

Utility of intraoperative flexible endoscopy in frontal sinus surgery

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ABSTRACT

Background: Surgical management of the frontal sinus can be challenging. Extensive frontal sinus pneumatization may form a far lateral or supraorbital recess that can be difficult to reach by conventional endoscopic surgical techniques, requiring extended approaches such as the Draf III (or endoscopic modified Lothrop) procedure. Rigid endoscopes may not allow visualization of these lateral limits to ensure full evacuation of the disease process.

Methods: Here we describe the utility of intraoperative flexible endoscopy in two patients with far lateral frontal sinus disease.

Results: In both cases, flexible endoscopy allowed confirmation of complete evacuation of pathologic material, thereby obviating more extensive surgical dissection.

Conclusion: In cases where visualization of the far lateral frontal sinus is inadequate with rigid endoscopes, flexible endoscopy can be used to determine the need for more extensive dissection.

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Since its introduction, the rigid endoscope has transformed the field of rhinologic surgery. In the past two decades, the evolution of endoscopic techniques and instrumentation has allowed surgeons to carry out major sinonasal and skull base surgery in a fully endoscopic manner. Despite these advances, there are situations that continue to present significant technical challenges. Because of its anatomic position and potential for variability, the frontal sinus can pose just such a challenge, particularly when exuberant pneumatization has led to the formation of deep lateral and/or supraorbital recesses.

Two common pathologic entities that can affect this region are fungus balls (formerly known as “mycetoma”) and mucocele. Fungus balls are masses of tangled fungal hyphae, most commonly *Aspergillus fumigatus*.¹ The mass of fungal debris accumulates with mucous within the sinus cavity, without involving the underlying mucosa.² These typically occur in a single sinus; the maxillary sinus is affected most commonly, and the frontal sinus is affected least commonly.^{2,3} Treatment for fungus ball includes its complete removal and creation of a patent sinus outflow tract. Historically, far lateral fungus balls have often required utilization of external sinusotomy.^{1–3} Mucoceles are epithelial-lined cystic masses that are filled with mucus and can obstruct the sinus ostia.⁴ These develop when mucociliary clearance is impaired, which leads to the accumulation of secreted mucus into an enlarging mass.⁵ Mucoceles can expand, erode bone, and violate the cranial vault or orbit.^{4,6,7} Treatment for mucoceles consists of total resection or evacuation. Frontal sinus mucoceles that extend to far lateral recesses can sometimes be difficult to reach endoscopically; even when it can be partially reached, it is impossible to assure full evacuation when the limits of the lateral recess are outside the reach of a rigid endoscopy.

Options for reaching far lateral pathology have previously been described either as part of the original Draf classification of frontal sinusotomy^{8–12} or, subsequently, as variations on these techniques.^{13–16} Although extended frontal sinusotomy techniques may be required for full mucocele evacuation, oftentimes a mucocele can be evacuated even when only parts of it can be reached. In these situations, however, confirmation of complete evacuation

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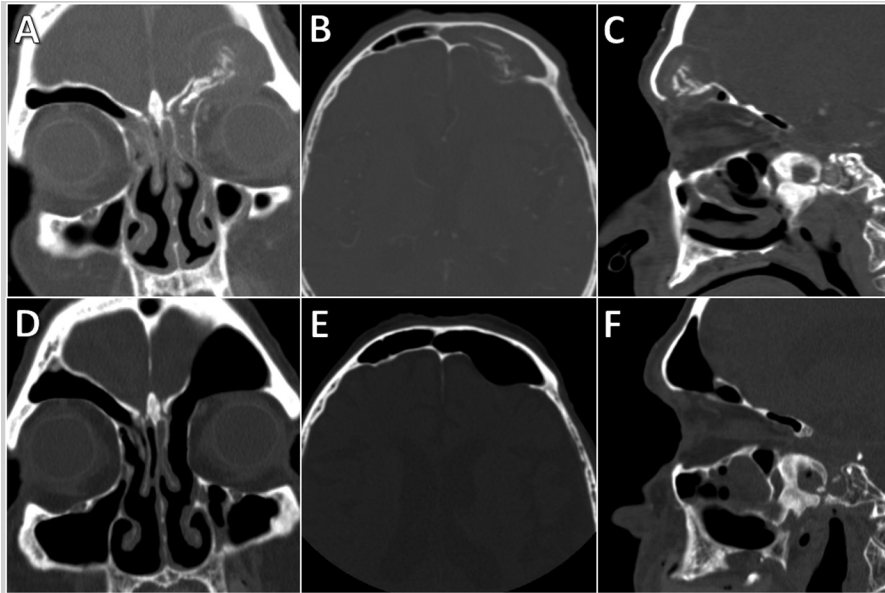


Figure 1. (A–C) Coronal, axial, and sagittal computed tomographies with intravenous contrast, demonstrating an expansile lesion in the left frontal sinus, with bony remodeling and dehiscence of the posterior table of the frontal sinus and superior orbital wall; note the heterogeneous appearance of the frontal sinus lesion consistent with fungus ball. (D–F) Images, showing appearance of frontal sinus after endoscopic frontal sinusotomy; note complete removal of the fungus ball.

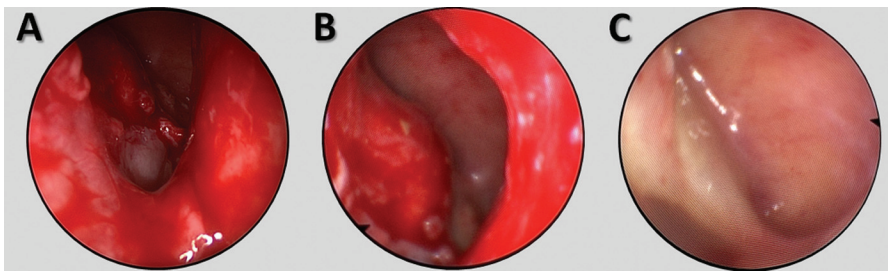


Figure 2. (A) A maximal lateral view of the frontal sinus when using a rigid 70° endoscope. (B) Further lateral view when using a flexible endoscope. (C) Lateral recess completely visualized by using a flexible endoscope.

is necessary. In this report, we explored the use of the flexible endoscope in adequately visualizing the lateral aspect of the frontal sinus after completing a Draf IIa frontal sinusotomy. We discussed two cases of far lateral frontal sinus pathology (one fungus ball and one mucocele) in which, by using the flexible endoscope to visualize the lateral recess, we obviated the need for more extended frontal sinus surgery.

METHODS

In both cases, informed consent was obtained for Draf IIa frontal sinusotomy as well as for possible Draf IIb or Draf III (and variant) approaches. The patients were positioned supine. The nasal cavities were examined by using 4-mm, 30°, rigid Hopkins telescopes. On completion of a standard frontal sinusotomy (Draf IIa) and evacuation of the pathology, the frontal sinus was inspected by using a 70° rigid Hopkins telescope and a high-definition video system (Karl Storz and Co., Tuttingen, Germany). After determining that the full extent of the lateral recess could not be adequately visualized, a flexible rhino-pharyngo-laryngoscope (Karl Storz) was connected to the high-definition video system and passed through the frontal sinus drainage pathway into the frontal sinus cavity. The endoscope

was maneuvered until all surfaces of the frontal sinus cavity were visualized.

CASE REPORTS

Case 1

An 82-year-old man who was admitted for pneumonia was noted to have left-sided ptosis for 3 weeks. Computed tomography (CT) demonstrated a left frontal sinus mass that caused expansion of the sinus as well as erosion of the posterior frontal sinus table and superior orbital wall (Fig. 1, A–C). The patient underwent a Draf IIa procedure. A 70° endoscope could not provide adequate visualization of the lateral recess of the frontal sinus (Fig. 2 A). Before proceeding to a modified hemi-Lothrop procedure (MHLP) or a modified Lothrop procedure, a flexible endoscope was used for visualization. On confirming the presence of a remnant fungus ball, the frontal sinus was irrigated until cleared of disease (Fig. 2, B and C). Bony dehiscence of the posterior table and orbital roof were evident, with fully intact mucosa. No extended frontal sinus procedure was necessary at that time. The patient did well after surgery and was subsequently discharged home.

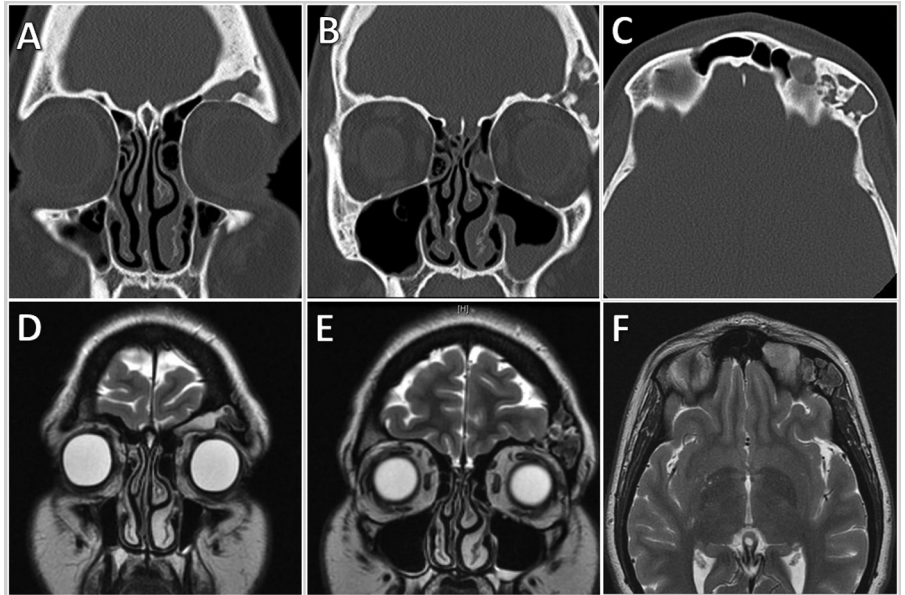


Figure 3. Coronal (A and B) and axial (C) computed tomographies, demonstrating an expansile lesion in the left frontal sinus with thinning of the orbital roof with extension into the calvarium. Coronal (D and E) and axial (F) T2-weighted magnetic resonance image of the same patient, showing material expanding the left frontal sinus, with mild protrusion into the superior extraconal space; no intracranial extension was noted.

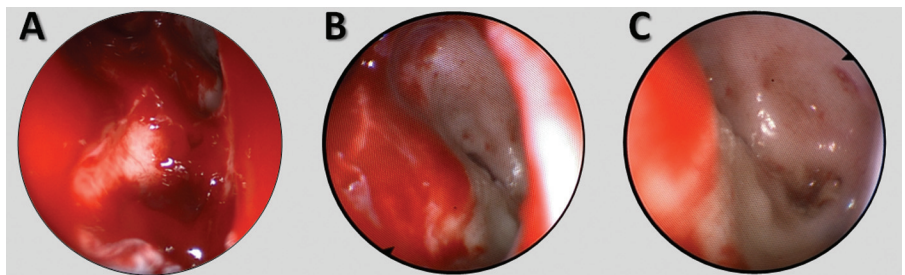


Figure 4. (A) A maximal lateral view of the frontal sinus by using a rigid 70° endoscope. (B) A further lateral view by using a flexible endoscope. (C) A lateral recess completely visualized by using a flexible endoscope.

Postoperative CT imaging confirmed complete removal of the fungus ball (Fig. 1, D–F).

Case 2

A 31-year-old woman was referred to our tertiary care rhinologic practice for chronic rhinosinusitis. CT and magnetic resonance imaging revealed a left-sided frontal sinus mucocoele with bony destruction and protrusion into the superior extraconal space (Fig. 3, A–F). A Draf IIa procedure was then performed. Copious irrigation was used to clear concretions from the sinus cavity. The 70° telescope could not fully visualize the lateral frontal sinus recess (Fig. 4 A). A flexible endoscope was successfully used to inspect the frontal sinus (Fig. 4, B and C). No retained concretions were noted. Again, no additional frontal sinus procedure was necessary at that time. The patient was discharged home on the day of surgery and did well after surgery.

DISCUSSION

Management of frontal sinus pathology has improved with the development of modern imaging technologies, surgical instrumentation, and minimal-access surgical techniques.⁸ However, dependent on surgeon training and experience, treatment of frontal sinus le-

sions can vary significantly, from fully endoscopic to fully open approaches. Several previous series demonstrated the efficacy of endoscopic approach in the management of fungus balls and mucocoeles.^{2,3,8,13,17,18} Hybrid open and endoscopic procedures as well as endoscopic approaches to the lateral recess of the frontal sinus have been described.¹⁸ The endoscopic modified Lothrop procedure, or Draf III, and the MHLP allow lateral frontal sinus recess access. This is obtained through maneuvering through the contralateral nasal cavity by way of a superior septectomy. The main advantage of the MHLP over the modified Lothrop procedure is the preservation (untouched) of one (contralateral) healthy frontal sinus outflow tract. Both of these approaches entail a superior septectomy, which could potentially lead to additional morbidity (*e.g.*, increased chance of epistaxis or olfactory dysfunction because this portion of the septum has been demonstrated to contain olfactory neuroepithelium).¹⁹

Given this potential (although limited) for increased morbidity, less-invasive sinusotomy is preferred as long as it allows for full evacuation of the fungus ball or mucocoele. The flexible endoscope can function as a simple diagnostic tool before proceeding to an extended frontal sinusotomy. For example, in the first

case, with the use of the flexible endoscope, we were able to visualize and, subsequently, irrigate the retained fungal concretions in the lateral and/or supraorbital frontal sinus recess instead of performing a more-extended surgical dissection. Moreover, in addition to visualizing the retained material, we were also able to assess for possible erosion of the posterior table and the superior orbit bony wall in clear detail with the flexible endoscope. A rigid endoscope, even with a modified Lothrop procedure or MHLP, may not have provided the same level of visualization in the lateral recess as the flexible endoscope. For such visualization, an open procedure (*i.e.*, trephine or osteoplastic flap) would have been required. The flexible endoscope is limited, however, by a lack of accompanying flexible instrumentation.

Although this procedure was described for a fungus ball and a mucocele in the two presented cases, this technique can also be used to determine complete resection of the attachment site of a solid frontal sinus lesion such as an inverted papilloma or a malignant tumor. In such a case, if the attachment is not completely resected, then a more-aggressive procedure may be necessary for adequate instrumentation. In addition, even with extended frontal sinus procedures, *e.g.*, the modified Lothrop procedure, it is sometimes necessary and useful to use this flexible endoscope technique. The study was limited by a small sample size and its retrospective nature. However, it was intended to serve as a “proof-of-concept” by illustrating the utility of a simple, low-cost, and readily accessible technology in assessing the adequacy of initial and/or minimal surgical intervention and potentially obviating a more-invasive procedure.

CONCLUSION

Flexible endoscopy can be a useful tool for intraoperative assessment of the lateral and/or supraorbital frontal sinus recess. In the two cases described, adequate visualization of this area was not possible through the Draf IIa procedure. Both cases would have required either a modified Lothrop procedure or MHLP to endoscopically confirm complete removal of mucocele concretions. In the first case, further frontal sinus irrigation was required to clear the concretions, and neither patient required a more-invasive sinusotomy procedure.

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