

## Functional Endoscopic Sinus Surgery (FESS)

### Objectives

1. Understand the indications and complications of FESS
2. Be able to describe pertinent anatomy of the nasal cavity and paranasal sinuses
3. Be able to interpret CT sinus imaging

### Indications for Sinus Surgery

- Complicated acute rhinosinusitis (intracranial or orbital extension)
- Chronic rhinosinusitis with or without nasal polyposis (CRSwNP, CRSsNP) refractory to medical management
- Nasal cavity and anterior skull base masses
- Foreign body removal
- Mucoceles
- Cerebral spinal fluid (CSF) leak repair
- Ophthalmic procedures including orbital decompression and dacryocystorhinostomy
- Hemostatic control of epistaxis

### Indications for Image Guided Sinus Surgery

- Revision sinus surgery
- Distorted sinus anatomy
- Extensive nasal polyposis
- Pathology extending into the skull base, optic nerve orbit, carotid artery
- CSF leak/skull base defect repair
- Benign and malignant sinonasal neoplasms
- Surgeon discretion

### Complications of Sinus Surgery

- General: infection, bleeding, including hemorrhage, recurrence or inadequate resolution of symptoms, scar tissue formation, nasolacrimal duct injury causing epiphora
- Septum: septal perforation, hematoma, palate numbness, nasal tip ptosis
- Ethmoid: altered or loss of sense of smell, orbital injury including vision loss, CSF leak, meningitis

### Vascular Supply to the Nasal Cavity

**Kisselbach's Plexus**- origin of anterior epistaxis (90-95% of nosebleeds)

- Ophthalmic artery-> **anterior ethmoidal artery**
- Maxillary artery-> **sphenopalatine artery**
- Maxillary artery-> descending palatine artery-> **greater palatine artery**
- Facial artery-> **superior labial artery**-> septal branches

**Woodruff's Plexus**- origin of posterior epistaxis (5-10% of nosebleeds)

- Ophthalmic artery-> **posterior ethmoidal artery**
- Maxillary artery-> **sphenopalatine artery**

### Intraoperative Bleeding Control

- Hypotension (SBP 90-100)
- Topical Afrin or epinephrine
- Injected lidocaine/epinephrine
- Warm irrigation

- TIVA (total intravenous anesthesia)

### Intraoperative Sinus Stents

- The goal of sinus stents is to decrease post-operative occlusion of the sinus ostia, reduce surrounding mucosal inflammation, and reduce regrowth of polyps through the delivery of a steroid (mometasone furoate)
- Two commonly used stents are PROPEL and SINUVA
  - PROPEL
    - Indications: CRSsNP and CRSwNP
    - Location: Ethmoid sinus (PROPEL Mini or full length- cylindrical), frontal sinus (PROPEL Contour- hourglass shaped)
    - Duration of action: 30-45 days
    - Dissolvable
    - Disadvantage: possible increased post operative crusting, foreign body reaction, expensive
  - SINUVA
    - Indications: CRSwNP with history of prior ethmoid sinus surgery
    - Location: Ethmoid sinus
    - Duration of action: 90 days
    - Mostly dissolvable, requires in office removal of central disc at or before 90 days
    - Disadvantage: possible increased post operative crusting, foreign body reaction, expensive, need to remove central disc

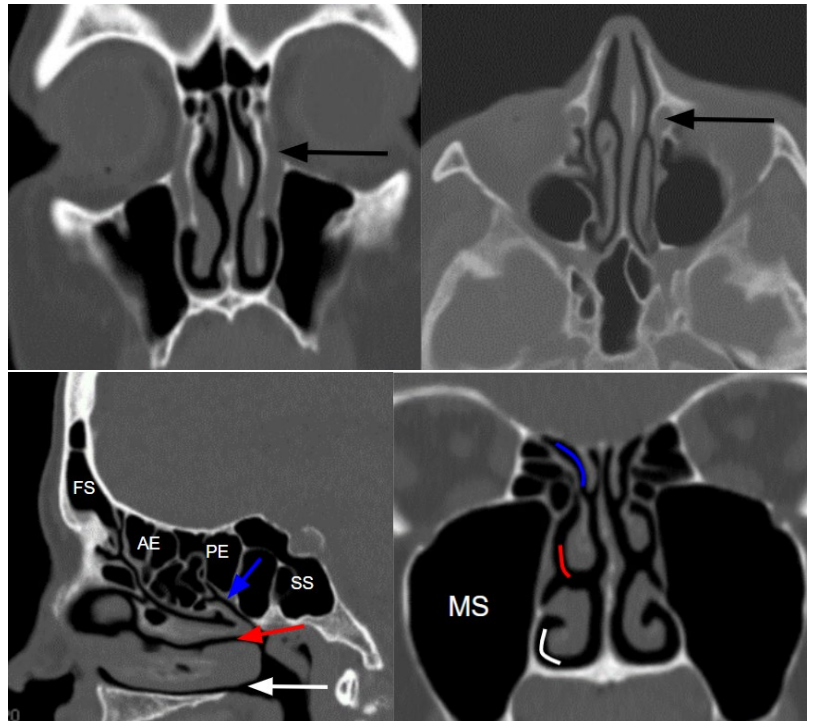
### Drainage of Sinuses

Inferior meatus (▲, ▮) : nasolacrimal duct (▲)

Middle meatus (▲, |) : maxillary sinus (MS), anterior ethmoid sinus (AE), frontal sinus (FS)

Superior meatus (▲, |) : posterior ethmoid sinus (PE)

Sphenoethmoidal recess: sphenoid sinus (SS)



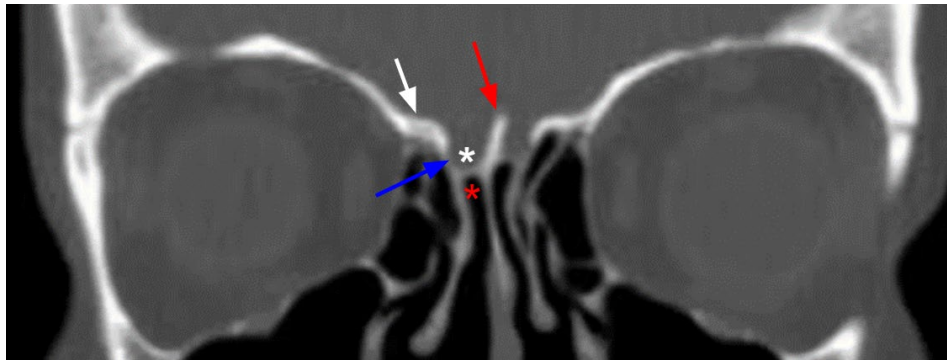
## Radiographic Approach to the Sinuses

The "CLOSED" mnemonic has been widely used for the pre-operative review of sinus CTs.

- *Cribiform Plate (review ethmoid roof anatomy)*
- *Lamina Papyracea*
- *Osteomeatal Complex/Onodi Cell/Optic Nerve*
- *Sphenoid Sinus/Septum Anatomy*
- *Ethmoid Artery (Anterior Ethmoid Artery Anatomy)*
- *Disease (Location of Sinus Disease and Surgical Planning)*

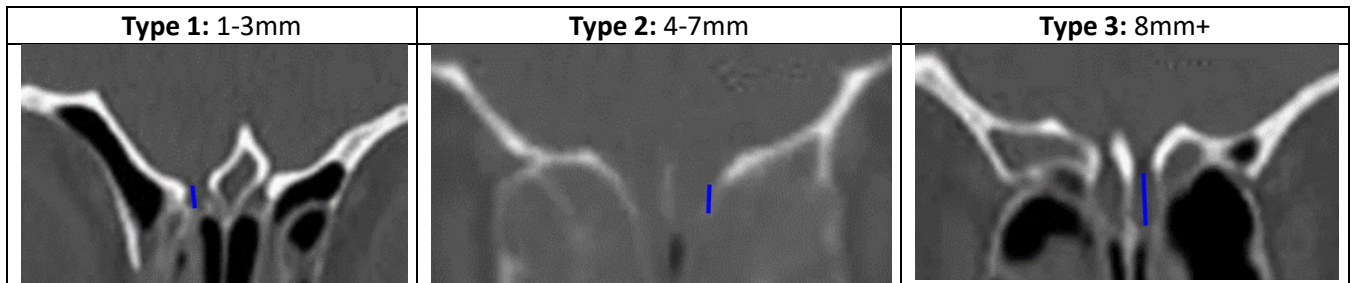
### **Cribiform Plate**

- Examine the cribriform plate for bony dehiscence (thinning) and asymmetry.
- The cribriform plate is the most common site for spontaneous CSF leaks.



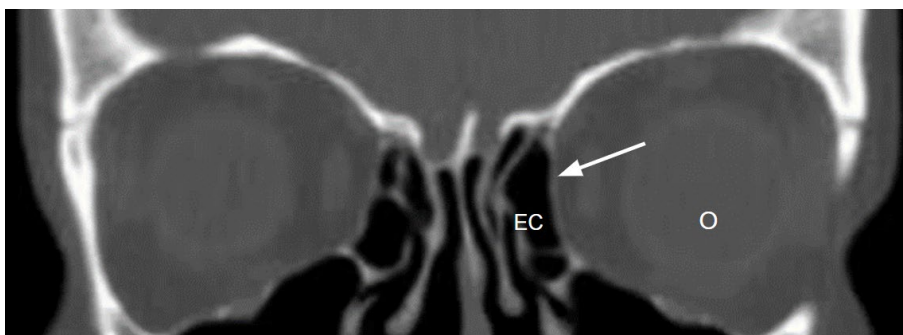
Lateral Lamella (↑)
Fovea Ethmoidalis (▲)
Crista Galli (↑)
Olfactory Fossa (■)
Olfactory Recess (✱)

The Kero's Classification is used to describe the depth of the olfactory fossa (vertical height of the lateral lamella).



### **Lamina Papyracea**

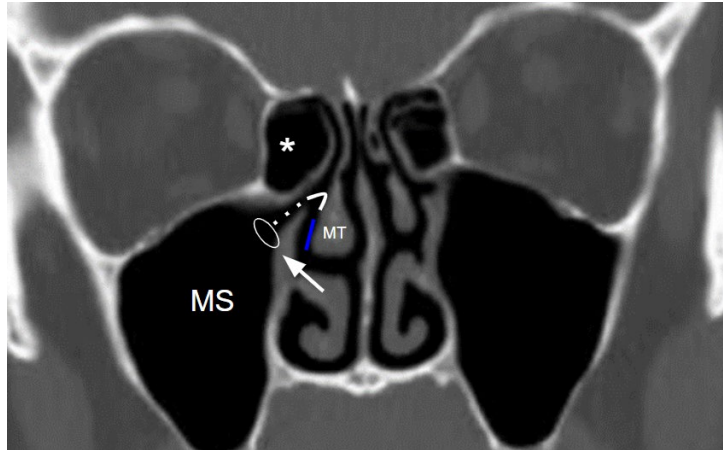
- The lamina papyracea is the most lateral border of the ethmoid sinus and medial border of the orbital wall.
- It is very thin and therefore, the orbit is at risk for injury during FESS.
- It can be damaged in the instance of a medial blowout fracture or purposely removed in orbital decompression surgery.



Lamina Papyracea (▲)
Orbit (O)
Ethmoidal Air Cells (EC)

## Osteomeatal Complex/Unit (OMC)

- The OMC is the site of common drainage for the maxillary, frontal, and anterior ethmoid sinuses.



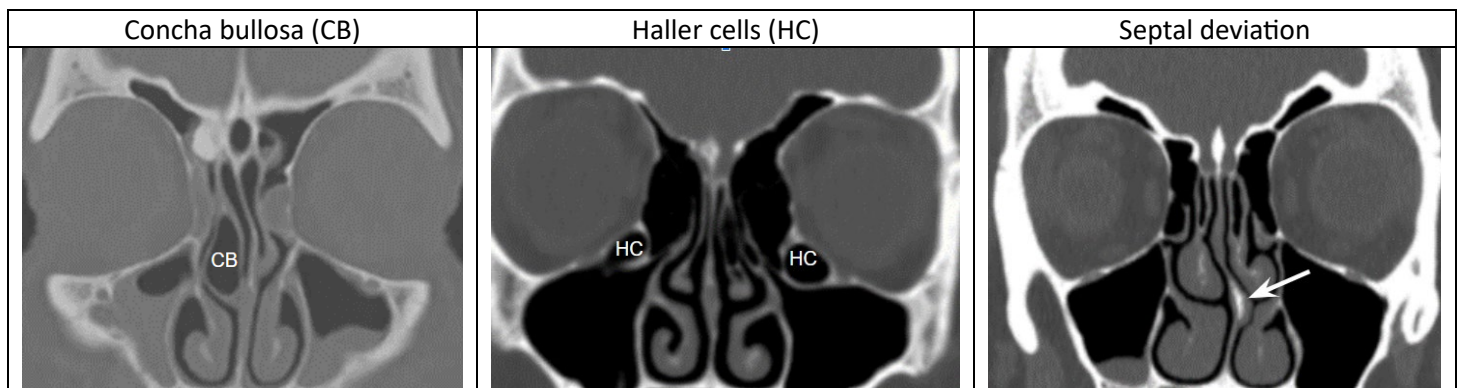
### Components of the OMC

1. Maxillary ostium (⊙)
2. Uncinate process (⬆)
3. Hiatus semilunaris (⌒)
4. Infundibulum (⌒)
5. Ethmoid bulla (⊕)

### Additional Structures

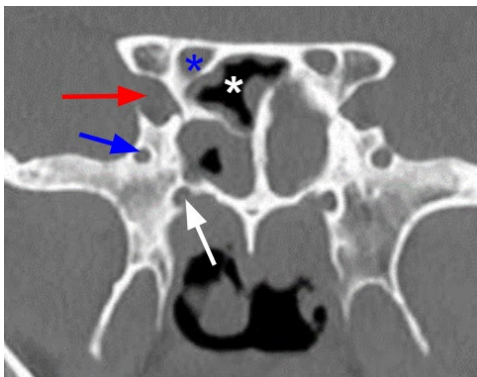
- Middle meatus (|)
- Middle turbinate (MT)

- Obstruction of the OMC can be due to
  - Concha bullosa (aerated middle turbinate)
  - Haller cells (infraorbital ethmoidal air cells)
  - Septal deviation or spur
  - Paradoxical rotation of the middle turbinates (not pictured)



## Onodi Cell (Sphenoethmoidal Air Cell)

- Onodi cells are posterior ethmoid air cells that lie superolateral to the sphenoid sinus.
- Recognition of onodi air cells prior to sphenoidotomy is imperative as they lie within close proximity to the optic nerve and internal carotid artery.
- It is important to examine the optic nerve and internal carotid artery structures for bony dehiscence, that would lead them more susceptible to injury.
- The location of the internal carotid artery can be identified by following septations within the sphenoid sinus.

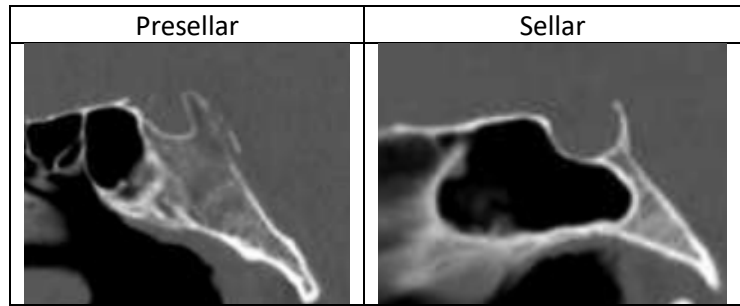


### Onodi Cell (⊕)




- Optic canal (containing CN2 optic nerve, \*)
- Foramen rotundum (containing V2 maxillary branch of trigeminal nerve, ⬆)
- Internal carotid artery (⬆)
- Vidian nerve canal (containing vidian nerve, ⬆)

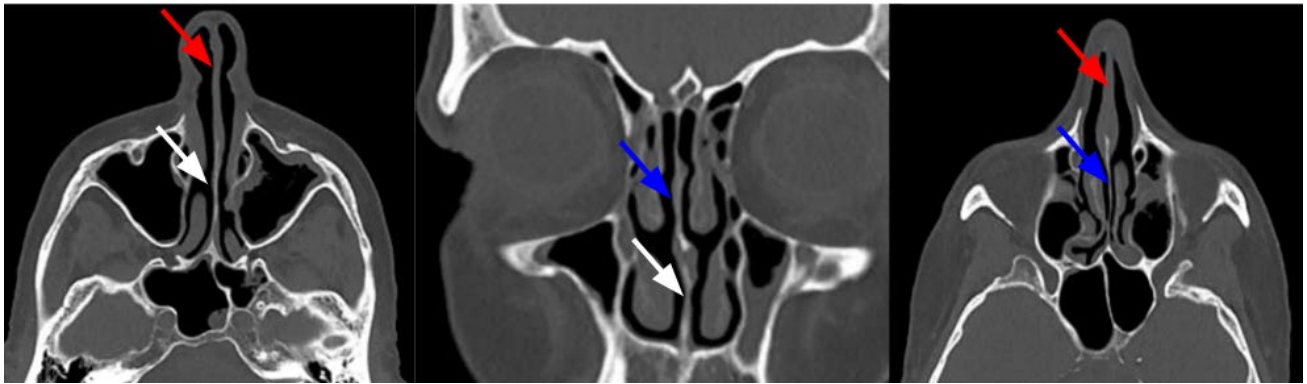
## Sphenoid Sinus

- Examine for pattern of pneumatization: conchal (not pictured), presellar, sellar.
- The sellar pattern is more susceptible to injury.







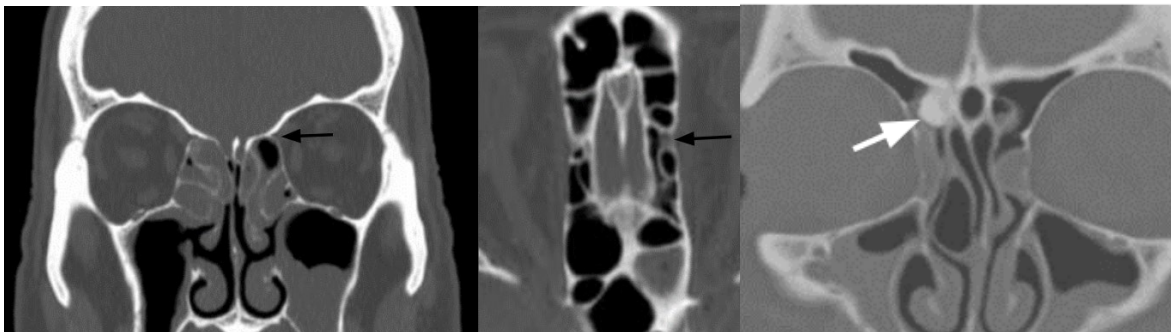
## Septal Anatomy

- The nasal septum is comprised of 3 components: nasal septal cartilage (most anterior, ) , vomer (inferior, ) , and the perpendicular plate of the ethmoid bone (superior, ) .
- Examine for the presence of septal deviations or spurs that may need to be managed intraoperatively prior to completing surgery on a more posterior sinus.

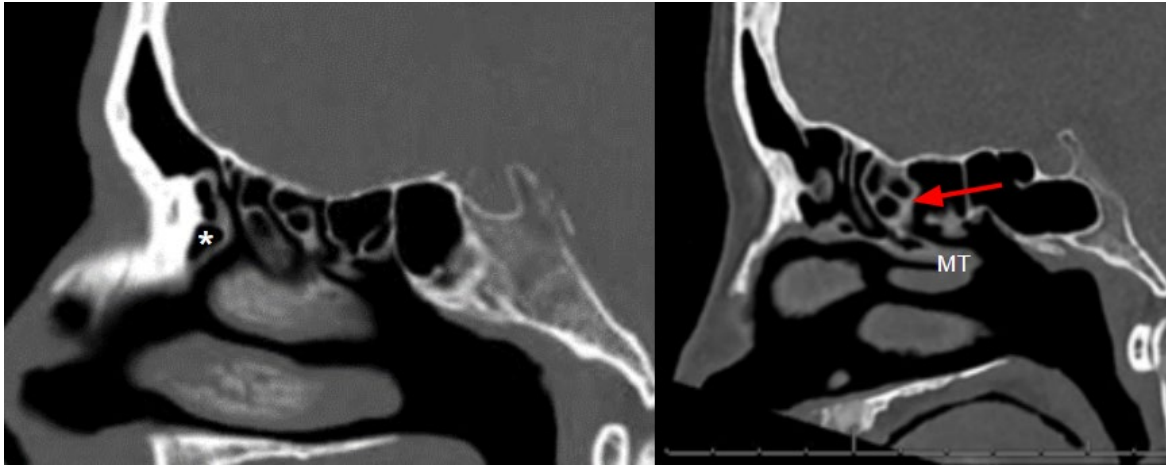


## Anterior Ethmoid Artery

- The anterior ethmoid artery () travels within the anterior ethmoid notch and is a branch of the ophthalmic artery responsible for perfusion of the anterior ethmoid sinus, frontal sinus, lateral nasal wall, and anterior nasal septum.
- Osteomas () most commonly originate in the ethmoid sinus.
- The basal lamella () provides support for the middle turbinate (MT) and serves as the division between the anterior and posterior ethmoid sinuses.
- The ethmoid bullae is the most anterior ethmoidal air cell (pictured above).
- Agger nasi cells () are the most anterior frontoethmoidal air cells and can block the drainage pathway of the frontal sinus (similar to haller cells and the maxillary sinus).

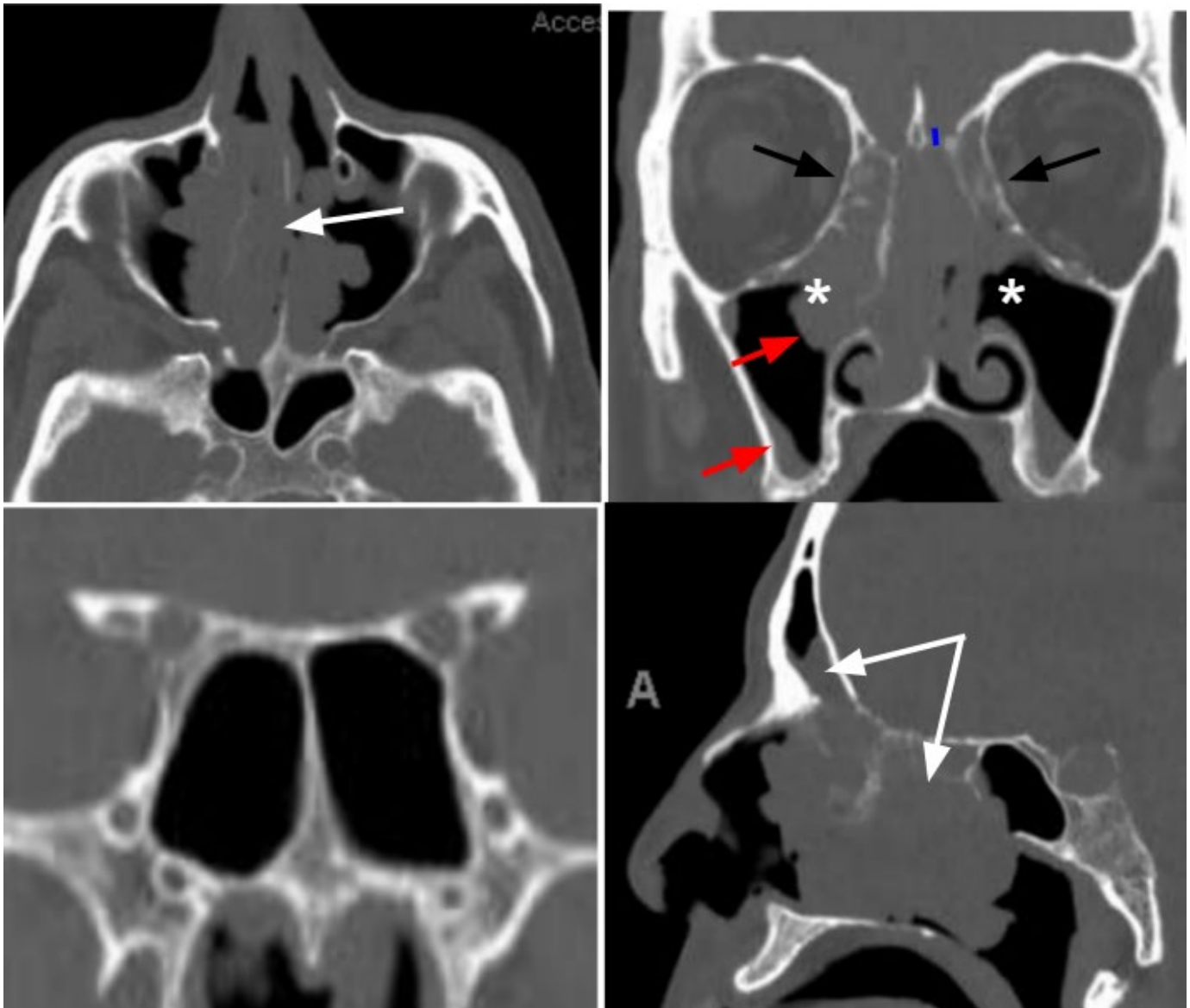






Disease (examples with surgical plans)

1. 65yo M with a history of chronic sinus congestion s/p two unknown FESS



**Overall:** multiple polypoid soft tissue densities (▲) filling the nasal cavity bilaterally, causing partial opacification of the bilateral frontal sinuses and complete opacification of the bilateral ethmoid sinuses and sphenoid recess

**C:** type 1 cribriform plate, possible bony dehiscence bilaterally, mild asymmetry with the right olfactory fossa extending deeper,

**L:** possible bony dehiscence bilaterally (▲), orbital structures normally visualized

**O:** soft tissue densities causing partial opacification of the bilateral maxillary sinuses (▲) extending into the OMCs, postsurgical changes suggestive of bilateral maxillary antrostomies (✱)

**S:** no bony dehiscence of the carotid or optic canals bilaterally, presellar pneumatization pattern, septum grossly midline

**E:** identified, postsurgical changes suggestive of bilateral ethmoidectomies

**D: Chronic rhinosinusitis with nasal polyposis-** well-circumscribed (which can help distinguish from chronic rhinosinusitis without nasal polyposis in less extensive disease), polypoid soft tissue densities, commonly bilateral, originates in the ethmoid sinuses.

### **Surgical Plan:**

Endoscopic revision bilateral maxillary antrostomies with tissue removal

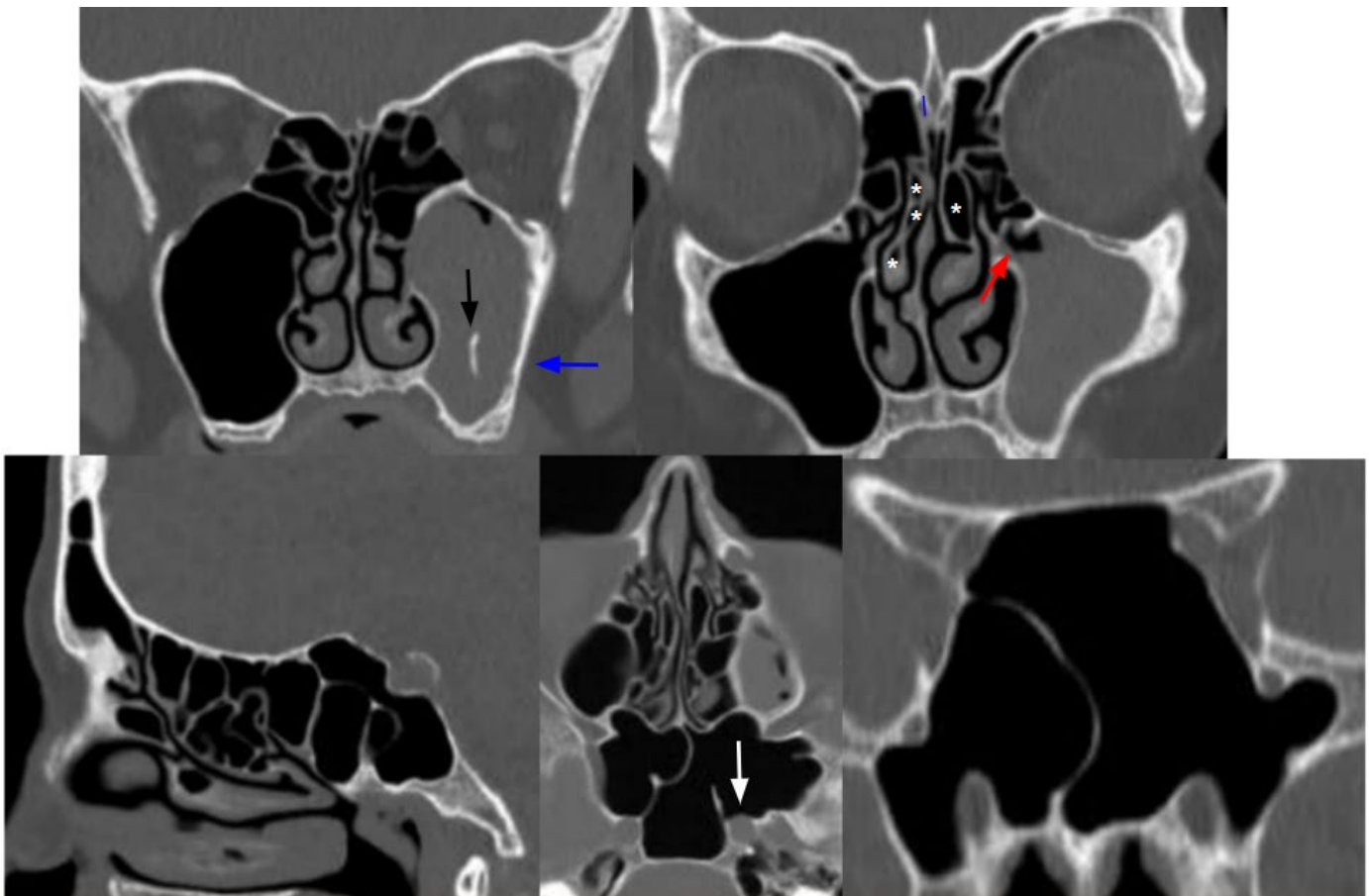
Endoscopic revision bilateral total ethmoidectomies and sphenoidotomy

Endoscopic revision bilateral frontal sinus exploration

**Sinus stents:** SINUVA bilaterally (ethmoid sinuses), PROPEL Contour bilaterally (frontal sinuses)

**Indications for image guided sinus surgery:** extensive nasal polyposis, revision sinus surgery (s/p bilateral maxillary antrectomies and ethmoidectomies), distorted sinus anatomy (possible bony dehiscence and asymmetric ethmoid roof)

## **2. 70yo F with a history of chronic maxillary sinusitis**



**C:** type 2 cribriform plates, no bony dehiscence or significant asymmetry

**L:** no bony dehiscence, orbital structures normally visualized

**O:** partial opacification of the left OMC (▲), complete opacification of the left maxillary sinus with a central linear hyperdensity (▲), sclerosis and thickening of the left maxillary sinus wall (▲, indicative of chronic inflammation), small concha bullosa bilaterally (✖)

**S:** bony dehiscence of the left carotid canal (▲), sellar pneumatization pattern, septum grossly midline

**E:** identified

**D: Fungal ball-** heterogenous soft tissue density, may have regions of gas or calcification, noninvasive, unilateral

**Surgical Plan:** Left maxillary antrostomy with tissue removal

## References

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