FRONTAL SINUS SURGERY

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KAISER PERMANENTE NORTHERN CALIFORNIA SINUS CENTERS

Collaborative Multi-Institutional Otolaryngology Residency Educational Program

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DISCLOSURES

- None

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OBJECTIVES

- Describe frontal sinus & recess anatomy and understand its many variations
- Develop a systematic approach for treatment of frontal sinus disease
- Describe the different types of endoscopic frontal sinus surgeries
- Discuss the role of external approaches to the frontal sinus

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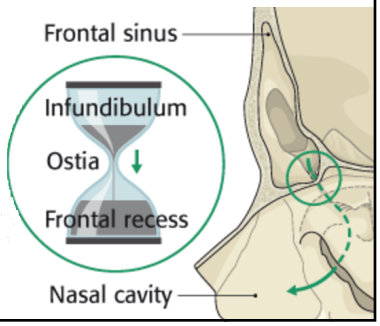
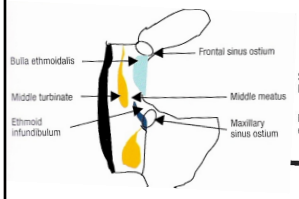
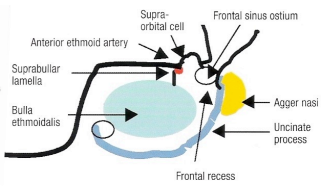
FRONTAL SINUS OUTFLOW TRACT

- Frontal sinus infundibulum
- Frontal sinus ostium
- Frontal recess



FRONTAL RECESS ANATOMY



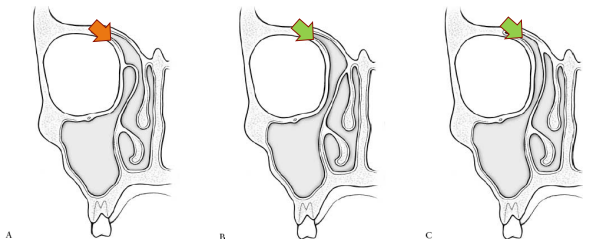


Medial: Middle turbinate
Lateral: Lamina papyrecea

Anterior: Uncinate process & agger nasi
Posterior: Ethmoid bulla & bullar cells

Superior: supraorbital ethmoid cell, AEA, frontal sinus ostium
Inferior: ethmoid infundibulum

UNCINATE PROCESS ATTACHMENT



Frontal recess drains into **middle meatus**

Frontal recess drains into **infundibulum**

FRONTAL SINUS CELLS

Types of Frontal Recess Cells

Cell Type	Description	Best Planes for Viewing
Frontal cell		
Type 1	Single cell above the agger nasi cell; it does not extend into the frontal sinus, and its posterior wall is a free partition in the frontal recess	Coronal, sagittal
Type 2	A tier of two or more cells above the agger nasi cell; its posterior wall is a free partition in the frontal recess	Coronal, sagittal
Type 3	Single large cell above the agger nasi cell; it extends into the true frontal sinus, and its posterior wall is a free partition in the frontal sinus or recess	Coronal, sagittal
Type 4	Isolated cell in the frontal sinus; its anterior or inferior margin is the anterior table or floor of the frontal sinus, and its posterior wall is a free partition in the frontal sinus	Coronal, sagittal
Supraorbital ethmoid cell	A cell extending over the orbit from the frontal recess; its posterior wall is the skull base, and it may mimic a septated frontal sinus	Axial, coronal
Frontal bullar cell	A cell above the ethmoid bulla pneumatizing into the frontal sinus; its superior wall is the skull base, and its anterior wall extends into the frontal sinus	Sagittal
Suprabullar cell	A cell above the ethmoid bulla; its superior wall is the skull base, and its anterior wall does not extend into the frontal sinus	Sagittal
Inter-frontal sinus septal cell	A pneumatized frontal sinus septum; it is associated with a pneumatized crista galli	Axial, coronal

FRONTAL SINUS CELLS

Cell type	Cell name	Definition	Abbreviation
Anterior cells (push the drainage pathway of the frontal sinus medial, posterior or posteromedially)	Agger nasi cell	Cell that sits either anterior to the origin of the middle turbinate or sits directly above the most anterior insertion of the middle turbinate into the lateral nasal wall.	ANC
	Supra agger cell	Anterior-lateral ethmoidal cell, located above the agger nasi cell (not pneumatizing into the frontal sinus).	SAC
	Supra agger frontal cell	Anterior-lateral ethmoidal cell that extends into the frontal sinus. A small SAFC will only extend into the floor of the frontal sinus, whereas a large SAFC may extend significantly into the frontal sinus and may even reach the roof of the frontal sinus.	SAFC
Posterior cells (push the drainage pathway anteriorly)	Supra bulla cell	Cell above the bulla ethmoidalis that does not enter the frontal sinus.	SBC
	Supra bulla frontal cell	Cell that originates in the supra-bulla region and pneumatizes along the skull base into the posterior region of the frontal sinus. The skull base forms the posterior wall of the cell.	SBFC
	Supraorbital ethmoid cell	An anterior ethmoid cell that pneumatizes around, anterior to, or posterior to the anterior ethmoidal artery over the roof of the orbit. It often forms part of the posterior wall of an extensively pneumatized frontal sinus and may only be separated from the frontal sinus by a bony septation.	SOEC
Medial cells (push the drainage pathway laterally)	Frontal septal cell	Medially based cell of the anterior ethmoid or the inferior frontal sinus, attached to or located in the interfrontal sinus septum, associated with the medial aspect of the frontal sinus outflow tract, pushing the drainage pathway laterally and frequently posteriorly.	FSC

Wormald P.J, Hoseman W, Callejas C, et al. The International Frontal Sinus Anatomy Classification (IFAC) and Classification of the Extent of Endoscopic Frontal Sinus Surgery (EFSS). Int Forum Allery Rhino. 2016;6:677-696

OLD VS. NEW NOMENCLATURE

- Type I Frontal cell
- Type 2 Frontal cell
- Type 3 Frontal cell
- Type 4 Frontal cell
- Supraorbital ethmoid cell
- Suprabullar cell
- Frontobullar cell
- Inter-frontal sinus septum cell

- Supra agger cell
- Supra agger frontal cell
- Supraorbital ethmoid cell
- Suprabullar cell
- Suprabullar frontal cell
- Frontal septal cell

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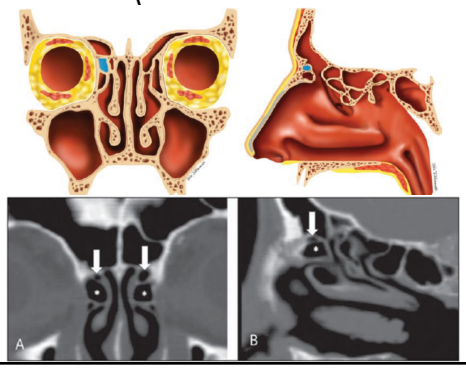
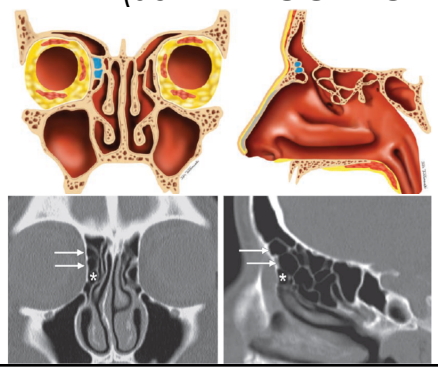
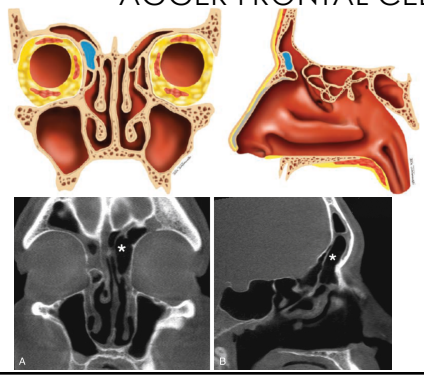
TYPE 1 FRONTAL CELL (SUPRA AGGER CELL)



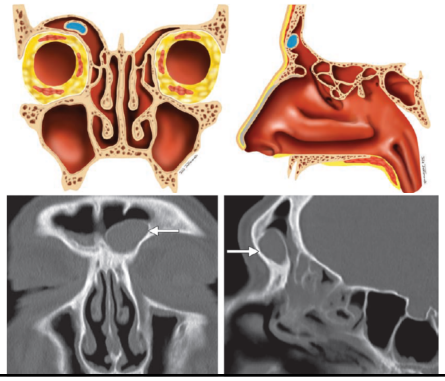
TYPE 2 FRONTAL CELL (SUPRA AGGER CELLS)



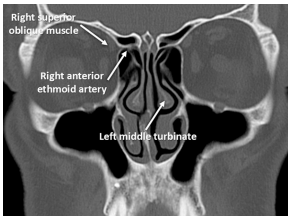
TYPE 3 FRONTAL CELL (SUPRA AGGER FRONTAL CELL)

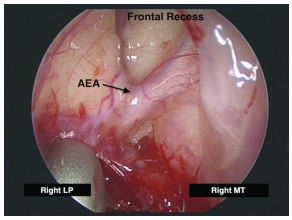


TYPE 4 FRONTAL CELL



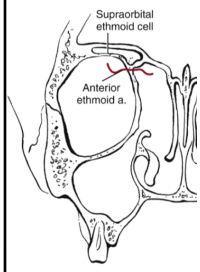
ANTERIOR ETHMOID ARTERY (AEA)

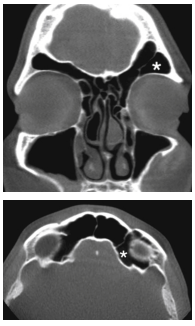


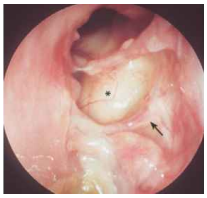


"speedbump along the skull base"

SUPRAORBITAL ETHMOID CELL



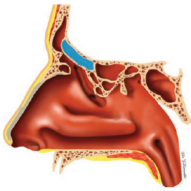




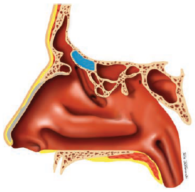
lateral & inferior to frontal sinus

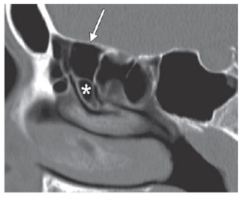
"false frontal"

FRONTAL BULLAR CELL (SUPRA BULLAR FRONTAL CELL)

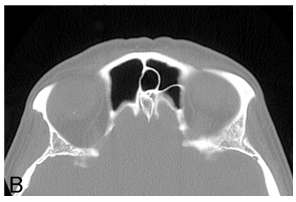


SUPRA BULLAR CELL





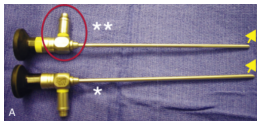
INTER-FRONTAL SINUS SEPTAL CELL (FRONTAL SEPTAL CELL)



"central frontal cell"

BASIC PRINCIPLES OF ENDOSCOPIC FRONTAL SINUS SURGERY

- Know the patient's anatomy – review the CT in ***multiple planes*** (coronal, sagittal, axial) ***multiple times***
- Identify lamina papyrecea & skull base early
- Preserve the MT (if possible) until the very end
- Meticulous mucosal-preserving dissection
- Hemostasis, hemostasis, hemostasis!
- Key angled instruments & powered instrumentation
- ***Reverse-post*** angled rigid scopes (30°, 45°,70°)



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KEY INSTRUMENTATION

"RECONSTRUCTIVE LADDER" FRONTAL SINUS SURGERY

- Osteoplastic Flap
- External Frontoethmoidectomy
- Trephination
- Draf III Frontal Sinusotomy
- Draf II Frontal Sinusotomy
- Draf I Frontal Sinusotomy
- Balloon Sinuplasty
- Nothing

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JUST DO NOTHING.

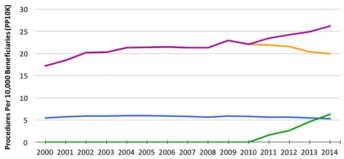
- **Anterior ethmoidectomy** alone leads to resolution of frontal disease in the vast majority of patients
- Abuzeid et al. IFAR 2016 Jun; 6(6): 597-604
  - CRS pts with frontal sinusitis: ESS with ethmiodectomy (but no frontal sinusotomy) vs. ESS with frontal sinusotomy
  - SNOT – no difference
  - Endoscopic scores – better in frontal sinusotomy group
  - Revision surgery in 0% of frontal sinusotomy group vs. 2.6% ethmiodectomy group

BALLOON SINUPLASTY

- Indications
  - Isolated frontal sinusitis
  - Mild chronic frontal sinusitis
  - Large type 3 frontal cell or SOE cells
  - Synechiae
  - In combination with traditional ESS ("hybrid" procedure)

Acclarent Spin

Entellus XprESS



Calixto NE et al. Laryngoscope, 127: 1976-1982, 2017

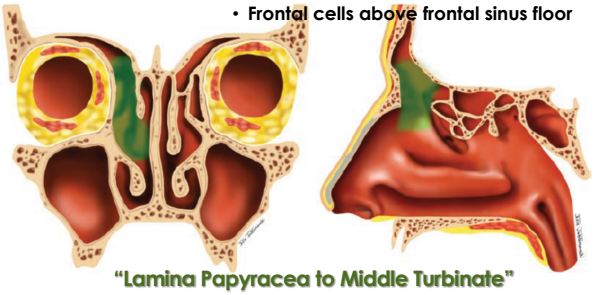
DRAF I

- **Anterior ethmoid cells**
- **Uncinate process**
- **Agger nasi cell**
- **Frontal cells below frontal sinus floor**

"Glorified Anterior Ethmoidectomy"

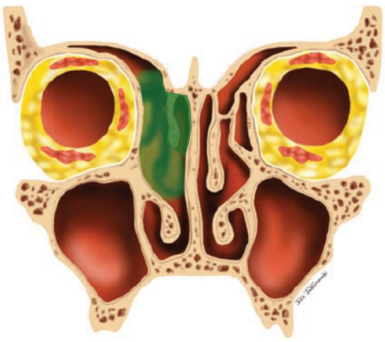
DRAF IIA

- Anterior ethmoid cells
- Uncinate process
- Agger nasi cell
- Frontal cells below frontal sinus floor
- **Floor of frontal sinus**
- **Frontal cells above frontal sinus floor**



"Lamina Papyracea to Middle Turbinate"

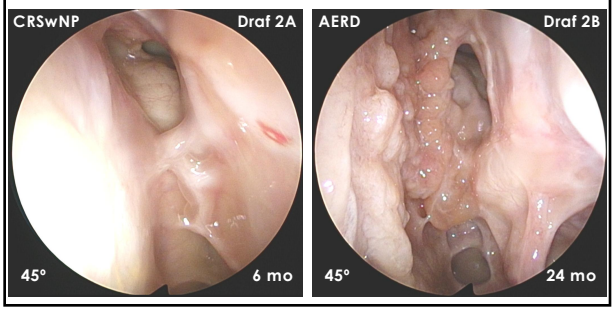
DRAF IIB



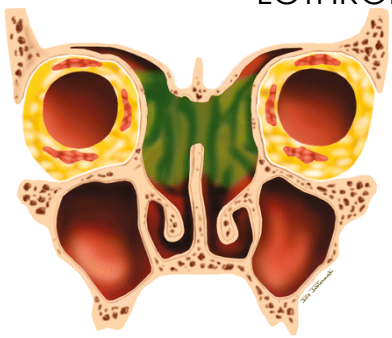
- Anterior ethmoid cells
- Uncinate process
- Agger nasi cell
- Frontal cells below frontal sinus floor
- Floor of frontal sinus
- Frontal cells above frontal sinus floor
- **Middle turbinate**

"Lamina Papyracea to Septum"

MAXIMIZE OPENING SIZE "BFF"



ENDOSCOPIC MODIFIED LOTHROP / DRAF III



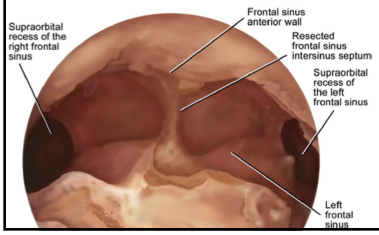
- Anterior ethmoid cells
- Uncinate process
- Agger nasi cell
- Frontal cells below frontal sinus floor
- Floor of frontal sinus
- Frontal cells above frontal sinus floor
- Middle turbinate
- **Superior nasal septum**
- **Inter-frontal sinus septum**

"Lamina Papyracea to Lamina Papyracea"

DRAF III APPROACHES

"Inside-Out" (traditional)

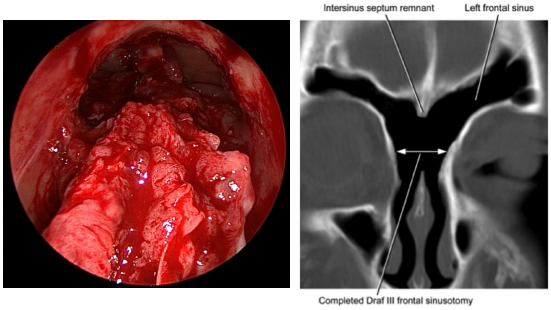
- Identify frontal recess (at least on one side)
- Drill from **inside the frontal recess**
- Drill **out** (inferoanteromedial) toward the contralateral frontal



"Outside-In"

- Identify the frontal process of maxilla
- Identify dissection limits early
  - Lateral: periosteum
  - Anterior: anterior table
  - Posterior: 1st olfactory fascicle
- Drill from **outside the frontal recess**
- Drill **in** (superoposterolateral) toward the frontal recess bilaterally

THE LOTHROP CAVITY



EXTERNAL FRONTAL PROCEDURES

- Primary aim is to restore sinus function
- Minimize tissue destruction
- Preserve mucosa whenever possible
- Image guidance is helpful (if available)

FESS = "Functional External Sinus Surgery"

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