Avoiding Complications and Optimizing Outcomes in FESS

Alexander Chiu, M.D.
Professor and Chief
Division of Otolaryngology-HNS
University of Arizona

Rewarding Surgery!!!

“All rhinologists are familiar with the chronic nasal invalid, the multi-operated patient who haunts their offices in desperate search for relief from symptoms which are far worse than those which he had previous to his first operation.”


….But can be truly frustrating!!!
……and very dangerous!!!!

**Professor Draf**

Draf 1 – Removal of ethmoid bulla
Draf 2a – Removal of Agger Nasi Cell and Frontal Recess Cells
Draf 2b – Removal of ipsilateral floor and sup attachment of middle turb
Draf 3 (Modified Lothrop) removal of b/l floor and intersinus septum

*Sinus surgery is hard, sinus surgery is hard, sinus surgery is hard….*

---

**Improving Your Results: Indications and Expectations**

- Nasal polyps vs. Recurrent acute sinusitis vs. Headaches vs. Chronic Rhinitis
- If Revision – Look for underlying systemic illness
  - Immune deficiency, autoimmune diseases, immobile cilia
- Was medical management maxed out?
  - Antibiotics, oral steroids
  - Allergy/Immunology evaluation
  - Neurology evaluation
Key Points for Patient Assessment

- Quality of Life Survey
  - What are pts. complaining about?
- Endoscopy
  - Flexible or angled scopes
- CT scan review
- See them when they are sick!!
- Good Cultures and Lab
- No bugs, no drugs
- Old scans, videos
- Patient’s response to previous surgery

Quality of Life Form – SNOT 22

Subjective History

- Set Expectations
  - Headaches
  - Anosmia
  - Recurrent Infection
  - Length of Infections
  - Nasal Congestion
  - Post-Nasal Drainage

- Use analogies they can understand
Set Patient Expectations

- Analogies
  - “A” student vs. “D” student
  - Nasal polyps like hypertension – will likely have for the rest of life
    - “We will grow old together”

- Surgery is an adjunct to medical therapy
  - Won’t stop PND

Complications

- Major
  - Brain
  - Eye
  - Major Blood Loss
  - Failing to meet patient expectations

- Minor
  - Synechiae
  - Atrophic rhinitis
  - Crusting
  - Epiphora
  - Decreased smell
  - Nasal obstruction
  - Iatrogenic frontal or sphenoid opacification

“By failing to prepare, you are preparing to fail.”

*Benjamin Franklin*
Prevent Complications: Minimize Intra-operative Bleeding

Pre-operative Steroid Regimen

- Nasal polyps, chronic hyperplastic sinusitis, AFS
  - Prednisone 40 mg po QD for 4 days, 30 mg po QD for 3 days – starting 1 week before surgery
  - Following surgery:
    - 20 mg po QD for 7 days, 10 mg po QD for 7 days following surgery
    - Intranasal steroid spray 1 week after surgery: 2 sprays BID
    - Follow with endoscopy
    - Taper oral steroids and replace with topical
      - Pulmicort rinses – 0.5 mg/2ml

Peri-op Antibiotics

- Start 1 week prior and continue for 2 weeks after
- Levaquin, Avelox, Tequin
  - Gram-negative coverage, QD dosing

- Clindamycin/Bactrim
  - Gram positive, Gram negative, Anarobe
  - Bone penetration

- Biaxin/Erythromycin
  - Low dose macrolide for anti-inflammation
Bleeding in FESS: Anesthesia Factors

- Hypotensive anesthesia
- Orthopedic literature
  - Revision hips - 30% reduction in blood loss

Anesthesia Factors

**Key to Limit Bleeding = Decrease in venous bleeding**

Physiologic Way to Do So = Decreased Central Venous Pressure

Decrease CVP

- Decrease fluid intake
- LMA vs. Endotracheal Tube
  - Decrease catecholamine surge in initial 15 minutes of surgery with LMA vs. ETT
- Maintain HR < 60

**TIVA – total intravenous propofol infusion with remifentanil infusion**
Anesthesia Factors


<p>| TABLE II |
| Summary of the Mean Scores in the SEVO and TIVA Groups with Statistical Significance |</p>
<table>
<thead>
<tr>
<th>Response</th>
<th>SEVO</th>
<th>TIVA</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>GI score</td>
<td>14.0 ± 2.0</td>
<td>13.0 ± 1.1</td>
<td>0.60</td>
</tr>
<tr>
<td>Vomiting time</td>
<td>7.25 ± 2.5</td>
<td>7.20 ± 6.0</td>
<td>0.08</td>
</tr>
<tr>
<td>Heart rate (beats/min)</td>
<td>7.41 ± 1.0</td>
<td>7.34 ± 1.0</td>
<td>0.07</td>
</tr>
<tr>
<td>MAP (mmHg)</td>
<td>71.65 ± 1.62</td>
<td>71.75 ± 1.32</td>
<td>0.90</td>
</tr>
<tr>
<td>Visual grade</td>
<td>2.0 ± 0.10</td>
<td>2.0 ± 0.05</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Surgical Preparation

- Position
  - Confluent sinuum pressure 0cm H₂O at 25deg (similar in the sagittal)
    - CVP lowered with reverse trendelenburg
      - Soonawalla Z. F. et al. Role of the reverse Trendelenburg patient position in maintaining low CVP anesthesia during liver resections. Langenbeck’s Archives of Surgery. 393:2. 2008
      - Avoid head rotation >60-80deg

Fig. 1. The effect of the position of a patient on the central venous pressure. The CVP consistently decreased in all the patients, from a mean of 9.2 mmHg when supine, to a mean of 1.7 mm Hg after a head-up 60°.
Positioning and CBF/CPP?

- Cerebral blood flow varies with head elevation
  - From 0 – 45 deg (46.3 to 28.7ml/min/100g)

- Cerebral perfusion pressure remains constant
  - No change between 0-30 deg
  - 62±3 to 57±4mmHg 30-45 deg


Preparation

- Position – arterial flow
  - 38.3% reduction of nasal blood flow with head elevation (at head of IT)
  - 4.7% change with PPF injection

Intra-op Maneuvers

- **Topical Thrombin/epinephrine**
  - 2 ampules thrombin (1:10,000) into 1 ampule epinephrine (1:1,000)
  - Plain epinephrine

- **Warm saline flushes**
  - Thought to stimulate coagulation cascade

Max Antrostomy

Anatomy Basics

- The **uncinate process** is made of thin bone covered by mucosa. It has attachments superiorly to the agger nasi cell or skull base
  - The uncinate process covers the infundibulum – the anatomical area where the maxillary sinus, anterior ethmoids and frontal sinus drain
  - The **ostiomeatal complex** is a functional area, not an anatomic area. Enlargening the ostiomeatal complex involves the removal of the uncinate process and ethmoid bulla.
  - The **middle turbinate** serves to humidify and moisturize the air that is breathed in. Care should be taken to preserve the middle turbinate when performing a maxillary antrostomy if possible.
Concha bullosa: pneumatization of the MT, usually from FR or agger nasi
Interlamellar cell: pneumatization of the vertical lamellae of the MT
Ostiumeatal Complex: Shaded in red, common drainage point of the maxillary, anterior ethmoid and frontal sinuses

Uncinate Process – 1st Vertical Lamellae

Pre-Operative Considerations - Radiographic
- Look at the axial and coronal CT scans
- Identify the presence of any infraorbital cells that may be contributing to the obstruction of the middle meatus
- Identify the presence of pathology along the floor and/or anterolateral walls of the maxillary sinus. If a retention cyst or polyp is present, make preparations to have angled instruments and endoscopes available to address these hard to reach locations.
- Identify the uncinate process and its relation to the medial orbital wall
- Beware of the uncinate process that is lateralized against the medial orbital wall. If identified, make sure to take great caution with the use of a sickle knife or microdebrider against the uncinate to prevent orbitotomy and orbital entry
Relation of the Uncinate Process to Medial Orbital Wall

Instrumentation

- 0 and 30 degree scopes
- 45 or 70 if need to remove pathology along floor or anterior wall
- Ball tip probe
- Backbiter
- Downbiter
- Angled Microdebider
- Straight thru cutter
- 120 degree giraffe
  - Used for retention cysts along the anterior and/or floor of maxillary sinus

Downbiter Forceps/ Backbiter Forceps
Pre-Operative Considerations

- The first 15 minutes after anesthesia induction is often a time where the patient's heart rate and blood pressure is at its greatest. Starting to operate prior to proper mucosal decongestion and local injection will often result in mucosal trauma and excess mucosal bleeding, especially in the areas of the anterior septum, anterior middle turbinate and lateral nasal wall. Trauma to these areas will add to the difficulty of the remainder of the procedure.

- To avoid unnecessary trauma and clouding of the operative field, be careful in manipulation of the middle turbinate. To create more space to address the uncinate process, gently move the middle turbinate medially with a freer elevator, and slide an oxymetazoline soaked pledget in the middle meatus for 5 minutes.

- When in doubt, perform a septoplasty if a septal deflection is preventing access to the middle meatus. A septal deflection will not only make intraoperative access difficult but will also create problems for post-operative debridement.

Injection of Local Anesthesia

Injection of Local Anesthesia

Sphenopalatine foramen. Note the location anterior to the sphenoid, posterior and superior to the middle turbinate.
Step 1: Locate the Maxillary Os

- Os is typically located between the inferior 1/3 and superior 2/3 of the uncinate process along the maxillary line.
- Visualize line prior to uncinectomy.

Step 2: Remove Uncinate Process

- Use the smooth, back end of the ball tip probe to move the middle turbinate medially to create more working space in the middle meatus.
- Use the ball of the ball tip probe to reflect the superior uncinate process anteriorly and inferior uncinate process medially.
Pearl: Use the back end of your instrument to create space in the middle meatus

Step 3: Remove Uncinate Process and Identify Natural Ostium

- Use the backbiter to remove the uncinate process from posterior to anterior to its attachment to the lacrimal bone.
- When first using the backbiter, place and open the blade at the 12 o'clock position in the middle meatus, then pronate your wrist to slide behind the free edge of the uncinate process.
- Stray mucosal edges of the uncinate process can be removed with a straight or angled microdebrider.

Pearl: Use Angled Endoscope
Step 4: Remove Superior Uncinate Process

- The superior attachment of the uncinate process is removed by first reflecting the uncinate anteriorly with a ball tip probe, and then removing with a 45 or 90 degree thru cutting forceps or angled microdebrider.

Step 5: Enlarge Antrostomy by Removing Posterior Fontanelle

- Use a 30 degree endoscope to visualize the natural ostium.

- To make a larger antrostomy, use a straight thru cutter to excise the fontanelle posterior to the natural ostium.

Step 6: Remove Inferior Uncinate Process

- The downbiter or angled microdebrider can be used to take down the inferior uncinate process to the superior border of the inferior turbinate.

- The size of the antrostomy is based on patient disease:
  - Recurrent, acute CRS with non-polypoid mucosa – minimal enlargement of natural ostium
  - Polyps, hyperplastic mucosa or revision surgery
  - Large antrostomy with complete removal of uncinate process and posterior fontanelle to the palatine bone.
Max Antrostomy

 Orbital Hematoma

- Periorbital injury
  - 1-20 cases: 8.3%
  - 20-100 cases: 4.7%
  - 100-200 cases: 2.5%
  - 200-300 cases: 0.2%
  - Stankiewicz (1999)
    - 15/3500
Orbital Bleeding

- Two types of orbital bleed
  - Fast hematoma - intraop
    - Anterior ethmoidal artery
    - Posterior ethmoidal artery
  - Slow bleed – 24 hr post-op period

Slow Orbital Bleed

- Slow (venous) orbital hematoma
  - Injury to orbital or ophthalmic veins with slow accumulation of blood or defect in lamina paprycea with backflow of bleeding
  - Gradual onset
    - Ecchymosis, proptosis, pupillary dilation, decreased vision
    - Rise in intraocular pressure
    - Ophtho consult - measure IOP
    - Remove any middle meatal packing

Most common cause – Inadvertant entry into orbit during max antros and ethmoidectomy
How to Prevent Orbital Injury:
Relation of the Uncinate Process to Medial Orbital Wall

Know where the Maxillary Os is in relation to the lamina
- Os is typically located between the inferior 1/3 and superior 2/3 of the uncinate process along the maxillary line
- Visualize line prior to uncinection

Tip: Improve your visualization of the natural os:
Use the back end of your instrument to create space in the middle meatus
Tip: Use a 30 degree endoscope to better visualize natural os

Early detection

- Fat exposure
  - Microdebriders can suck a whole bunch of fat and muscle real fast
  - Do not manipulate or remove fat
    - Do not use monopolar cautery to “shrink” fat
    - If fat is obstructing further dissection, use bipolar
  - Minimize nasal packing
  - Avoid nose blowing and sneezing

ARTERY RETRACTION
Ethmoidal Arteries

- Ethmoidal arteries branches of ophthalmic artery
- Enter nasal cavity along the frontoethmoidal suture

Anterior Ethmoid Artery

20-40% Below Skull Base
**Posterior Ethmoidal Artery**

- Injury to anterior/posterior ethmoidal artery with retraction into orbit
- Can often happen during rough extubation
- Immediate: Proptosis, chemosis, pupillary dilation → vision loss
- Rise in intraocular pressure – 90 minutes of retinal artery occlusion results in permanent blindness
- Requires urgent treatment

**Intra-op Orbital Hematoma**

- Fast (arterial) orbital hematoma
- Injury to anterior/posterior ethmoidal artery with retraction into orbit
- Can often happen during rough extubation
- Immediate:
  - Proptosis, chemosis, pupillary dilation → vision loss
  - Rise in intraocular pressure – 90 minutes of retinal artery occlusion results in permanent blindness
  - Requires urgent treatment

**Orbital Hematoma**

- **Bulb Test**
  - Gently palpate globe
  - Examine lamina papyracea with endoscope
  - Movement of periorbita and/or fat
Orbital Hematoma

- Ophthalmology consult
  - Ascertain for APD
  - Measure IOP
    - <30 mm Hg observe
    - >30 mm Hg decompress

General anesthesia lowers IOP!!!

---

Orbital Hematoma

- Eye massage
  - Redistributes intraocular and extraocular fluids
- Topical timolol (0.5%)
- Acetazolamide 500mg IV
- Mannitol 20% (1-2g/kg over 20-30 min)
- Steroids
- Remove non-absorbable packs
- Surgical maneuvers

---

Orbital Hematoma

- Surgical Maneuvers
  - Canthotomy and cantholysis
  - Medial orbital wall decompression
  - Orbital floor decompression
  - Endoscopic artery ligation
  - External artery ligation
Canthotomy and Inferior Cantholysis

Extraocular Muscle Injury

- Most common structures
  - Medial rectus > superior oblique > inferior rectus
- Forced duction to rule out entrapment or laxity
**Extraocular muscle injury**

- Prior orbital trauma
- Most common
  - Medial rectus
  - Superior oblique
  - Inferior rectus
- Forced duction
  - r/o entrapment
- If viable muscle found
  - Repair by ophthalmology
- If not detected until post op early exploration with repair

**Continuing with the FESS…..**

**CT Scan – Ethmoid Bulla – 2nd Vertical lamellae**

Sagittal CT Scans demonstrating multiple (left) and few (right) posterior ethmoid air cells (left). Note the more shallow skull base anteriorly (right).
Radiographic Considerations: Short and Tall Ethmoid Roofs

Coronal CT scan demonstrating a short (left) and tall (right) ethmoid roofs. Note the thin bone of the lateral lamellae compared to the thick bone of the ethmoid roof.

Step 1 – identify medial border ethmoid bulla

Endoscopic view of a left maxillary antrostomy with ethmoid bulla superiorly. Note the j-curette medializing the middle turbinate.

Step 2: Remove ethmoid bulla post-ant and med-lat

J-curette entering the retrobullar space and fracturing the ethmoid bulla in an antero-lateral direction. Note the left sided maxillary antrostomy in the background.
Step 3 – Remove ethmoid bulla

Left side endoscopic view of a Blakesley forcep removing the previously fractured ethmoid bulla.

Ethmoid Bulla

The University of Pennsylvania
Department of Otorhinolaryngology

Step 4: Enter basal lamellae

Figure 10: STEP 4

J-sawtete entering the basal lamellae at the height of the maxillary sinus roof.
Step 5 – Maintain horizontal portion of basal lamellae

Figure 11: STEP 5

Step 6: Clean off medial orbital wall and skull base

Posterior Ethmoidectomy Sphenoidotomy

The University of Pennsylvania Department of Otorhinolaryngology
CSF Leaks

- Frequency of iatrogenic CSF leaks
  - 1-20 FESS: 3.3-4%
  - 20-100 FESS: 1%
  - >100 FESS: 0.0.5%

Post-septoplasty

Anatomy – Skull Base
Preoperative Checklist

- Skull base anatomy
- Maxillary-to-ethmoid sinus ratio
- Slope of the skull base
- Anterior ethmoidal artery
- Lamina papyracea
- Optic nerve
- Stigmata of ICH

Anatomy - Ratios

<table>
<thead>
<tr>
<th>High Risk Feature/Variant Percentage (%)</th>
<th>Maxillary-to-ethmoid ratio 1:1</th>
<th>Maxillary-to-ethmoid ratio 2:1</th>
<th>Maxillary-to-ethmoid ratio &gt;2:1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>38.6</td>
<td>54.3</td>
<td>7.1</td>
</tr>
</tbody>
</table>

Intraoperative Maneuvers – CSF Leak

- Step I
  - Stop and recompose
  - Hemostasis
  - Review the anatomy
    - CT or MRI
    - Patient anatomy
  - REORIENT
  - Make sure you be honest with yourself – and critically look at size and number of defects
Can’t identify site? Defect large? Seeing Brain?

- **Step II**
  - Antibiotics
  - Hemostasis
  - Lightly pack nose and place nasal trumpet to divert air
  - Aspirate stomach
  - Antiemetics
  - QUIET WAKE-UP
  - Stat Head CT/CT angiogram if microdebrider entry

If cannot identify site:

- Lightly pack nose
- Perioperative IV antibiotics
- Quiet wake-up
- CT of head
- Consult colleague
- Transfer to rhinologist

---

**Intraoperative Maneuvers - II**

- Can identify site
  - Proceed with Repair
  - IV antibiotics
  - Site preparation

---

**Intraoperative Maneuvers - II**

- Site preparation – don’t compound the problem
  - Maximally open surrounding sinuses
  - Strip mucosa (3-5 mm rim)
  - Bipolar cautery of residual mucosa
Intraoperative Maneuvers – II

- Step II
  - Measure defect size
  - Graft selection
    - Multiple variables
    - Location of injury
    - Suspect ICH?
      - Large cells
      - Arachnoid pits
      - Personal Hx

- Mucosa
  - Inferior turbinate
  - Middle turbinate
  - Septum
  - Nasal floor
  - Nasoseptal flap if extremely large defect

- Closure
  - Graft pressure
    - Stent frontal sinus
    - Silastic sheeting
    - Avitene/FloSeal
    - Surgicel/Gelfoam
    - Nonabsorbable packing
Frontal Sinus

**Draf 1** — Removal of ethmoid bulla

**Draf 2a** — Removal of Agger Nasi Cell and Frontal Recess Cells

**Draf 2b** — Removal of ipsilateral floor and sup attachment of middle turb

**Draf 3 (Modified Lothrop)** removal of b/l floor and intersinus septum

---

**Endoscopic Draf 2a**

- Removal of agger nasi and frontal recess cells – Workhorse

**Keys to success:**
- Identify the cells that block the frontal recess
- Remove through natural drainage pathways
Instrumentation for Frontal Recess Work

- Visualization
  - 45 and/or 70 degree endoscopes
- Image Guidance
- Vascular Control
  - Bipolar cautery
- Frontal Sinus Hand Instruments and Probes
- Balloon Dilatation Tools

Visualization

30 Degree 70 Degree

Hand Instruments, Probes and Balloons
Image Guidance

- Allows for greater understanding of anatomy
- Multiple planes
  - Axial
  - Coronal
  - Sagittal
- Pre-operative planning

Room Set-up

Reverse 30 and 70 degree Scopes

Surgical Game Plan – Dissect in Stepwise Fashion

- Treat it like a box – 4 walls
  - Anterior border – agger nasi, uncinate process
  - Posterior border – ethmoid bulla, supraorbital cell, anterior ethmoid artery
  - Lateral border – lamina papyracea
  - Medial border – cribiform plate, interseptal cell
Cells causing Frontal Recess Obstruction

Step 1: Identify Skull Base at Posterior Ethmoid/ Sphenoid Sinus

Step 2: March along the Skull Base from Posterior to Anterior
Suprabullar Recess

- Aerated space between the ethmoid bulla and skull base
- Superior: ethmoid roof
- Inferior: roof of bulla
- Lateral: lamina papyracea
- Posterior: basal lamella of MT

Step 3: Identify Anterior Ethmoid Artery

20-40% Below Skull Base
Step 4: Identify Supraorbital Cell

Removing the common wall
Step 5: Address Anterior Border

“Uncapping the egg”

Agger Nasi & Frontal Cells
Cells causing Frontal Recess Obstruction

ANTERIOR

Agger Nasi Cell

Frontal Intersinus Septal Cell

Supraorbital Ethmoid Cell

Suprabullar Cell

LEFT Frontal Recess: 70 Degree Endoscopy

30 y/o with frontal headaches

A.R. Frontal Sinusotony

The University of Pennsylvania Department of Otorhinolaryngology

Balloon Sinuplasty
**Entellus**

- Easier and quicker to use
- Requires knowledge of anatomy and ability to remove superior uncinate process and ethmoid bulla

**Left Frontal**

**Balloon Dilatation**

- As a tool to open the frontal recess
- Evidence for opening recess and maintaining patency
  - CLEAR studies
  - Focus on patient subjective improvement
  - Patency
  - Demonstrated in the short-term f/u studies
  - Sometimes difficult to assess
Three Months Post-op – Patency Maintained

Right frontal using traditional instruments
Left frontal using balloon dilatation alone

Tool for the Lesser Experienced; Pricey but Effective

Indications for Balloon Dilatation of Frontal Sinus = Indications for Frontal Sinus Surgery

- Patient symptoms with radiologic presence of frontal sinus/recess disease
- Primary Frontal Sinus Surgery for
  - Simple frontal recess anatomy, i.e. agger nasi cell
  - Mild inflammatory disease of frontal recess
- Post-operative dilation of stenosed frontal recess
Where Balloon Often Fail

- Extensive neo-osteogenesis
- Moderate to Severe inflammatory disease of the frontal recess
- Type 2 and 3 frontal recess cells when used as sole maneuver

Maintain Indications for Frontal Sinus Surgery!!!!

12 y/o s/p 3 balloon procedures for right frontal sinusitis

S/p Left frontal sinus balloon sinuplasty X 2

Needed FS Obliteration for Persistent Symptoms From Neo-osteogenesis of Left Frontal Recess
**Unpublished Series of Post-Balloon Failures**

Treated 14 patients over 3 year period
Symptomatic despite balloon procedure of frontal sinus

- 14/14 for revision FESS
  - 12/14 did well w/Draf 2a or 2b
  - 2/14 re-stenosed
    - Modified lothrop
    - FS obliteration after a failed modified lothrop

---

**Common cause of Failure—Neo-osteogenesis and Ostial Stenosis**

---

**Modified Lothrop**

- As a revision procedure - Previously Failed Draf 2a or 2b with neo-osteogenesis
- Primary surgery only for Extensive Bony Inflammation
  - Cholesterol granuloma, Frontal bone osteomyelitis
- Access to Frontal Sinus Lesions
  - Inverted papilloma
  - Fibro-osteous lesions
  - FS encephaloceles
Stenosis

Average stenosis of 33% of original opening by 1 year

- 28.6% with stenosis >60% of original opening
  - Tran 2007
- 20-30% reoperation rate
  - Shirazi 2007

6 months post-op

Post-op Debridements

- Weekly for 4 weeks
- Continue oral Prednisone – 20mg QD for at least 1 week, 10 mg QD for 2-4 weeks
- Budesonide drops BID in head hanging position

4 weeks post-op

Sphenoid Ostium Stenosis

- Often seen with primary surgery for highly inflammatory sphenoid lesions
  - Fungal Balls
  - Difficulty in debriding post-op
    - Especially if transnasal sphenoidotomy
  - Cicatrical scarring
    - 360 degrees of raw, bony edge
- Surgical Alternative
  - Wide antrostomy – cover 180 degrees with vascularized mucosa
  - Posterior septectomy
Nasoseptal Flap

- Septal mucosa pedicled off the septal artery branch of the sphenopalatine artery
- Use for skull base reconstruction
- Flaps can be made to 7 cm in length
- 1-2 cm needed for sphenoid stenosis

Conclusion

- Good knowledge of anatomy
- Mucosal-sparing techniques
- Visualization is key

- Despite advances in technology, maintain proper indications for frontal sinus surgery since stenosed frontals are difficult on the patient and surgeon!!