Surgical Anatomy of the Paranasal Sinuses
Relationships Important in Endoscopic Sinus Surgery

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Surgical Anatomy of the Paranasal Sinus
Outline

• The middle turbinate / basal lamella
• Anterior ethmoid region
• Maxillary sinus
• Frontal recess
• Posterior ethmoid region
• Sphenoid sinus
• Ethmoid roof / skull base

The Osteomeatal Complex or Unit

• Evolved from Messerklinger’ s concepts
• Kennedy cautioned against over emphasis
• Remains basis for fundamental endoscopic surgical technique and concept

Basal Lamella of the Middle Turbinate

Three attachments
1. Anterior - in sagittal plane, attached to lateral edge of the cribiform plate
2. Middle - in frontal plane, attached to lamina papyracea
3. Posterior - in axial plane, attached to lamina papyracea, medial wall of maxilla, and perpendicular process of palatine bone

Basal Lamella of the Middle Turbinate

Anatomy of the Anterior Ethmoid Region

Important Structures

• Uncinate process
• Ethmoid bulla
• Suprabullar and retrobullar recess
• Agger nasi
• Ethmoid infundibulum
• Maxillary sinus
• Frontal recess
Anterior Ethmoid
We will start our anatomic construction with a sphere. The next step will be sectioning that sphere in the vertical (or sagittal) plane.

Anterior Ethmoid
Next, the smaller portion of the sphere will be discarded. What is left is a sphere where one internal "wall" is made by a vertical plane.

Anterior Ethmoid
The sphere and plane are rotated. The sphere represents the ethmoid bulla and the plane represents the lamina papyracea. The bulla "is like a bleb on the lamina papyracea."

Anterior Ethmoid
Next we will attach a hook-shaped outgrowth of bone to the lateral wall of the nose, parallel to the surface of the bulla. The yellow line demonstrates its attachment.

Anterior Ethmoid
The derived Latin name for a hook-shaped outgrowth of bone is uncinate process. Note how the posterior edge parallels the anterior surface of the ethmoid bulla.

Anterior Ethmoid
Typically the bulla attaches to the skull base. This attachment is called the bulla lamella. This skull base attachment may also be pneumatized.
Anterior Ethmoid
Within the anterior portion of the lateral nasal wall, there is a mound of bone that is often pneumatized to form a cell. The term for nasal mound is agger nasi; when aerated, it’s called an agger nasi cell.

Anterior Ethmoid
Addition of a middle turbinate completes the construction of the anterior ethmoid complex.

Uncinate Process
- Thin bone in sagittal plane
- Posterior margin is free
- Variable structure
- Important relationships
  - Frontal recess
  - Maxillary sinus ostium

Uncinate Process
- Attaches to the maxillary bone adjacent to nasolacrimal duct (NLD)
- Forms medial border of a trough-like space
  - Ethmoid infundibulum
The Variable Superior Insertion of the Uncinate Process

Ethmoid Bulla
- Bulla = hollow, thin-walled, bony prominence
- Largest and most constant of ethmoid cells
- Formed by pneumatization of the bulla lamella
- Drains medially and posteriorly

Ethmoid Bulla
- Often extends to skull base
  - Near the anterior ethmoidal artery
  - Forms posterior border of the frontal recess
  - The ethmoid bulla is the pneumatized portion of the bulla lamella

Bulla Lamella
- Between roof of bulla and skull base (suprabullar)
- Between posterior wall of bulla and basal lamella of middle turbinate (retrobullar)

Suprabullar and Retrobullar Recess
- Between roof of bulla and skull base (suprabullar)
- Between posterior wall of bulla and basal lamella of middle turbinate (retrobullar)
Suprabullar & Retrobullar Recess

- Suprabullar recess
- Retrobullar recess

Suprabullar Cell

Agger Nasi Cell
- Bulge or mound in lateral nasal wall
- Present in 90%
- Most anterior ethmoid cell
- One of the keys to understanding the frontal recess

Agger Nasi Cell

Ethmoid Infundibulum
- Trough formed by uncinate process and lamina papyracea
Maxillary Sinus
- Typically single chamber
- Ostium located within posterior-inferior 1/3 of infundibulum
- Os typically covered by uncinate
- Anatomic variations:
  - Infraorbital ethmoidal cells
  - Hypoplasia

Ethmoid Infundibulum
The maxillary os
- In this illustration, note the angle at which the maxillary os opens into the ethmoid infundibulum
- The maxillary os opens into the floor at nearly a 45 degree angle
- Not directly into the lateral wall

Middle Meatus and the Maxillary Sinus Ostium

Location of Maxillary Sinus Os

Anatomy of the Maxillary Sinus Ostium
Right maxillary sinus os
the pear

Basic Anatomy of the Frontal Sinus & Frontal Recess
Anatomy of the Frontal Recess

• Critical components of the frontal recess
  • Uncinate process
  • Agger nasi cell
  • Frontal cells
  • Suprabullar cell & frontal bulla cells

Frontal Recess

• Viewing the frontal recess structures from “above”
  • There are a number of anatomical variations and iatrogenic factors that can narrow the frontal recess...

Boundaries of the Frontal Recess

Olfactory Fossa (medial)
Fovea Ethmoidalis (roof)
Anterior Ethmoid Artery

Frontal Beak / Agger Nasi (anterior)
Lamina Papyracea (lateral)

Posterior Ethmoid Region

Important Structures to Discuss

• Superior turbinate
• Posterior ethmoid cells
• Sphenethmoidal (Onodi) cell
• Sphenethmoidal recess

Superior Turbinate

Posterior Ethmoid Sinus

Superior Turbinate

Sphenethmoidal Cell (Onodi)
**Sphenoid Sinus**

- Centrally located
- Borders several vital structures
- Variable pneumatization
- "Not directly behind posterior ethmoid cells"

**Sphenoid Sinus Relationship to the Superior Turbinate**

Right sphenoid sinus

- Medial to ST 8.3%
- Lateral to ST 1.7%

**Sphenoid Sinus Critical Anatomic Relationships**

View of left lateral sphenoid sinus wall with 30-degree scope

**The Ethmoid Roof**

- Ethmoid cells are "open" superiorly
- Frontal bone extension
- Foveolae ethmoidales
- Variability

**The Anterior Ethmoid Artery**

- Mesentery 15 – 45%
- 45-degree angle lateral (orbit) to medial (skull base)
- Sites of penetration = areas of weakness
Surgical Anatomy

Overview of Important Structures

- Ethmoid labyrinth
- Basal lamella of MT
- Uncinate process
  - Superior attachment
  - Terminal recess
- Bulla lamella
  - Skull base relationship
- Agger nasi
  - Frontal recess
- Suprabullar & retrobullar recess
- Ethmoidal infundibulum
- Frontal recess
- Superior turbinate
- Sphenoid sinus
- Sphenoethmoidal cell
- Maxillary sinus
  - Location of os
- Ethmoid roof