Microscopic Endonasal Surgery of the Paranasal Sinuses and the Parasellar Region

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• **The anatomic principles and operative techniques currently applied to functional endoscopic endonasal surgery have allowed for significant refinements in another approach to regional pathology that uses the operating microscope, newly designed sinus instruments, and a self-retaining nasal speculum system. The main benefits of this method are the superb widefield stereoscopic vision and the distinct freedom to work bimanually. Additionally, direct bipolar cautery of bleeders is afforded while use of the observer tube or video allows for excellent teaching. The precise nature of this surgery affords less fear of serious complications in the treatment of periorbital, paranasal sinus, and parasellar diseases. We describe technical aspects of the surgery and associated complications in 219 patients treated from 1984 to 1987.**

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Microscopic endonasal surgery (MES) of the paranasal sinuses has been performed in adults since the late 1950s, and was first reported for sinus surgery in children in 1976.[1,2] It was initially used as a technique for creating an antrostomy, and recently has been used for more difficult intranasal ethmoidectomy and transethmoidosphenoidectomy.[3,4] The development of special self-retaining nasal speculum systems have greatly aided this form of surgery in both adults and children with a variety of regional abnormalities, including chronic sinus infection, benign polyps, orbital abscess, and tumors of the orbit, parasellar, and hypophyseal regions. The speculum holder is attached to the operating table enabling the surgeon to work bimanually. The surgeon may stand or be seated at the patient's side with the operating hands resting on the patient, thus affording excellent control of the instruments. Binocular, stereoscopic vision with excellent illumination creates additional precision and control in delicate ethmoid and sphenoid sinus surgery. The Zeiss operating microscope with a 300-mm objective lens and halogen illumination is recommended, while an observer arm or video camera mounted on the microscope has provided an outstanding opportunity for resident teaching (Figs 1 through 3).

Preoperative shrinkage of the nasal mucous membranes is done with topical vasoconstrictors; however, injections with local anesthetics plus epinephrine have proved unnecessary. Microscopic endonasal surgery should be performed using hypotensive anesthesia (systolic blood pressure, 70 to 90 mm Hg) to decrease intraoperative bleeding, and the patient should be placed in a semi-Fowler's position enabling blood and mucus to drain from the skull base and away from the operative field. The eyelids are left uncovered and should always remain in the peripheral field of vision. Bilateral surgery attempted at the same sitting is not contraindicated and is usually completed within 60 to 90 minutes. This technique was used with local anesthesia in two cases, but it was found unacceptable due to the constant pressure exerted by the nasal speculum.

The complex anatomy of the paranasal sinuses, the parasellar region, and the surrounding vital structures has become more familiar to our specialty with the advent of endoscopic endonasal sinus surgery.[5-8] Currently, fewer Caldwell-Luc and other external approaches are deemed necessary, except in cases where malignancies are suspected.[4] The diagnosis of chronic sinusitis is made when obstruction of the ostia occurs due to persistent disease in the region of the ostia and bulla ethmoidalis with irreversible mucosal thickening evident by radiologic evaluation. High-resolution axial and coronal computed tomographic scans offer a precise way to evaluate the presence of sinus disease and further aid in determining when surgery is indicated.[9]

Many patients with chronic sinusitis and/or polyposis will require specific allergy testing and treatment. We advocate that definitive surgery, when indicated, be performed first.[10] In the event a rare postoperative infection develops, allergy testing should be deferred until all signs of infection are thoroughly cleared to avoid an inaccurate response. Postoperative antibiotics were routinely used in the initial 150 cases, while in the remaining cases none were given unless a purulent sinusitis or abscess was found at the time of surgery. The use of postoperative antibiotics in MES for chronic sinusitis (with or without polyposis) is the source of an ongoing study in our clinic and final results will be available within several months.

ETHMOIDAL AND SPHENOIDAL SINUS SURGERY

The middle turbinate is displaced medially under microscopic vision, and next the self-retaining speculum is introduced into the nose and positioned within the proximal middle meatus, supporting the middle turbinate toward the septum (Fig 4). An infundibulotomy is performed with a 30° ethmoid forceps by first resecting the uncinate process and then by entering the larger anterior ethmoidal cells.

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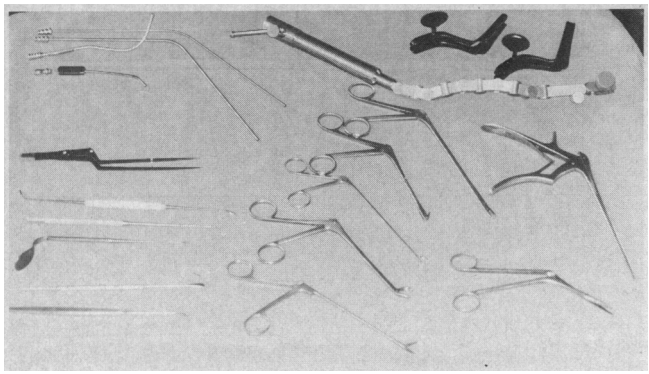

Fig 1.—Set of useful microscopic endonasal instruments.

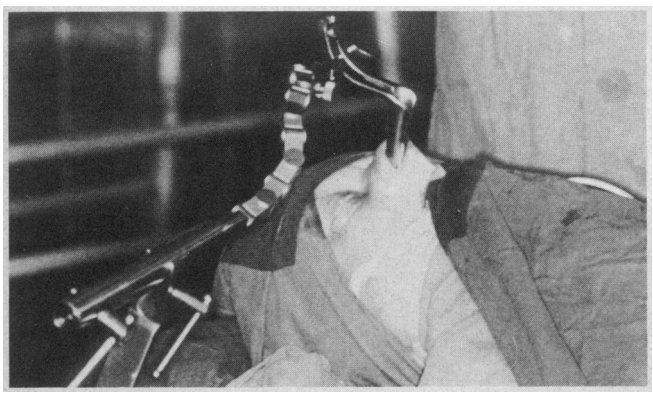

Fig 2.—Self-retaining speculum system inserted into the nose and fixed to the operating table.

Fig 3.—Bimanual microscopic endonasal surgery with opportunity for resident teaching.

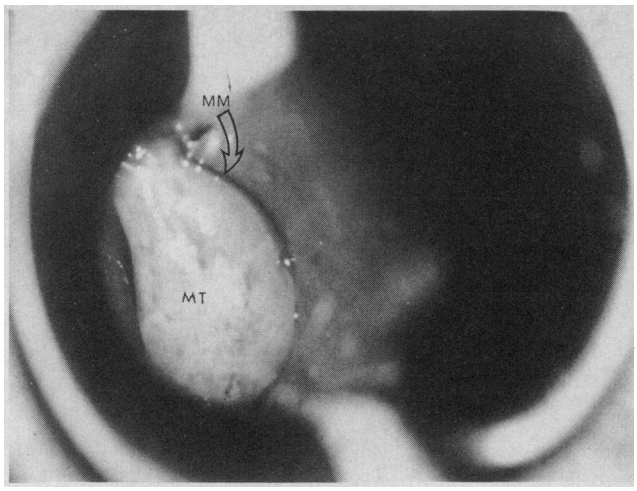

Fig 4.—Microscopic view through the speculum demonstrating the middle turbinate (MT) and the middle meatus (MM; arrow).

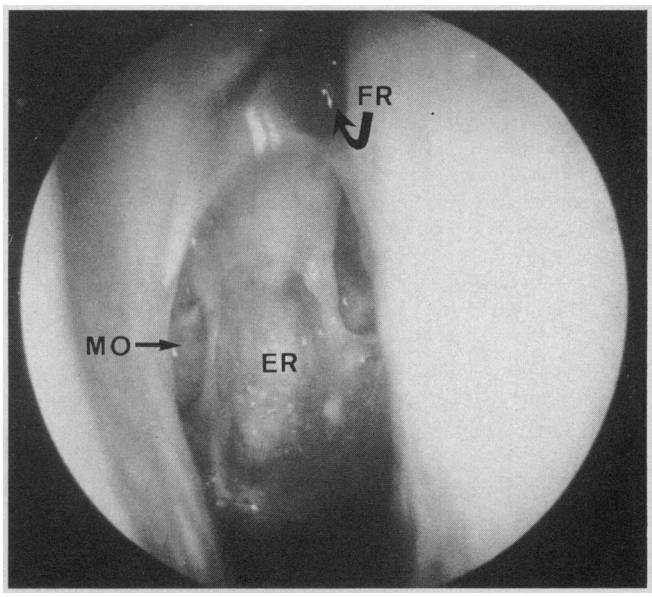

Fig 5.—Postoperative view of epithelialized ethmoidal cavity 2 years after surgery. FR indicates frontal recess; MO, maxillary ostium; and ER, ethmoidal roof.

The bony labyrinth (including mucosa, polyps, and/or secretions) is removed with either a straight ethmoid forceps or a Caspar bone forceps. The middle turbinate is used to guide the dissection directly posterior until the anterior wall of the sphenoid sinus is exposed and the roof of the ethmoid sinus is identified. Resection then follows the ethmoidal roof from posterior to anterior, and a curved 30° curet is gently used to expose the entire roof and lateral sinus wall, which represents the lamina papyracea of the orbit. This lateral wall may be opened, when indicated, to allow for intranasal drainage of an orbital abscess. Bleeding is usually not a problem and is adequately controlled with selective bipolar cautery using long and delicate forceps.

Dissection should not be performed medial to the superior attachment of the middle turbinate, since the bone of the cribriform plate is extremely thin and delicate, and injury to this region is likely to result in cerebrospinal fluid rhinorrhea. During the operation the anterior portion of the middle turbinate is carefully preserved as a useful anatomic landmark in the event secondary procedures are indicated. The posterior half of the middle turbinate is routinely resected, since, in earlier cases, we found that it obstructed proper cleansing of the posterior cavity, especially in the region of the sphenoidotomy. In addition to resecting this portion of the middle turbinate, we cauterize the posterior end of the inferior turbinate. In the event a concha bullosa is present we recommend resection of the lateral half of the remaining middle turbinate with the associated air cell(s).

The incidence of sphenoidal sinus disease is greatly reduced when compared with ethmoidal disease. In the event sphenoidotomy is indicated based on preoperative radiologic evaluation and intraoperative findings, this may be accomplished by gently pushing through the anterior sphenoid wall with the straight ethmoid forceps or a curet. This opening is then enlarged with a fine 30° ethmoid forceps or a curet. The diseased contents of the sinus must be cautiously removed, since in 13% of our cases the lateral bony wall of the sinus was partially dehiscent and careless curettage could have resulted in injury to the optic nerve or the internal carotid artery. We recommend delicate palpation of the lateral wall with a forceps or suction prior to removal of the sinus contents. The sphenoid sinus has been entered by this transethmoidal approach and by access through its natural ostia in the sphenoethmoidal recess to repair traumatic defects of the ethmoidal and sphenoidal roof with concomitant cerebrospinal fluid leakage. The dural dehiscence is repaired using fascia obtained from the anterior layer of the rectus abdominis sheath and the sinus is subsequently packed with alternating layers of abdominal fat and pressed collagen sheets, all held in place by fibrin glue.

The approach for hypophysectomy is usually lateral to the middle turbinate by accessing the sphenoid sinus via posterior ethmoidal air cells. Similar exposure may be used to perform a biopsy and/or to resect parasellar tumors, provided the dura is intact and the extent of disease is limited. The bony skull base has been resected when invaded by tumor, but only if it appears that the tumor is respecting the dura. For more extensive disease with dural invasion, neurosurgical evaluation is obtained and, if deemed resectable, a bicoronal or pterional approach is used. Microscopic endonasal surgery is by no means an acceptable approach to extensive tumors that may require more radical resection, but serves as a suitable means to obtain a biopsy specimen that may prove a valuable adjunct in patient management.

FRONTAL AND MAXILLARY SINUS SURGERY

External approaches to the frontal sinus are reserved for traumatic defects, tumors, and bony obliteration of the nasofrontal ducts. The frontal recess is usually identified in the anterior portion of the roof of the ethmoid, and occasionally ethmoidal polyps hinder direct visualization of this opening. These polyps represent the most common cause of frontal sinus obstruction in this study, a situation readily improved by complete polypectomy. In rare cases, when preoperative evaluation reveals an opacified sinus but no ethmoidal polyps are found intraoperatively, a check for patency of the duct is made using a Ritter bougie or a 70° backward-cutting curet. If the preoperative computed tomographic scan reveals a normal frontal sinus and the patient is asymptomatic, then this portion of the surgery may be omitted. Similarly, problems within the maxillary sinus most commonly result from obstruction of the natural ostium. Once this obstruction is removed, the natural ostium is gently probed to see if the 70° curet may be introduced. If this maneuver is not possible, the ostium is enlarged with a backward-cutting antral punch, avoiding the region of the nasolacrimal duct.

Visualization of areas requiring angular views, such as the maxillary antrum and frontal recess, are attempted initially by moving the patient's head and by looking directly into these regions. In 35% of our cases this view was achievable. When direct visualization is not obtained by position changes of the head, angled 30° and 70°, telescopes are recommended.

POSTOPERATIVE CARE

A continuous nasal tamponade consisting of 2-cm-wide surgical gauze impregnated with sulfur gel is loosely packed into the sphenoidal and ethmoidal sinus cavities. Half of the entire tamponade is removed from each side 24 hours after surgery, and the portion remaining on the second postoperative day. Gentle suction of the cavities, including the internal nasal airways, is then performed and the patient is instructed to begin nasal irrigations three times a day with lukewarm saltwater. Additionally, a decongestant nasal spray followed by a topical nasal steroid inhaler are both applied three times a day. Finally, a menthol nasal salve is applied to the nostrils as needed to help prevent postoperative drying and crusting. It should be emphasized that careful débridement of the cavities must be performed at 2- to 3-day intervals during the first postoperative week. The previously described regimen of irrigations and sprays has significantly improved patient comfort and reduced the occurrence of secondary infections. The steroid nasal inhaler is continued after the first week for 3 to 12 months to reduce nasal mucosal edema and to

Indications for Microscopic Endonasal Surgery in 219 Patients	No. of Cases (N = 219)
Choanal atresia	2
Chronic sinusitis and/or polyposis nasi	165
Maxillary sinus mucocele	5
Concha bullosa	4
Traumatic sphenoid; cerebrospinal fluid rhinorrhea	19
Orbital abscess/decompression	7
Sphenoidal/ethmoidal tumor biopsy	10
Inverted papilloma lateral nasal wall	1
Hypophysectomy	6

prevent early polypoid changes, while the irrigations and decongestant spray are omitted. Occasionally the gel is continued for a longer period in an effort to enhance nasal moisturization. Allergy testing and immunotherapy, when indicated, are essential in preventing the early and undesirable recurrence of intranasal polyps (Fig 5).

COMMENT

The most common indication for MES in this series was chronic sinusitis frequently complicated by polyposis nasi that accounted for 75% of all cases (Table). For each of these indications the results were satisfying not only to the surgeon, but also to uniformly grateful patients. All of these situations were sucessfully handled during the initial MES, including the biopsy of 10 paranasal sinus tumors and the permanent control of 19 cases of traumatic ethmoidal and/or sphenoidal cerebrospinal fluid rhinorrhea. No external approaches or secondary MES procedures were necessary to complete the diagnosis or treatment in the study group.

The patients with chronic sinusitis and polyposis are predictably well controlled with this procedure and experience a dramatic improvement in their overall condition and nasal respiration. This subgroup of 165 patients had a mean postoperative follow-up time of more than 2 years (830 days). Recurrent or persistent polyps were observed in 21 patients (13%), and were easily removed in the clinic, with the patient receiving topical anesthesia, during the patient's postoperative examination. Recurrent sinusitis in this group of patients has not been observed following MES.

The rate of severe complications was markedly less with MES compared with the traditional external approaches. Bleeding that required transfusion, visual disturbances as a result of nerve or muscle injury, cerebrospinal fluid fistula with abscess or meningitis, alterations of facial or dental sensation, or impairment of olfaction are all theoretically possible, but have not occurred to date. Septal perforations have not been attributed to usage of the self-retaining speculum system or to septoplasty performed in conjunction with MES. The most common complications in the 219 patients reported have been limited to minor epistaxis occurring in 44 (20%), headache in 37 (17%), and mild to moderate midfacial pain with swelling observed in 13 (6%). The epistaxis was controlled without further packing, and the pain with swelling is improved tremendously when the intranasal packs are completely removed. The special equipment required for MES, including a microscope, telescopes, and general anesthesia, should be mentioned as potential disadvantages of this technique.

Endoscopic endonasal procedures are used in our clinic in patients who require limited resections for disease in the anterior ethmoidal cells, or in evaluating and eradicating disease confined to the maxillary sinuses. The frontal recess and frontal sinus mucosa are best visualized with the 30° and 70° endoscopes, and with periorbital cellulitis the endoscopes are used exclusively. Microscopic visualization is reserved for the patient with bilateral, massive polyposis involving almost all of the paranasal sinus system with resultant total or near-total nasal obstruction. Bleeding encountered from the anterior and posterior ethmoidal arteries is easily controlled with the microscopic technique. The field of vision afforded allows for bimanual control of instruments and selective bipolar cautery of vessels.

Improved diagnostic techniques, especially high-resolution computed tomographic scanning, now enable precise localization of paranasal sinus and parasellar diseases. Major advances in operative instrumentation and a better understanding of the mucociliary clearance patterns have led to this concept of MES. This technique results in decreased morbidity, allows preservation of normal tissue, and, in the majority of cases, avoids the necessity for external procedures.

Microscopic endonasal surgery using newly designed instruments with the self-retaining speculum system allows for bimanual surgery with excellent control of instruments, while the binocular vision ensures excellent surgical precision and illumination. Microscopic endonasal surgery of the paranasal sinuses and parasellar region affords adequate resection or biopsy of diseased tissues with less fear of serious complications. Troublesome bleeding is easily controlled by selective bipolar cautery, hypotensive general anesthesia, and use of the semi-Fowler's position that allows blood and mucus to flow away from the operative field. The use of an observer arm or video camera mounted on the microscope provides an outstanding opportunity for resident teaching.

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