Contemporary Review

A Golden Experience: Fifty Years of Experience Managing the Frontal Sinus

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Objectives/Hypothesis: The frontal sinus is one of the most anatomically complex and inaccessible of the paranasal sinuses. As a result, surgeons have continually tried to improve surgical management of the frontal sinus. The senior author (c.a.) shares 50 years of experience managing the frontal sinus.

Data Sources: PubMed literature search.

Review Methods: Review of the literature regarding landmark innovations in frontal sinus surgery.

Results: Open approaches established that the frontal sinus is accessible, and in certain circumstances, such as with large osteoma or papilloma, are still required. The endoscope changed the surgical landscape and allowed for greater finesse and decreased morbidity. Sinus balloon dilation is the newest change in frontal sinus management and shows promise in properly selected cases.

Conclusion: Surgery of the frontal sinus continues to evolve and improve. Although there are new techniques, the older techniques are still pertinent.

Key Words: Frontal sinus, chronic sinusitis, endoscopic sinus surgery, Lothrop procedure, balloon dilation, stent.

Laryngoscope, 126:802-807, 2016
Because of the intimate relations, in the adult, of the infundibulum ethmoidale and the ductus nasofrontalis or the sinus frontalis directly, the infundibulum ethmoidale serves, in many instances, as a channel to convey secretion from the sinus frontalis to the sinus maxillaris. This is enhanced in those cases in which the infundibulum ethmoidale is deep and ends dorsally in a blind pouch, thus directing drainage through the ostium maxillare into the sinus maxillaris (figs. 8 and 12). In other words the sinus maxillaris is often a cesspool for infectious material from the sinus frontalis and certain of the anterior group of cellulae ethmoidales.

Geographic and temporal trends in frontal sinus surgery

Peter F. Svider, MD1, Vibhav Saksaria, MD2, David S. Cohen, MD1, Jean Anderson Eloy, MD, FACS1,2,3,4, Michael Setzen, MD, FACS1,2,5 and Adam J. Folbe, MD1

Background: The purpose of this study was to evaluate geographic and temporal trends in frontal sinus surgery procedures.

Methods: Medicare Part B data files from 2000 to 2011 were examined for temporal trends in various frontal sinus procedures, and the most recent year containing geographic information (2010) was evaluated for Current Procedural Terminology (CPT) code use. Additionally, nationwide charges per procedure were recorded. Regional populations of individuals ≥65 years old were obtained from the 2010 U.S. Census, and surgical society websites were used to determine the number of practicing rhinologists and otolaryngologists in each region.

Results: The use of open approaches declined by one third, while endoscopic procedures went from 6,463 to 19,626 annually, with the most marked increases occurring from 2006 through 2011. Geographic variation was noted, with practitioners in the South Atlantic states performing the greatest number of endoscopic procedures in 2010, whereas the East South Central states had the greatest number when controlling for population. There was an inverse relationship between endoscopic procedures performed and number of fellowship-trained rhinologists (controlling for regional populations) ($R^2 = 0.66$). The first year frontal sinus balloononing had a unique CPT code illustrated decreased reimbursements for non-balloon endoscopic surgery ($6099$) relative to balloon approaches ($9255$).

The advent of balloon sinus dilation has raised questions regarding optimal procedures for sinus surgery. In the frontal sinus, this has allowed practitioners, who might have otherwise avoided the more technically demanding endoscopic frontal sinus surgery, to explore the option of performing a minimally invasive and relatively safe technique for frontal sinusotomy. Although reimbursement for...
Frontal Sinus Development
Frontal Drainage Terms

- Frontal Infundibulum
- Frontal Recess
- Nasofrontal Duct
- Frontal Sinus Outflow Tract
- The “Beak”
Uncinate process

88%

12%
Frontal Sinus Cells
3D Computed Tomographic Analysis of Frontal Recess Analysis of 50 Patients with no history of frontal sinus disease

Frontal and recess cell types present in adult sinuses (N=100)

- Agger Nasi
- Supraorbital
- Type 1
- Blind recess
- Type 2
- Suprabullar
- Interfrontal Septal
- Frontal Bullar
- Type 3

This study describes frontal pneumatization in patients without a history of conditions that influence frontal pneumatization.

### TABLE 1. International Frontal Sinus Anatomy Classification (IFAC)

<table>
<thead>
<tr>
<th>Cell type</th>
<th>Cell name</th>
<th>Definition</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior cells (push the drainage pathway of the frontal sinus medially, posterior or posteromedially)</td>
<td>Agger nasi cell</td>
<td>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.</td>
<td>ANC</td>
</tr>
<tr>
<td></td>
<td>Supra agger cell</td>
<td>Anterior-lateral ethmoidal cell, located above the agger nasi cell (not pneumatizing into the frontal sinus).</td>
<td>SAC</td>
</tr>
<tr>
<td></td>
<td>Supra agger frontal cell</td>
<td>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.</td>
<td>SAFC</td>
</tr>
<tr>
<td>Posterior cells (push the drainage pathway anteriorly)</td>
<td>Supra bulla cell</td>
<td>Cell above the bulla ethmoidalis that does not enter the frontal sinus.</td>
<td>SBC</td>
</tr>
<tr>
<td></td>
<td>Supra bulla frontal cell</td>
<td>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.</td>
<td>SBFC</td>
</tr>
<tr>
<td></td>
<td>Supraorbital ethmoid cell</td>
<td>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.</td>
<td>SOEC</td>
</tr>
<tr>
<td>Medial cells (push the drainage pathway laterally)</td>
<td>Frontal septal cell</td>
<td>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.</td>
<td>FSC</td>
</tr>
</tbody>
</table>
Medical Approaches

TOPICAL CORTICOSTEROIDS
Budesonide nasal irrigations in the postoperative management of chronic rhinosinusitis

David W. Jang, MD, Vasileios A. Lachanas, MD, PhD, Jamie Segel, MD and Stilianos E. Kountakis, MD, PhD

Background: Nasal steroids play an important role in the postoperative management of patients with chronic rhinosinusitis (CRS). However, commercially available nasal steroid sprays may not deliver adequate amounts of medication to the entire postoperative sinus cavity. The off-label use of budesonide nasal irrigation (BNI) theoretically solves this problem by delivering concentrated steroid solution through a high-pressure, high-volume system. Several studies have attested to the safety of BNI, but there are very few reports of its efficacy.

Methods: This is a retrospective review of prospectively-collected data. We identified 60 patients who were prescribed BNI postoperatively, but had a lapse in therapy for 1 month or longer. The 20-item Sinonasal Outcomes Test (SNOT-20) and Lund-Kennedy endoscopy scores while the patients were using BNI were compared with scores from the same patients while they were not using BNI. Student paired t test was used for statistical analysis.

Results: Thirty patients had eosinophilic chronic rhinosinusitis (eCRS) with polyps (eCRSwNP), 13 had allergic fungal sinusitis (AFS), 13 had Samter’s triad (ST), and 4 had eosinophilic chronic rhinosinusitis without polyps (eCRSxNP). Mean follow-up time was 25 months (range, 2-89 months). Overall, SNOT-20 scores were significantly lower with BNI ($p < 0.05$). On subgroup analysis, SNOT-20 scores were significantly improved with BNI for patients with eCRS and Samter’s triad ($p = 0.04, 0.03$). Endoscopy scores were significantly improved only in the eCRS group ($p = 0.02$).

Conclusion: The addition of BNI is beneficial in the postoperative management of patients with CRS. © 2013 ARS-AAOA, LLC.

Key Words: budesonide; sinusitis; rhinosinusitis; postoperative outcomes; nasal steroids

Steroid Irrigations
Steroid Drop Administration via Mygind’s Position
UVA Retrospective Study

- **Inclusion**
  - Any patient started on steroid via Mygind’s position

- **Exclusion**
  - Any other concomitant changes to medical therapy

- **48 Patients**
  - 48/48 with endoscopy scores
  - 37/38 with SNOT-22 pre/post scores available
Mygind’s Results

**Average SNOT-22 Score**

- Pre-Mygind: 40
- Post-Mygind: 30

**Endoscopic Scores**

- Right Pre-Mygind: 50
  - 0: 20
  - 0.5: 10
  - 1: 5
  - 1.5: 10
  - 2: 5
  - 2.5: 10
  - 3: 20
- Right Post-Mygind: 50
  - 0: 20
  - 0.5: 10
  - 1: 5
  - 1.5: 10
  - 2: 5
  - 2.5: 10
  - 3: 20
- Left Pre-Mygind: 50
  - 0: 20
  - 0.5: 10
  - 1: 5
  - 1.5: 10
  - 2: 5
  - 2.5: 10
  - 3: 20
- Left Post-Mygind: 50
  - 0: 20
  - 0.5: 10
  - 1: 5
  - 1.5: 10
  - 2: 5
  - 2.5: 10
  - 3: 20

*Significant difference
Surgical Options

TWISTS ON OLD THEMES
Patient – Frontal Mucocoele

- 81 yo female referred for frontal mucocoele found on CT scan for unrelated metallic taste / burning mouth syndrome
- CT showed posterior table erosion
- Taken to OR for mucocoele
- Various medical methodologies tried to help burning mouth
Type IV Frontal Mucocele
How I Do It

Modified Glabellar Rhytid Incision for Frontal Sinus Trephination

Brian A. Fishero, MD; Philip G. Chen, MD; Spencer C. Payne, MD

INTRODUCTION
Surgical management of the frontal sinus is more complex compared to the other sinuses. Testament to this fact is that for years the standard for refractory frontal disease has been the destructive procedure of an osteoplastic flap with complete obliteration of the sinus.1

With better understanding of the physiology of the paranasal sinuses, there has been a shift toward surgery directed at functionally improving drainage by widening the natural outflow pathway with purely endoscopic techniques. Whereas expanded frontal approaches such as the endoscopic modified Lothrop procedure (EMLP) can provide quite extensive access,2 they can be nicely augmented with a concomitant mini-trephination. In circumstances such as complicated acute frontal sinusitis,

MATERIALS AND METHODS

Patients
This case series was approved by the University of Virginia’s Institutional Review Board for Health Sciences Research. The medical records of patients presenting for management of chronic rhinosinusitis to the University of Virginia were reviewed. Those patients failing medical therapy or who had pathology requiring surgical approach without prior medical therapy (e.g., neoplasia) and underwent a trephine-assisted endoscopic frontal sinus exploration were included. Patients requiring emergent-isolated trephination for complications of acute frontal sinusitis were excluded from this analysis because their disease process necessitated an inferior and smaller brow-based trephine for drainage as opposed to surgical access.
Glabellar Rhytid Incision
Glabellar Rhytid Incision
Navigation Probe in Frontal
Endoscopic View of Sinus

- Mucocele
- Orbital Roof
- Posterior Table
- FSOT
Mucocele Opened into Frontal
Surgical Options

NEW INSTRUMENTATION
AAO-HNSF
Clinical Consensus Statement:
Balloon Dilation of the Sinuses

McCormick Place Convention Center
Chicago, Illinois

Wednesday, September 13, 2017
- Balloon dilation can be effective in Frontal sinusitis
  **Mean 7.08, Outliers 1**

- There can be a role for balloon dilation in patients with persistent sinus disease who have had previous sinus surgery. **Mean 7.62, Outliers 1**

BSD in CRS: Graz Experience

- 45 patients with CRS scheduled for FESS
- 112 sinuses attempted as BSD
  - 68 balloon only; 24 successful
  - 44 hybrid; 15 successful
- 65-66% failure rate considered unacceptable and study abandoned

Tomazic et al. Rhinology. 2013;51:120-127. PMID 23671892
Frontal Stenosis

- Lateralized Middle Turbinate
- Frontal Sinus Rescue
Balloon Dilation of Frontal Stenosis

- LacriCATH device
- 6 patients underwent 7 dilations
  - 1 patient had >50% contraction and underwent repeat
- All ostia patent at last f/u (4-9 mos)

Office Management of Frontal Ostium Stenosis

- 7 patients; 3 in OR, 4 in office
- All received balloon dilation
- 3 patients of 4 tolerated office procedure
- All sinuses patent at avg. f/u of 9 mos

34 patients: 17 BSD, 17 Draf I/IIa

Outcomes: VAS, RSDI, Frontal permeability (yes/no), radiologic resolution

Frontal Sinus Dilations: 21 of 26 attempted (80.76%)

Frontal Sinus FESS: 13 Draf I, 9 Draf IIa

Plaza et al. Annal Otol Rhinol Laryngol. 2011;120:511-518. PMID 21922974
Plaza results

- Results:
  - Permeability:
    - BSD 73.0%
    - Draf I/IIa 62.5%
  - Revisions:
    - BSD 1
    - Draf I/IIa 3
What to do?

- 67 yo male
- 13 prior sinus surgeries
- Left forehead pain
- 3rd day on job
Surgical + Medical

DRUG ELUTING STENTS
Mometasone Eluting Stent
Hourglass Shape – “Contour”

Research

JAMA Otolaryngology-Head & Neck Surgery | Original Investigation

Safety and Effectiveness of a Bioabsorbable Steroid-Releasing Implant for the Paranasal Sinus Ostia
A Randomized Clinical Trial

Ambar Luong, MD, PhD; Randall A. Ow, MD; Amreet Singh, MD; Robert L. Weiss, MD; Joseph K. Han, MD; Roland Gerencer, MD; J. Pablo Stolovitzky, MD; James W. Stambaugh, BS; Aarthi Raman, PhD

**IMPORTANCE** Suboptimal outcomes of endoscopic sinus surgery (ESS) are often associated with restenosis and inflammation of frontal sinus ostia. Steroid-releasing sinus implants have been shown to maintain sinus patency by minimizing inflammation and scar tissue formation. An hourglass-shaped, bioabsorbable, steroid-releasing implant was developed to provide mechanical support and optimize drug delivery to paranasal sinus ostia.

**OBJECTIVE** To assess the safety and efficacy of the hourglass-shaped, bioabsorbable, steroid-releasing sinus implant in improving postoperative outcomes when placed in the frontal sinus ostia (ESO) following ESS in patients with chronic rhinosinusitis (CRS).
Mometasone Eluting Stent
Hourglass Shape – “Contour”

Figure 3. Need for Postoperative Interventions in the Frontal Sinus Opening at Day 30 as Judged by an Independent Reviewer and by Clinical Investigators

Summary

- Frontal sinus has complex anatomy
- Newer techniques and nomenclature will facilitate better care with less invasiveness
- Some patients will require significantly more surgical management however and treatment needs to match disease
Thank you!