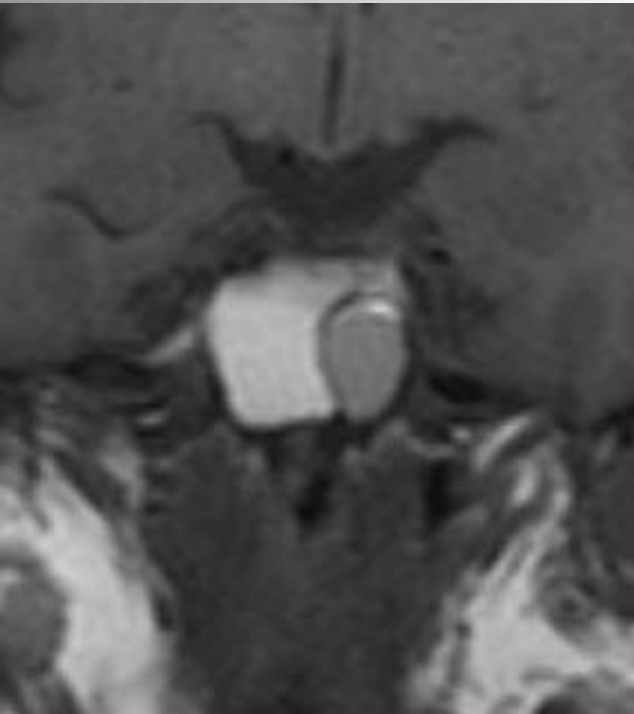
# Ethmoid Mucocele



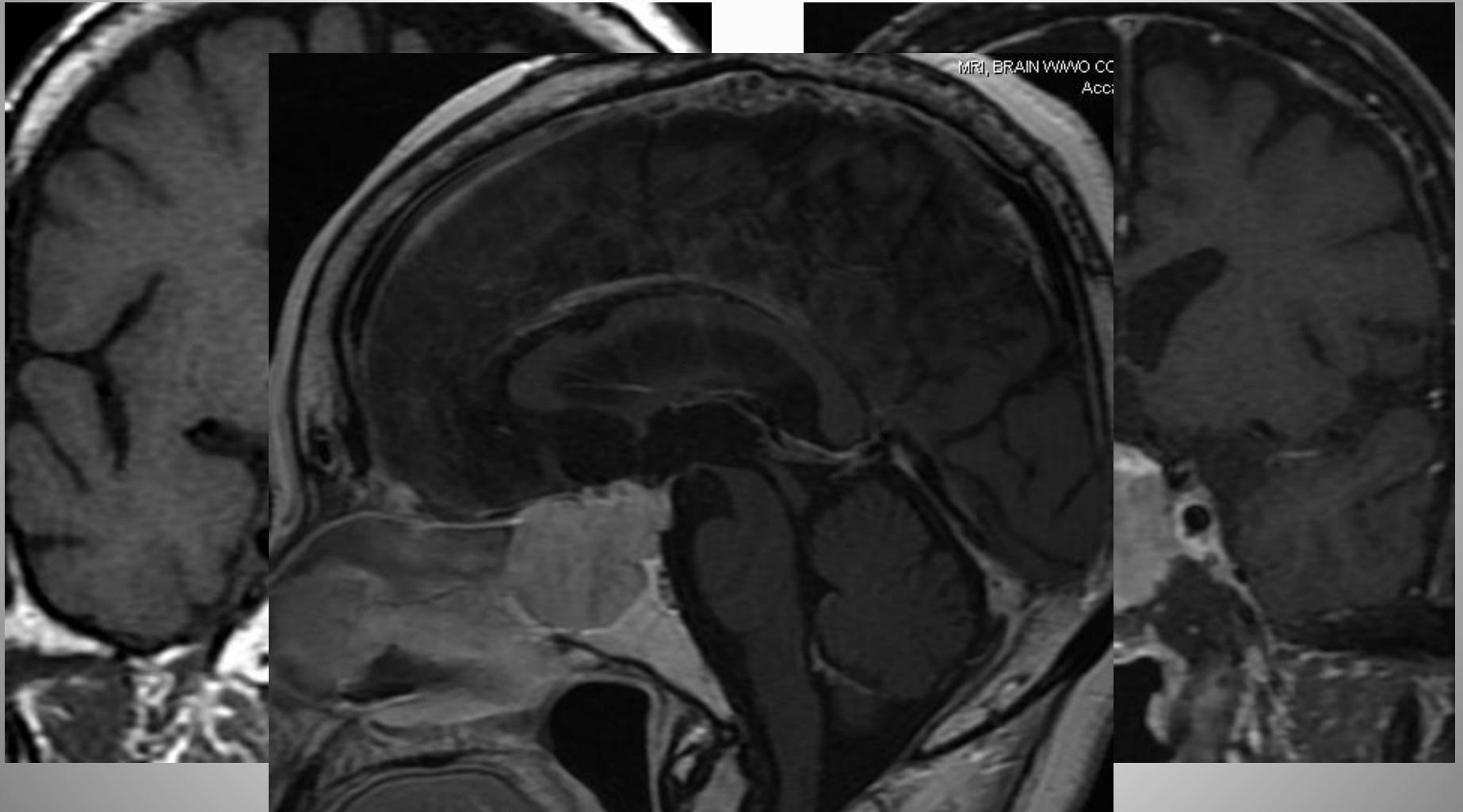
# Sphenoid Sinus Mucocele



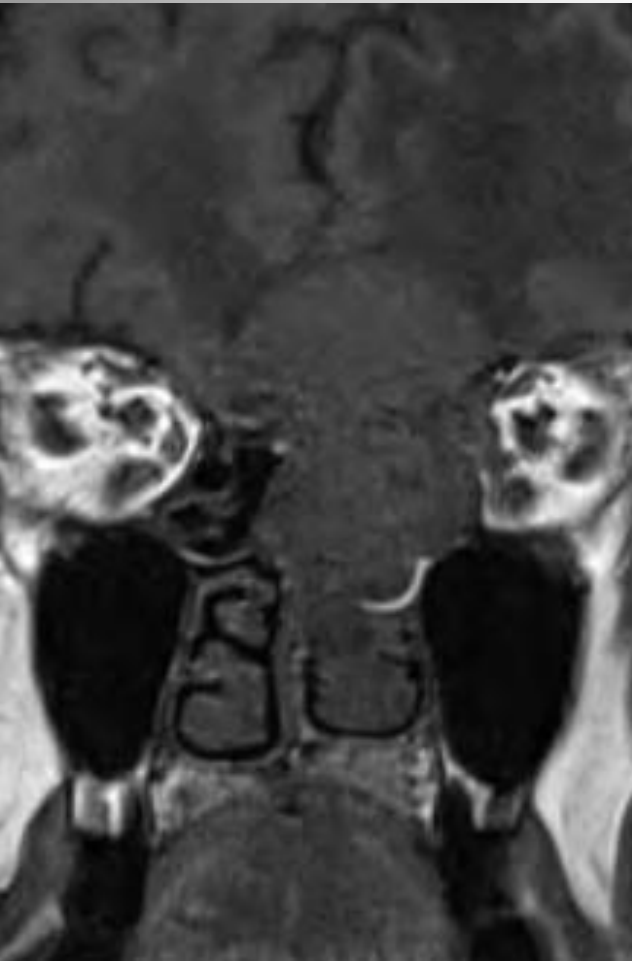
# Sphenoid Sinus Mucocele



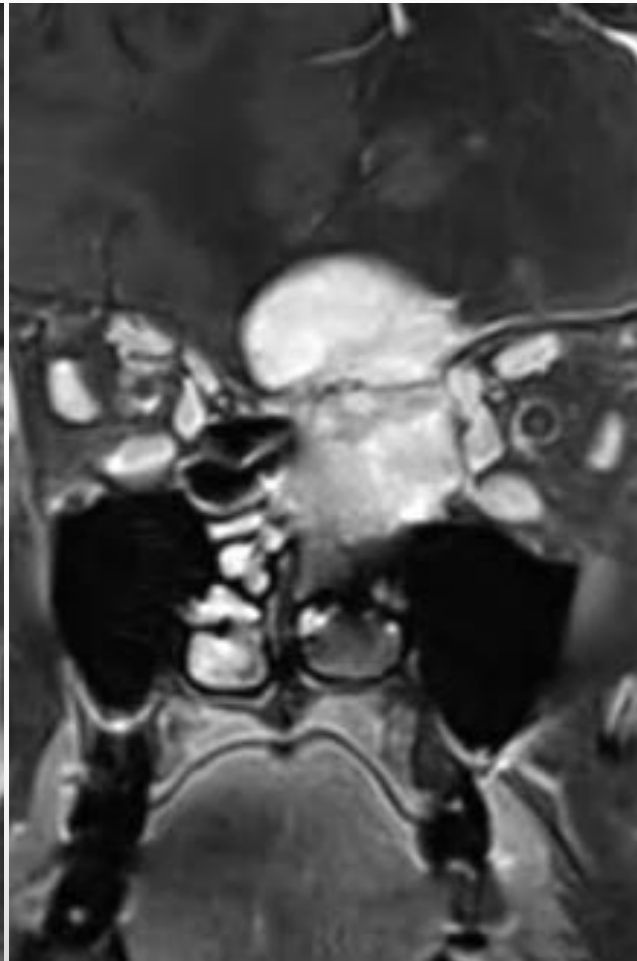
# Sphenoid Sinus Meningioma



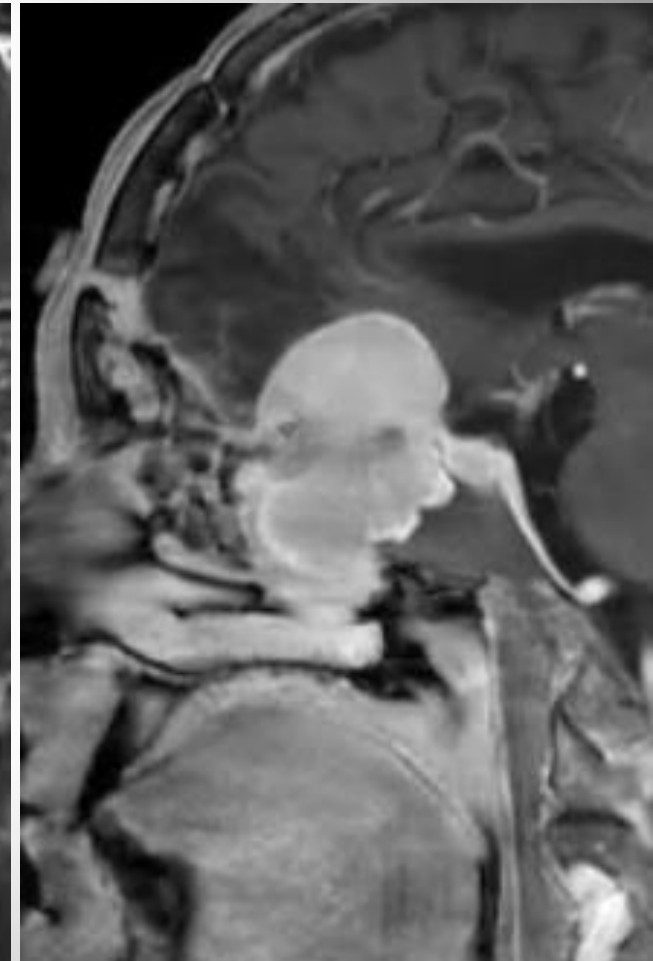
# Olfactory Groove Meningioma



T1

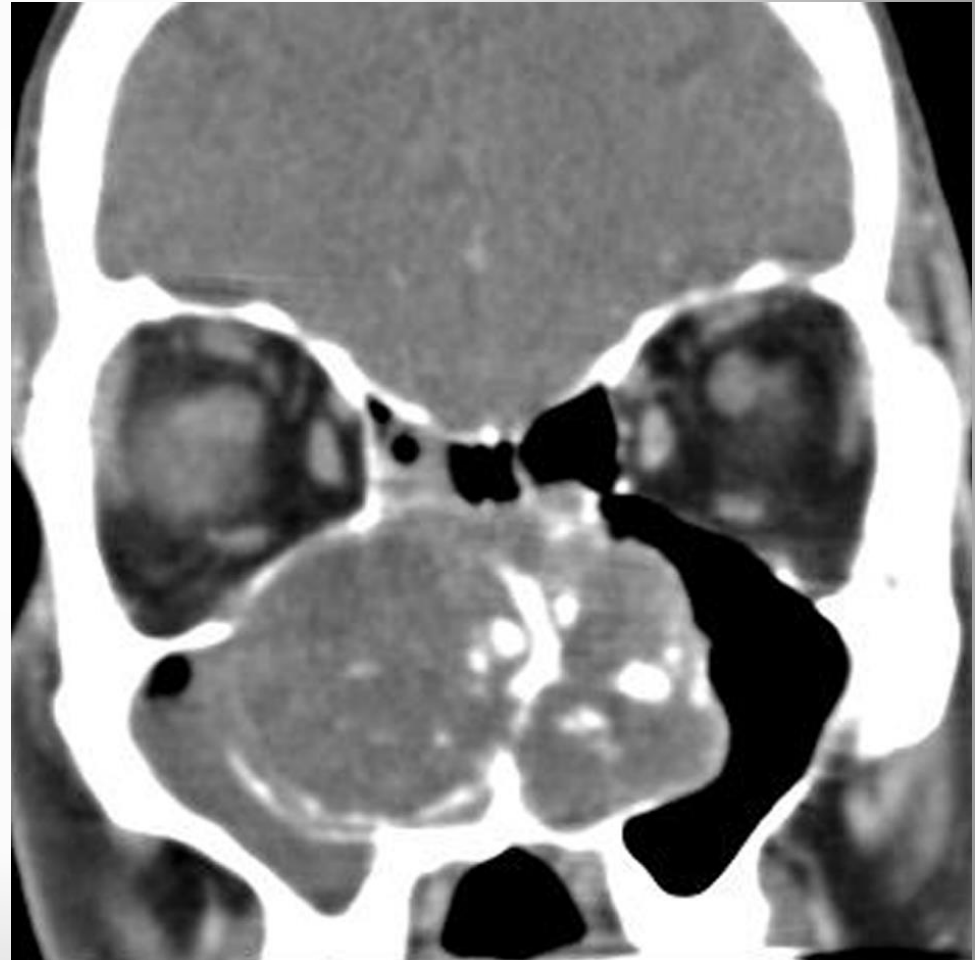
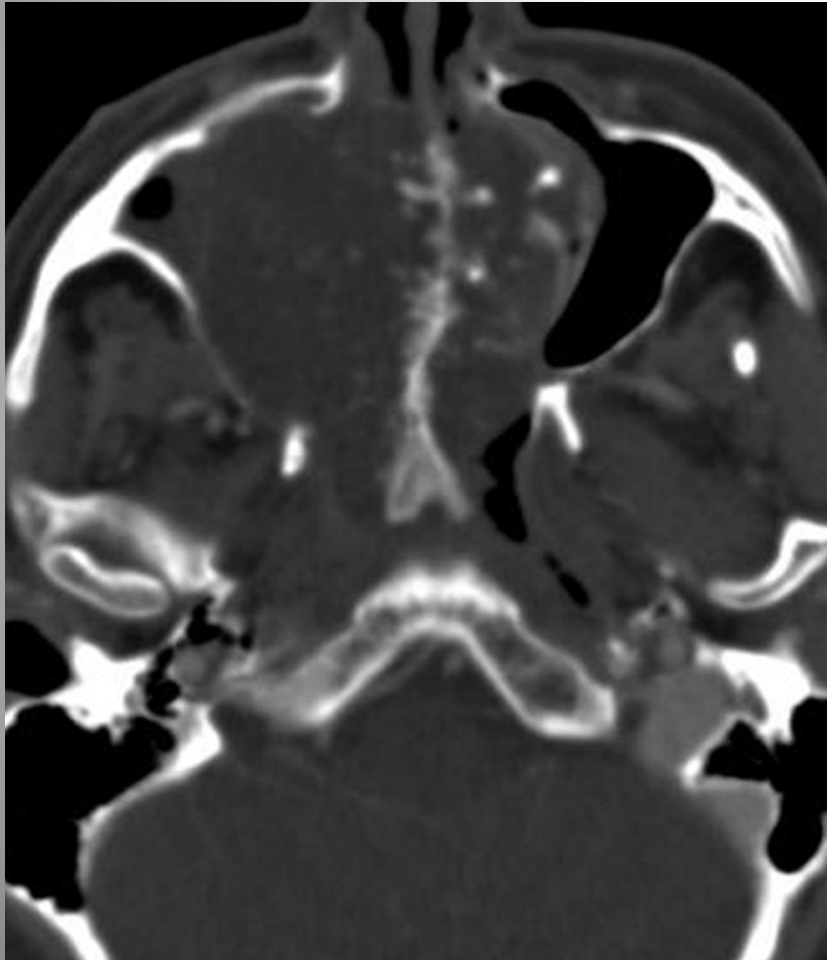


T1 post

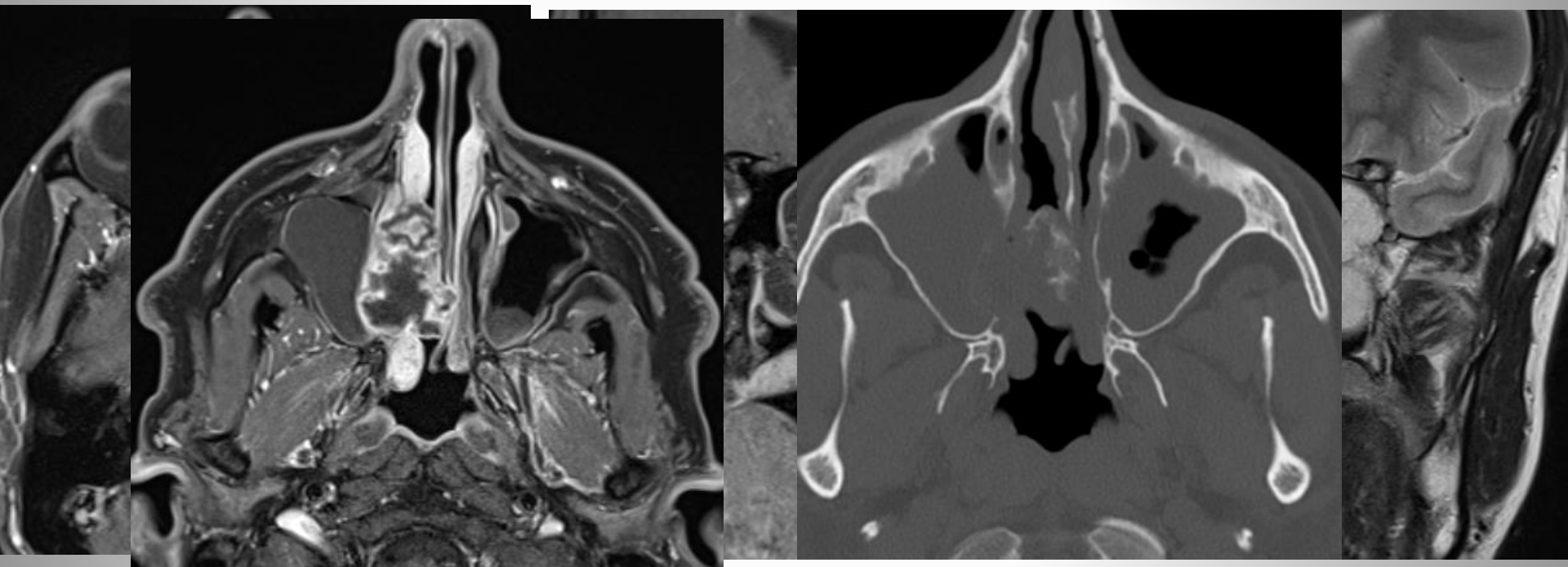


T1 post

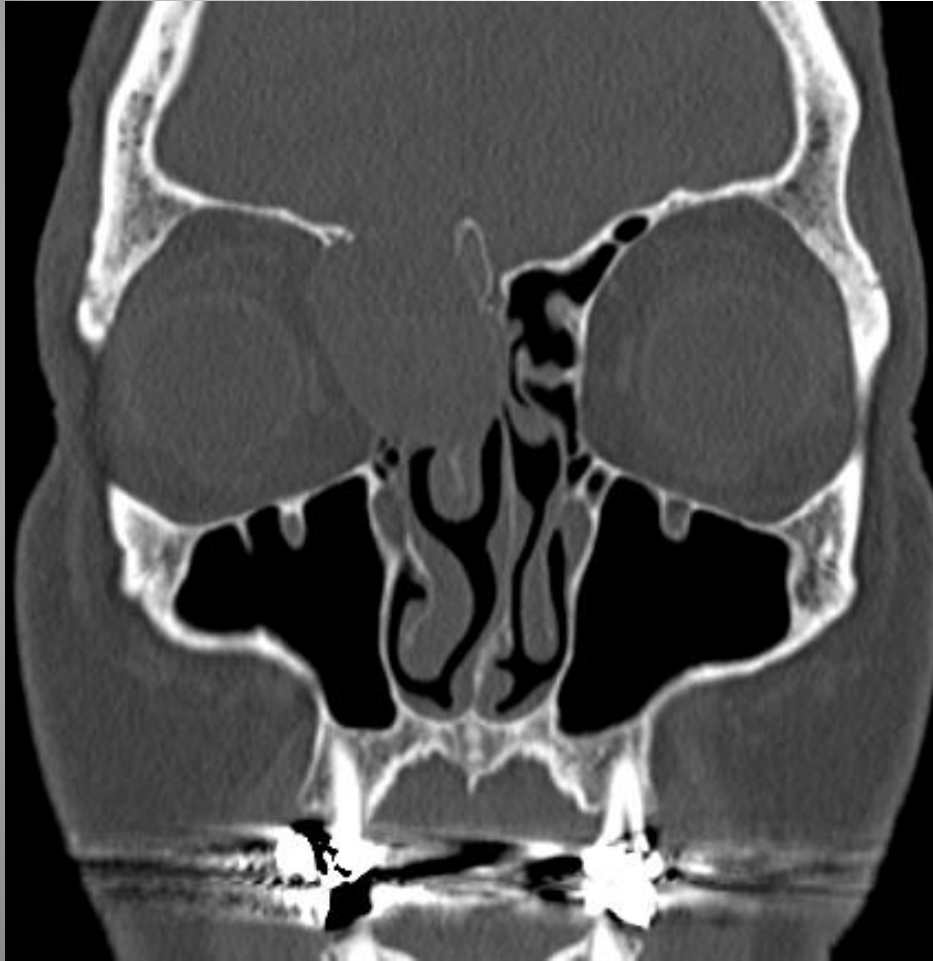
# Chondrosarcoma of the Nasal Septum

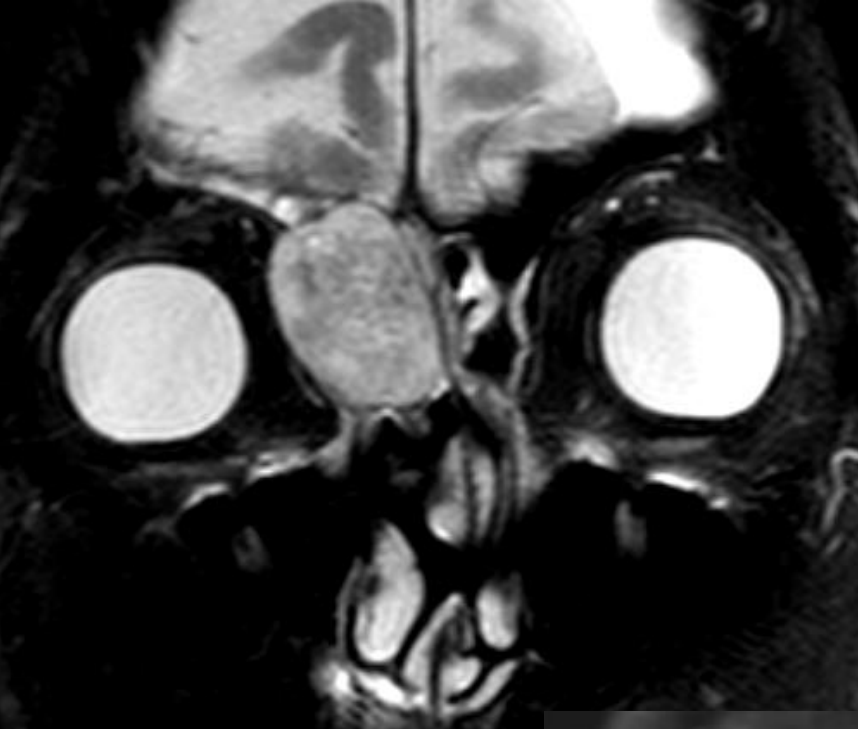


# Sinonasal Chondrosarcoma



# Ethmoid Schwannoma

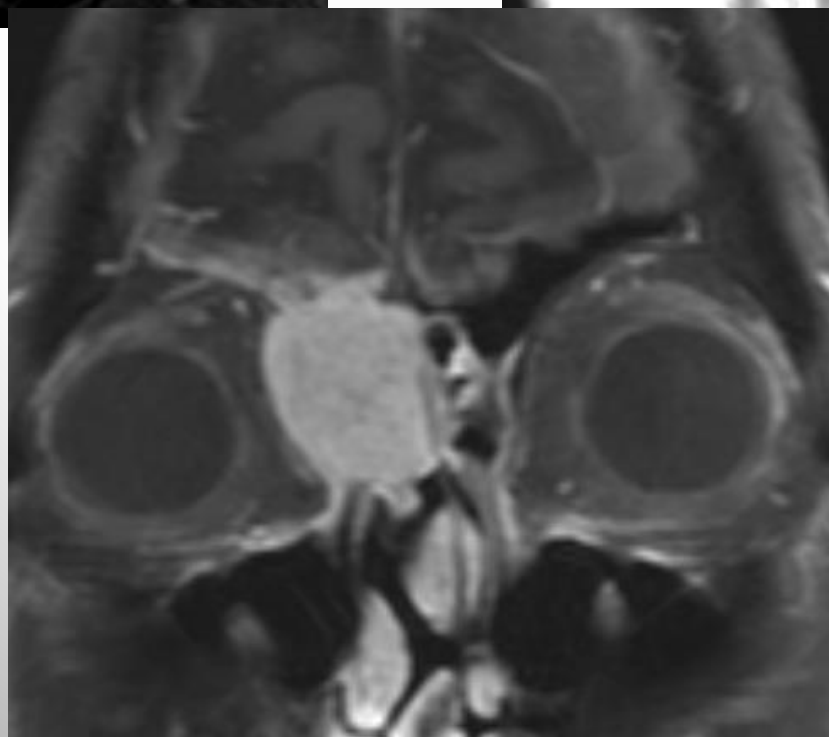




STIR



T1



T1 FS PC



# Summary

- CT is the modality of choice for sinonasal inflammatory disease
  - MRI employed for extrasinus extension
  - Role of imaging is to identify complications, mimics, surgical planning
- Early diagnosis of acute invasive fungal sinusitis
- CT and MRI play a complementary role in the evaluation of sinonasal masses
- Significant overlap of imaging appearances of sinonasal masses
  - Recognize the presence of a mass, describe its boundaries and any adjacent structures involved