

Surgical Approaches for Frontal Sinus Disease: An Integrated Approach

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Surgical Approaches for Frontal Sinus Disease

Philosophical Approaches

- Traditional sinus surgery-maximum exposure and maximal tissue removal
- Sinus surgery with telescopes-minimally invasive approach but with maximal tissue removal
- **Functional endoscopic sinus surgery**
 - Preservation of normal structures
 - Mucous membranes are not irreversibly damaged
 - Maximum mucosal preservation
 - Restoration of natural ventilation and drainage

Surgical Approaches for Frontal Sinus Disease

Historical Perspective

1946-Mosher-"frontal sinus surgery in my hands has been bitterly disappointing. Temporary favorable results have been common. Permanently favorable results I could never guarantee."

1954-Ellis-"surgical treatment of chronic frontal sinusitis is difficult, often unsatisfactory, and sometimes disastrous."

1954-MacBeth-"treatment of chronic frontal sinusitis has remained one of the most unsatisfactory items in rhinology."

Surgical Approaches for Frontal Sinus Disease

- Citardi, Batra-"Over the past decade rhinology has experienced a period characterized by numerous innovations..."
 - Technologic developments
 - Better instrumentation
 - Powered instrumentation
 - Computer-aided surgery (CAS)
- Oto Clinics of North America, 2006



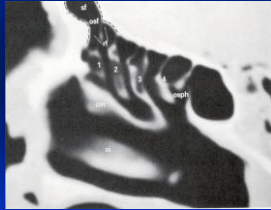
Surgical Approaches for Frontal Sinus Disease

Etiology of Frontal Sinus Disease

- Most frontal sinus disease is a **secondary** event-de novo isolated frontal sinus disease is the exception
- Analogies-large sinus emptying into a narrow space
 - Bottleneck, cork in a bottle
 - Inverted funnel
 - Cap of the egg

Surgical Approaches for Frontal Sinus Disease

- Frontal sinus outflow tract has three components (hourglass shape):
 - frontal sinus infundibulum
 - frontal sinus ostium
 - frontal recess



Functional Endoscopic Sinus Surgery, Stammberger 1991

Surgical Approaches for Frontal Sinus Disease

Integrated Approach to Frontal Sinus Disease

- Partial ethmoidectomy (Draf I)-ethmoid "epicenter"
- Intranasal frontal sinusotomy-mucosal sparing
- Above and below approach
 - Trephination and/or osteoplastic frontal sinusotomy
- Frontal Sinus Rescue Procedure
- Extended Procedures
 - Draf II (A,B), III
 - Endoscopic Modified Lothrop Procedure
 - Osteoplastic Frontal Sinusotomy
 - Unobliteration

Surgical Approaches for Frontal Sinus Disease

Integrated Approach to Frontal Sinus Disease

- **What** is the underlying **anatomy**?
- **What** is the **pathology**?
- **Where** is the **pathology**?
- How much **exposure** do I need?
- How will this approach effect **long term follow-up**?
- What are **my skills/comfort level**?
 - Cadaver training lab

Surgical Approaches for Frontal Sinus Disease

Integrated Approach to Frontal Sinus Disease

- **Teaching objectives:**
 - Understand the anatomy of the frontal recess and its influence on the frontal sinus
 - Recognize the surgical options and appropriate instrumentation in patients with medically refractory/non-medical frontal sinus disease
 - Understand the principles of surgical techniques applied to the frontal sinus

Extended Approaches

- Draf Procedures (II-A, II-B and III)
 - Type I
 - Type IIA/IIB
 - Type III
 - Axillary flap technique
- Endoscopic Modified Lothrop Procedure
- Osteoplastic Frontal Sinusotomy
- Unobliteration

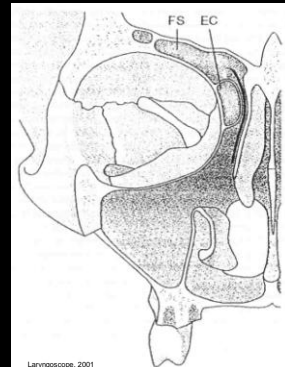
Extended Frontal Sinus Procedures

- Indications
 - Rare primary indications-neoplasm, trauma, skull base defect
 - Secondary indications-failed endoscopic surgery of the frontal recess/sinus
- Relative Contraindications
 - Small frontal sinus with narrow A-P diameter between anterior skull base and the nasal bones (sagittal and axial CT's); narrow M-L diameter (coronal and axial CT's)

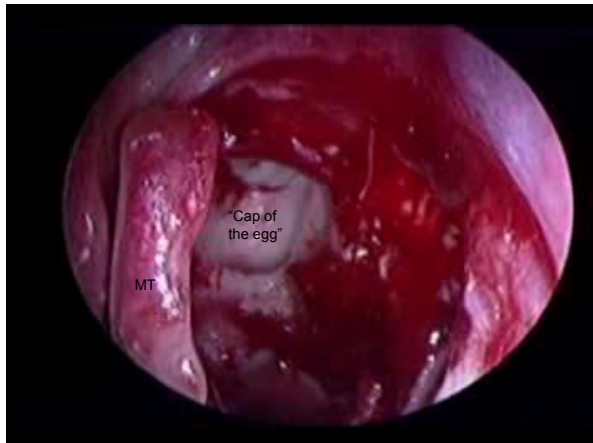
Extended Approaches

- Draf Procedures (I-III)
 - Type I-removal of disease inferior to the frontal sinus ostium; ethmoid air cells obstructing outflow from the frontal recess are removed without altering the frontal sinus ostium
 - Type II-A-Removal of ethmoid cells projecting into the frontal sinus; B-removal of the frontal sinus floor from the lamina papyracea to the nasal septum
 - Type III-contiguous bilateral enlargement with removal of superior nasal septum and intersinus septum

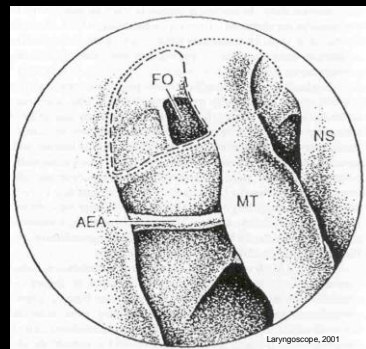
Draf II A



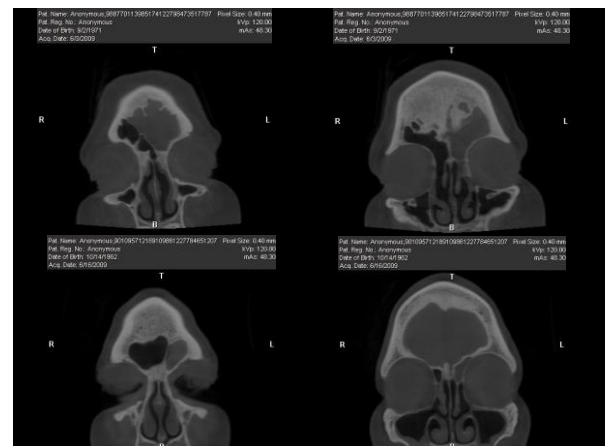
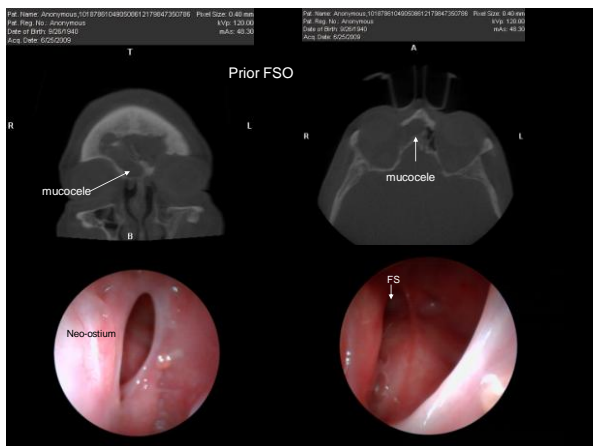
Laryngoscope, 2001

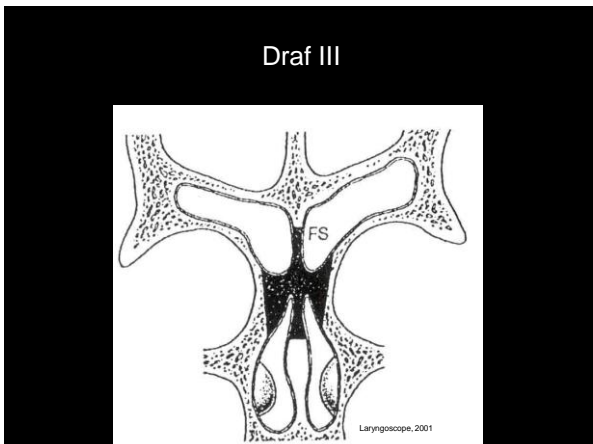
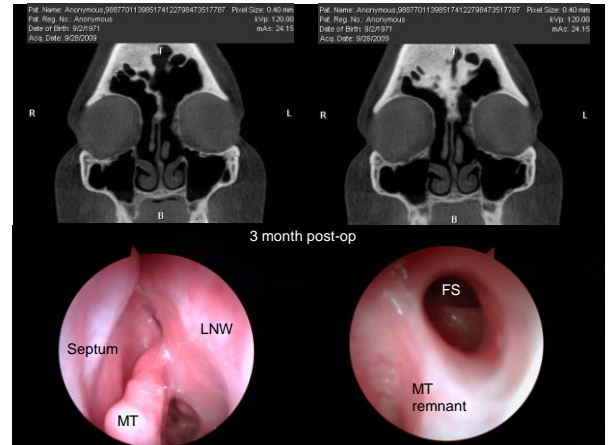
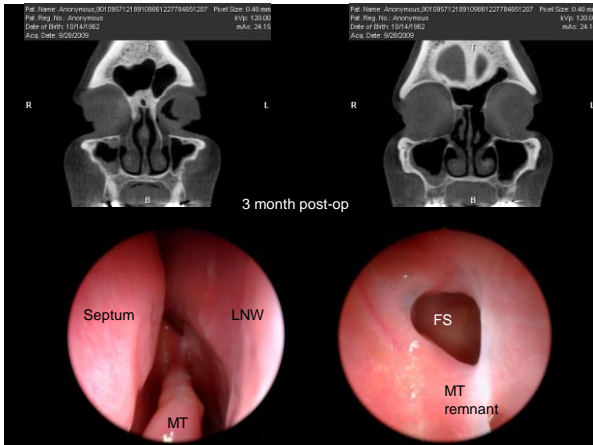
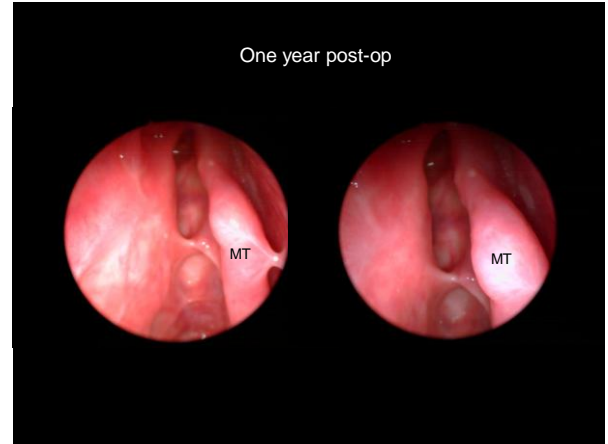
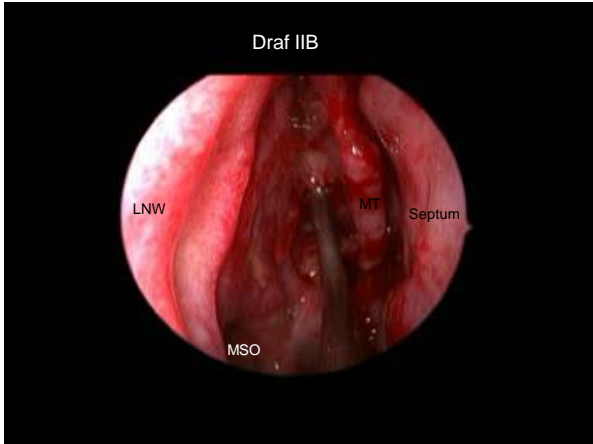


Draf II B



Laryngoscope, 2001





Endoscopic Modified Lothrop Procedure

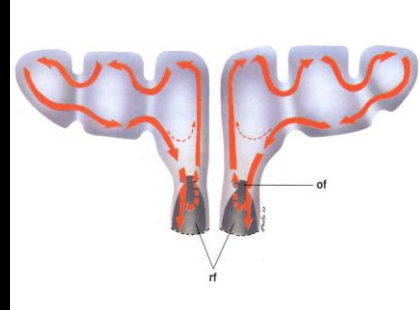
- Lothrop-1914 described external ethmoidectomy approach through which he removed the intersinus septum and the floor of the frontal sinus; tendency for orbital contents to collapse and narrow the frontal recess

Surgical Approaches for Frontal Sinus Disease

Endoscopic Modified Lothrop Procedure

- Close (1994) and Gross (1995) described a modification through a transnasal endoscopic approach
- Technically, this is not a “functional” procedure since it disrupts the normal mucociliary clearance from the frontal sinus; clinically, may not be important

Frontal Sinus-Mucociliary Clearance

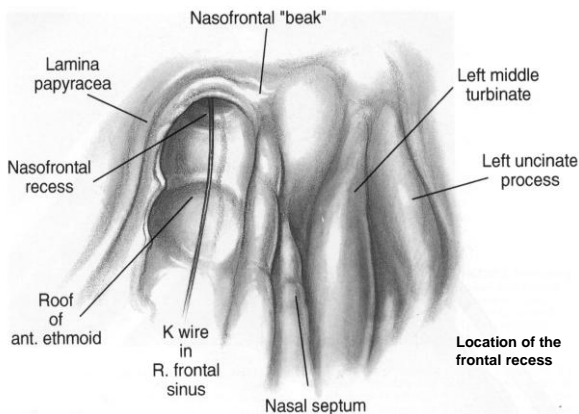
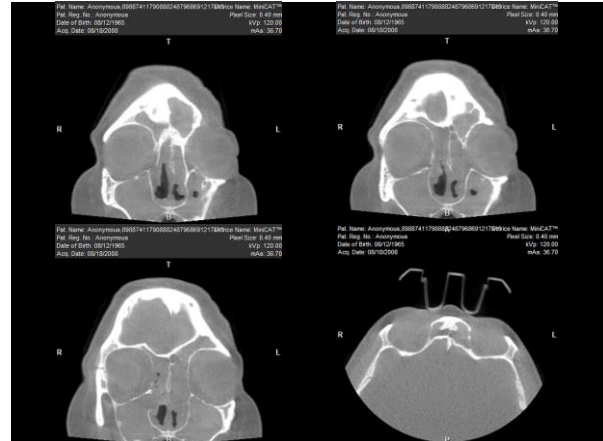


Stammberger, Functional Endoscopic Sinus Surgery p. 31, 1991

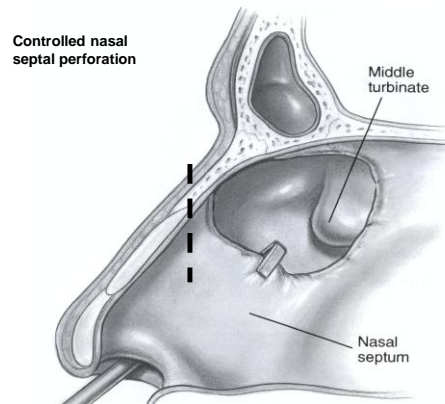
Surgical Approaches for Frontal Sinus Disease

Endoscopic Modified Lothrop Procedure

- Indications:
 - medically refractory chronic frontal sinusitis
 - failure of intranasal frontal sinusotomy and/or other more conservative techniques
 - no identifiable bony remnants in the frontal recess
 - neoplasm, skull base defect

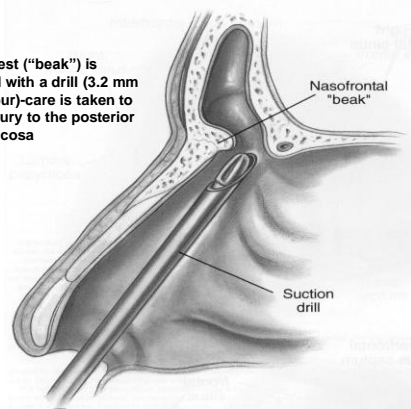


Operative Techniques in Otolaryngology-Head and Neck Surgery 6:193-200, 1995



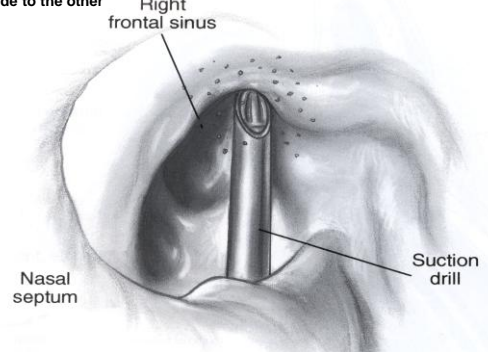
Operative Techniques in Otolaryngology-Head and Neck Surgery 6:193-200, 1995

Nasal crest ("beak") is removed with a drill (3,2 mm angled bur)-care is taken to avoid injury to the posterior table mucosa

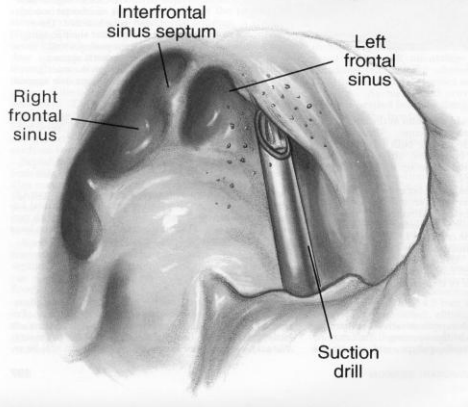


Operative Techniques in Otolaryngology-Head and Neck Surgery 6:193-200, 1995

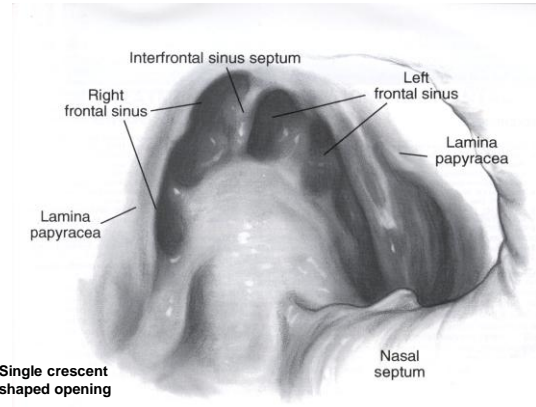
Drilling progresses from one side to the other



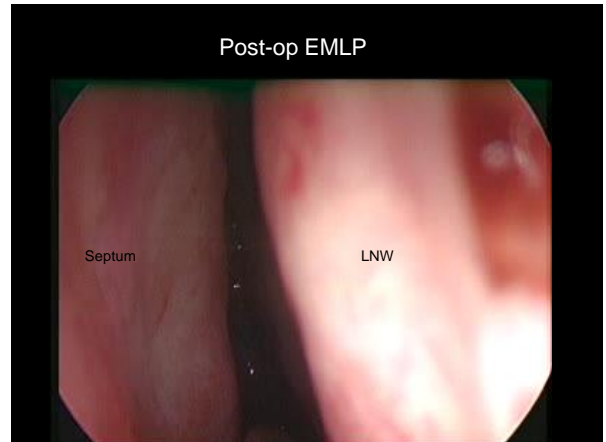
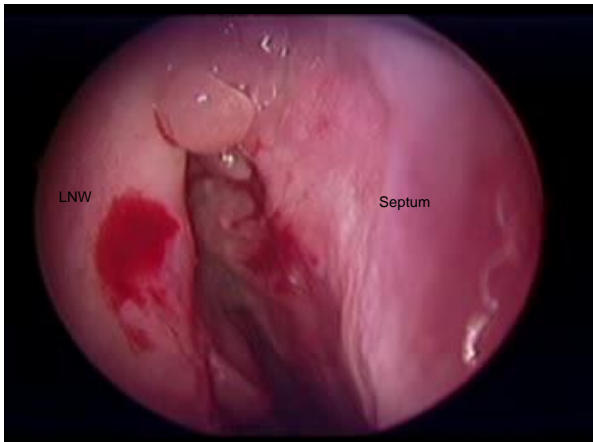
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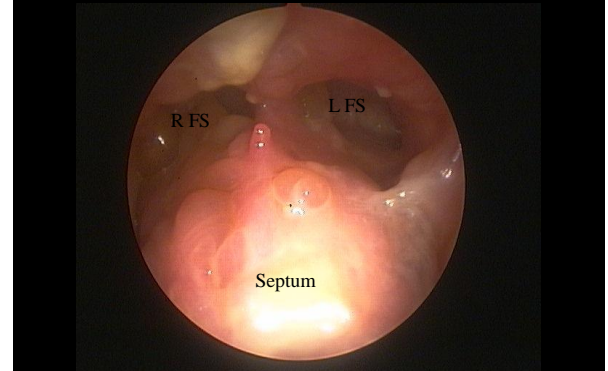
Operative Techniques in Otolaryngology-Head and Neck Surgery 6:193-200, 1995



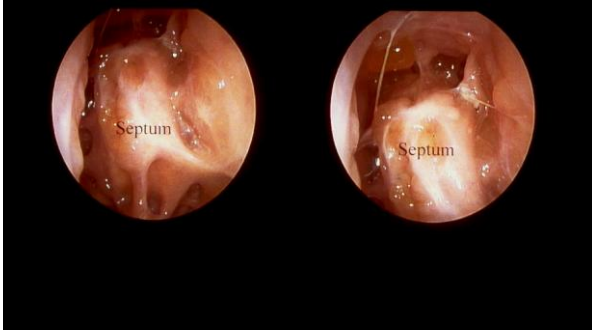
Modified Lothrop Procedure in Sinonasal Polyposis



One Month Post-op



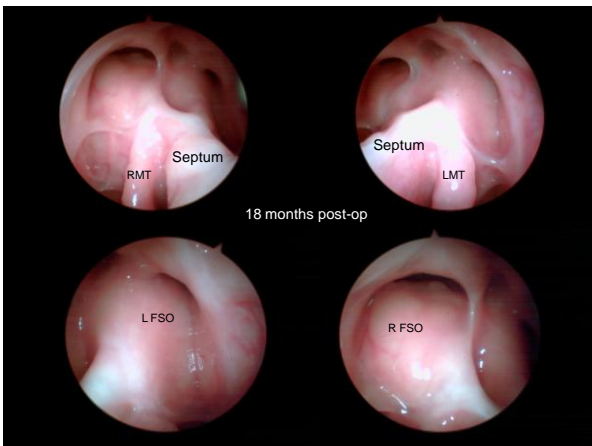
Six Months after Modified Lothrop Procedure



Surgical Approaches for Frontal Sinus Disease

Endoscopic Modified Lothrop Procedure

- Results:
 - Variable-symptom scores, ostial patency, concomitant disease (“success” -82-95 %)
- Complications
 - Bleeding
 - Scarring/Stenosis
 - Orbital
 - Intracranial



Endoscopic Modified Lothrop Procedure

- **21 patients** Casiano, et al-University of Miami
– *American Journal of Rhinology*, 12:335-339, 1998.
- **20 patients** McLaughlin, et al-University of Pennsylvania
– *American Journal of Rhinology*, 13:279-287, 1999.
- **54 patients** Schlosser, et al-University of Virginia
– *American Journal of Rhinology*, 16:103-108, 2002.
- **83 patients** Wormald, et al-Adelaide and Flinders University
– *Laryngoscope* 113: 276-283, 2003.
- **156 patients** Weber, et al –Fulda Hospital, Germany
– *Laryngoscope*, 111(1):137-46, 2001.

Surgical Approaches for Frontal Sinus Disease

- Pearls
 - Narrow AP diameter (< 8 mm-sagittal and axial views) and lateral dimension (< 16 mm-coronal and axial views) tends to lead to stenosis
 - Narrow AP diameter between anterior skull base and nasal bones and small frontal sinus are relative contraindications
 - Use of mini-trephination for irrigations post-op for 5 days (Wormald)
 - Most stenosis occurs within the first year with an average narrowing of 33% (Wormald)
 - *Laryngoscope*, 2007 Aug;117(8):1457-62.

Endoscopic Modified Lothrop



Surgical Approaches for Frontal Sinus Disease

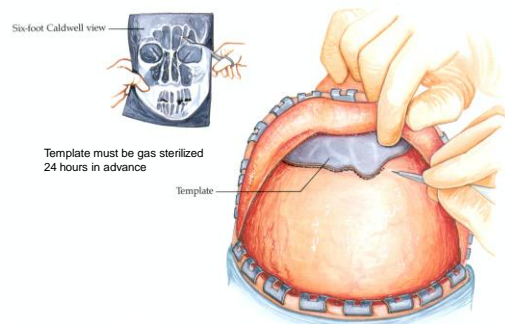
Osteoplastic Frontal Sinusotomy

- Indication-**EXPOSURE**
 - Neoplasm
 - Inverting papilloma
 - Osteoma
 - Malignancy
 - Fracture repair/inspection
 - Failed endoscopic approaches

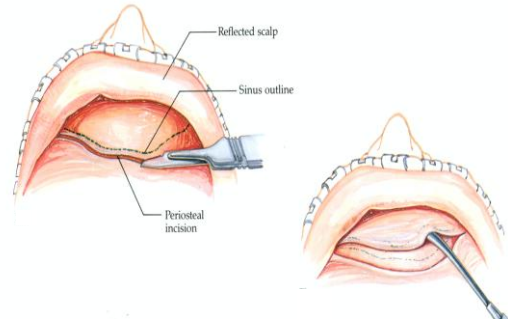
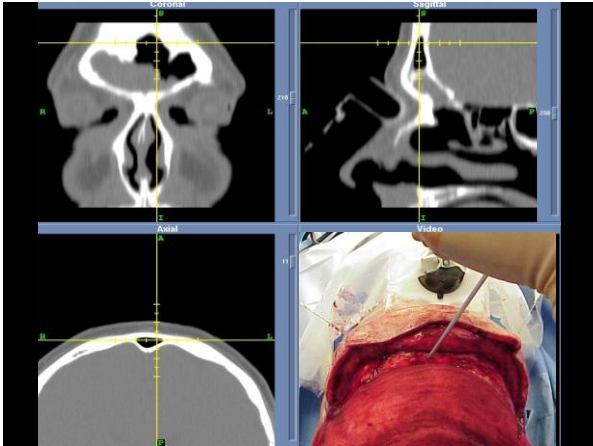
Surgical Approaches for Frontal Sinus Disease

Osteoplastic Frontal Sinusotomy

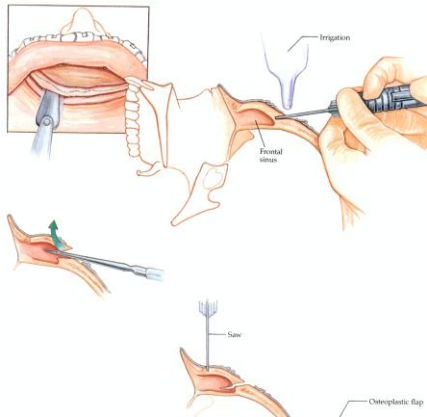
- Incisions
 - Brow-”gull wing”
 - Mid-forehead
 - Coronal-bevel incision to preserve hair follicles
- Unilateral or bilateral bone flap



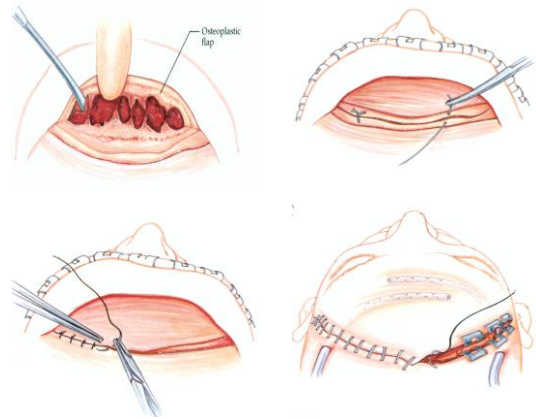
Atlas of Head and Neck Surgery Vol. 1 237-250, 1990



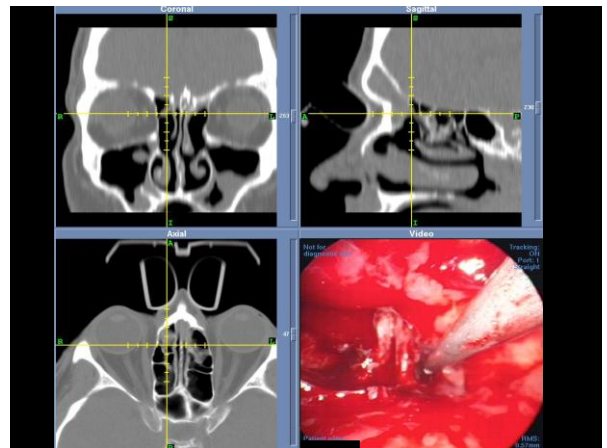
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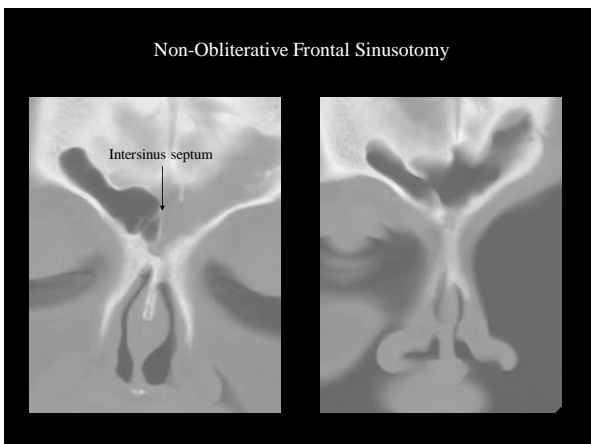
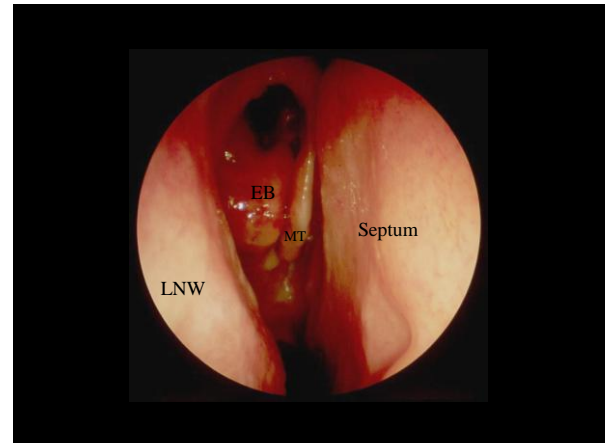
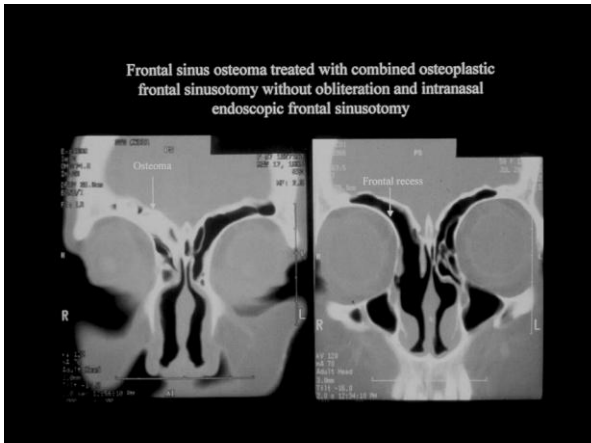
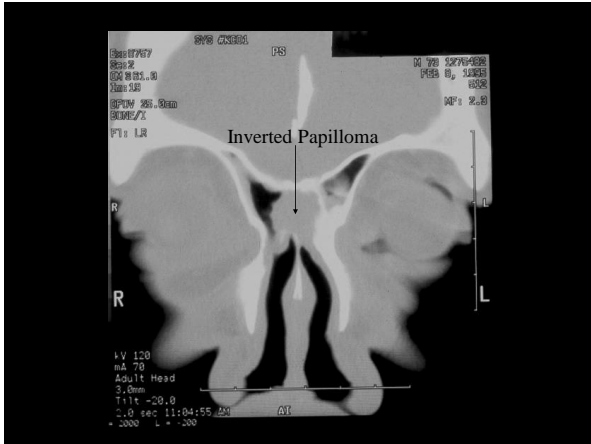


Atlas of Head and Neck Surgery Vol. 1 237-250, 1990



Atlas of Head and Neck Surgery Vol. 1 237-250, 1990





Surgical Approaches for Frontal Sinus Disease

Osteoplastic Frontal Sinusotomy

- Obliterate (FSO) or Re-establish Ventilation and Drainage?
 - Hardy and Montgomery, 1976-250 operations
 - 93 % were asymptomatic
 - 18 % complication rate
 - 9.5 % required revision
 - 7 % had significant neuralgia
 - Post-traumatic cephalgia may be related to osteotomy, flap elevation

Surgical Approaches for Frontal Sinus Disease

Osteoplastic Frontal Sinusotomy

- Obliterate or Re-establish Ventilation and Drainage?
 - Up until the endoscopic era, obliteration was the gold standard
 - Significant trend in the last 2 decades to re-establish sinus function rather than obliterate
 - Recent Medline search found numerous citations related to frontal sinus fractures, osteomas, and mucoceles treated without obliteration

Surgical Approaches for Frontal Sinus Disease

Osteoplastic Frontal Sinusotomy

- Obliterate or Re-establish Ventilation and Drainage?
 - Relative contraindications to obliteration
 - Neoplasm-difficult to distinguish fat graft from possible residual/recurrent tumor
 - Erosion of lamina papyracea and/or the posterior table of the frontal sinus- impossible to completely remove all mucosa from the periorbita and/or dura
 - Allergic fungal rhinosinusitis
 - Extensive frontal sinus/supraorbital ethmoid pneumatization

Surgical Approaches for Frontal Sinus Disease

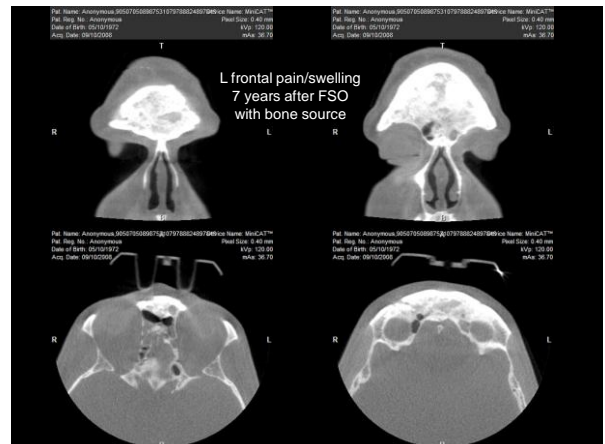
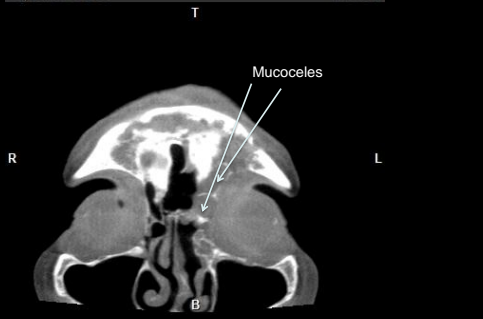
- What if obliteration is chosen?
 - Meticulous removal of all mucosa
 - “Permanent” occlusion of the frontal sinus outflow tract
 - Choice of appropriate material-consider “What if it needs to be removed?”
 - Autogenous-fat, cancellous bone
 - Auto-obliteration with osteoneogenesis
 - Pericranial flap
 - Bioactive glass
 - Hydroxyapatite cement

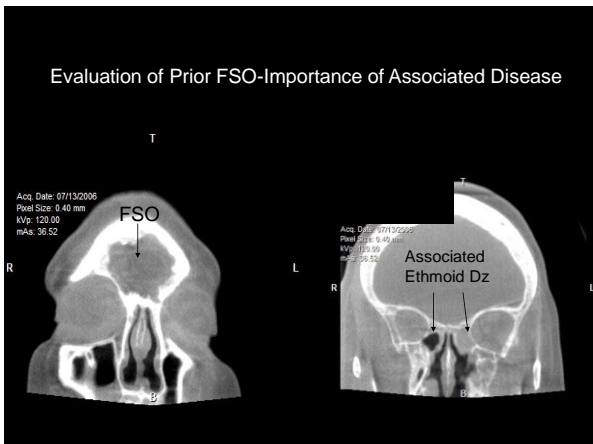
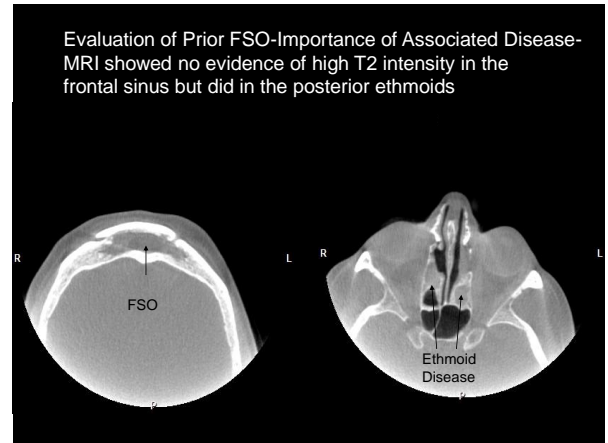
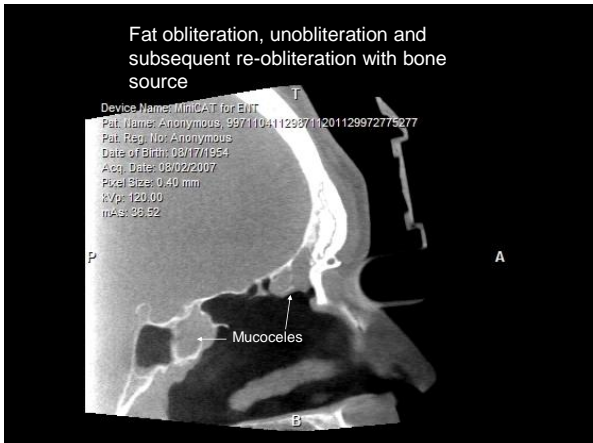
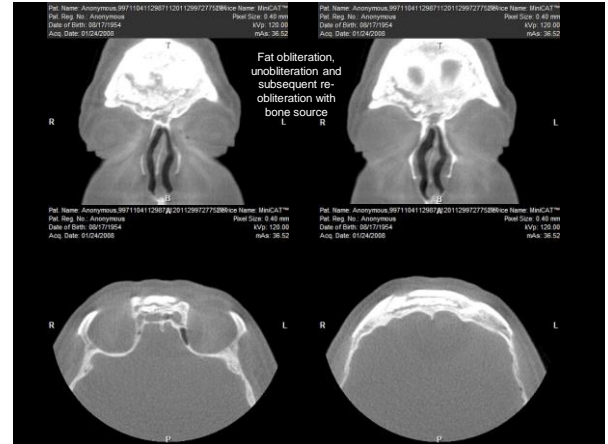
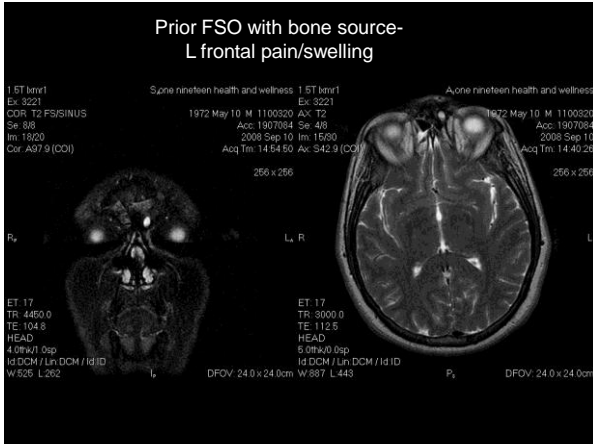
Unobliteration

- What is the fate of the fat graft?
 - Most evidence is from animal models with infected and normal sinuses.
 - Fat viability ~ 50 %
 - Average resorption ~ 20 %; up to 80 % if mucosa incompletely removed
 - Auto-obliteration by osteoneogenesis resulted in mucocele formation
- CT/MR Evaluation-malposition of bone flap, > 50 % fat attenuation, “scalloping”, T₂ weighted images

Prior FSO with fat graft-
L frontal/periorbital pain

Pat. Name: Anonymous.807110810690849912177106734898 Device Name:
Pat. Reg. No.: Anonymous Pixel Size: 0.40 mm
Date of Birth: 07/22/1924 kVp: 120.00
Acq. Date: 12/19/2005 mAs: 36.52



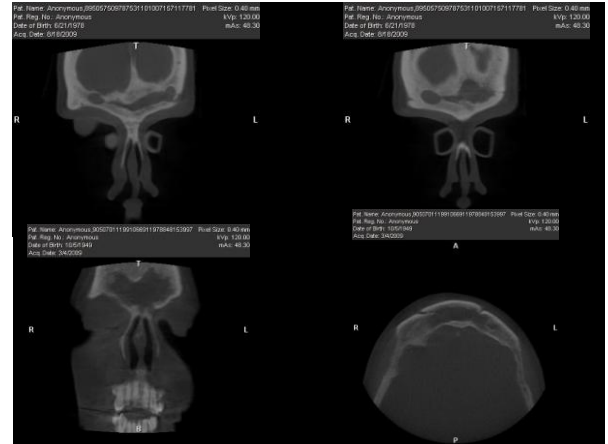


Unobliteration

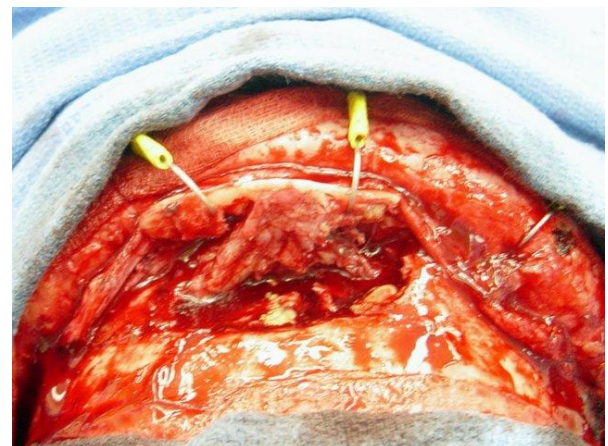
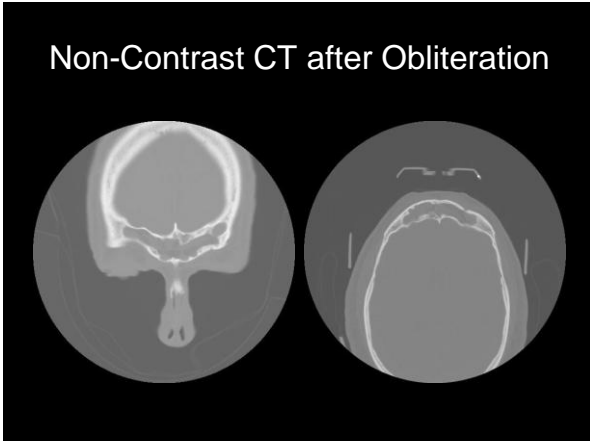
- Indications for Unobliteration
 - Frontal sinus pathology not amenable to endoscopic techniques
 - Symptomatic patient with suggestive/equivocal CT/MR findings
 - Intracranial complications
 - Posterior table erosion
 - Infected fat graft

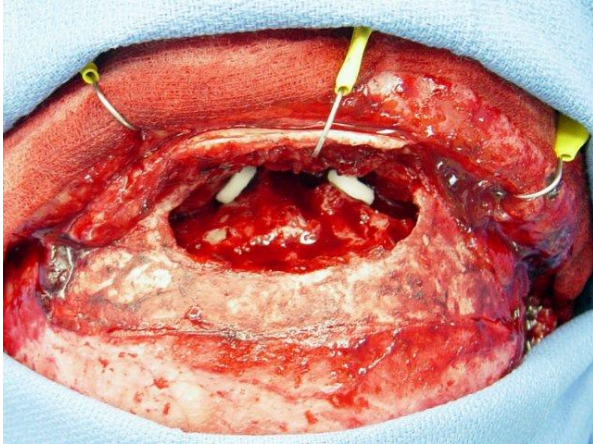
Unobliteration

- Technical Considerations
 - Raising the bone flap
 - Removing the fat graft/bone source
 - Send to pathology and microbiology
 - Avoid injury to dura/periorbita
 - Options?
 - Reconstructing the frontal sinus outflow tract
 - Remove residual ethmoid cells
 - Modified Lothrop procedure
 - Stent placement
 - Re-obliteration



Non-Contrast CT after Obliteration





Surgical Approaches for Frontal Sinus Disease

Conclusions:

- There are numerous surgical approaches for treating pathology in the frontal sinus
- Most frontal sinus disease is a secondary event
- The anatomy of the frontal recess is varied and complicated, but must be understood
- Surgical approaches should be made on an individualized basis