AAAAI Work Group Report: Nasal and Sinus Endoscopy for Medical Management of Resistant Rhinosinusitis, Including Post-surgical Patients

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Introduction

Nasal endoscopy has been practiced by allergists since the early 1980's; however, allergists in general have not embraced endoscopic evaluation of patients with sinus disease, either before or after surgery. Allergists are in a unique position to render medical (as opposed to surgical) care of patients with sinusitis. There has been a growing realization that endoscopy is a valuable procedure for the evaluation and medical management of patients with difficult sinusitis. This has resulted in the need for a resource to allow allergists to understand the nature of endoscopic findings in patients with sinusitis, either pre- or post-operatively. This paper will introduce the findings during endoscopy that are common in patients with sinusitis, including those that may be seen after surgery. The findings include perforation of the septum, retained secretions, small surgical ostium due to post-operative ostial stenosis, previous Caldwell Luc procedure, recirculation of mucus, hyperplastic nasal disease, synechiae, recurrent disease in previously unaffected sinuses, empty nose syndrome, frontal sinus disease, dental disease, as well as other more complicated entities.

Practice parameters and practical descriptions for performance of nasal endoscopy have been written previously but have not been recently updated. [1, 2] This paper will focus on the use of nasal and sinus endoscopy for chronic rhinosinusitis in both pre- and post-surgical patients. The paper will not focus on normal anatomy and diagnostic aspects of normal endoscopy, as these subjects have been reviewed previously. [3]

History and philosophy

Allergists began performing flexible nasal and sinus endoscopy (herein referred to simply as "endoscopy") in the early 1980's.[4] Around the same time, functional endoscopic sinus surgery began gaining popularity and has since become the primary surgical technique for treatment of patients with chronic rhinosinusitis that has proven refractory to medical treatment. [5-7] Endoscopy is a useful technique that affords the allergist the ability to assess and localize sinus pathology with far greater precision than a routine nasal exam. Use of endoscopy can also

improve diagnostic accuracy and thereby reduce costly and unnecessary medication usage (e.g., antibiotics).

It is highly desirable that all specialists treating nasal and sinus disease be able to perform a complete endoscopic evaluation of the nose and sinuses, especially for evaluation of inflammatory disease.[8] Endoscopy should be viewed as part of a complete examination of the nose and sinuses. Allergists are in a unique position to treat the entire "unified airway".[9] For these reasons, it is highly desirable for allergists to be skilled in nasal endoscopy and in the pre- and post- operative management of rhinosinusitis patients.[6, 10-12] A strong argument can be made for incorporating endoscopy into the routine care of **any** patient with chronic rhinosinusitis. According to the ENT literature, sinus surgery affords benefit in the vast majority of cases selected for surgery. [6, 10-12] Still, relapses after surgery are not infrequent and are usually best managed medically, provided that the initial sinus surgery was technically adequate and resulted in an acceptable outcome. The list of conditions amenable to medical management in post-surgical patients is long and includes: (1) allergic or nonallergic chronic inflammation, (2) chronic infection, (3) fungal colonization, (4) hyperplastic mucosa, (5) nasal or sinus polyposis, and (6) aspirin hypersensitivity. With experience, it is also possible to recognize anatomic abnormalities that may contribute to persistent disease after surgery. [13] Competence in endoscopy merely enhances the already important role of the allergist in recognizing and treating all diseases of the noses and sinuses and in recognizing other important contributing conditions such as GERD, aspirin sensitivity, and immunodeficiencies, as well as less common diseases such as cystic fibrosis, sarcoidosis, Wegener's granulomatosis and ciliary dyskinesia or tumors. Wegener's typically may have constitutional symptoms associated with nasal blockage, crusting, and epistaxis with facial pain, septal perforation and nasal collapse. Tumors most commonly arise in the maxillary sinus. They tend to be unilateral, with nasal obstruction, hyposmia, and epistaxis. Orbital symptoms are common. If any suspicion of malignancy occurs, the patient should be referred for biopsy.

It has been shown that patients with chronic rhinosinusitis and allergic rhinitis fare better after endoscopic sinus surgery if their allergies are managed optimally.[14] Although some allergists have expressed concern about performing nasal endoscopy, nasal endoscopy is generally considered part of normal procedures for allergists by both malpractice and health insurance companies and is usually included in malpractice insurance. In addition, many allergists receive training in endoscopy during their fellowship or at subsequent courses.[3]

Advantages of flexible over rigid endoscopes

In our experience, it is easier to examine certain areas such as the sphenoethmoidal recess, the anterior wall of the maxillary sinus (in patients who have had previous surgery) and the sphenoid sinus with a flexible endoscope. This is also true with respect to large patent accessory maxillary sinus ostia. Often, the entire maxillary sinus can be examined with the flexible endoscope in patients who have had previous surgery.

Safety issues

Although concerns about safety have been expressed by some allergists, there are minimal concerns other than vasovagal reactions.[15] Most allergists do not perform biopsies (other than perhaps mucosal brushings); as a result, there is little, if any, risk of bleeding. Assuming that

one does not attempt to forcibly enter a small sinus ostium or pass through an area where there are sharp bony fragments such as the frontal recess, there is minimal, if any, risk of problems removing the endoscope.

Equipment

Although rigid endoscopes are the most popular among otolaryngologists, flexible endoscopes are preferred by allergists for the reasons mentioned above.[3] This partially relates to the fact that allergists, unlike ENT surgeons, do not perform procedures requiring rigid endoscopes (e.g. FESS), but the main reason is the ease of use and the ability to easily manipulate the flexible endoscope into narrow recesses. On the contrary, many otolaryngologists prefer the superior optics and visualization afforded by the rigid endoscopes. In addition, it is easier to use another instrument along side the rigid scope.

Rigid endoscopes are made in varying angles: 0, 30, 45, and 70 degrees. The less experienced examiner will typically start with a zero degree endoscope. Flexible endoscopes are made by numerous manufacturers (Pentax, Olympus, and others) in varying diameters. Endoscopes with and without procedure or biopsy channels are available. The narrowest useful diameter without a channel is approximately 2.2 mm, however with the narrower pediatric fiberoptic endoscopes, some sacrifice must be made in image quality in order to use a smaller diameter endoscope. One must therefore choose whether to use a narrower scope and compromise some image quality. The 2.2 or 2.4 mm endoscopes are most commonly used. The narrowest endoscope with an internal biopsy channel is 3.4 mm.

Care must be taken in handling the endoscopes, as they are delicate and easily damaged; repairs may cost several thousand dollars. Although more expensive Xenon light sources can be used, halogen light sources are usually adequate. Cleaning of the endoscope is accomplished easily. Initially a leakage test should be performed to ensure that the integrity of the instrument has not been compromised and will not be damaged in the cleaning process. The instrument is then rinsed to remove any gross debris and very gently wiped down to prevent damaging the instrument. The instrument is then placed in an enzymatic cleaner (e.g. Endozime, Ruhoff, Mineola, NY or Enzol, Johnson & Johnson, Irvine) for the recommended time (usually 10 minutes). The instrument is once again rinsed and gently wiped down. It is then placed in glutaraldehyde (e.g. Cidex, Metricide) or a related product, ortho-phthalaldehyde (e.g. Cidex-OPA) following the manufacturer's suggestions for duration of sterilization. For Cidex-OPA, the time required is 10 minutes. Thereafter, the endoscope must be thoroughly rinsed to remove all traces of the microbicide and then dried. A wall mounted cleaning stand can be used to simplify the process (EndoCaddy, Aztec Medical Products, Williamsburg, Virginia). If an endoscope with a channel is used, more extensive cleaning is required. A suggested protocol for the use of Cidex-OPA is included in the Appendix. (Appendix 1 and 2)

The endoscopic procedure can either be viewed through the eyepiece or through a video monitor. With the smaller diameter endoscopes, there is a significant reduction in image quality that may compromise the evaluation when used with a video monitor. Various video camera attachments are available for recording purposes. Although cameras (Figure 1) are now small (e.g. 5x3x3 cm), the bulk at the head of the endoscope may make subtle maneuvers more difficult to

perform. Alternatively, a video camera cable can be attached to the endoscope and connected to a table-mounted camera. It is also possible to mount the endoscope from a ceiling support.

During endoscopy, it is possible to perform a number of therapeutic procedures. First, in patients who are having acute pain during the procedure, it is possible to irrigate tissues with small amounts of lidocaine using a Sinus Irrigation Catheter (Medtronic /Xomed) (Figure 2). (Otolaryngologists may use lidocaine or cocaine soaked pledgelets or injections of local anesthetics, but these may not be available to allergists.) For patients with inflammatory disease or signs of infection, it is possible to directly instill corticosteroids, saline or antibiotics into a sinus cavity if the sinus ostium is patent.

There are several options for patients who need procedures performed during the endoscopy. First, as described previously, fiberoptic endoscopes are available which have a separate channel contained within the endoscope through which procedures can be performed. The advantage being that the channel is self-contained within the endoscope. However, this type of endoscope is impractical for everyday use. Although the same endoscope can be used both for routine endoscopy as well as for cultures or other therapeutic endeavors, the greater diameter of the dual channel endoscope makes it more difficult to maneuver and more uncomfortable for the patient . Also, the dual channel endoscope requires more extensive cleaning or use of a protective sheath each time the endoscope is used, whether or not the channel is used. Hence, the dual channel scope is usually reserved for special procedures or research activities.

There is a sheath available with an external channel (Vision Sciences/Medtronic Xomed) (Figure 3). This has been a valuable addition to the endoscopist's armamentarium. Originally, sheaths were developed as a means for using endoscopes (particularly GI endoscopes with internal channels) without having to sterilize them after each use. The sheath is applied over the endoscope and disposed of after one use. This significantly shortens the time between procedures. The sheath protects the channel as well and the cleaning process is therefore much easier. It was later discovered that it was possible to create a sheath with a channel external to the endoscope but self-contained within the sheath. Using this device, brushings, or procedures such as foreign body or fungus ball removal can be performed using a brush (figure 4), snare (Figure 5) or basket (Figure 6) with an endoscope that was not originally designed for surgical procedures.

A sinus puncture device (Sinoject, Atos Medical, Milwaukee, Wisconsin) was recently developed that has dramatically reduced the complexity of sinus puncture, however this procedure remains infrequently used due to trauma, patient dislike for the procedure, and the risk of iatrogenically introducing organisms into the sinus.[16] The Sinoject is not currently distributed in the United States.

Unlike rigid endoscopes, where the examiner can perform endoscopy and other procedures without assistance, use of the flexible scope requires an assistant to perform other procedures or cultures. The examiner must use one hand to hold the tip of the endoscope and the second hand for obtaining the cultures. With practice, the assistant can be taught to hold the endoscope during this procedure.

Diagnostic cultures

All too frequently in routine practice, patients treated for sinus infections do not respond to treatment. In part, this is due to empiric use of antibiotics without knowledge of the bacteria, fungi, mycobacteria[17] or other organisms involved. There is also a real risk of creating more severe infections, such as those caused by gram negative or methicillin-resistant *Staphylococcus aureus* by repeatedly using antibiotics empirically. Fungal overgrowth is another possible side-effect. Obtaining meaningful cultures during endoscopy can help alleviate these problems and afford medical management a much greater likelihood of success.[16,18] That being said, meaningful cultures are not simple to obtain and must be performed with proper techniques, appropriate collection vessels and transport media, and timely delivery to the laboratory. Therefore, the endoscopist must be aware of these factors before embarking on culturing sinus mucus. The techniques for specimen collection require some practice, and equipment must be obtained specifically for this purpose.[19]

Samples must be placed in proper transport media to avoid desiccation and to support the growth of pathogens. Specimens must be transported to the lab within time constraints set for the transport media selected; otherwise, the culture results cannot be trusted. Fungal cultures must be sent in appropriate transport medium to a lab with expertise in mycology, including speciation of fungi and determination of antifungal sensitivities. Adequate amounts of material must be sent for both bacterial and mycological cultures. The larger the volume of material, the more likely a pathogen will be recovered.[19] We recommend not obtaining cultures unless these points are taken into consideration.

Culturing for anaerobic bacteria is more difficult than culturing for aerobic bacteria and requires special techniques and specimen handling. The role of culturing for anaerobic bacteria has been emphasized by Brook in several studies but is of uncertain value in the outpatient management of chronic rhinosinusitis.[20, 21]

Although strict criteria for timing of cultures do not exist, generally cultures should not be performed during antibiotic treatment. If they need to be performed, the presumption is that the antibiotic being used is not effective. Although some authors have suggested otherwise, the antibiotic should therefore be stopped for at least 48 hours prior to obtaining cultures to avoid misleading culture results

Cultures should be taken from appropriate areas, especially from the middle meatus[16] or directly from the sinuses in patients who have patent ostia. Care must be taken not to contaminate the specimen. Unlike cultures taken from the nose, endoscopically guided cultures from the ostiomeatal unit using Dacron urethral swabs have been found to accurately reproduce cultures taken from within the sinuses, either at the time of surgery or via sinus puncture, however, larger studies still need to be performed.[16, 18, 22] Generally, the most reliable cultures can be expected when the mucus collected is visibly purulent[16, 23] but there may be exceptions to this rule. For instance, Orobello et. al. reported a strong correlation between middle meatal cultures and both maxillary and ethmoid sinus cultures in children even though gross purulence was not present in the former location.[24]

Devices such as the Xomed Sinus Secretion Collector (a catheter (Medtronic/Xomed) (Figure 7) with long thin tubing for collection of sinus mucus and debris) can be directed into the middle meatus (OMU) or, occasionally, into a sinus ostia.[25] The sinus secretion collector consists of a 2mm plastic malleable catheter inside a protective sheath attached to a suction device. The protective sheath minimizes but does not completely eliminate contamination from the anterior nares. After introduction into the middle meatus or sinuses, the outer sheath is retracted, suction applied and a sample taken. The cultured material is retained within a Lukens collection trap. This device allows collection of larger volumes of mucus for more accurate and less contaminated cultures. Once collected, the sample can be divided, transferred to special bacterial or fungal transport media, and then sent to the laboratory. In addition, a sample may be sent for cytology in an appropriate medium. Because of the low recovery rate for fungal stains and cultures, consideration should be made to sending specimens to more than one lab. Cultures should be relied upon for species identification, as identification of species is often difficult on the basis of stain, cytology or surgical specimen.

Equally important are discussions with the laboratory supervisor. These discussions should occur before the endoscopist begins performing cultures so the requirements for these cultures can be established. Depending on the clinical circumstances, bacterial and fungal cultures and sensitivities can be obtained using the appropriate culture media suggested by the supervisor. If the patient has persistent infection despite adequate therapy, other unusual types of infections such as those caused by atypical mycobacteria or other organisms, should also be considered. It may be necessary to consult with the microbiologist and mycologist regarding what sensitivities may be done. Generally, if swabs are used for culture, it is preferable not to use cotton tipped swabs as they may reduce the yield of cultures. In some cases, a gram stain or cytologic examination for eosinophils and Charcot-Leyden crystals may also be useful. Fungal stains such as GMS or PAS are most commonly used to stain mucus for fungal hyphae, however, staining may be unreliable. As a result, a more sensitive fluorescein-labeled chitinase stain that stains the chitin layer of the fungal organism (e.g. Fungalase, Anomerics, Baton Rouge) has been described.[26] However, this stain is not yet in general use.

Endoscopy in the patient who has not had previous sinus surgery

The following section focuses primarily on patients who have not had surgery, although some aspects will also apply to post-surgical patients.

Anatomy:

A detailed review of anatomy will not be provided here, however, the reader should be familiar with the anatomy of the nose and sinuses, especially the nasal valves, the uncinate process, the infundibulum, hiatus semilunaris, ethmoid bulla, , and frontal recess, as well as the entire ostiomeatal unit (Figure 8). Review of endoscopic anatomy [28-29,30] or observing FESS or attendance at a training course for FESS (which includes cadaveric dissection) can be invaluable in training. Courses on advanced endoscopy have now been included at AAAAI meetings, and are critically important for the allergist who wishes to perform the techniques suggested herein.

Septal Deviation:

Septal deviation is common but rarely severe enough to prevent nasal endoscopy, especially if a pediatric endoscope is used. After noting the amount of the septal deviation prior to

decongestion, the examiner can evaluate the effects of the decongestant. It is important to observe the effect of the decongestant clinically prior to nasal endoscopy, particularly in regard to mucosal swelling, turbinate hypertrophy and clinical symptoms such as headache. Septoplasty is often done at the same time as endoscopic sinus surgery, but is not always necessary. Indications will not be addressed here, but there are numerous references concerning this subject.[31,32]

Middle meatus:
The patient must be adequately anesthetized and decongested prior to the procedure. Sometimes one must decongest and reanesthetize the patient to examine the area adequately. It is possible to do so when doing the endoscopy by placing lidocaine saturated Dacron swabs in the middle meatus or wherever the patient is having discomfort. It is also possible to direct lidocaine solution with an irrigation catheter into the area that needs to be further anesthetized. Injected hyperemic tissue is not unusual, but occasionally tissue may look normal despite inflammation in the sinuses. This can occur when there is complete obstruction of the ostiomeatal unit. Care must be taken not to inflict more pain than necessary upon attempting to visualize the middle meatus. Swelling and inflammation with reduction in size of the meatus may significantly compromise the ability to examine the area. Inflamed turbinates may swell enough to compromise the meatus.

Uncinate process and hiatus semilunaris:
The uncinate is located on the lateral nasal wall underneath the posterior portion of the middle turbinate. It is the most anterior portion of the middle meatus, and typically is the first structure removed during endoscopic sinus surgery. (Figure 9, 10). The hiatus semilunaris is the area between the uncinate process and the ethmoid bulla.

Some endoscopists are able to examine these areas in selected patients prior to surgery using flexible pediatric endoscopes, but this requires special skill and preparation. The middle meatus must be very well decongested and anesthetized in order to avoid discomfort. It is highly desirable to examine this area if possible to look for inflammation. This area may appear inflamed when other areas appear normal.

It is important for the endoscopist to gain experience in recognizing the appearance of the uncinate process, as well as the appearance after uncinectomy. Extensive experience with endoscopy is important when making an assessment of this area. Observation of normal sinus anatomy at the time of sinus surgery can be an invaluable learning experience in this regard.

Accessory ostia:
Accessory ostia into the maxillary sinus have been reported in between 25 and 50% of patients.[30, 33] The ostium may vary from pinpoint in size to several millimeters. The accessory ostia are found in the mid-portion of the lateral nasal wall at the sites of the anterior or posterior fontanelles. Sometimes, it is possible to cannulate the ostium and directly visualize the mucosa of the maxillary sinus and perform cultures. Further discussions of the examination of the maxillary sinus will be found in the section on post-surgical patients.

Sphenoethmoidal recess and choana:
The sphenoethmoidal recess and choana can be inflamed as a result of drainage through the posterior ethmoid or sphenoid sinus where inflammation is present in those sinuses. Upon reaching the sphenoethmoidal recess and deflecting the tip of the endoscope superiorly, one should be able to visualize the superior turbinate and possibly the sphenoid sinus ostium. Less commonly, the posterior ethmoidal ostia are also visualized. It is sometimes possible to cannulate the sphenoid sinus ostium and inspect the mucosa in the sphenoid sinus. One can sometimes visualize pus streaming from one or more sinus ostia into the sphenoethmoidal recess.

Anatomic considerations in treatment of children
In children, adenoidal hypertrophy can play a significant role in causing sinus disease.[34] It is important to make an assessment of the percentage of airway obstruction in pediatric patients with nasal disease,[35] and this should be addressed and treated in conjunction with the sinusitis.[34] We have performed nasal endoscopy in infants a few months old in selected cases. Pediatric otolaryngologists will suggest adenoidectomy at the same time as sinus puncture in some patients before considering FESS.[34, 36] One must remember that anesthesia must also be used for debridement after surgery in children. In adults, adenoidal hypertrophy is more a result of, rather than a cause of, sinusitis. It may contribute to upper airway obstruction in patients with obstructive sleep apnea. In some cases, adenoidal hypertrophy may warrant a biopsy and concern for the possibility of malignancy or HIV disease.[37]

Epiglottis and larynx:
Inflammation of the epiglottis and larynx may be the result of postnasal drainage from sinusitis [38] as well as from non-respiratory causes such as GERD. [39] Examination of these areas should be included in the complete endoscopic examination.

Post-surgical considerations:
Once patients have had FESS surgery for sinus disease, additional structures become accessible to endoscopic evaluation and postoperative complications can be evaluated.

Anatomical changes after surgery
Understanding of sinus anatomy is essential in evaluating the post-surgical patient. This is especially true with respect to the complex anatomy of the OMU and adjacent structures.[28-30]

Depending on the amount of surgery performed, there may be a septal perforation, reduction in size or absence of the turbinates, inferior or middle meatal antrostomies, removal of the uncinate processes and part of the lateral nasal wall, resection of the ethmoid or sphenoid sinuses, or resection of the frontal recess and frontal sinus. In some patients, the frontal sinus surgery may involve a frontal sinus obliteration (osteoplastic flap) in which the frontal sinuses are obliterated with transplanted fat. Extremely rarely, resection of the posterior portion of the septum may be performed.

Complications may occur in the immediate post-operative period, but the otolaryngologic surgeon is primarily responsible for care in these cases. Potential complications include: CSF leak, hemorrhage, periorbital ecchymosis, emphysema or hematoma, visual changes, arterial injury or stroke, or meningitis. These have been discussed in a recent review.[40]

Perforated septum
Perforation of the septum can occur as a result of septal surgery or as a result of non-iatrogenic causes.[41] The septum is most commonly damaged at the time of a septoplasty.[42] It is possible that the perforation may be appreciated during the postoperative period. The septum is potentially vulnerable to injury after surgery, both from the patient as well as during postoperative debridement.[42,43]

Retained secretions:
Retained mucus in the maxillary sinus may be caused by infection, inspissation of secretions, foreign body (rarely), abnormal mucus rheology, mucus recirculation, continued ostiomeatal obstruction, or mucociliary disturbance. It is not a sine quo non for infection. Nonetheless, retained mucus is often colonized with pathogens, and the colonized mucus can elicit local inflammation. For this reason, it is often helpful to obtain cultures (bacterial and fungal) from the mucus.

Even though patients have had their ostia surgically enlarged, patients may be found to have mucus inside the sinuses. The quality of the mucus can vary from thin white to yellowish or greenish purulence to dark, almost black and inspissated. Occasionally, fungal growth can be seen on surface of black mucus. It may be possible to remove it at the time of endoscopy with a rigid catheter or a sinus secretion collector. The secretions may be so viscous as to obstruct the secretion collector. A sinus irrigation catheter may be needed to irrigate with saline, antibiotics, steroids or lidocaine (in patients who need additional anesthesia). In addition, the endoscope procedure channel may be used (either external in the endosheath or internal) to remove this material, as well as perform brush biopsies, or tissue removal (e.g. fungal balls).

Patency of the surgical ostium:
An assessment of the patency of the surgically created ostium should be made. Some ENT surgeons prefer to create a small (3-4 mm size) surgical ostium.[44] Discussion of the reasons for different surgical techniques are beyond the scope of this review, however, it is important to examine the surgical ostium for post-operative narrowing as a result of synechiae, edema, thickened mucus, fungus balls or polyps.[45-47] The thickness of the lateral nasal wall at the margin of the surgical ostium should also be noted. This wall is usually a thin structure. Thickening can occur as a result of scarring but may represent inflammatory or polypoid thickening within the maxillary sinus.

Caldwell Luc procedure:
Prior to current endoscopic surgery, the standard operation was a Caldwell Luc procedure, in which an inferior meatal antrostomy and maxillotomy were performed, typically after an incision above the canine fossa. The uncinate was typically not removed. As a result, the basic pathology in chronic sinusitis, obstruction of the naturally directed mucociliary flow towards the middle meatus, was not altered, leading to accumulation of mucus in the middle meatus, and inadequate drainage. Consequently, the inferior antrostomy was not entirely successful.[48-50] Occasionally, a middle meatal antrostomy would be performed, but the uncinate would not usually be removed. Hospitalization time and post-operative recovery were much longer than with the more recent endoscopic procedures.

With the exception of malignant disease, Caldwell Luc procedures are rarely performed now.[51] During the endoscopic examination, an examination of the inferior meatus should be made to determine if a previous antrostomy was performed. Occasionally, patients are unaware of which procedure was performed. Patients with previous Caldwell Luc procedures may be able to irrigate their sinuses, but they may nonetheless have continued middle meatal obstruction.[51]

Recirculation of mucus

Mucus recirculation occurs when mucus draining through a sinus ostium reenters the maxillary sinus through a different ostium in close proximity. These ostia can include surgically created ostia, accessory sinus ostia or the natural ostium. This is now recognized as a potential cause of persistent sinusitis.[31,51-53] Irrigation may sometimes resolve this problem, however, surgery may be needed to create a single ostium instead of two or more ostia.

Hyperplastic nasal disease:

Patients may have persistent disease involving nasal polyps, mucosal edema or polypoid mucosa despite surgery.[51] Sinus endoscopy greatly facilitates the assessment of hyperplastic mucosal disease. Other exacerbating factors, such as aspirin sensitivity, fungal disease, allergic rhinitis, or cystic fibrosis also need to be addressed in patients with this condition.

Synechiae (bridging scar formation):

Synechiae or bridging scar formation is not uncommon after sinus surgery. [47] Careful surgical follow-up in the immediate postoperative period will minimize this;[6, 54] however, despite good surgical follow-up, synechiae may still be found especially between the middle turbinate and the lateral nasal wall, or between the middle turbinate and the nasal septum. The former may result in lateralization of the middle turbinate and obstruction of the middle meatus.[55] Occasionally synechiae may be severe enough to reduce the size of the middle meatus or maxillary ostium, and revision surgery may be needed to remove them. In some cases, this can be done in-office by the surgeon. Surgical procedures involving mucosal stripping are associated with an increased risk of scarring and are typically no longer performed.[56]

Synechiae may occasionally form in the ethmoid sinuses, creating a completely normal appearing mucosa. One must be careful not to dismiss patient complaints after surgery based on "normal" appearing tissue in this area since disease may still be present in one of the ethmoid cells. A follow-up CT scan may be needed for adequate evaluation.

In the situation where synechiae form in the area of the anterior ethmoids and frontal recess, frontal sinus disease may develop post surgery.[25] This may be more common in patients with previous middle turbinate surgery.[57-59]

Empty nose syndrome:

Some patients who have had excision of the inferior and/or middle turbinates may report increased symptoms thereafter.[60] They may report a reduction in nasal mucus, nasal dryness or sensation of nasal obstruction or blockage and a general reduction in their sense of well-being. Out of concern for this problem, many surgeons are now reluctant to perform any significant

amount of surgical turbinectomy. As a result, preservation of as much turbinate tissue as is possible is now considered by many to be an important part of surgical management.

Many surgeons will only remove a very small portion of the middle turbinate if absolutely necessary in order to achieve adequate visualization or to remove devitalized tissue. Operative descriptions of the extent of resection may be variable, and the endoscopist should make an independent assessment of the amount of resection performed. Radiofrequency ablation of the turbinates (e.g. Somnoplasty) has not caused the same problems as surgical turbinate reduction.[61]

Frontal sinus disease:
It is often possible to visualize the frontal sinuses in patients who have had previous frontal sinus surgery. During the course of endoscopy, the examiner may be able to see light emanating from the forehead as the frontal sinuses are entered. Entering the frontal sinus must be done with care, as the ostia are often very small with bony prominences.

Evaluation of frontal recess disease is very difficult, even for the experienced endoscopist. Previous surgery can cause scarring and obstruction of mucus outflow from the frontal recess. If revision surgery must be performed, it is often possible to resect the scarring in the anterior ethmoids including remnants of the uncinate and frontal recess without entering the frontal sinuses.[31] The advent of image-guided surgery has facilitated frontal sinus surgery in some centers by those skilled in the procedure,[62,63] however a decision regarding this must be made by a surgeon with extensive experience in revision surgery.

Dental and related disease:
Dental material as well as other foreign bodies can be found in the nose and sinuses and can be evaluated during endoscopy. This material can create a variety of inflammatory responses and must typically be removed, usually at the time of surgery. “Foreign bodies” can include periodontal disease, infected roots of normal teeth, remnants of partially extracted molars, hydroxyapatite, or other dental material, implants, etc.[64] During endoscopy, one must remove all mucus and other non-dental debris from the base of the sinuses, since pus or other material in the base of the maxillary sinuses may obscure diseased dental or mucosal tissue as well as other foreign bodies. Gentle probing with the endoscope can also be helpful in determining disease, particularly if there are areas of tenderness. Oro-antral fistulae may also be identified. Few oral surgeons have the capability to adequately evaluate and treat odontogenic sinus disease but it is important to involve them in its treatment. Dental CT scans may also be required, but interpretation may be very difficult**.**

Atrophic rhinitis:
With age, it is not unusual for patients to develop dry, inflamed, thin, crusted mucosa. This must be recognized and treated appropriately with saline or other agents. A similar condition occurs with the empty nose syndrome.[60]

Other potential anatomic reasons for recurrent disease following sinus surgery:
Persistence of disease in the maxillary or anterior ethmoid sinus after surgery may be caused by anatomic factors, such as a retained uncinate process or partial ethmoidal resection. Persistence

of disease in the frontal sinus may be due to frontal recess disease. These conditions relate to important and often subtle aspects of sinus anatomy that require considerable experience to recognize. If a portion of the uncinate is retained, functional drainage from the maxillary sinus may remain impaired, and mucus may continue to collect in the middle meatus.[65] It is important to examine the surgical ostium and the sinus mucosa to address the adequacy of drainage through the middle meatus. Endoscopic examination may sometimes reveal an apparent middle meatal antrostomy when, in actuality, the resection has been made of an ethmoid air cell. In this case, the uncinate process will not have been removed, and the middle meatus will continue to be obstructed leading to lack of proper drainage through the ostiomeatal unit.

Residual disease in the anterior or posterior ethmoid sinuses may occur due to incomplete resection of ethmoidal cells with persistence of infection, mucus impaction or development of new disease in these cells.[51] Disease in the posterior ethmoid sinuses may be more difficult to resolve since surgery involving the posterior ethmoids may be more technically difficult.

If any of these conditions are suspected, the allergist should consult with an otolaryngologist raising specific questions about these concerns and whether revision endoscopic surgery is advisable.

Preparation for surgery:
One of the most valuable functions of the allergist is to evaluate and provide proper medical treatment for nasal and sinus disease up to the point that sinus surgery is deemed necessary. This evaluation should include an understanding of the points at which medical therapy will no longer be successful and surgical intervention preferable. We have also found that pre-operative discussions with the otolaryngologist can promote higher quality patient care and foster greater physician communication. Discussions regarding the role of allergic sensitivities and immunotherapy, aspirin desensitization (especially prior to nasal polypectomy), stains and cultures of surgical specimens are examples. If the allergist has previously followed the patient, suggestions may be made regarding operative management by those allergists experienced with endoscopic sinus surgery. Once postoperative management has been completed, allergists can again provide valuable follow-up care and periodic reassessments to identify recurrence of disease.

In our practices, patients are typically referred to the surgeon after medical treatment options have been exhausted and the sinus CT scan suggests disease amenable to surgical correction. As a result almost all patients referred to the surgeon ultimately undergo surgery. A busy surgeon will appreciate referrals much more if the patient presents to their office prepared for surgery. A detailed discussion of the parameters we use to make a decision about surgery is not feasible here, but several points will be highlighted.

In considering whether surgery (either endoscopic sinus surgery, septoplasty, osteoplastic flap, etc.) may provide benefit to a patient whose disease has failed medical management, the endoscopist should consider how well the patient's symptoms correlate with objective measures of disease, including the findings on endoscopy (both before and after treatment) and the findings on CT scan, and the patient's response to medical treatment. If sinus surgery is considered likely, it may be cost-effective to obtain an image-guided CT scan prior to the

surgical referral. (This is usually done after communication with the surgeon before the surgical referral, especially since there are several image guided systems currently available.) An image guided CT is an essential component of image-guided surgery and is helpful when there is concern about entering the orbit, the skull base, the frontal recess or in circumstances when previous surgery has removed landmarks.[66, 67] It is recommended that allergists interested in treatment of sinusitis observe a surgeon perform imaged guided endoscopic sinus surgery to better understand its usefulness and to become familiar with the various image-guided techniques currently in use. Review of recently published articles can also be helpful in understanding the treatment technique.[31,62- 63, 68]

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The Vision Sciences®Slide-On™ Endosheath® System is manufactured by Vision Sciences® and distributed exclusively by Medtronic Xomed. The Medtronic Xomed™ Tami Sinus Secretion Collector is manufactured by Medtronic Xomed, Inc.

Work Group Disclosures

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Figure Legend:

1. Videocamera (courtesy Pentax Medical)

2. Irrigation Catheter (courtesy Medtronics Xomed)

3. Endoscope with endosheath and external channel (courtesy Vision Sciences® MedtronicsXomed

4. Brush (courtesy U.S. Endoscopy)

5. Snare (courtesy U.S. Endoscopy)

6. Basket (courtesy U.S. Endoscopy)

7. Sinus Secretion collector (courtesy Medtronics Xomed)

8. Coronal diagram of sinuses

9. Middle meatus and uncinate process: EB - ethmoid bulla, S - septum, U - uncinate process, MT - middle turbinate

10. Resected uncinate with maxillary antrostomy: MT - middle turbinate, S - septum, * - synechiae and purulent discharge, O - surgical ostium

Appendix 1

POLICY AND PROCEDURE
FOR USE OF CIDEX OPA SOLUTION FOR HIGH LEVEL DISINFECTION
OF NON-LUMENED RHINOSCOPES

POLICY: It is the policy of _____that all high level disinfectants be utilized in a safe and effective manner.

OBJECTIVES: To provide guidelines for staff using high-level disinfectants
To identify employee safety practices when working with high-level disinfectants.
To utilize the high-level disinfectants in an efficacious manner.

NOTE: **Contact with CIDEX OPA solution may stain skin or clothing. If the solution contacts skin, wash with soap and water for a few minutes, the stain should disappear within 1-2 days. The solution may also stain environmental surfaces such as walls, floors and countertops. Cidex OPA is a proven skin sensitizer, potent irritant, and can elicit allergic reactions. It should not be used in patients who are sensitive.**

PROCEDURE:

Nursing actions	**Rationale**
1. Don personal protective equipment (PPE) a. Double glove (not vinyl or neoprene) b. Eye protection c. Fluid-repellent gown	PPE must be worn when handling contaminated instruments and equipment or working with chemicals
2. Thoroughly clean rhinoscope in enzymatic detergent* a. Wipe handle thoroughly with 70% alcohol	The first step in the disinfection process is thorough cleaning with a mile protein-dissolving agent
3. Rinse instrument surfaces with large amounts of fresh water	Residual detergent must be removed prior to disinfection
4. Remove excess moisture from the instrument by drying gently	This will reduce the dilution of CIDEX OPA solution by residual rinse water. Refer to instrument manufacturer's labeling for additional instructions on disassembling, cleaning and leak testing of particular instruments
5. Read the directions for use on the bottle label and package insert, then pour CIDEX OPA solution into a CIDEX solution tray or appropriate container. Label and date the	

container. a. Solution left in the bottle may be stored for up to 75 days	
6. Record the date that the solution was poured from the original container and the date that it can no longer be used (not to exceed 14 days)	
7. Immerse clean, dry instrument in the CIDEX OPA	Ensure that all contaminated surfaces are completely submerged
8. Soak instrument for 12 minutes at 20 degrees C	High-level disinfection is accomplished in 12 minutes
9. Following disinfection, rinse instrument thoroughly with 2 gallons of water	Sterile water is recommended for rinsing. See package for detailed instructions
10. Repeat the rinse process twice, for a total of 3 rinses. Each rinse should use a fresh bottle of sterile water. Do not reuse rinse water.	Each rinse should be a minimum of 1 minute in duration
11. Thoroughly dry the instrument	See manufacturer's instructions for drying flexible endoscopes
12. Disinfected instruments should be used immediately, or stored in a manner to minimize recontamination	Refer to manufacturer's labeling for additional storage and handling instructions
13. Test CIDEX OPA solution on a daily basis prior to use with CIDEX OPA solution test strips. Record results.	Verify the minimum effective concentration (MEC) is present. Discard solution if MEC not verified.
14. Discard CIDEX OPA solution after 14 days, even if test strips indicate a concentration above the MEC.	CIDEX OPA solution may be discarded down hospital and office drains in accordance with local regulations.

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