

New Concepts and the Use of Powered Instrumentation (the “Hummer”) for Functional Endoscopic Sinus Surgery

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The three major issues in functional endoscopic sinus surgery (FESS) are *visualization*, *instrumentation*, and *the extent of surgery* in a given clinical situation. *Visualization* has become a minor issue as a result of the advent of the endoscope and improved lighting. However, current development of three-dimensional, virtual reality, and other endoscopic displays reflects an ongoing concern for visualization and orientation. Furthermore, the lack of real-time suction during the procedure compromises both visualization and safety.

Instrumentation is the second major issue, undergoing little change since the inception of endoscopic operative intervention for sinus disease. Concepts regarding the surgery are relatively new, especially the functional approach; however, the instruments, although more refined, fall short of enabling the surgeon to deliver a precise technique.

For the most part, available instrumentation influences the decision regarding the third major issue, *the extent of surgery*. Obviously, the functional approach to surgery dictates as limited a procedure as necessary to reestablish mucociliary clearance. Most physicians agree that sinus outflow tracts are small in healthy individuals (Fig. 20-1) and are often measured in millimeters. In many instances, sinus function is surprisingly well maintained, even when the area is diseased or partially obstructed. The ultimate surgical success seems to be a sinus with a small outflow tract that can be returned to health. However, the traditional concept of “large-hole surgery,” ie, converting a small ostium to a larger opening, remains alive and well.

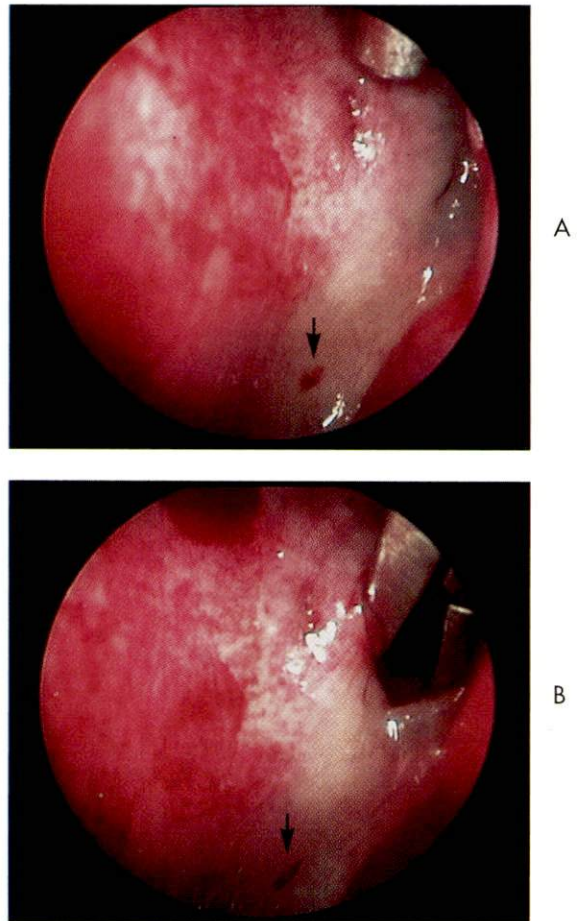


Fig. 20-1. A and B, Healthy sphenoid sinus despite pin-point ostium (see arrows).

The lack of resolution in the above issues relating to visualization, instrumentation, and extent of surgery impacts directly on the pervasive fear that underlines most sinus surgery. The surgeon's remedy for fear is precision—the kind of precision that eliminated the nightmarish outcomes of mastoid surgery before the microscope and powered cutting burr were introduced. Is it possible that another powered instrument could deliver real-time suction, thus improving the physician's visualization and orientation? Might the same instrument also create a precise technique that could reduce the risks to neighboring structures and make the elusive goals of functional surgery a reality? Finally, would it then be possible to explore the "small-hole" limits of functional surgery and answer the questions relating to the extent of surgery necessary to reverse chronic sinus disease?

Searching for answers to the above questions during August of 1992, the genesis of powered instrumentation for sinus surgery occurred at Great Plains Regional Medical Center in North Platte, Nebraska. The unit was an existing off-the-shelf device originally designed for temporomandibular joint (TMJ) surgery. Although the promise of the device was evident in early trials, this experience belied the future. Questions quickly arose regarding tip selection, suction requirements, hook up, prevention of line clogging, clearing of lines when clogging occurred, and sinus surgery possibilities using the device.

Initially utilized as an adjunct to the procedure, (ie, for clean up or touch up following traditional instrumentation) it soon became evident for use with all sinuses but the frontal that the device could replace most of the instrumentation used for sinus surgery. In addition, a more limited and less traumatic procedure could be performed with

healing measured in days, rather than weeks or months.

The power instrumentation (the "Hummer") used in these efforts is made by Stryker Endoscopy of San Jose, California. Although there are similar devices, our experience is limited to the Stryker unit (Fig. 20-2).

As of August 1994, the "Hummer" has been used by the author in 261 adult and 64 pediatric patients in primary cases. The patients are drawn from a stable, rural midwest population. Postoperative results are pending and only preliminary observations will be reported in this chapter.

The potential advantages of the instrument became a reality with increasing experience. The benign contours of the relatively small diameter tip (3.5 mm) dramatically reduced inadvertent trauma to nasal mucosa (Fig. 20-3). The blunt end appeared to decrease the risk of violating the lamina papyracea, lateral lamella of the cribriform, or skull base. The closed nonworking side of the

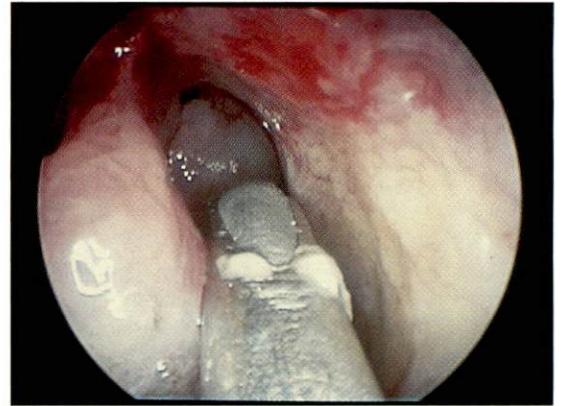


Fig. 20-3. "Hummer" tip with benign contours and window closed.



Fig. 20-2. The "Hummer" power unit and footswitch.

tip proved to be advantageous and relatively atraumatic for access in the middle meatus when slight medial retraction was required.

Tip length (8 cm) and the blunt end appeared to dramatically reduce the possibility of optic nerve or carotid artery violation via the sphenoid. The tip also proved sturdy enough to handle most required approaches to bony structures and for repositioning tissue.

The actual mechanism of the tip action in the nose and sinuses, especially with polyps, was both fortuitous and dramatic. The notion of pulling tissue into a small window by suction and then removing it with an internal spinning blade was not a new idea, but attempting this without continuous irrigation in the nose and sinuses was.

It became evident with the first attempt that powered instrumentation for nasal polyps would become the technique of choice. No other approach compares with the precision, speed, and visualization available with this technique. Further, the anatomic structures within the nose and middle meatus can clearly be defined, thereby converting a difficult procedure to a routine one.

Even now, approximately 2 years later, some physicians would recommend the technique for nasal polyps only; nothing could be further from

the truth. In fact, the only real limitation to global sinus surgery is the lack of a curved tip to access the frontal recess—although many frontal cases have been performed with the available instrumentation.

What is the mechanism of action, and how is the "Hummer" used in sinus surgery other than polyps? (See *Utilization of a Powered Micro-debrider System in Functional Endoscopic Sinus Surgery*.) The tip has two parts (Fig. 20-4): an outer protecting sheath with a window near the end and a rotating insert with an accompanying window. The rotating insert is the blade, the recessed cutting action providing a measure of safety.

Its effectiveness is dependent upon suction through the hollow core of the blade pulling tissue, bone, blood, and irrigation fluid into the window (Fig. 20-5), resecting or removing the same from the operative field. Any clogging of the suction line is immediately recognized as a reduced efficiency of this action.

After much experimentation, it was determined that the most effective vacuum pressure was 170 to 180 mm Hg. This setting allowed for effective removal of surgical by-products without unwanted stripping of mucous membrane. A simple suction hookup to facilitate irrigation clearing of an occa-

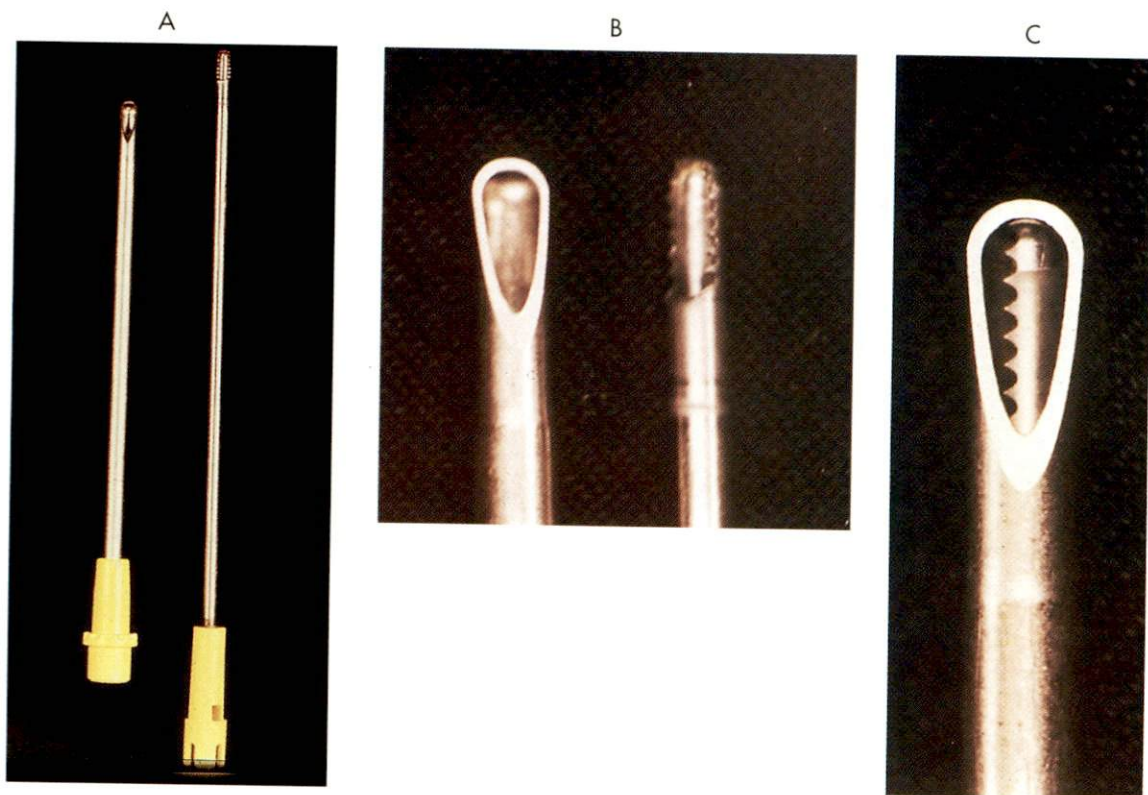


Fig. 20-4. A, Unassembled sheath on the left and insert on the right; B, unassembled sheath on the left and insert on the right; C, assembled window partially opened.

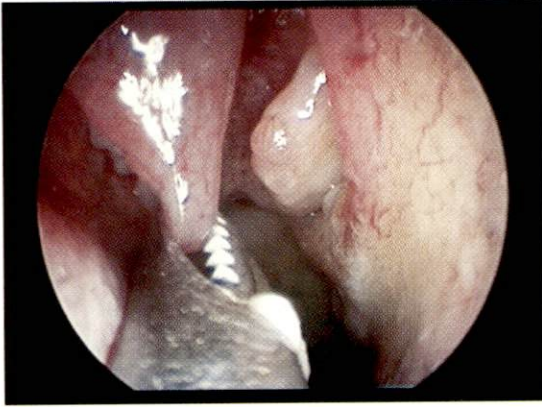


Fig. 20–5. Suction of polyp into window.

sionally clogged line is shown in *Utilization of a Powered Micro-debrider System in Functional Endoscopic Sinus Surgery*. Commercial set-ups designed for this purpose and for collecting specimens for pathology are now available.

The theoretic advantages of real-time continuous suction have long been appreciated. Ingenious modifications of forceps represent attempts to implement the concept for sinus surgery. However, they do fall short of real-time suction operative devices.

The theoretic advantages of real-time suction become a reality with powered instrumentation. Because the resected tissue or bone and blood are removed up the suction line, withdrawing the instrument from the nose to remove tissue or clear the operative field of blood is no longer necessary, reducing the probability of trauma to nasal mucosa or soiling of the endoscope lens. Should the endoscope become soiled, it can be cleared with targeted irrigation down the barrel of the

endoscope, immediately removing the irrigation fluid from the field. In the *absence* of line clogging, visualization at the surgery site is unimpaired and real-time with respect to the resection.

As mentioned, the device was originally designed for TMJ surgery. However, the handpiece is remarkably adaptable to sinus surgery, whether working through the scope or off of the monitor (Fig. 20–6). It weighs 5 ounces, is 6 inches long, and is connected to its power source by a 10-foot coaxial cable. A suction port on the handpiece is the proximal end of a tube within the handpiece that runs to a chamber. In this chamber, the tip connects and delivers the evacuated material from the operative field. Tissue and debris then move from the chamber, through the handpiece, and on to the collecting system.

The power unit offers a range of power setting selections up to 1600 RPMs at a 100% setting. Speed can be varied by the degree of the depression on the foot switch. Cutting action is possible in forward, reverse, and oscillation settings. Sinus surgery is most effectively performed with full power—full depression of the foot switch and the oscillation setting. An increased frequency of oscillation further enhances the device's effectiveness and can be a retrofit on existing units.

Although both cutters and burrs are available for insertion into the handpiece by a quick-lock collar; the burrs are mentioned only to point out their limited application in early cases. Cutters are available in many configurations in both 2.5- and 3.5-mm diameters (Fig. 20–7). The aggressive straight cutter in a 3.5-mm diameter has proved to be most effective in both pediatric and adult sinus surgery. Limited experience with prototype curved tips indicates some added advantage for frontal sinus surgery.

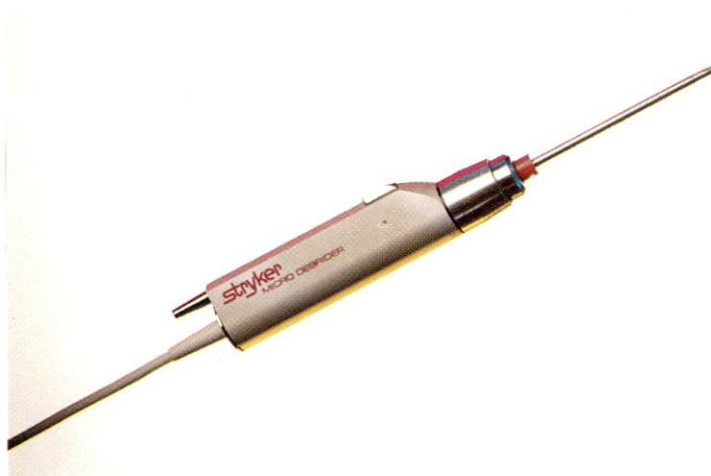


Fig. 20–6. Close-up of handpiece.

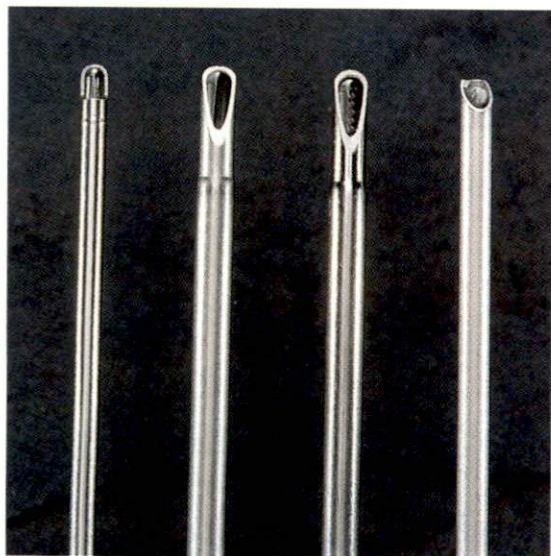


Fig. 20-7. "Hummer" tips; the aggressive cutter is third from the left.

At this time, the early promise of powered instrumentation has become a reality. The use of the device addresses all of the major issues of concern with today's sinus surgeon. Real-time suction makes the visualization potential of the improved endoscope a reality. The increased visualization with the precise and less traumatic surgery afforded by the "Hummer" causes less bleeding and a reduced healing burden for the patient.

Anatomic structures and variations can be appreciated with the "Hummer" as with no other approach. Powered instrumentation FESS can be approached as a dissection, not a "grab and tear" best effort. Preservation of the middle turbinate is possible in all cases and the early recommendations for performing the surgery under local anesthesia are considerably enhanced.

Our experience with the use of powered instrumentation has spawned several surgical techniques that have proved invaluable in standardizing the procedure. Using retrograde resection of the uncinat process as recommended by Parson, we modified the approach, creating a window into the infundibulum. Two new anatomic concepts, the exit and the final common pathway of the infundibulum, can be defined in all cases. Furthermore, a progression anteriorly from the exit along the final common pathway of the infundibulum will invariably track to the natural maxillary sinus ostium, dropping off inferiorly and laterally (Fig. 20-8).

Although the concept of leaving the natural ostium undisturbed is not new, a new procedure for ostium management has also been developed.

Powered instrumentation has allowed the resection of the uncinat to the anterior limits of the infundibular window and a submucosal resection of the remaining inferior and tail portions of the uncinat. By trimming the resulting mucosal flaps, a mucosal seam is created that allows direct entry of the maxillary sinus ostium into the nasal fossa. No instrumentation is performed to the natural ostium or the surrounding mucosa (Fig. 20-9). This nonmiddle meatal antrostomy approach has been performed on 240 consecutive patients, both pediatric and adult, since February 1993, with no patients returning for maxillary revision at the time of this chapter's completion (August 1994). Formal data collection is underway and will be reported elsewhere.

An additional surgical technique developed with the use of powered instrumentation involves removal of the ethmoid bulla from its medial interface with the middle turbinate, working from medial to lateral (Fig. 20-10). The surgeon can in all cases, then, clearly define the basal lamella or sinus lateralis of the ethmoid.

Powered instrumentation can also be used to resect the residual upper portion of the uncinat. If the frontal recess must be inspected or approached, the surgeon can enter the agger nasi cell inferiorly and with precision approach, the postero-medial wall of the agger nasi cell to evaluate the frontal recess and drainage (Fig. 20-11).

There are many other possible applications for the instrumentation, including transnasal removal of choanal adenoids, selective adenoidectomy, clean up of the delayed epistaxis case, the creation of abrasions resulting in small planned synechia between the middle turbinate and the septum to medialize the turbinate, and in choanal atresia (Fig. 20-12).

Surgery on the sphenoid sinus—an area of much concern to the sinus endoscopist—has been greatly simplified by the use of powered instrumentation. If outflow tract obstruction is indeed the culprit, powered instrumentation by way of a direct approach to the face and natural ostium of the sphenoid has proved to be most effective. The ostium is quite readily cleared or enlarged with the device. More extensive sphenoid surgery, and the accompanying increased risk, has been reserved for use in fungal sinusitis of the sphenoid or other uncommon clinical presentation.

UTILIZATION OF A POWERED MICRO-DEBRIDER SYSTEM IN FUNCTIONAL ENDOSCOPIC SINUS SURGERY

Basic Set-Up and Technique

The following guidelines are designed to help otolaryngologists obtain maximum effectiveness

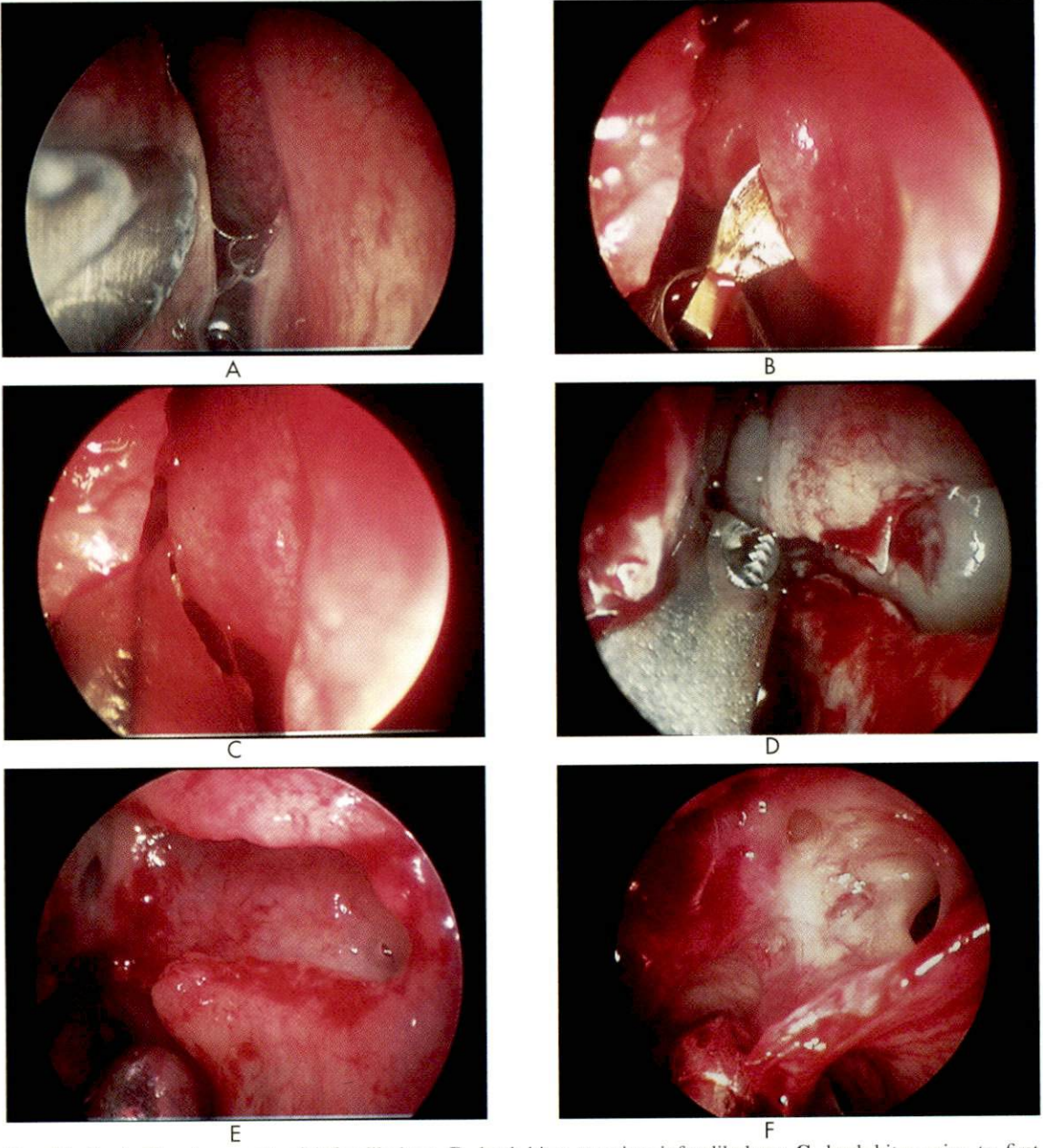


Fig. 20–8. **A**, Pus from exit of infundibulum; **B**, back-biter entering infundibulum; **C**, back-biter prior to first unciniate cut; **D**, window roughly cut; **E**, window after edging; **F**, exit and final common pathway of infundibulum, leading to the natural ostium of the maxillary sinus.

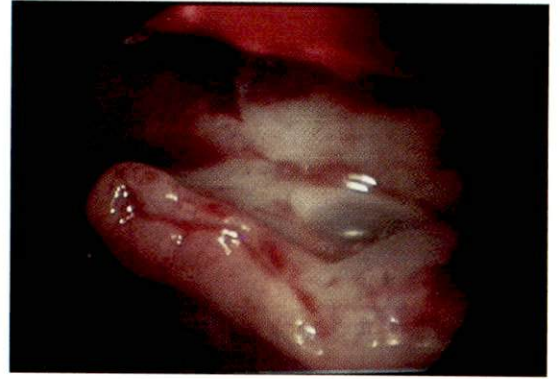
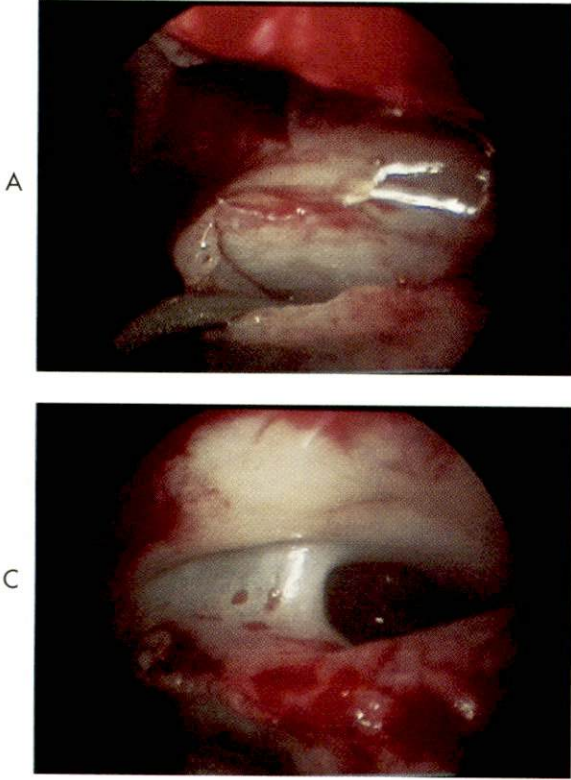


Fig. 20-9. **A**, Submucosal dissection of inferior uncinate; **B**, mucosal seam after uncinate removal; **C**, final appearance of the natural ostium in lieu of the middle meatal antrostomy.

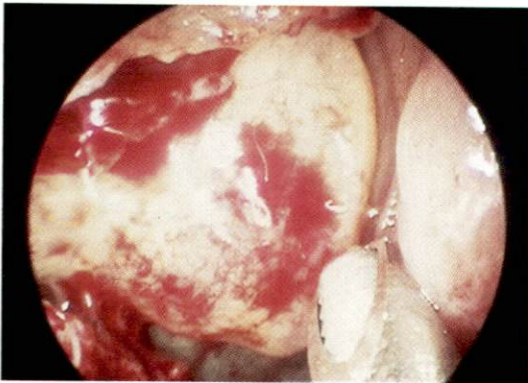


Fig. 20-10. "Hummer" positioned to begin medial to lateral dissection of the ethmoid bulla.

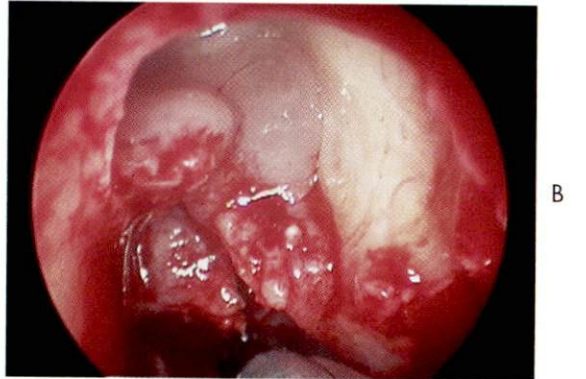
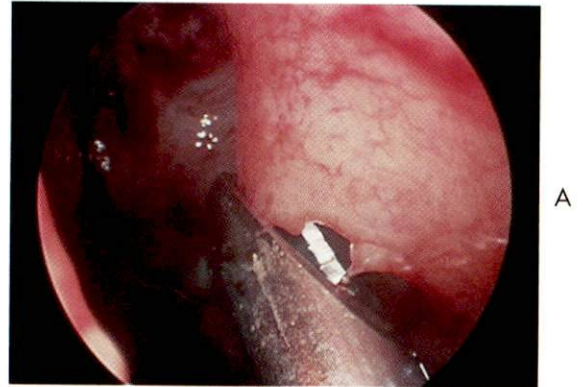


Fig. 20-11. Resection of upper uncinate to access agger nasi cell. **A**, "Hummer" positioned to resect upper uncinate; **B**, agger nasi cell.

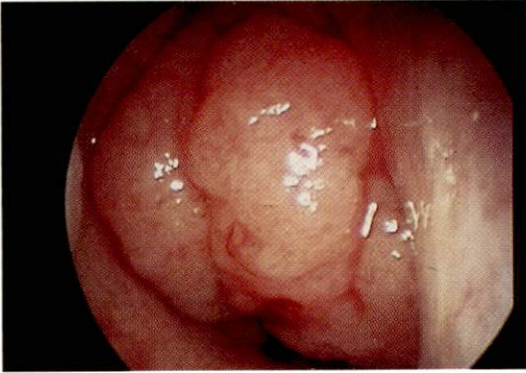


Fig. 20-12. Choanal adnoid.

in the application of a powered rotary shaving device (micro-debrider system) to functional endoscopic sinus surgery (FESS). These guidelines were developed after experience was obtained 250 patients from both with more than a private practice and a university referral center.

Surgeons are advised to begin slowly using the micro-debrider as an adjunct to standard surgical technique. Polypectomy and touch-up, clean up are simple and safe applications that allow the surgeon to get the feel of the instrument and learn the basic techniques of the cutter tip action and suction control that are important for success in more procedures complex. A natural progression to wider application of the instrument will occur as the surgeon gains both experience and confidence.

At this point in our experience, the micro-debrider system has replaced 80% or more of the manual instrumentation normally used for FESS. Its effect on the course of FESS is analogous to the effect of powered drills on mastoid surgery when they were introduced.

Required equipment

- Micro-debrider system (1)
- 2.5-mm and 3.5-mm aggressive cutters (2)
- 51-cm intravenous extension set (Baxter No. 2c5625 or equivalent)
- Three-way stopcock (Baxter No. K75 or equivalent)
- 30- to 50-mL syringe

Equipment set-up

- Attach the handpiece and the footswitch to the console of the micro-debrider system. Refer to the operations manual for instructions on set-up and sterilization.
- Insert a cutter into the handpiece.
- Attach an intravenous extension set to the suction port at the rear of the micro-debrider handpiece.

Interpose a three-way stopcock between the extension set and the catheter tip adapter.

Attach the adapter to standard suction tubing.

Connect suction tubing to the suction canister and the wall suction. Set the wall suction at 180 mm Hg.

Attach the syringe filled with saline to the third port of the stopcock.

See schematic (Fig. 20-13)

Basic technique

Set the micro-debrider to 100% speed level and oscillating mode. The oscillating mode has proved to be the most effective cutting mode for sinus tissues.

Stabilize the cutter shaft against the piriform aperture or some other point to act as a fulcrum for cutter motion if needed.

A useful technique for cutting is that of brief contacts of the tip with tissue or bone during the dissection allowing brief non-contact intervals for evacuation of blood and dissected tissue. However, cutter tip action may vary from a dabbing, curetting, and rolling motion of the tip to a more aggressive technique depending on the consistency of the tissue being resected and the angle of approach of the cutter mouth. Experience will dictate the appropriate technique for various types of tissue.

Utilizing the proper technique, any indication of a lack of dissection progress will most likely be the result of obstruction of the suction path at some point in the system.

Suction Control

Suction is a critical component of the dissection technique. The micro-debrider depends on suction to pull tissue into the cutter window, stabilize it for resection by the oscillating blade, and remove it from the operative field. To minimize the potential for suction line blockage, observe the following:

- Do not share suction with another instrument.

- The micro-debrider should have a discrete suction line.

- Suction should be set at 180 mm Hg. Hospital suction systems vary. Wall-mounted control boxes are not always accurate. Suction may vary throughout the day depending on the number of operating rooms in use. In general, set the suction in the high range. Experience will dictate the appropriate setting for your operating room.

- Whenever the instrument is withdrawn from the nose, insert the tip of the

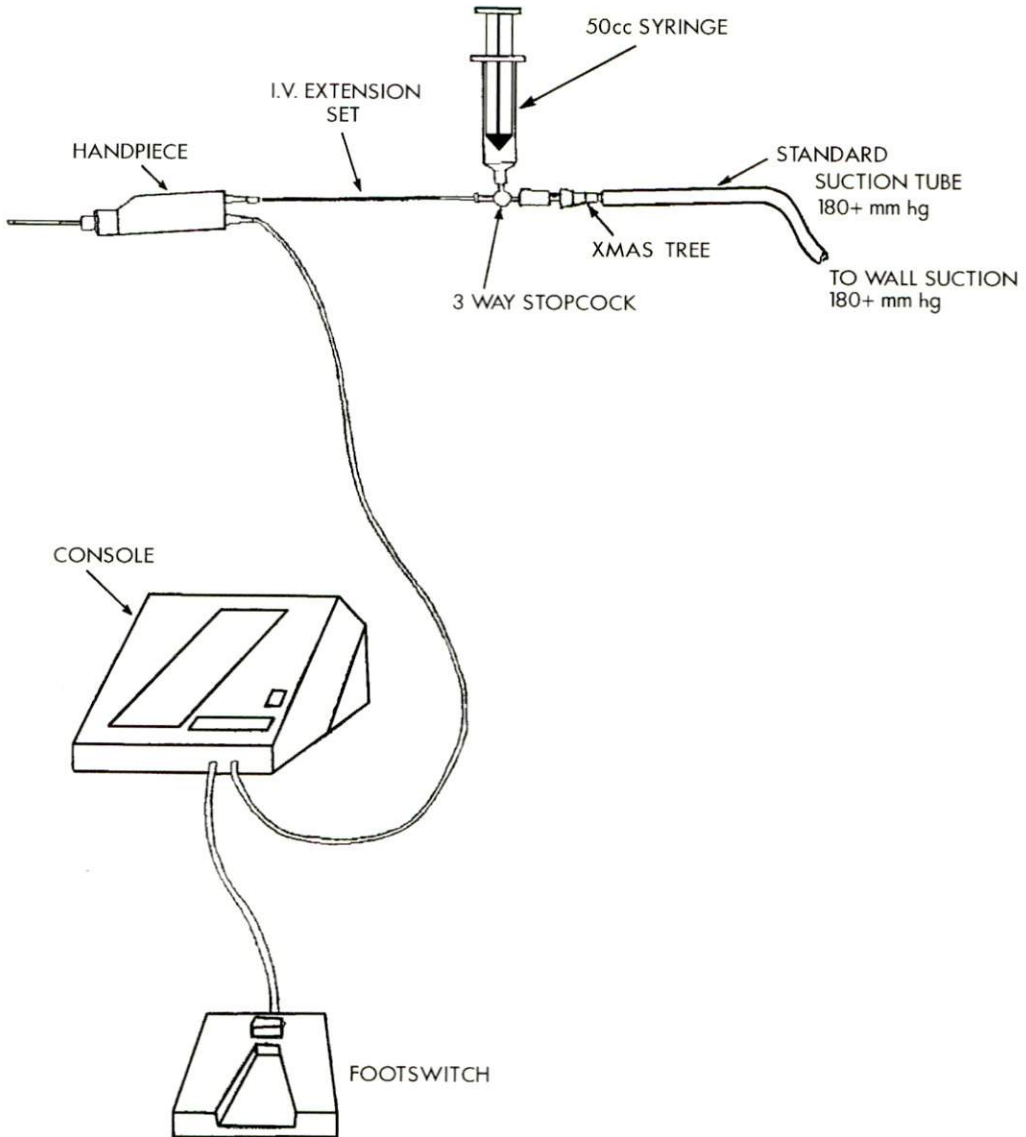


Fig. 20-13. Suction control set-up for micro-debrider system.

cutter into a bowl of saline and run the handpiece with full power to clear the suction line.

If the above does not clear the handpiece and cutter completely, shut off the suction with the three-way stopcock and inject saline through the third port of the stopcock. This will flush the handpiece toward the tip of the cutter. Be sure the cutter window is in the open position and activated.

Occasionally, it may be necessary to flush toward the suction canister or disconnect the intravenous extension set from the suction port and insert a 19-gauge blunt needle into the suction port and flush.

Rarely, it may be necessary to remove the cutter from the handpiece, disassemble it, and clean it manually.

General recommendations

When the patient is under general anesthesia,

it is possible to clean the endoscope with irrigation rather than frequently withdrawing it for cleaning. The irrigation fluid also helps to keep the suction line clear.

When the middle turbinate mechanically limits access to the middle meatus, as in a severe paradoxical curvature, limited removal of its lateral surface (thinning the middle turbinate) may be performed in lieu of more extensive turbinectomy.

A partial uncinectomy or the creation of an uncinat window using a back biter and the micro-debrider instead of a sickle knife approach is possible as the beginning surgical step. Reduced bleeding and an enhanced prospect of precise identification of the natural ostium of the maxillary sinus are advantages of this approach.

The remaining upper uncinat may be removed with the micro-debrider. Submucous removal of uncinat bone with pediatric forceps may facilitate this step.

Following the removal of the superior uncinat (and without the use of tissue forceps) the dome of the agger nasi and frontal

recess are usually visible with a 30° scope. The frontal recess may sometimes be enlarged with the micro-debrider by removal of the postero-medial wall agger nasi.

When using the micro-debrider to begin the ethmoid dissection, start at the interface between the medial wall of the ethmoid bulla and the middle turbinate, working from medial to lateral. Remove large or free-floating bone fragments with pediatric forceps as needed to continue the dissection.

Identification of the sinus lateralis and basal lamella is assured if the previous step is carefully done. The micro-debrider is quite effective in dissecting the thinner bony partitions and large cells of the posterior ethmoids with preservation of mucous membrane at the limits of the dissection.

The benign contours of the micro-debrider allow a relatively atraumatic approach to the face of the sphenoid. Cleaning the natural ostium of the sphenoid is readily done with the instrument.