

Evolution in the surgical management of chronic rhinosinusitis: Current indications and pitfalls



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Chronic rhinosinusitis (CRS) consists of a range of inflammatory conditions in the sinuses that can result in clinical symptoms. The underlying pathophysiology and its relationship to lower airway disease are complex. Current definitions of CRS can serve more as an indication for potential surgical intervention rather than a marker of disease state. CRS can be asymptomatic and may require medical management to avoid disease progression and minimize the risk of lower airway disease. Endoscopic surgery has undergone a significant evolution and refinement, but the most common surgical complication remains persistent inflammation and disease recurrence. It is important to recognize that surgery alone rarely cures CRS and patients require long-term medical therapy for continued asymptomatic inflammation. Careful postoperative care and endoscopic follow-up to ensure resolution of inflammation are key to ensuring optimal surgical outcomes and reduce the risk of revision surgery. Future work on CRS endotypes will allow discovery of new therapies to treat CRS, as well as refine indications for medical or surgical intervention and postoperative care. (J Allergy Clin Immunol 2018;141:1561-9.)

Key words: Chronic rhinosinusitis, nasal polyps, endoscopic surgery, surgical complications

Chronic rhinosinusitis (CRS) encompasses a broad spectrum of inflammatory conditions of the sinuses that can result in clinical symptoms. Like asthma, CRS can be symptomatic or asymptomatic, and its optimal management requires close cooperation between surgeon and allergist. The syndrome is complex, and

Abbreviations used

CRS: Chronic rhinosinusitis
CRSsNP: Chronic rhinosinusitis without nasal polyps
CRSwNP: Chronic rhinosinusitis with nasal polyps
CT: Computed tomography
FESS: Functional endoscopic sinus surgery
SNOT: Sino-Nasal Outcome Test

the pathology is multifactorial and partially unknown, involving elements of innate mucosal immunity and the adaptive inflammatory response.

Mucociliary clearance is diminished in patients with CRS, which can, in part, relate to local hypoxia in an obstructed sinus that could push epithelial cells away from a fully differentiated state into a state of epithelial to mesenchymal transition.^{1,2} Mucosal barrier integrity is also compromised in patients with CRS, in whom there is altered or decreased expression of tight junction proteins.^{3,4} Prolonged alterations in mucosal integrity might allow for enhanced transmission of bacterial, viral, or fungal byproducts or epithelial products secreted into the mucus across the epithelium that can result in prolonged and ultimately pathologic inflammatory signaling.

Altered expression or polymorphisms in pathogen and pathogen byproduct recognition by pattern recognition molecules or bitter taste receptors can reduce the ability of the immune response to clear a pathogen from the upper respiratory system.^{3,5-7} Variations in the expression of these pattern recognition molecules or bitter taste receptors could affect the biodiversity of the sinus flora and make subjects more susceptible to CRS. The richness and diversity of the upper respiratory microbiome is reduced in patients with CRS,⁸⁻¹⁰ and this might be a reflection of the underlying inflammation in the sinonasal mucosa or a result of prolonged and repetitive antibiotic overuse. It remains to be seen whether changes in the microbial community are a driver of inflammation observed in patients with CRS or a reflection of the underlying inflammatory status.

CRS can be classified into 2 main cohorts: chronic rhinosinusitis with nasal polyps (CRSwNP) and chronic rhinosinusitis without nasal polyps (CRSsNP).¹¹ CRSsNP is characterized mostly by fibrosis and neutrophilic inflammation, as well as by T_H1 or T_H17 responses.¹² CRSwNP (Fig 1) is associated with moderate or severe T_H2 eosinophilic inflammation and comorbid asthma. However, several studies in recent years have suggested that the molecular diversity in CRS pathogenesis is more complex and that this classification might not be sufficient.¹³⁻¹⁵ Several different endotypes were identified in a recent study based on molecular inflammatory profiles in patients with CRS rather than phenotypic profiles.¹⁵ Biologics for the treatment of asthma that target IgE or IL-5 or IL-4/IL-13 receptors are being assessed

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Disclosure of potential conflict of interest: E. Toskala has received a grant from Medtronic. D. W. Kennedy has received consultant fees from Sinuwave, Sinopsys, Lannett, and Medtronic, royalties from Medtronic-Xomed, and reported partnerships with Entent Care and AcceptEnt. M. Kohanski declares no relevant conflicts of interest.

Received for publication January 25, 2018; revised March 20, 2018; accepted for publication March 26, 2018.

Available online March 29, 2018.

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0091-6749/\$36.00

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<https://doi.org/10.1016/j.jaci.2018.03.003>

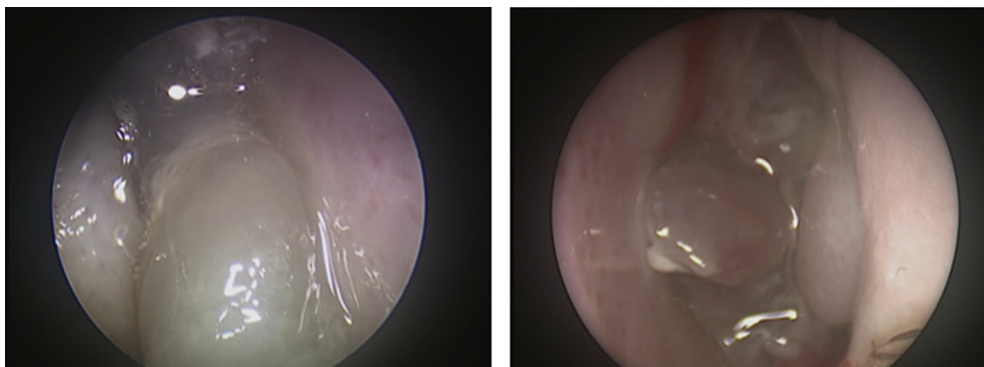


FIG 1. Inflammatory sinonasal polyps filling the nasal cavity in a patient with CRSwNP.

for efficacy in the treatment of CRSwNP,¹⁶⁻¹⁸ and more refined CRS endotyping in the future will hopefully allow for optimal selection of an appropriate biologic agent for the treatment of CRS.

Both phenotypic characterization of CRS and endotype profiling indicate that there is a relationship between CRS and lower airway disease. The advantage of upper airway control of inflammation on lower airway disease has been well documented.^{19,20} Recent studies have also suggested that earlier surgery in appropriately selected patients decreases the risk and lessens the severity of asthma.^{21,22} However, it is important to recognize that essentially all patients undergoing surgery for CRS have persistent inflammation, which is frequently asymptomatic, after surgical intervention (Fig 2). These postoperative patients require ongoing medical management in the form of oral steroids, topical steroid sinus washes, and a prolonged oral antibiotic treatment for exposed bone to reduce the inflammatory burden in the sinuses. Endoscopic surveillance should continue until the mucosa has clearly stabilized and again returned to normal after upper respiratory tract infections or environmental exposures. It is in this medical management that a close working relationship between a surgeon and an allergist is invaluable, and such care highlights the importance of allergists as skilled nasal endoscopists able to recognize minor asymptomatic mucosal changes and appropriately adjust medical therapy.

The breadth of medical therapeutic options continues to expand. Efforts to better classify CRS are underway²³⁻²⁵ and will be important moving forward toward more targeted efforts to treat patients and to assist in decision making for surgical intervention.

INDICATIONS FOR SURGICAL INTERVENTION

Surgery is usually reserved for patients in whom medical therapy fails. CRS is a clinical syndrome classically defined by the presence of rhinologic symptoms together with evidence of sinus inflammation on nasal endoscopy, computed tomographic (CT) imaging, or both. Although the overarching phenotypic diagnostic criteria are defined, the specific diagnostic criteria and approach to treatment continue to evolve along with our understanding of CRS.

According to the American Academy of Otolaryngology–Head and Neck Surgery guidelines from 2015²⁶ and the European Position Paper on Rhinosinusitis and Nasal Polyps (EPOS 2012),¹¹ CRS is defined as the presence of 2 or more of the following: mucopurulent anterior or posterior nasal discharge, nasal congestion, sinus pressure, and diminished sense of smell



FIG 2. Postoperative inflammation in the ethmoid in an asymptomatic patient.

present for 12 or more consecutive weeks plus endoscopic evidence of mucopurulence or inflammation in the middle meatus or polyps for CRSwNP or evidence of inflammation on CT scanning. The International Consensus on Allergy and Rhinosinusitis put forth by a multinational panel of rhinologists defines CRS by the same set of clinical symptoms along with evidence of mucopurulence from the paranasal sinuses or osteomeatal complex and evidence of inflammation on CT scans.²⁷ However, these definitions of CRS are flawed and serve more as an indication for potential consideration of surgical intervention than as a true indicator of disease state. We now recognize that even significant CRS can be asymptomatic and require medical management both in terms of avoiding disease progression and in terms of minimizing the risk of lower airway disease.^{19,28}

Patients who meet the objective criteria for CRS should be offered a course of appropriate medical therapy before surgery is considered, unless there is a concern about the possibility of a tumor or another disease entity (Fig 3). Medical therapy for CRS is widely variable²⁹ but can include sinus irrigation and topical intranasal corticosteroids with or without oral antibiotics, steroids, or both. Based on current guidelines,^{11,26,27} use of nasal irrigation

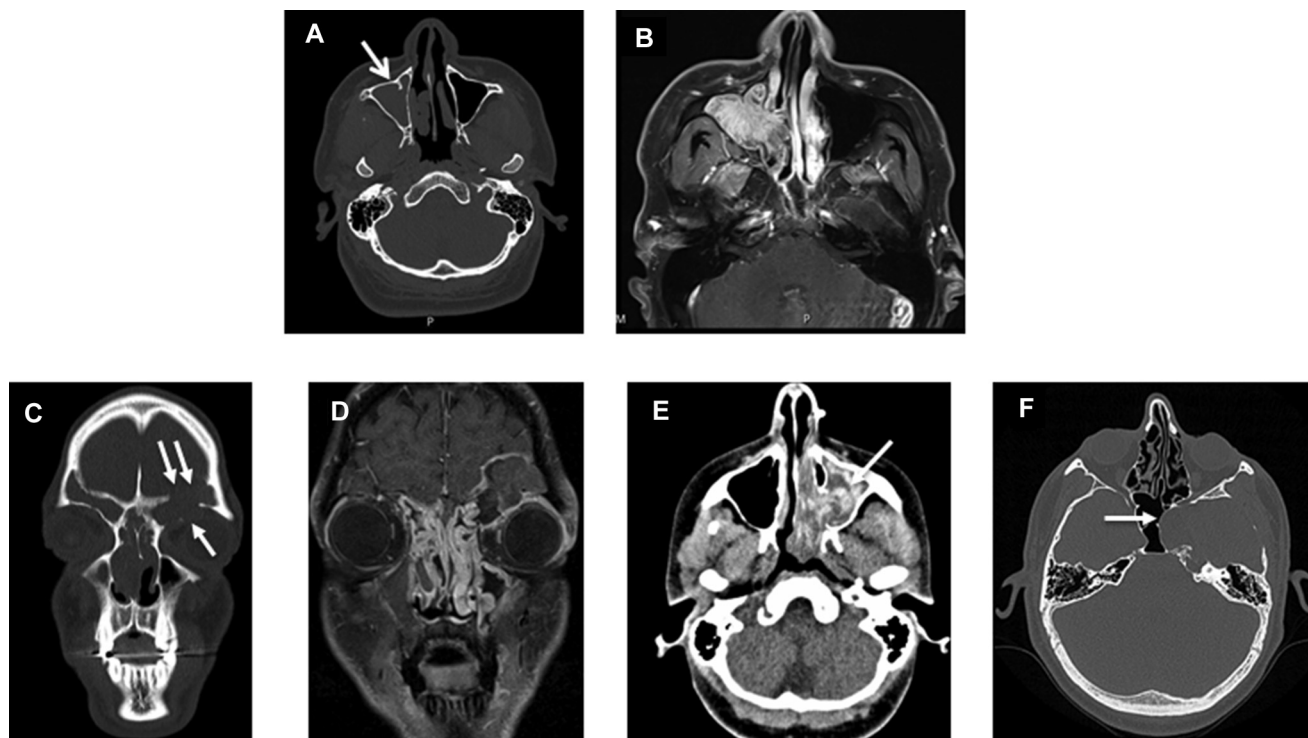


FIG 3. Characteristic imaging findings suggestive of sinus-related conditions requiring surgical intervention. **A** and **B**, Imaging findings associated with inverted papilloma. Fig 3, **A**, Axial noncontrast CT scan of the sinuses demonstrating opacification of the right maxillary sinus, with an area of bony thickening (*arrow*) representing the attachment point of the inverted papilloma. Fig 3, **B**, Axial T1-weighted postcontrast magnetic resonance imaging of the sinuses demonstrating a hyperintense/hypointense striped pattern of an inverted papilloma oriented toward the attachment site of the inverted papilloma. **C** and **D**, Noncontrast coronal CT scan of the sinuses demonstrating a left frontal sinus mucocoele with erosion of the orbital roof (*single arrow*) and skull base (*double arrow*; Fig 3, **C**) and associated coronal T1 postcontrast magnetic resonance image demonstrating a noncontrast enhancing region in the left frontal sinus consistent with mucocoele (Fig 3, **D**). **E**, Allergic fungal sinusitis. Noncontrast CT scan of the sinuses demonstrating heterogeneous hyperdense material (*arrow*) within the left maxillary sinus that is characteristic of allergic fungal sinusitis. **F**, Patient with a history of meningitis who presents with a left sphenoid pseudomeningocele (*arrow*).

and topical intranasal corticosteroids is recommended for CRSsNP and CRSwNP. The level of evidence for the off-label use of high-dose, high-volume steroid nasal irrigations (0.6 to 2 mg of mometasone or 0.5 mg of budesonide in 240 mL of normal saline irrigation) is reported as level Ib in patients with CRS,^{27,30} but it is the authors' opinion that this topical therapy has also significantly reduced the need for surgical intervention.

The use of oral antibiotics as a first-line treatment for CRS is more variable. The International Consensus on Allergy and Rhinosinusitis position paper²⁷ discusses the paucity of high-quality trials for antibiotics in the treatment of CRS and makes a limited recommendation for the use of macrolides in the treatment of CRS. Per American Academy of Otolaryngology–Head and Neck Surgery guidelines,²⁶ first-line treatment for acute rhinosinusitis should be with amoxicillin or amoxicillin plus clavulanic acid; however, there are no explicit recommendations for antibiotic treatment specifically for CRS. The EPOS guidelines¹¹ recommend steroids as first-line treatment for CRSsNP and CRSwNP with level Ia evidence and that long-term antibiotic therapy should be considered in those cases in which steroids and saline rinses have not adequately controlled symptoms.

The indications to offer surgery for failure of medical therapy are evolving. The primary goals of surgery are to reduce inflamed/

diseased tissue, open natural drainage pathways, and allow for better application of topical therapeutics and rinses (Fig 4). Failure of appropriate medical therapy constitutes a lack of objective improvement on endoscopy and opacification seen on CT scans, as well as a failure to improve symptoms as measured with quality-of-life metrics, such as the Sino-Nasal Outcome Test (SNOT) 22.^{31,32} Minimal clinically important differences in symptom scores can be used in a standardized fashion to help guide treatment decisions.³³ Objective findings on endoscopy can correlate with SNOT-22 scores,^{34,35} and both clinical findings and quality-of-life metrics should be used to inform decisions on observation, continued medical therapy, or surgical intervention. For example, in one study treatment failure (≥ 8 weeks of topical intranasal corticosteroids plus culture-directed antibiotics [CRS] or oral steroids [CRSwNP]) has been defined as a SNOT-22 score of 20 or greater and posttreatment CT with a Lund-Mackay score of greater than 1.³⁶ Surgical decision making should also take into account the effect of sinonasal disease on the lower airways and the improved control of lower airway disease demonstrated in some recent studies with earlier surgical intervention.^{21,22}

For those with aspirin-exacerbated respiratory disease, higher SNOT-22 scores correlate with increased severity of reactions during aspirin desensitization.³⁷ Complete sinus surgery before

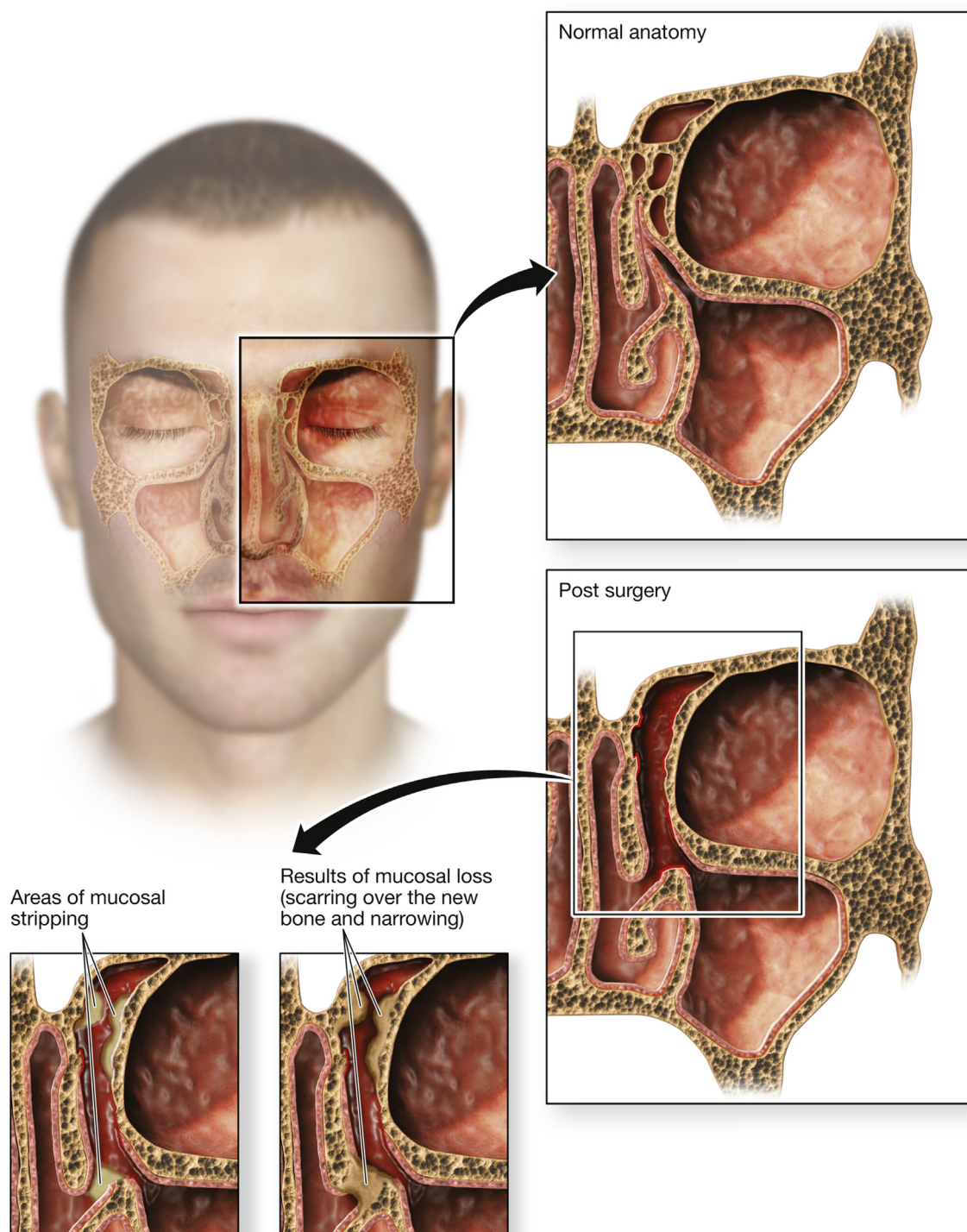


FIG 4. Extent of endoscopic sinus surgery demonstrating a patent maxillary antrostomy and complete removal of bony ethmoid partitions. Sequela of mucosal stripping with resultant scar tissue formation and narrowing of sinus drainage pathways also shown. Figure created by Craig Durant of DragonFly Media LLC.

aspirin desensitization can effectively reduce sinus symptoms and need for revision surgery.³⁸ Furthermore, long-term inflammation and osteitis (Fig 5) in patients with CRS^{39,40} can have a significant effect on the ability of the sinuses to return to a quiescent functional baseline status. Additional trials together with a better

understanding of the molecular mechanisms of CRS will advance our diagnostic criteria on when to intervene surgically for CRS.^{32,41,42}

Because surgery opens up naive mucosa to airflow, environmental factors, including occupational, pollutant, and allergen



FIG 5. Osteitis in patients with CRS. Axial noncontrast CT scan of the sinuses demonstrating opacification of the ethmoids bilaterally with marked thickening (osteitis) of the bony ethmoid partitions.



FIG 6. Continued inflammation secondary to residual bony partitions. Coronal noncontrast CT scan of the sinuses demonstrating persistent opacification of the left ethmoid likely caused by residual bony partitions.

exposures, are best minimized or managed before elective surgical intervention when this is possible. Although there is evidence of an association between smoking and CRS, evidence regarding the effect of smoking on failure of surgical intervention remains controversial,^{43,44} but in our experience continued smoking significantly adversely affects the surgical outcome to the extent that the senior author will no longer perform elective surgery for CRS in patients who have not yet quit smoking. Continued smoking appears to result in significant granulation tissue on exposed bone, resultant stenosis, and persistent disease.

SURGICAL PITFALLS

Extent of surgery

There is still significant debate about the appropriate extent of surgical intervention in patients with CRS,⁴⁵ but the importance of mucoperiosteal preservation is generally accepted and has become more easily achievable as surgical instrumentation has advanced.^{46,47} The advent of balloon dilatation of sinus ostia has further raised the question as to whether just opening the sinuses and recreating a mucus drainage pathway is sufficient therapy in patients with CRS.⁴⁸ However, this approach does little in terms of resolving the inflammation or allowing access for topical therapies, and the latter has increasingly become a goal of surgery. Balloon dilatation is not US Food and Drug Administration approved for the treatment of polypoid disease, and studies have demonstrated early involvement of the underlying bone in patients with CRS, something that might be a factor in terms of why the inflammation can be difficult to manage with medical therapy alone.^{49,50} Accordingly, it is our recommendation that the bony partitions be completely removed within the area of disease, while, at the same time, the mucoperiosteum is preserved on the skull base and the medial orbital wall. If retained, bony

partitions typically become increasingly osteitic and thickened,^{51,52} making them more difficult to remove as part of a subsequent surgical procedure, as well as allowing for persistent entrapment of mucus. In our opinion the hallmarks of a good surgical approach are ones in which there is essentially no exposed bone at the end of the surgical procedure but that also meticulously removes the bony partitions within the area of inflammation (Fig 4). However, whatever the extent of surgery, ongoing postoperative endoscopic follow-up and medical management based on endoscopic control are essential.³⁶

Today, endoscopic sinus surgery is performed on an outpatient basis and generally after achievement of total intravenous anesthesia, which can improve endoscopic visualization during surgery.⁵³ This can be related to a reduction in blood loss during surgery, although data on this topic are limited and varied.^{44,53} At the completion of surgery, biodegradable steroid-eluting stents can now be placed in the sinus, especially in patients with polypoid eosinophilic disease. Surgery does not require postoperative nasal packing, and discomfort is usually minimal. However, bloody nasal discharge is common for several days after surgery, and a few days off work is normally recommended. Patients frequently report some level of fatigue, possibly related to anesthesia, for 1 to 2 weeks after surgery. Additionally, it is critically important that patients return for regular (typically weekly) endoscopic follow-up and sometimes debridement in the early postoperative period. It is the endoscopic appearance that determines any alteration or weaning of the postoperative medical therapy.

Revision surgery

When an initial surgical procedure is performed and there is ongoing medical management of persistent and possibly asymptomatic postoperative inflammation, the incidence of revision surgical procedures is low. A study performed in the early 1990s

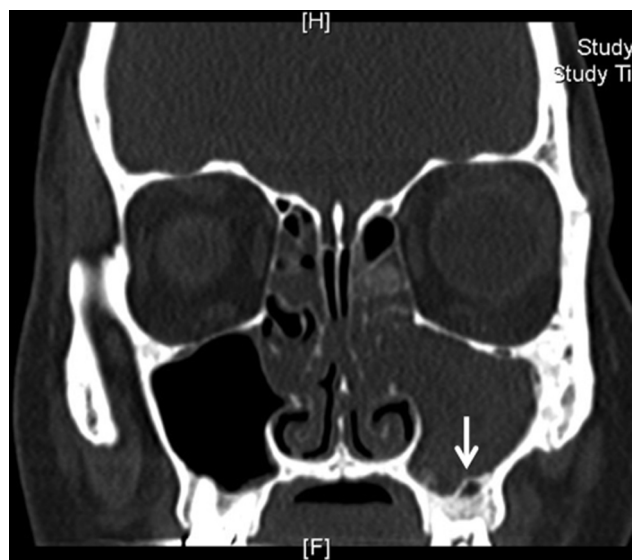


FIG 7. Odontogenic source of CRS. Coronal noncontrast CT scan demonstrating opacification of the left maxillary sinus and bilateral ethmoid sinuses. Note the dental infection–periapical lucency in the left maxillary molar (white arrow) as the source of the CRS.

demonstrated a nearly 18% revision surgical rate over a nearly 8-year postoperative follow-up.⁵⁴ However, our surgical techniques and our postoperative medical management have significantly improved since that point in time. Accordingly, although we have not performed another long-term follow-up study, we believe that the need for revision surgery has decreased significantly during the past 25 years, although the incidence remains dependent on the underlying pathology, the extent of disease at the initial surgical procedure, and especially individual patient adherence with ongoing medical management, even when no longer symptomatic. It is important for the rhinologist, allergist, and patient to all have a strong working relationship to ensure this adherence to a long-term treatment regimen.

It is critical to recognize that decisions regarding revision surgical procedures are individualized and multifactorial. Consideration needs to be given to environmental factors, general host factors, and local host factors that can be involved in the underlying inflammatory process. In general, if disease persists despite appropriate medical therapy for the underlying pathology present, revision surgery needs to be considered. Appropriate medical therapy continues to evolve, and it will be interesting to see how biologics used for asthma treatment will be incorporated in a more widespread manner into our treatment paradigms for the management of CRS.

Nasal endoscopy provides important information about prior surgery and the potential need for surgical intervention. It provides anatomic details with regard to the sinus cavity, such as whether obstructive scarring is present, whether there is residual uncinate process, whether the natural ostium of the maxillary sinus has been opened appropriately, as well as information regarding persistent inflammation.

When persistent maxillary sinus disease is present, particular attention should be paid to endoscopic visualization of the natural ostium of the maxillary sinus. A poorly performed maxillary antrostomy, such as one that opens the accessory ostium rather than the primary ostium or a procedure that does not open the

ostium all the way anteriorly is one of the more frequent causes of persistent disease.⁵⁵ Indeed, one of the criticisms of balloon dilatation of the maxillary sinus ostium is that in several studies this approach has been demonstrated to more frequently create an iatrogenic accessory ostium rather than dilating the primary maxillary ostium through which mucociliary clearance is directed.⁵⁶

CT scanning provides additional information regarding the extent of persistent inflammation and the number of residual bony partitions present (Fig 6). In general, the threshold for revision surgery decreases when significant residual bony partitions are present because this increases the likelihood of entrapped mucus, areas not accessible to topical irrigation, and persistent bony osteitis. CT scanning should not be used to screen serially for persistent inflammation; rather, it should be used as an adjunct to nasal endoscopy in situations in which there is concern for an obstructed region that correlates with the patient's symptoms as part of the decision algorithm for revision surgery.

In patients with persistent frontal sinus disease after prior frontal sinusotomy, an extended midline frontal sinusotomy or Draf III procedure has been demonstrated to improve access for topical steroid irrigations^{57,58} and to improve the chances of disease resolution.⁵⁹ This procedure involves removing a localized area of the nasal septum below the frontal sinus and then creating one large frontal sinus drainage pathway for both frontal sinuses extending from medial orbital wall to medial orbital wall. The procedure typically involves the use of a 65° bur to open up the frontal sinus and the placement of flaps or grafts to cover exposed bone. Long-term patency has proved to be excellent, but it is a technically more difficult procedure and introduces some additional variability in wound healing and increased need for endoscopic follow-up.⁵⁹ Although occasionally advocated as a primary procedure in patients with severe polyposis, such as patients with aspirin-exacerbated respiratory disease, this surgery is almost universally reserved for persistent chronic sinusitis at this point in time. Bioabsorbable drug-eluting stents also show promise in terms of maintaining frontal sinus patency and reducing inflammation postoperatively⁶⁰⁻⁶² and might reduce the need for Draf III procedures in those with nasal polyps.

Complications

The most common surgical complication is disease recurrence. It is critical to recognize that surgery alone rarely cures CRS and that patients require long-term medical therapy for the persistent asymptomatic inflammation that is typical after surgery. Endoscopic surgical intervention exposes mucosa that, in normal anatomy, is well protected from airflow, pollutants, and allergens, and therefore it is important that environmental control and allergy desensitization are performed when indicated before surgery. On the other hand, surgical intervention makes the sinuses much more accessible for topical therapies, including high-dose, high-volume nasal steroid irrigations. Topical steroid sinus irrigation significantly improves postoperative endoscopy scores and is generally considered safe for long-term use with a minimal risk profile (<3% of patients experience endogenous cortisol suppression when not receiving additional inhaled steroids) relative to long-term oral steroids.⁶³⁻⁶⁵

In all patients presenting with CRS, attention should be paid to prior dental history, as well as any notable oral cavity findings on examinations. More importantly, review of CT images should

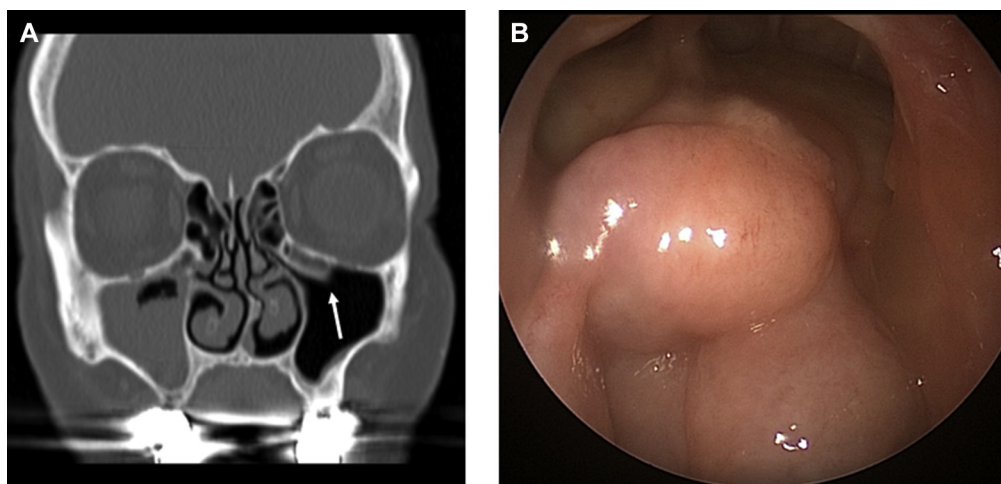


FIG 8. A, Coronal noncontrast CT scan of the sinuses demonstrating an infraorbital ethmoid cell (white arrow). B, Common frontal sinus cavity created after a Draf III procedure.

always include a careful overview of the maxillary dentition and any communication with the maxillary sinus or the presence of periapical lucency (Fig 7). Patients with odontogenic CRS often do not have dental pain or sensitivity, and a panorex might not adequately identify an infected tooth.⁶⁶ Failure to address an odontogenic source of infection either before or shortly after functional endoscopic sinus surgery (FESS) will lead to continued infection in the adjacent sinus and increases the risk of failure of the surgical procedure.

The most common minor post-FESS complication is perioperative epistaxis.⁶⁷ Risk factors for postoperative complications include the presence of nasal polyps and asthma,⁶⁸ patient age, and revision surgery.⁶⁷ Major complications include severe bleeding requiring intervention by means of angiography or in the operating room, injury to the orbit, cerebrospinal fluid leak, and injury to the brain. The rate of major complications is decreasing as training and image guidance equipment improve, and in one study the rate was estimated at 0.36%, although in our experience it appears to be significantly lower.⁶⁹

Anatomic considerations

When evaluating patients for revision surgery, care should be used to account for anatomic variations that can lead to both surgical failure and persistent inflammation. Residual sinus partitions in a diseased sinus can serve as a reservoir of persistent infection and inflammation. Removal of infraorbital (Haller) cells (Fig 8, A), when present, can ensure adequate opening of the maxillary sinus. Meticulous dissection in the frontal recess and recognition of supraorbital ethmoid and frontoethmoidal cells are key to ensuring appropriate opening and drainage from an obstructed or diseased frontal sinus. The creation of a common frontal sinus outflow tract through a Draf III procedure (Fig 8, B) should be considered in patients who have already undergone sphenoidectomies, maxillary antrostomies, and frontal sinusotomies (Draf II procedure) and have recurrent nasal polyposis in the frontal sinus.⁷⁰ A septoplasty can be indicated to obtain adequate access to the ethmoidal and frontal sinuses and might be associated with a lower rate of revision sinus surgery over a 5-year time period.⁷¹

POSTOPERATIVE CARE

Postoperative management of patients with CRS is critical to ensuring optimal outcomes in the management of CRS. Postoperative care should consist of serial endoscopies, debridements (as required), and sinus irrigations to remove clots and debris and prevent buildup of mucus that can become infected, limit healing, and promote scar tissue formation, as well as long-term endoscopic surveillance.

The use of postoperative oral antibiotics and oral steroids should be strongly considered in the postoperative setting. Antibiotics should provide adequate coverage against *Staphylococcus aureus*, which has been associated with CRSwNP. The use of oral steroids in the early postoperative period is helpful in patients with type 2 inflammatory conditions, such as CRSwNP. The duration of postoperative antibiotic and oral steroid treatment should be determined on a case-by-case basis based on objective endoscopic evaluation of postoperative edema, polypoid formation, scarring, crust, and mucus buildup. Exposed bone as a result of mucosal stripping can be a nidus of persistent inflammation and crusting and should be treated aggressively with a combination of in-office debridement and oral and topical medications. Clindamycin has good bone penetration and can reduce bacterial load and subsequent inflammation of exposed bone. Our patients are routinely started on an oral probiotic (*Saccharomyces boulardii* [Florastor; Biocodex, Redwood City, Calif]) to reduce the risk of antibiotic-associated diarrhea or *Clostridium difficile* infection.⁷²

Topical therapies in sinus washes, including steroids (eg, budesonide or mometasone), antibiotics (eg, mupirocin or ceftazidime), and/or baby shampoo,⁷³ can help supplement or possibly replace some oral therapies to help directly reduce infectious/inflammatory burden on healing sinus tissue. Steroid-eluting sinus stents may also help reduce or replace oral therapies as a means to reduce inflammation in healing sinus tissue. Failure to adequately debride, monitor, and treat post-FESS patients with CRS increases the likelihood of poor healing, contracture of the sinus ostia, and risk of requiring rescue antibiotics/steroids or revision surgery.

Better characterization of CRS endotypes^{13,24} will allow for discovery of new therapies to treat CRS and refine indications for medical or surgical intervention, as well as postoperative management. Network biology and bioinformatics tools can harness available clinical data, pathology, and biomarker data to classify patients into cohorts.^{15,23,25} Biologics that target IL-5 or IL-4/IL-13 for the T_H2-biased endotypes and phenotypes of CRS⁷⁴ can provide novel means of managing upper airway inflammation in both the presurgical and postsurgical setting.

CONCLUSION

CRS is a broad syndrome requiring individualized decisions regarding the role and timing of surgical intervention. In general, surgical intervention is reserved for symptomatic disease not responding to medical therapy, but the beneficial effect of control of the upper airway on lower airway inflammation is also a consideration. Surgical instrumentation and techniques continue to evolve and become less traumatic, but surgery, at least in the short term, does not totally resolve the inflammation in patients with CRS, and asymptomatic or minimally symptomatic disease is common. Management of this requires ongoing endoscopic surveillance, medical therapy, and close interaction between the surgeon, allergist, and patient to ensure appropriate ongoing medical therapy and patient adherence to the regimen.

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