THE SMALL-HOLE TECHNIQUE IN ENDOSCOPIC SINUS SURGERY

Reuben C. Setliff III, MD

Humankind's most prevalent recurring viral illness, the common cold, is usually a self-limiting rhinosinusitis of varying severity. Even when it progresses to a bacterial sinusitis, a favorable and lasting response to medical intervention is the rule. Chronic sinusitis is thus an aberration—a dramatic departure from the norm.

Operative intervention for sinus disease has a long history, but the pathogenesis and random occurrence of the disease remain poorly understood. The etiology is usually considered to be extremely complex because of the multifactorial nature of the potential insults. Further confusion arises with the listing of the suspect variables, such as allergy, bacteria, viruses, pollution, irritants, mechanical factors, fungi, and anatomic variations. Beyond identification of a swelling that causes sinus blockage, the specifics of the etiology remain a mystery.

When rhinosinusitis fails to resolve spontaneously or persists despite medical therapy, does the ongoing disease cease being a medical problem and become a surgical problem? If so, what is the extent of surgery necessary to reverse the medical failure? Is there a threshold intervention which would deliver the same or better result as a more extensive procedure?

The most commonly given rationale for sinus surgery is that the openings to the sinuses must be made larger. The implication is that, as a consequence of nature, sinus ostia are too small and therein lies the pathogenesis. Based on this long-standing hypothesis, surgical intervention has been directed toward the sinus ostia and the enlargement thereof, that is, "large-hole" surgery (Fig. 1). However, little evidence supports the concept of a critical threshold size for a sinus opening. The author has observed extremely small to pinpoint openings with no pathology on CT

From the Setliff Clinic, Sioux Falls, South Dakota

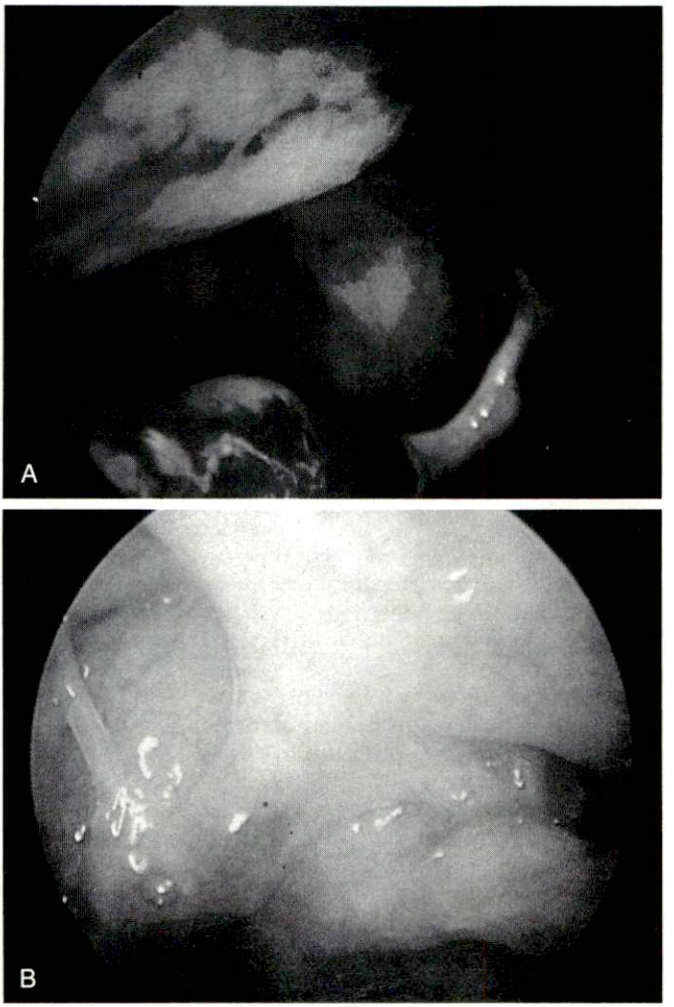

Figure 1. *A*, Right side, 30° lens, middle meatal antrostomy including natural ostium at 9 o'clock. *B*, Left side, 30° lens, healed quiescent ethmoidal bulla and maxillary ostium.

or within the sinus itself. Furthermore, even in the presence of extensive nasal or middle meatal pathology (with obvious compromise of an already small ostium), the sinuses may be relatively spared. A functioning ostium may be necessary to sinus health, but the size requirement seems to be limited.

If the notion of multiple factors acting singly or in combination in the precipitation of sinusitis has reasonable merit, it seems equally reasonable to speculate, given the universality of small ostia and the random occurrence of sinusitis, that the response to each of the insults is not highly variable and may not be at the point of the sinus ostia. Small openings

are common to all sinuses, but, statistically and clinically, sinus disease begins in the anterior sinuses resulting in disease in the ethmoidal bulla, maxillary sinus, or both. The remaining sinuses seldom participate in the initiating event.

Based on such observations concerning the distribution of sinus disease (Fig. 2) and the differences between the drainage pattern of the anterior and posterior sinuses (Fig. 3), the precipitating insult and response in the etiology of sinus disease may, in fact, occur not at the sinus ostium but at the narrow mucous membrane–lined transition spaces into which the anterior sinuses drain.

For the maxillary sinus, the transition space is the infundibulum. A less often mentioned but possibly equally or more important space is the hiatus semilunaris posterior, the transition space for the ethmoidal bulla, found at the interface between the medial wall of the bulla and the lateral aspect of the middle turbinate.

Both spaces (and not their respective ostia) are exposed within the middle meatus and receive the full measure of its insults. The frontal sinus drainage is variable, the most common pattern being an opening into the space posterior and medial to the agger nasi cell. Frontal disease is commonly associated with closure of the space. The spaces in question are eliminated in traditional surgery in the process of enlarging the ostia, an intervention which conclusively has been shown to be therapeutic.

The *threshold* of surgical intervention required to reverse the disease process in chronic sinusitis is unknown. Every upper respiratory tract infection is complicated by a sinusitis which, in most cases, resolves spontaneously. Even if the process is persistent and requires medical therapy, the response is overwhelmingly favorable. Were that not true, sinusitis requiring surgical intervention would be epidemic. However, only an ex-

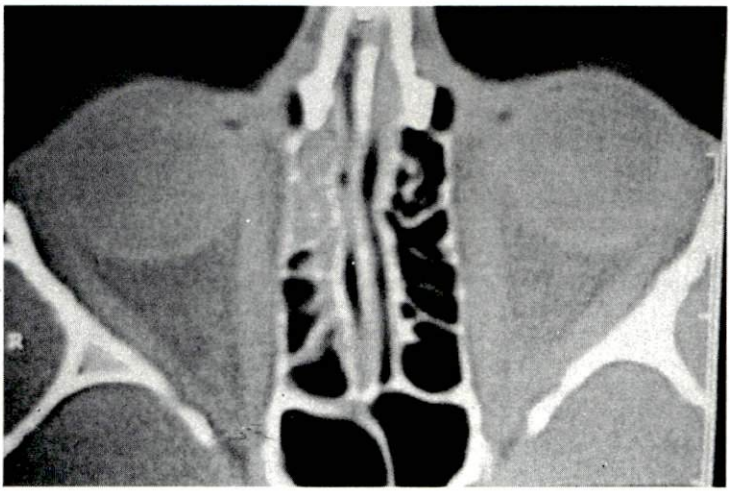

Figure 2. Axial CT shows disproportionate anterior ethmoidal disease.

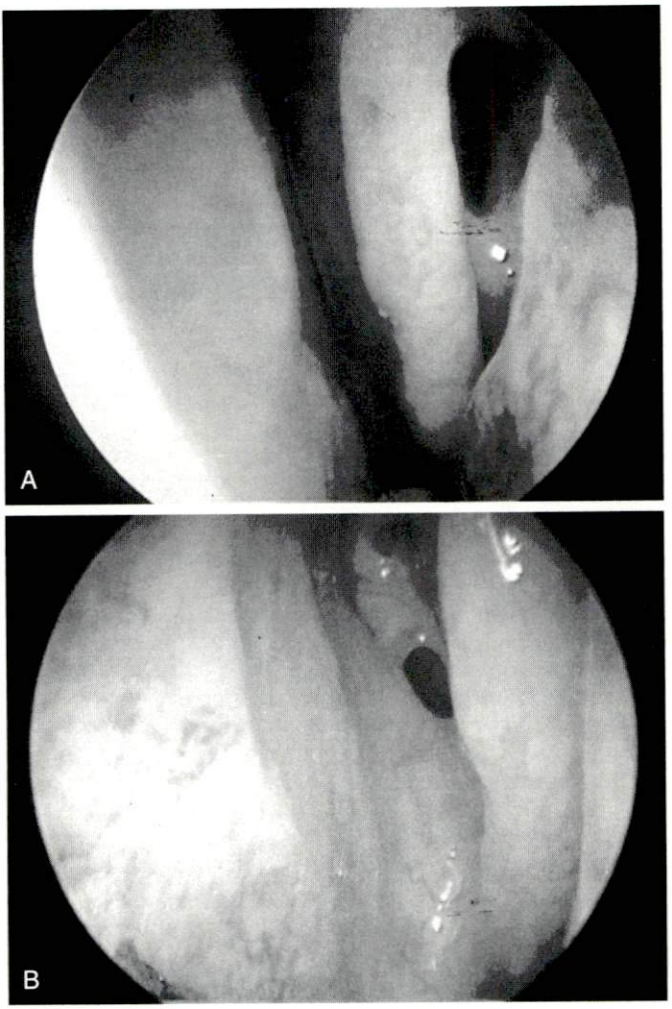

Figure 3. *A,* Left side, 30° lens, superior meatus and posterior ethmoidal entry into nasal cavity. *B,* Left side, 0° lens, sphenoid entry into nasal cavity.

tremely small percentage of patients require surgical intervention. It would be helpful to know how much surgery is necessary to reverse the process and make the disease medically responsive, the norm for most patients.

The author has proposed a rationale for the pathogenesis of sinusitis and has tested the merits thereof by using a previously described technique for minimally invasive surgery addressing, not the sinus ostia but the transition spaces of the anterior sinuses. The author's discovery of powered instrumentation and the possibilities of the precision afforded

thereby led to the concepts of "small-hole" surgery. Although the concepts have been utilized since February of 1993, they are based on "A Philosophy of FESS" proposed by the author and first offered at an academy course in 1992 (appendix).

Under the model, the uncinate process (Fig. 4), not the maxillary sinus ostium, becomes the critical anatomic factor in surgery for maxillary sinus disease. With the removal of the uncinate process, the maxillary sinus has the same direct entry into the nasal cavity as the less susceptible posterior ethmoid and sphenoid sinuses. If the ostium is left undisturbed in its

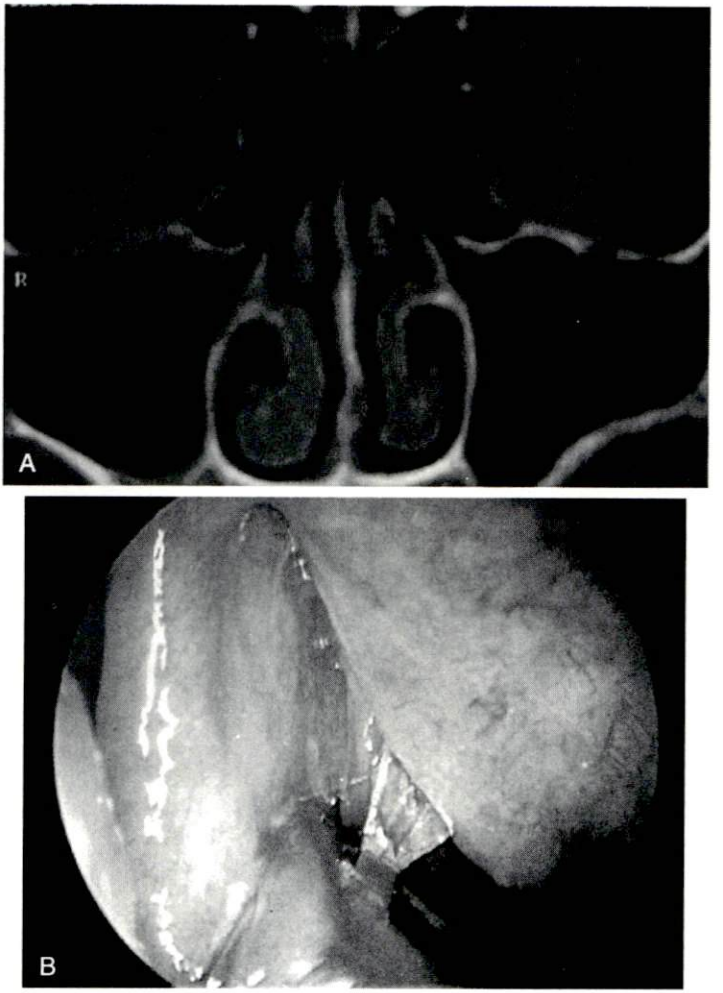

Figure 4. *A*, Coronal CT shows maxillary entry into tight and narrow infundibulum. *B*, Left side, 0° lens, backbiter blade inside infundibulum.

oblique plane (as opposed to the parasaggital plane of an accessory ostium or a middle meatal antrostomy), the tilt away from the midline protects it from any possibility of obstruction secondary to a lateralized middle turbinate or synechiae between the lateral nasal wall and the middle turbinate (Fig. 5). The ostium is left undisturbed regardless of its size or pathologic condition. The worst pathologic change found within the infundibulum or at the maxillary ostium is usually no more severe than the anticipated polypoid reaction prompted by a more aggressive surgical approach.

Since February 1993, no maxillary antrostomies have been made in more than 1000 consecutive sinus procedures, both pediatric and adult. The ostium is visualized in all cases with a 30-degree 4-mm endoscope and without regard for its pathology left alone. A frequent finding is a closed transition space with an ostium of surprising proportions once the uncinate process is removed. A submucosal resection of the lower uncinate or tail is sometimes required for complete uncinate removal and to prevent any violation of the ostium, especially the medial rim.

The full range of pathologic findings has been accepted with no removal of tissue from the ostium, even in patients with severe polyps. Polypoid disease within the sinus is accepted. Large antral cysts are optionally decompressed via a large ostium, accessory ostium, or antral puncture. Grossly purulent material is optionally removed in the same manner, if present.

The most commonly observed drainage for the ethmoidal bulla is an ostium or space of varying proportions located in the posteromedial aspect of the bulla just anterior to the basal lamella (Fig. 6). The space is eliminated by simply removing the medial wall of the bulla and cutting the band of tissue anterior to the site of egress into the hiatus semilunaris posterior. Polypoid change in the transition space is common in sinus disease, perhaps caused by both the mucosal approximation and the direct exposure of the space to inspired air (and its insults) entering the middle meatus.

Removal of the medial wall of the ethmoidal bulla, the critical anatomic factor in anterior ethmoid surgery, opens the interface between the bulla and middle turbinate and leads directly to the bulla's transition space. Simple elimination of the transition space is therapeutic, providing the needed direct entry into the nasal cavity. As with the maxillary sinus ostium, polypoid disease within the bulla is usually no worse than that following more aggressive surgery and should be accepted. Transition space surgery for the frontal sinus requires only that the posteromedial wall of the agger nasi cell be brought forward or removed as required to provide a direct entry for the frontal sinus (Fig. 7).

Although the surgery performed in small-hole intervention includes both the removal of nasal polyps and accessible redundant tissue and the elimination of the transition spaces for the anterior sinuses, neither procedure is done at the expense of exposure of bare bone. The final mucosa of the nasal cavity or mucous membrane of the sinuses is accepted and left in place no matter how diseased. There are no criteria by which a surgeon could with certainty make a determination of irreversibly diseased mucosa or mucous membrane with justification for removal. Nei-

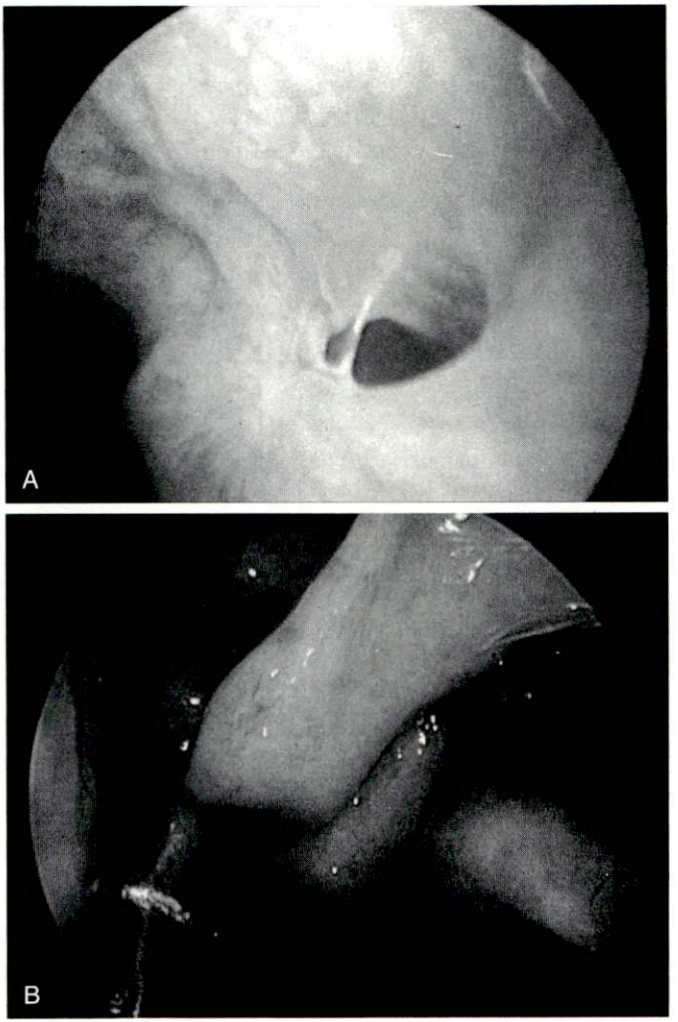

Figure 5. *A*, Left side, 30° lens, healed and quiescent maxillary ostium in oblique plane. *B*, Left side, 30° lens, healed and quiescent ethmoidal bulla and maxillary ostium in oblique plane.

ther are there criteria for the clinical designations of hyperplastic disease, intrinsic mucosal disease, condemned lining, and osteitis, all used to justify extensive tissue removal.

In the absence of clearer indications than simple efficacy, giving diseased mucous membrane the benefit of the doubt is not only prudent but in the best interest of the patient. Recovery of the diseased mucous membrane would be the best possible procedure the patient could have. When the same period of watchful waiting given postsurgical swelling and pol-

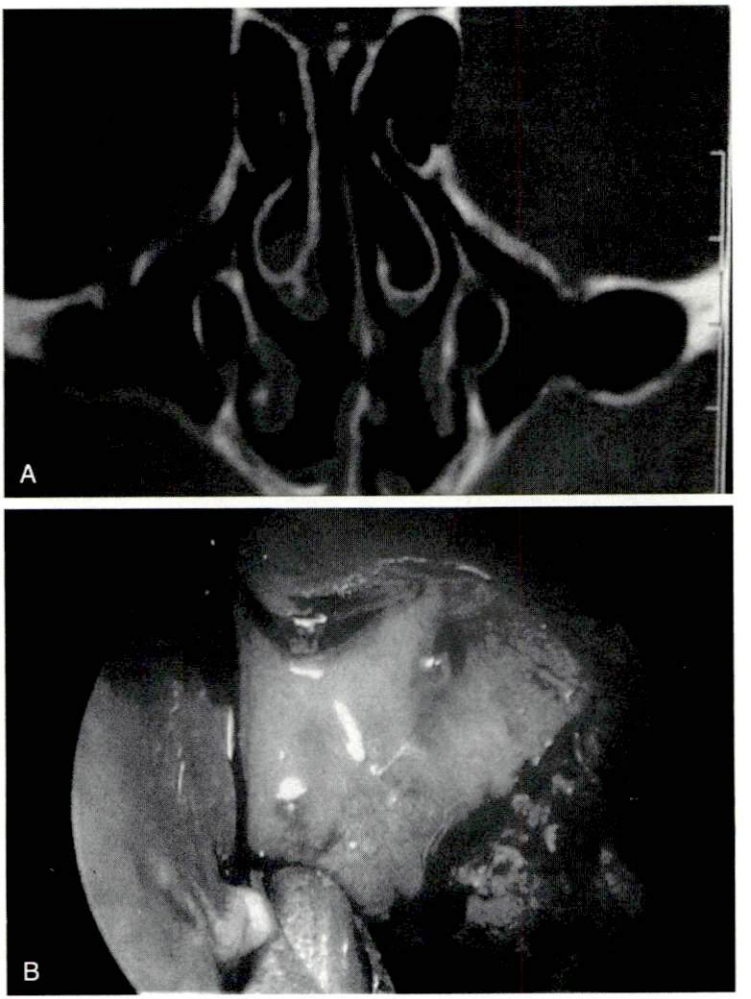

Figure 6. *A*, Coronal CT of bilateral concha bulla and ethmoidal bulla entry into hiatus semilunaris posterior. *B*, Left side, 0° lens, face of ethmoidal bulla seen through uncinate window; closed hiatus semilunaris posterior at interface of middle turbinate and medial wall of ethmoidal bulla.

ypoid change is also applied to the primary disease, the expected recovery is the rule.

DATA

No clinical or research outcome data are available to support the author's work. Data relating to the revision rate have been used as a ba-

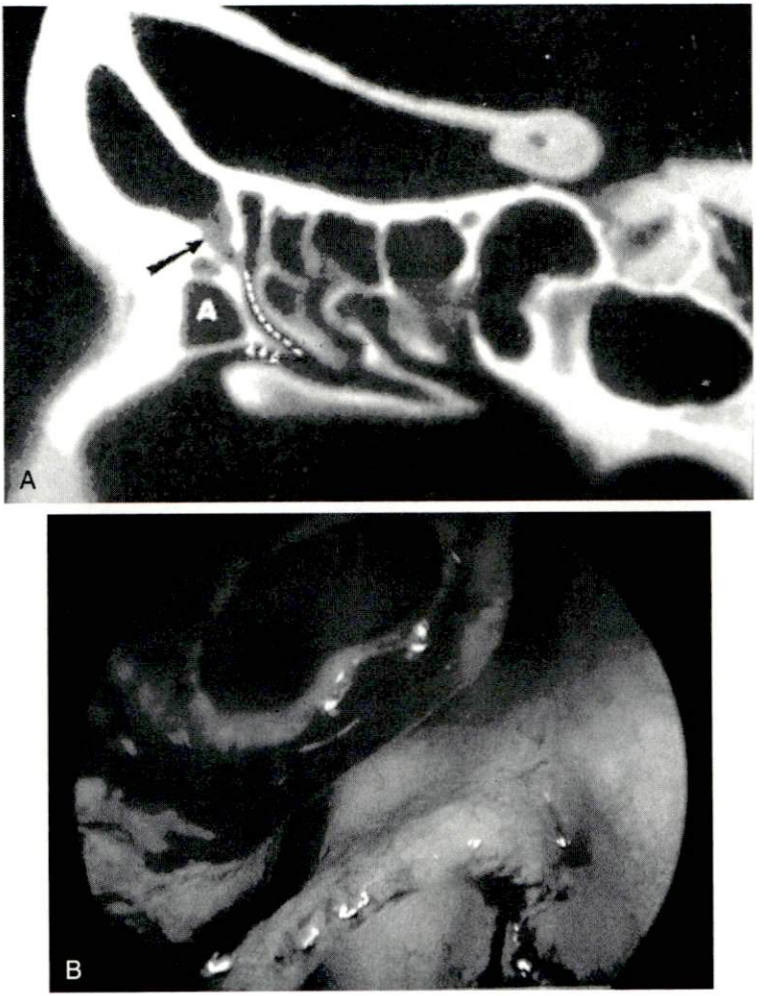

Figure 7. *A*, Near midline sagittal CT shows relationship of the frontal sinus entry and agger nasi cell (*A*). *B*, Right side, 30° lens, agger nasi cell at 12 o'clock with transition space for the frontal sinus posterior and medial, thereto.

rometer for the success or failure of the approach. From an initial revision rate of 30% in the initial 500 cases (before powered instrumentation), a progressive decline has been noted, with a current revision rate of 5% based on a survey of 160 patients. The rate assumes that no cutting or tissue removal was done on postoperative follow-up visits and includes one patient who went elsewhere for additional surgery. There is justifiable concern about the lack of data to support the concepts of small-hole minimally invasive sinus surgery. Outcome data are needed, the standards of which are yet to be evident.

DISCUSSION

In the absence of a clear explanation of the pathogenesis of sinusitis, attempts to standardize surgical interventions and to make data comparisons are laudable but futile. Multiple and sometimes empirical approaches are the norm in the treatment of diseases for which the etiology remains obscure. For sinusitis, the standard surgical approach has been a large-hole intervention which attempts to correct the perceived problem of small sinus ostia and to remove most, if not all, accessible diseased tissue. Until recently, available instrumentation dictated a less than precise surgical delivery with a less than predictable surgical wound. Despite the limitations, the efficacy of such intervention is widely reported.

The model of small-hole minimally invasive surgery is not new, but the proposed surgical intervention is being limited to the elimination of the transition spaces, particularly with respect to the maxillary sinus. The approach carries over to surgery addressing the remaining sinuses. The removal of tissue is limited to redundant disease, and the exposure of bare bone is rejected regardless of the appearance of the mucous membrane.

The polypoid change of the primary disease process is usually less than the observed surgically induced polypoid change using more invasive techniques, the latter prompting only a patient wait-and-see attitude. In most cases, the model dictates an even more conservative approach to the posterior ethmoid and sphenoid. Being last to participate in the disease process, it has been observed that these cells are not infrequently the last out, with or without direct intervention.

One of the more surprising findings in patients with extensive disease by either nasal endoscopy or CT is the relatively more limited pathologic findings in the underlying mucosa and mucous membrane itself. In most cases, precise removal of the redundant tissue in the nasal cavity or ethmoidal sinuses may be accomplished without stripping the mucosa or mucous membrane and exposing bare bone. In the absence of a precision instrument, the sinus lining may be inadvertently removed with the redundant tissue. The difference in the two results has profound implications for both surgeon and patient. With the former result, the surgeon experiences less bleeding and preserves anatomic features for reference. The patient has less morbidity and a marked reduction in both healing burden and the potential for scarring.

The previous observations support the original philosophical concepts of functional surgery, especially regarding the reversibility of sinus pathology. Intervention for frontal sinus disease in a primary case is limited to manipulation or removal of the posterior wall of the agger nasi cell, the critical anatomic factor in surgery for frontal sinus disease, and visualization of the ostium or the pathology therein. The sphenoid sinus is approached between the middle turbinate and nasal septum with simple clearing of the sphenoethmoid recess with or without clearing the sphenoid ostium. In early cases, the superior meatus was cleared of polyps, but, for the most part, superior meatal polyps are now accepted and expected to clear with postoperative steroids.

CONCLUSION

An approach to the surgical treatment of patients with chronic sinusitis is presented. A theory of the pathogenesis of the disease is offered as the model on which to base a standardized surgical approach. The surgical approach, a threshold intervention directed at the cause of the disease rather than at the disease itself, addresses three critical anterior anatomic landmarks and their respective transition spaces. The premise for the intervention is that sinusitis is a surgical disease only to the extent required to render it medically responsive.

The surgical results support the original concepts of functional endoscopic sinus surgery regarding the reversibility of disease in the paranasal sinuses with limited surgical intervention. Application of the technique requires precision instrumentation such as a powered device and an expectation that primary disease may be accepted with the same expectation for resolution as is obtained in surgically induced tissue changes. Early indications are that the approach delivers a more favorable result for both patient and surgeon with less risk for both.

References

1. Setliff RC: Minimally invasive sinus surgery: The rationale and the technique. Otolaryngol Clin North Am 29:1, 1996

Address reprint requests to
Reuben C. Setliff III, MD
2709 E. 26th Street
Sioux Falls, SD 57103

APPENDIX

A Philosophy of FESS

SEPTEMBER 1992

1. Chronic sinusitis is the most common and overriding indication for functional endoscopic sinus surgery. However, certain anatomic variations may constitute indications for relief of recurring headache and/or nasal airway obstruction.
2. The definition of chronic sinusitis as it pertains to the indications for FESS may vary relative to the clinical situation, from patient to patient, and from surgeon to surgeon. Suffice to say that, when it is agreed to by both patient and surgeon that medical options have either been exhausted or are no longer feasible, operative intervention may well be a viable option.
3. As in other medical disciplines, the clinical history is the most important factor in the patient evaluation. Supporting findings on endoscopic examination or CT review may or may not be present. In the final analysis, the patient is the gold standard as to the severity of the problem.
4. The signs and symptoms of sinus and nasal fossa disease tend to be broad and at times complex. A single symptom presentation is not unusual.
5. All abnormal sinus disease was once early and limited. The concept of intervention for limited but persistent disease in a symptomatic patient is probably sound.
6. Functional surgery implies that the goal of the surgery is to improve sinus function. Outflow tract obstruction is recognized as the primary etiologic factor in chronic sinusitis.
7. Preservation of normal and/or diseased structures and/or mucous membrane is fundamental to FESS. In all cases, the middle turbinate will be preserved and sinus mucous membrane left intact at the limits of the dissection.
8. Inherent in the concept is the expectation that diseased mucous membrane can and will begin to improve to normal or near-normal in appearance and function once outflow tract obstruction has been corrected.
9. Although FESS is most likely a new standard of care, it can neither be expected nor represented to effect a cure. A limitation of the surgery is that it is not "excision" surgery.

10. In the absence of the ability to "excise" the sinuses, healing must take place. Often, healing may not occur as desired or expected, resulting in the need for a secondary extension and/or revision procedure. Even though the postoperative symptom complex and/or CT may be impressive, the revision surgery needed is usually relatively minor. A more radical surgical approach is rarely, if ever, needed.
11. The extent of FESS is made by a combination of the history and the endoscopic, CT, and operative findings. Errors in judgment can lead to the necessity for additional surgery as well.

SEPTEMBER 1993

12. Powered instrumentation is to sinus surgery what the power drill was to mastoid surgery. The precision of powered instrumentation provides many distinct advantages over traditional "grab and tear" surgical approaches.
13. Healthy paranasal sinuses have outflow tracts measured in millimeters. Large-hole surgery, although effective in a high percentage of cases, is usually not necessary, altering sinus anatomy, physiology, and function.

Reuben C. Setliff III, MD