Advances in the Surgical Management of Chronic Rhinosinusitis

Erin D. Wright, MDCM, MEd, FRCSC; Saul Frenkiel, MDCM, FRCSC

Abstract

The surgical management of chronic rhinosinusitis has evolved considerably in the last decade. We currently have a more refined understanding of the various disease entities that make up the generic diagnosis of chronic rhinosinusitis. This has led to the development of more sophisticated medical and surgical therapy for the different entities. Failure of maximal medical therapy leads to the consideration of surgical intervention with the general intent of improving the patient's quality of life. Recent technical innovations such as mucosa-preserving instrumentation and image guidance systems for intraoperative localization have given surgeons increased confidence and enabled more complete and effective surgical management of chronic rhinosinusitis, particularly in revision surgeries or in the presence of distorted landmarks. Improved packing materials and refinement of postoperative care are active areas of investigation and innovation that, it is hoped, will also translate into improved patient care.

Assumption and Statement of Scope

This article is intended to provide an overview of the surgical management of chronic rhinosinusitis (CRS). We assumed a general understanding, on the part of the reader, of sinonasal anatomy and physiology which are well covered elsewhere and beyond the scope of this review.[1,2]

E. D. Wright — Department of Otolaryngology, University of Western Ontario, London, Ontario; S. Frenkiel — Department of Otolaryngology, McGill University, Montreal, Quebec

Correspondence to: Dr. Erin D. Wright, London Rhinosinology Centre, St. Joseph's Health Care, 900 Richmond Street, 3rd Floor, London, ON N6A 5B3

Diagnostic Considerations

Prior to beginning a discussion of surgical management of CRS, it is worthwhile to mention the diagnostic methodology and a classification of CRS. CRS is primarily a clinical diagnosis based on history and physical examination. The physical examination of the sinusitis patient must include nasal endoscopy, which can often detect subtle disease that is not visible on anterior rhinoscopy. Adjunctive measures in the diagnosis of CRS may include endoscopically directed culture of the middle meatus and radiographic imaging with computed tomography (CT). CT is a very sensitive method for detection of even subtle mucosal thickening in areas of the paranasal sinuses not visible on nasal endoscopy. This imaging modality also provides detailed images of the intricate anatomy of the paranasal sinuses, such as the ethmoid sinuses and the ostiomeatal complex (Figure 1). There is also a more limited role for magnetic resonance imaging when issues of diagnosis concern a distinction between soft tissue planes and lesions (Figure 2).

Recent years have led to an evolution in our understanding of the disease entities that make up the all-encompassing term of CRS. Because the treatment and prognosis of the varying disease entities may be quite different, it is worthwhile to consider a classification scheme for CRS (Table 1). For example, in the setting of recurrent acute sinusitis, diagnostic considerations relating to surgical intervention would include the presence of anatomic abnormalities that could predispose the

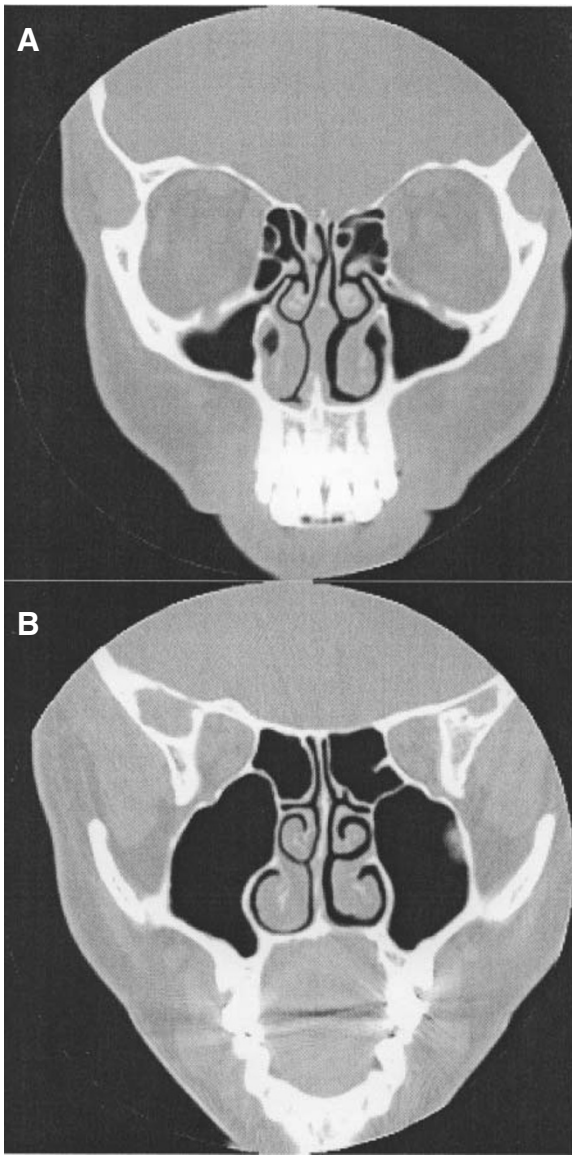

Figure 1 Computed tomographic scan of normal paranasal sinuses. *A* demonstrates the anterior ethmoid and ostiomeatal complex. *B* demonstrates the posterior ethmoid. Note is made of the absence of mucosal thickening or retained fluid.

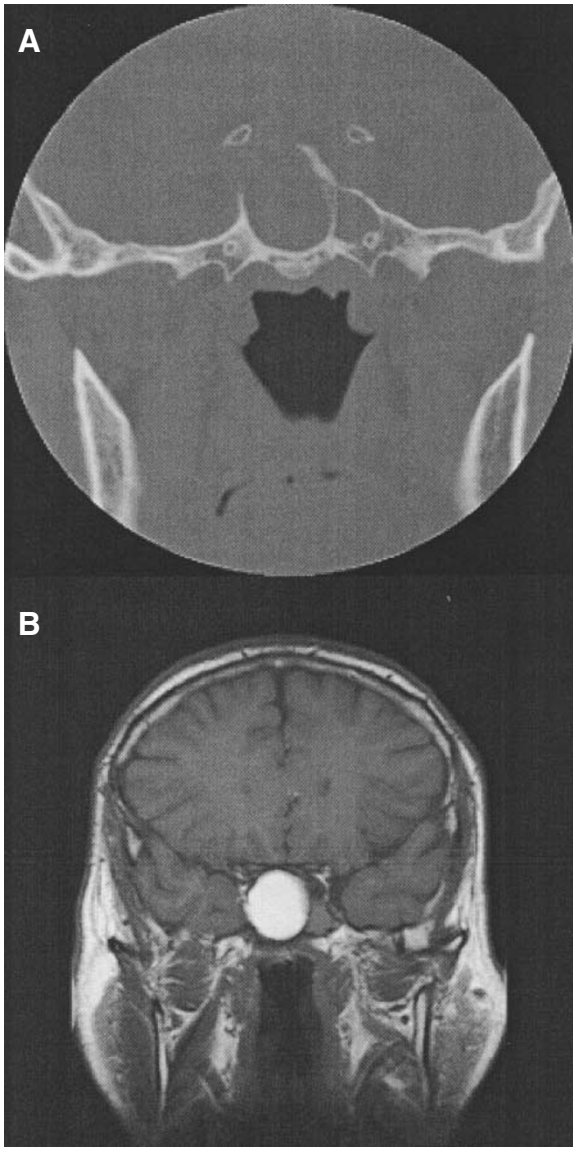

Figure 2 *A,* Computed tomographic scan of a patient who presented with a presumed mucocele of the sphenoid sinus with extension to the ethmoid and orbit. There was concern that the mucocele had eroded intracranially in the sphenoid. *B,* Magnetic resonance image cut that corresponds to the CT cut shown in *A* that fails to demonstrate intracranial extension or dural enhancement. This clarified the diagnosis and helped in the surgical planning.

patient to impaired drainage of the ostiomeatal complex. Such abnormalities might include an atelectatic uncinate process or concha bullosa (Figure 3), and the presence of such abnormalities would make a patient a surgical candidate likely to obtain relief from his or her symptoms.

From a clinical and a radiologic perspective, there seem to be distinctions that can be made between patients with diffuse mucosal thickening involving the paranasal sinuses (chronic hyperplastic rhinosinusitis) but without polyposis and those patients with diffuse sinonasal polyposis with polyps projecting into or completely occluding the nasal airway (CRS with polyposis). However, the prognostic implications of such distinctions remain to be demonstrated on the basis of scientific evidence.

Within the generic disease of CRS, there has been a further distinction created to include those patients with allergic fungal sinusitis, a

Table 1 Classification of Chronic Rhinosinusitis

Recurrent acute rhinosinusitis
Chronic purulent rhinosinusitis
Chronic hyperplastic rhinosinusitis
Chronic rhinosinusitis with polyposis
Samter's triad[3]
Allergic fungal rhinosinusitis[4]
Eosinophilic mucin rhinosinusitis[5]

disease entity with some similarities to allergic bronchopulmonary aspergillosis. Although there is currently considerable controversy regarding the incidence and pathogenesis of fungal sinusitis,[3–5] most sinus surgeons would agree that, in at least some patients with CRS and polyposis, reactivity to commensal fungal organisms or some similar disease process is occurring. The typical findings with allergic fungal sinusitis include polypoid mucosa and tenacious allergic mucin with abundant eosinophils and eosinophil breakdown products.

Patient Selection

A logical consequence of the emerging subclassification of CRS is that the treatment may differ depending on the disease process at work in any given patient. Surgical intervention, in terms of scope and expectations, can vary with the different subtypes of CRS. Nonetheless, a general rule that is followed is that patients become candidates for surgical intervention for treatment of their sinus disease when they have failed maximal medical therapy. Exceptions to this rule obviously include evidence of impending complications (eg, expanding mucocele or mucopyocele) or the suspicion of neoplasm. Depending on the diagnosis, maximal medical therapy may include a prolonged trial of topical, intranasal corticosteroids, a prolonged trial of broad-spectrum antibiotics, systemic corticosteroids, and adjunctive measures such as saline irrigations. The use of the term surgical candidate implies that surgery is not absolutely indicated but that it becomes an option to help manage or definitively treat a patient with CRS.

Taking the example of recurring acute sinusitis with the absence of chronic mucosal changes and a normal appearance between episodes, surgical intervention would be indicated if the acute infections are of sufficient frequency. (Generally considered to be greater than 3 episodes of acute bacterial sinusitis per year requiring antibiotic therapy). The aims of surgery in this instance would be the correction of anatomic factors that can predispose the patient to ostial obstruction (Table 2) and the improvement of sinus outflow tracts. This is typically what is referred to as functional endoscopic sinus surgery,[6,7] which consists of an infundibulotomy, middle meatal antrostomy, and anterior ethmoidectomy with possible posterior ethmoidectomy, sphenoidotomy, or frontal sinusotomy, as

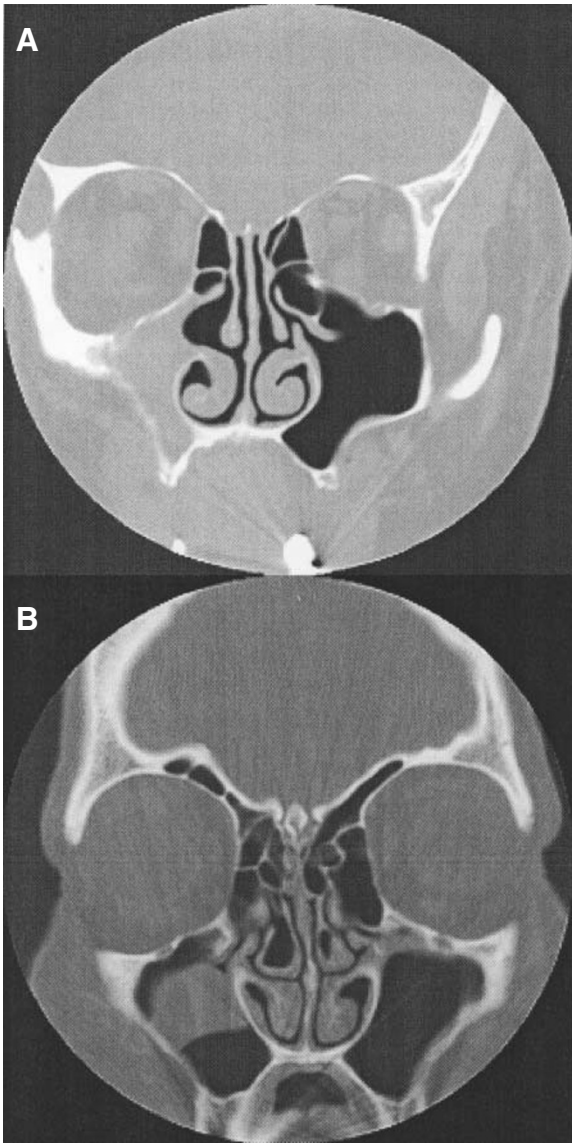

Figure 3 *A,* Example of an atelectatic uncinate process with obstruction of maxillary sinus outflow and resultant sinus opacification. *B,* Example of a large concha bullosa (patient's right side) in a patient with a history of recurrent acute flare-ups of mild chronic rhinosinusitis.

Table 2 Variants of Normal Anatomy that Can Predispose Patient to Chronic Rhinosinusitis

Concha bullosa (pneumatized middle turbinate)
Paradoxically curved middle turbinate
Atelectatic uncinate process
Infraorbital ethmoid pneumatization (Haller's cell)
Agger nasi air cell

deemed appropriate by the surgeon. These latter two sinuses are frequently left alone in the clinical setting of recurrent acute sinusitis.

A different example might include that of the treatment of CRS with polyposis. In this setting, a candidate for surgical intervention would likely have failed trials with topical intranasal corticosteroids and systemic corticosteroids. Some patients have contraindications to systemic corticosteroids or are reluctant to take the medication because of potential side effects. In the setting of the patient with polyposis, the aim of surgery is first to provide immediate relief of symptoms such as nasal obstruction and facial pressure or congestion and to help in the long-term management of the inflammatory sinus disease. Patients are frankly apprised of the high likelihood that further medical therapy will still be required to manage their disease but that marsupialization of the ethmoid sinus cavity with surgical widening of the ostia of the secondary sinuses (frontal, maxillary, sphenoid) provides access to topical medications and access in the clinic to help identify and control recurrent inflammatory disease. Further, in some instances, surgical cleaning of polyps and obstructing mucosal hypertrophy can result in long-term control or "cure" of the sinus disease from both objective (endoscopic) and subjective perspectives. Thus, it can be seen that the aim and extent of surgical intervention can vary significantly depending on the presentation, diagnosis, and impact on the quality of life of the patient.

Indications and goals for revision endoscopic sinus surgery are not dissimilar to those for primary surgical intervention. Again, failure of medical therapy is generally a prerequisite. From a technical perspective, there are sometimes indications for revision surgery, such as retained bony partitions in the ethmoid, scar formation with resultant obstruction of sinus ostia, and scarring closed of the sinus ostia owing to bony or soft tissue contraction. Obviously, another indication for revision surgery is recurrent polyp disease that cannot be managed medically or in the office.

Technical State of the Art

The current state of the art in endoscopic sinus surgery includes many recent innovations. Probably the most fundamental change in sinus surgery has been the adaptation of rigid endoscopes for use in the nose. These 4 mm endoscopes permit superb visualization and are available in various angles ranging from 0 to 30, 45, and 70 degrees. They also afford surgeons the opportunity to handle instruments with their free hand while maintaining the view of the operative field. This paradigm shift, in the form of endoscopic sinus surgery, began in North America in the mid- to late 1980s[6] and has become the widespread standard of care.

From a technical perspective, there has been the realization that meticulous handling of sinonasal mucosa results in a better and more rapid return to the function of mucociliary clearance. To help achieve this goal, new instrumentation has been developed that helps avoid the mucosal stripping that can result in impaired mucociliary clearance or neo-osteogenesis or osteitis with bony thickening owing to exposed periosteum. Examples of such instrumentation include sharp through-cutting forceps (Figure 4) and microdébriders (Figure 5). The through-cutting forceps permit the precise removal of diseased mucosa and bony partitions without stripping of adjacent mucosa that is healthy or has the potential to return to normal function. Microdébriders are a relatively new addition to the surgical armamentarium. They are devices that employ suction in concert with an oscillating blade that allows the efficient removal of diseased tissue in a relatively bloodless field with preservation of adjacent healthy or recoverable tissue. They are particularly helpful when removing bulky polypoid disease but have also been improved to help with removal of ethmoid partitions and other thin areas of bone. Various blades can be used in the ethmoid sinus, maxillary sinus, and frontal recess, as well as drill tips that can be driven by the same handpiece that drives the regular suction débrider blades.

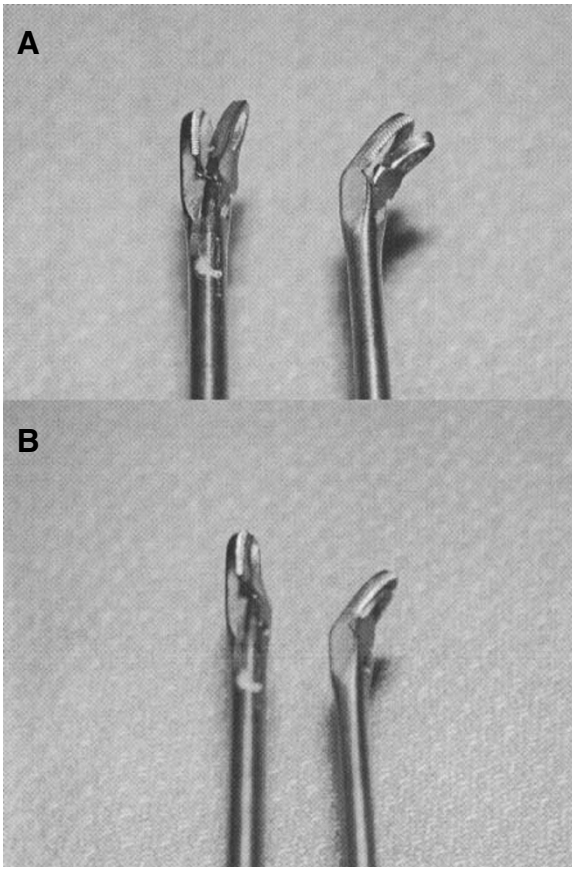

Figure 4 Through-cutting instruments used in endoscopic sinus surgery. These instruments avoid stripping of healthy or salvageable mucosa.

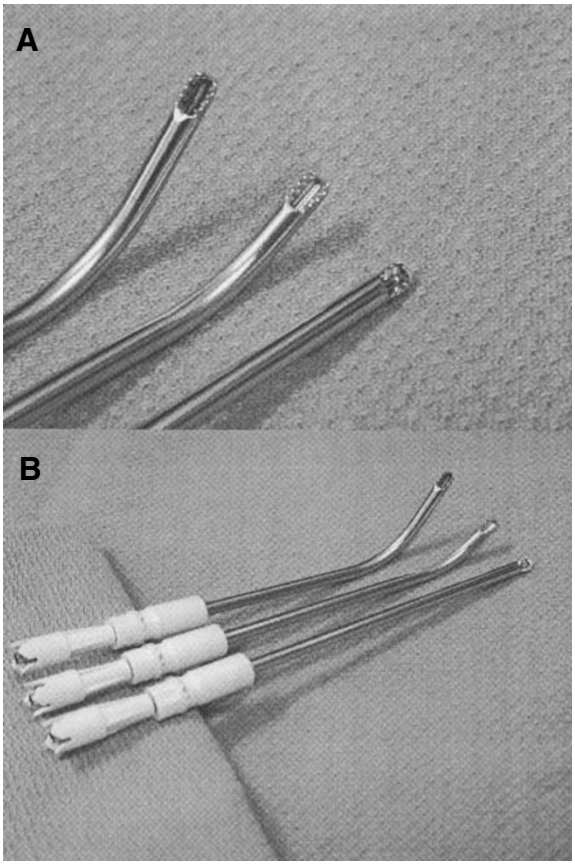

Figure 5 Microdébrider and blades used for precise and efficient removal of polyps, mucosa, and bone in endoscopic sinus surgery.

Perhaps the most significant and exciting innovation in the area of endoscopic sinus surgery is that of image-guided surgery (Figure 6). This technology uses frameless stereotactic navigation to help surgeons precisely localize their instruments in space (and therefore in the patient's sinuses). The basic process involved is that of correlation between patients' actual bony anatomy and their preoperative CT scans, which is performed by sophisticated software.

In brief, a patient undergoes a preoperative CT scan using a predetermined protocol, following which the data are downloaded to the image guidance system, usually over a network connection. At the time of surgery, the CT data stored in the computer are registered, along with known points of the patient's anatomy, after which the computer can then give the surgeon the location of various instruments that have been placed in the patient's nose. There are currently two types of image guidance systems. One such system is based on electromagnetic technology, whereas the other is based on optical reference using infrared emitters and sensors.

The impact of this new technology has been, theoretically, to increase the safety and completeness of surgery in addition to increasing the confidence of the surgeon. This accounts for the increasing numbers of health centres that have purchased or are considering purchasing a system. To date, however, no scientific studies remain to confirm an increase in safety (reduced incidence of complications). A reduction in complications with endoscopic sinus surgery would be extremely difficult to demonstrate because the incidence of serious complications is, fortunately, already very low. Image-guided surgery has not yet, and may never, become the standard of care and is not required for routine or limited surgery. Nonetheless, it is an invaluable tool for the more complex surgical cases, such as those that involve the frontal and sphenoid sinuses, as well as for revision surgeries in which the normal anatomy normally used for visual reference has been distorted.

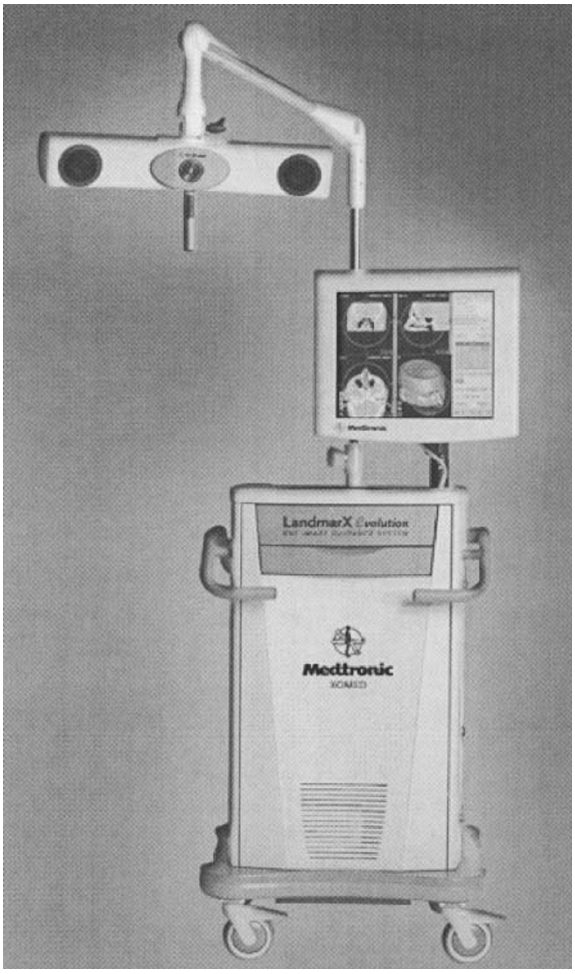

Figure 6 Example of an optical image guidance system for intraoperative use in endoscopic sinus surgery.

Another recent innovation in the surgical management of CRS is that of biocompatible dressings and packing materials. Recent literature describes the use of such materials, which are generally based on acellular connective tissue matrix glycoproteins.[8] The body breaks down the packing or dressing, and any residuum can be easily suctioned from the sinus cavities. It is likely that future innovations will include the manufacture and modification of these dressings to deliver medication to the healing sinus cavities, which may help suppress inflammation or infection, thereby improving surgical outcome and minimizing complications such as scar band formation and sinus ostial obstruction.

Postoperative Care

In recent years, an appreciation has developed for the importance of postoperative care in the sinus surgery patient. Currently, postoperative care is defined to include both endoscopic débridement and monitoring of the sinus cavities in the outpatient clinic, as well as medical pharmacotherapy.

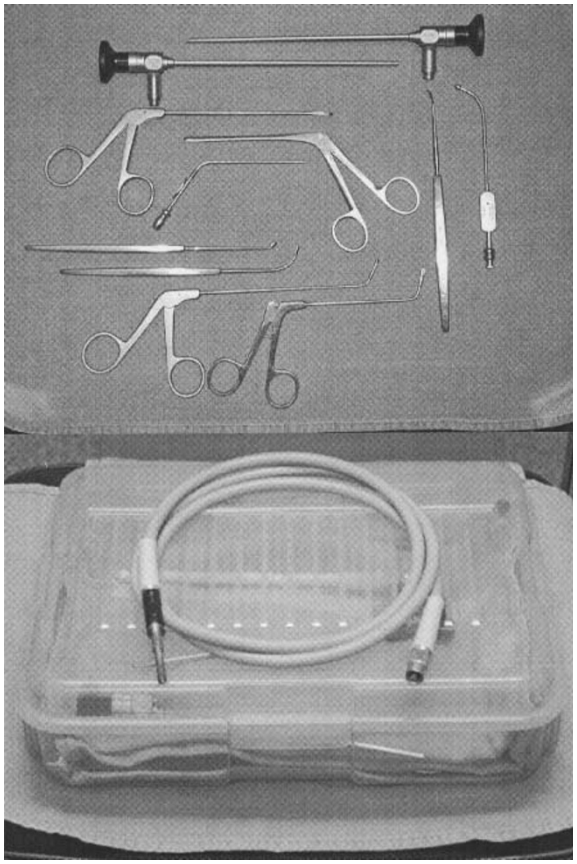

Figure 7 Commonly used equipment in the outpatient clinic for postoperative débridement and ongoing care. Endoscopic visualization permits suction, tissue removal, polypectomy, and directed cultures.

In the initial weeks following endoscopic sinus surgery, there is the need for removal of devitalized tissue and retained secretions from the operated sinuses. This is important because the return to normal mucociliary function does not typically occur until 4 to 6 weeks after surgery. Also, any scarring that is beginning to form that may stenose or occlude access to the sinus cavities is easily divided at this early stage, whereas it is much more difficult to deal with mature synechiae once formed. Endoscopic assessment of the cavities can also determine the effectiveness of healing and the need for further medical therapy in an effort to optimize outcome.[9] Examples of this medical care include the need for antibiotics in the presence of purulence or granulation tissue. Also, the need for saline irrigations and even corticosteroids can be determined.

A strong argument can be made for regular surveillance with sinus endoscopy because early treatment of ongoing inflammation or infection may avoid the need for revision surgery.[9] Ongoing or recurrent inflammation or infection can be detected before it becomes overtly symptomatic, at a time when treatment may be easier and more effective. This objective assessment of outcomes is gradually gaining acceptance in the literature and in the staging systems used for CRS. In longitudinal studies of patients who have undergone functional endoscopic sinus surgery, with a mean follow-up of 7.8 years, a sinus cavity that has normalized to endoscopic assessment at 18 months following surgery has a strong likelihood of remaining normal and of that individual avoiding the need for any revision surgery.[10]

Given the currently available instrumentation, it is possible to perform many small procedures in the outpatient clinic. The use of rigid nasal endoscopes and surgical instruments (Figure 7) permits office débridement of the sinus cavities, directed cultures from the middle meatus or marsupialized sinus cavities, and polypectomies. Patients presenting for follow-up who show evidence of polyps reforming can have these early polyps débrided with topical and/or local anesthesia. Such ongoing cavity "maintenance" can often keep these individuals out of the operating room and avoid the need for more extensive surgery, with its attendant risks. It is even possible to lyse synechiae; revise sinus ostia that have obstructed, such as the maxillary or frontal; and even revise ethmoid cavities that have small bony partitions or fragments that were retained.

Conclusion

Recent innovations in the surgical management of chronic sinusitis include an improved understanding of the disease entities being treated, which has enabled more refined diagnostic criteria for the various subclassifications of CRS. This better understanding permits tailored medical therapy for these disease entities. When maximal medical therapy has failed, patients become candidates for endoscopic sinus surgery, which is also tailored to treat the specific disease of an individual patient. New instrumentation, including mucosa-sparing techniques and image-guided surgery, continues to revolutionize the endoscopic management of CRS. Improved packing and ongoing refinements in postoperative care are active areas of innovation.

References

1. Cummings CW. Otolaryngology—head and neck surgery. 2nd ed. St. Louis: Mosby; 1995.
2. Kennedy D, Bolger W, Zinreich S. Diseases of the sinuses: diagnosis and management. Hamilton (ON): BC Decker; 2001.
3. Samter M, Beers RF Jr. Concerning the nature of intolerance to aspirin. J Allergy 1967;40:281–93.
4. Katzenstein AL, Sale SR, Greenberger PA. Allergic Aspergillus sinusitis: a newly recognized form of sinusitis. J Allergy Clin Immunol 1983;72:89–93.
5. Ferguson BJ. Eosinophilic mucin rhinosinusitis: a distinct clinicopathological entity. Laryngoscope 2000;110(5 Pt 1):799–813.
6. Kennedy DW. Functional endoscopic sinus surgery. Technique. Arch Otolaryngol 1985;111:643–9.
7. Kennedy DW, Zinreich SJ, Rosenbaum AE, Johns ME. Functional endoscopic sinus surgery. Theory and diagnostic evaluation. Arch Otolaryngol 1985;111:576–82.
8. Frenkiel S, Desrosiers MY, Nachtigal D. Use of hylan B gel as a wound dressing after endoscopic sinus surgery. J Otolaryngol 2002;31 Suppl 1:S41–4.
9. Kennedy DW, Wright ED, Goldberg AN. Objective and subjective outcomes in surgery for chronic sinusitis. Laryngoscope 2000;110(3 Pt 3):29–31.
10. Senior BA, Kennedy DW, Tanabodee J, et al. Long-term results of functional endoscopic sinus surgery. Laryngoscope 1998;108:151–7.