Sinus Surgery and Postoperative Imaging

Vijay Rao, MD, FACR
The David C Levin Professor and Chair
Department of Radiology
Thomas Jefferson University
Philadelphia, PA

Functional Endoscopic Sinus Surgery (FESS)

- Over 20,000 FESS procedures are performed each year in the US
- High success rate (76-98%) reported with primary FESS
- 23% of patients may require revision surgery with 65-78% success
- Although there is not a direct correlation between post op imaging findings and symptoms (patients may show sinus disease but feel better)
- But there are imaging findings that serve as negative prognostic indicators

Endoscopic Sinus Surgery Spectrum of Surgical Intervention

- Directed at the anterior OMC:
  - Uncinectomy (widens natural ostium)
  - Maxillary sinus (middle meatal) antrostomy connecting to the natural ostium
  - Bulla ethmoidectomy followed by resection of ethmoid air cells anterior and inferior to basal lamella and exposure of the frontal recess
  - Septoplasty: common adjunct procedure
  - Turbinectomies (partial or subtotal resection of inferior and middle turbinates)

- Directed at the posterior OMC:
  - Posterior ethmoidectomy
  - Transethmoidal sphenoidotomy

- Directed at the frontal recess and frontal sinus for failed FESS
  - Draf I, II, III

- Sinus ballooning – balloon catheter inserted endoscopically. Balloon inflated widening the ostium. No resection of bone

Post FESS Imaging: Concepts

- Extent of surgery largely guided by intra-operative findings in a given individual and variable
- At the time of interpretation of post op examination, pre-op CT often not available for comparison
- No reproducible surgical cavity
- Examine each side on post-op CT separately, establish a new anatomic baseline
- Integrity of surgical landmarks - lateral lamella, cribriform plate, ethmoid roof, lamina papyracea, anterior ethmoidal artery canal

FESS: Directed at the anterior OMC

Pre-op

Post-op

Pre-op

Post-op
Post-op Maxillary antrostomy

Pre-op L basal lamella

Post-op R basal lamella

Post FESS Imaging:

Minor Complications

- Scarring and stenosis of middle meatus
- Lateralized middle turbinate
- Recirculation of mucus
- Retained frontal recess cells
- Neo-osteogenesis
- Persistent/recurrent sinonasal polyposis and inflammatory disease

Lateralized middle turbinate obstructing the left maxillary sinus

Bolgerization performed to prevent middle turbinate from lateralizing

Post FESS: Scar/adhesions obstructing left maxillary sinus

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Bolgerization performed to prevent middle turbinate from lateralizing

Post Op Sinus Imaging:

Minor Complications

- Scarring and stenosis of middle meatus
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Recirculation: Non contiguous native ostium & antrostomy

Post Op Sinus Imaging: Minor Complications

- Scarring and stenosis of middle meatus
- Lateralized middle turbinate
- Recirculation of mucus
- Residual frontal recess cells
- Neo-osteogenesis
- Persistent/recurrent sinonasal polyposis and inflammatory disease

Post FESS: Neo-osteogenesis

Neo-osteogenesis (osteitis, hyperostosis) refers to new bone formation and may be caused by chronic inflammation

Much higher prevalence in post op cases (nearly 40%)

Usually a combination of surgical mucosal trauma and chronic inflammation / infection

Pre op neo-osteogenesis is a predictor of poor surgical outcome

Scarring/ostietis at FR, resulting in frontal sinus mucocele

Post op Patient with Persistent Sinus Symptoms

Persistent frontal sinus disease requiring revision surgery directed at the frontal recess: residual frontal recess cells

Post Op Sinus Imaging: Minor Complications

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Chronic sinonasal polyposis

Chronic sinonasal polyposis: Post FESS
Empty nose syndrome

Post FESS Patient with Persistent Symptoms and Frontal Sinus Disease (Failed FESS)

Frontal sinus surgery is one of the most difficult and challenging endoscopic procedures
Frontal recess anatomy is the most varied of all sinuses
Frontal recess region most prone to post op scarring /stenosis

Endoscopic Frontal Sinus Surgery: Failed FESS

- Draf I: Frontal recess approach
- Draf II: Frontal sinusotomy
- Draf III: Transeptal double barrel (Modified Lothrop)
- Frontal sinus trephination
- Frontal sinus stents
- Osteoplastic flap with frontal sinus obliteration

Endoscopic Frontal Recess Approach: Draf Type I for Failed FESS

- All structures surrounding the frontal recess are removed including anterior ethmoid cells and frontal cells
- Frontal sinus ostium is not altered
Endoscopic Frontal Sinusotomy: Draf Type II

- Removal of frontal sinus floor between the lamina papyracea and nasal septum
- Frontal sinus ostium is maximally enlarged on one side
- Difficult to distinguish from Draf I on coronal imaging alone

Endoscopic Median Frontal Drainage: Draf Type III

- “Modified Lothrop procedure”, “trans-septal sinusotomy”, “double barrel”
- Severe frontal sinusitis with OPF & obliteration as only alternative
- Contiguous bilateral enlargement of frontal drainage
- Removal of the floor of frontal sinus on both sides from orbit to orbit
- Removal of interfrontal septum and superior nasal septum

Miscellaneous Frontal Sinus Procedures

- Trephination
- Stents (ostium <5mm)
- Drug eluting stents

Osteoplastic flap with frontal sinus obliteration

- Procedure
  - Outline of sinus using a cut plate of a 6 foot Caldwell X-ray
  - Ostectomy and mucosa removed
  - Frontal recess occluded
  - Sinus filled with fat graft / soft tissue
  - Bony flap replaced
- Postoperative imaging appearance variable
Osteoplastic flap with frontal sinus obliteration

- ↑ T2 signal, replacement of fat, & enhancement do not mean inflammation in asymptomatic pts
- Evolution of fat over time with necrosis, cyst formation, transformation to granulation tissue
- 51 OFF procedures
- Post-up MR 2-5 years
  - < 20% adipose in 53%
  - > 60% in 18%

Post FESS Imaging: Major Complications

- Orbital complications
  - Penetration
  - Hematoma
  - Abscess
  - Blindness
  - Motility disorder

Orbital penetration post FESS

Pre-op: Atelectatic sinus-silent sinus syndrome

Post FESS: Fracture of orbital floor, contusion of inferior rectus muscle

Courtesy of Jenny Huang

Post FESS: Orbital penetration
Fracture of lamina papyracea, medial rectus contusion, herniation of orbital fat

Post FESS: Orbital apex & intracranial penetration
Post FESS Imaging:
Major Complications

- Intracranial injury
- CSF leak
- cerebritis
- abscess
- parenchymal bleed
- subarachnoid hemorrhage
- pneumocephalus
- encephalocele
- ventricular injury

CSF leak post FESS

Nasal stuffiness post FESS

Courtesy Pat Hudgins

Post FESS: Intracranial penetration

Post FESS: Pneumocephalus

Post FESS: Infarcts

Balloon Sinuplasty / Sinusotomy

Summary

• Reviewed spectrum of surgical intervention under the umbrella of FESS
• Reviewed post surgical imaging findings including minor and major complications